FISHERIES (BRITISH COLUMBIA) TECHNICAL REPORT FOR THE TRANS MOUNTAIN PIPELINE ULC TRANS MOUNTAIN EXPANSION PROJECT

December 2013

REP-NEB-TERA-00006

Prepared for:

TRANSMOUNTAIN

Trans Mountain Pipeline ULC
Kinder Morgan Canada Inc.
Suite 2700, 300 – 5th Avenue S.W.
Calgary, Alberta T2P 5J2
Ph: 403-514-6400

Prepared by:

TRITON ENVIRONMENTAL CONSULTANTS LTD.

Triton Environmental Consultants
1326 McGill Road
Kamloops, BC V2C 6N6
Ph: 250-851-0023

ACKNOWLEDGEMENTS

Trans Mountain Pipeline ULC would like to acknowledge Chief and Council, the Lands Department, Administration and members of the following communities:

- Lheidli T'enneh;
- Aseniwuche Winewak Nation;
- Simpcw First Nation;
- Tk'emlúps te Secwépemc;
- Lower Nicola Indian Band;
- Nicola Tribal Association on behalf of Nooaitch Indian Band, Nicomen Indian and Shackan Indian Band;
- Yale First Nation;
- Chawathil First Nation;
- Shxw'ow'hamel First Nation;
- Cheam First Nation;
- Seabird Island Band;
- Popkum First Nation;
- Scowlitz First Nation;
- Le'qa:mel First Nation; and
- Kwantlen First Nation.

All of their time, effort, commitment and participation is much appreciated and was fundamental to the success of the fisheries field surveys for the proposed Trans Mountain Expansion Project.

EXECUTIVE SUMMARY

Fish and fish habitat investigations were carried out to satisfy application and regulatory requirements in support of an environmental and socio-economic assessment for the Trans Mountain Expansion Project (the Project). The approximately 674.4 km proposed pipeline corridor (BC portion) will pass through 13 watersheds and comprises four pipeline segments (Hargreaves to Darfield, Black Pines to Hope, Hope to Burnaby and Burnaby to Westridge) and two power lines (Black Pines power line and Kingsvale power line).

The fish and fish habitat effects assessment considered potential effects to fish and fish habitat within the proposed pipeline corridor and each watershed crossed by the Project. Fish habitat was rated for spawning, rearing, overwintering and migration and habitat sensitivity was rated as high or low. Key indicator species for the BC portion of the Footprint Study Area (FSA) include coho salmon, Chinook salmon, bull trout, rainbow trout and cutthroat trout. Fish and fish habitat assessments also considered potential for species at risk along the proposed pipeline corridor, including *Species at Risk Act* (*SARA*)-listed white sturgeon (Upper Fraser River Population), green sturgeon, salish sucker, nooksack dace; provincially Red-listed white sturgeon (Middle and Lower Fraser River Population); Blue-listed mountain sucker, bull trout, eulachon, and chiselmouth, and COSEWIC ranked Interior Fraser coho salmon and Cultus Lake sockeye salmon.

Prior to field investigations, a thorough review of existing historical literature of fish species presence and distribution within watercourses crossed by the proposed pipeline corridor was carried out. Site-specific field surveys to document current fish and fish habitat information (baseline conditions) and crossing recommendations for each watercourse crossing were carried out in 2012 and 2013 field seasons. Overall fish and fish habitat potential (*e.g.*, spawning, rearing, overwintering, and migration) was rated for each watercourse crossing and a fish sensitivity (high or low) was derived based on potential species presence (recreational, commercial, ecological or Aboriginal importance) and habitat potential. Fish and fish habitat assessments also considered local Traditional Ecological Knowledge (TEK) / Aboriginal Traditional Knowledge (ATK) knowledge within watersheds crossed by the Project. Field surveys were also used to screen which waterways were navigable, potentially navigable and minor or non-navigable.

All results of the fish and fish habitat assessments are summarized within the body of this report, the Watercourse Crossing Summary Table (Appendix A), fish-bearing atlas (Appendix B), nonfish-bearing atlas (Appendix C) and fish sensitivity map (Appendix D). The following totals summarize the results from the 2012 and 2013 field programs.

- In total, 800 potential watercourse crossings have been identified along the proposed pipeline corridor, and 36 potential watercourses were identified along the proposed powerline corridor.
- In 2012 and 2013, field investigations were carried out through spring, summer and fall at 776 potential watercourses.
- There are currently 393 defined watercourse crossings within the BC portion of the proposed corridor, including 202 fish-bearing and 191 nonfish-bearing watercourses. A total of 8 supplemental sites were included in the fish-bearing total as they have adequate historical information.
- Of the 202 fish-bearing watercourses, 174 have fish-bearing reaches within the proposed corridor; additionally there are 12 fish-bearing wetlands within the proposed corridor.
- Of the 186 (fish-bearing watercourse reaches and wetlands) within the proporsed corridor, 154 were assessed as having a high sensitivity and 32 were considered to have a low sensitivity.
- A total of 154 potential watercourses investigated along the proposed corridor were classified as non-classified drainages (NCD), 35 were classified as wetlands (NCD-W) and 202 were classified as having no visible channel (NVC).
- There were 60 potential watercourse crossings that were not accessible during the 2012-2013 field programs, where available, existing literature and data were used to develop interim assessment results and proposed mitigation measures. With available access, these sites will be visited in 2014.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF DRAWINGS

LIST OF APPENDICES

Definition and Acronym Table	
Acronym	**Full Name**
ADFG	Alaska Department of Fish and Game
AENV	Alberta Environment
ATK	Aboriginal Traditional Knowledge
ATV	All Terrain Vehicle
Avoidance	a means to prevent a potential adverse effect through routing/siting of the project, changes to project design or construction timing
BC	British Columbia
BC CDC	BC Conservation Data Centre
BC MELP	BC Ministry of Environment, Lands and Parks
BC MFLNRO	BC Ministry of Forests, Lands and Natural Resource Operations
BC MOE	Ministry of Environment
BC MOF	Ministry of Forests
BC MWLAP	BC Ministry of Water, Land and Air Protection
BC OGC	BC Oil and Gas Commission
BGC	Biogeoclimatic Zones
BPEF	Backpack Electrofishing
CAPP	Canadian Association of Petroleum Producers
CCME	Canadian Council of Ministers of the Environment
CEA Act 2012	*Canadian Environmental Assessment Act 2012*
CN	Canadian National
Compensation/offset	A means intended to compensate unavoidable and/or unacceptable effects. May consist of offsets (no net loss), research, education programs, and financial compensation (considered only when all other options have been exhausted)
COSEWIC	Committee for the Status of Endangered Wildlife in Canada
DFO	Fisheries and Oceans Canada (Department of Fisheries and Oceans)
DO	Dissolved Oxygen
EcoCat	Ecological Reports Catalogues
EPP	Environmental Protection Plan
ESA	Environmental and Socio-economic Assessment
FIDQ	Fisheries Inventory Data Queries
FFSBC	Freshwater Fisheries Society of BC
FISS	Fisheries Information Summary System
FPC	Forest Practices Code
FRPA	*Forest and Range Practice Act*
FSZ	Fish sensitive zone
GIS	Geographic Information System
GPS	Geographic Positioning System
HDD	Horizontal Directional Drill
HWY	Highway
KMC	Kinder Morgan Canada
LGL	LGL Ltd. Environmental Research Associates
LOA	Letter of Advice
LSA	Local Study Area
Mitigation	means measures for the elimination, reduction or control of the adverse environmental effects of the project, and includes restitution for any damage to the environment caused by such effects through replacement, restoration, compensation or any other means
MOU	memorandum of understanding
NCD	Non-classified drainage
NCD-W	Non-classified drainage with wetland
NEB	National Energy Board
NRC	Natural Resources Canada

Definition and Acronym Table	
Acronym	**Full Name**
NVC	No Visible Channel
NWPA	Navigable Waters Protection Act
OGAA	Oil and Gas Activities Act
OS	Operational Statement
Post-construction monitoring	a type of monitoring program that may be used to verify that mitigation measures were properly implemented and that such measures effectively mitigate the predicted adverse environmental effects
QA	Quality Assurance
QC	Quality Control
QAES	Qualified Aquatic Environmental Scientist (Alberta)
QEP	Qualified Environmental Professional (British Columbia)
RIC	Resources Inventory Committee
RISC	Resources Inventory Standards Committee
RK	Reference Kilometer
RSA	Regional Study Area
SARA	*Species at Risk Act*
SFU	Simon Fraser University
Supplemental studies	studies to be conducted post submission of the application to provide supplemental information in support of the application
TBD	To Be Determined
TEK	Traditional Ecological Knowledge
TLU	Traditional Land Use
TLRU	Traditional Land and Resource Use
the Project	the Trans Mountain Expansion Project
TMPL	Trans Mountain Pipeline
TRIM	Terrain Resource Information Management
TSS	Total Suspended Solids
Trans Mountain	Trans Mountain Pipeline ULC
UTM	Universal Transverse Mercator
VEC	valued ecosystem components
ZOI	Zone-of-Influence

Fish Species Acronym List		
Acronym[1]	**Common Name**	**Scientific Name**
AO	Salmon (General)	*Oncorhynchus* spp.
BB	Burbot	*Lota lota*
BCB	Black crappie	*Pomoxis nigromaculatus*
BL	Western brook lamprey	*Lampetra richardsoni*
BMC	Brassy minnow	*Hybognathus hankinsoni*
BNH	Brown bullhead	*Ameiurus nebulosus*
BSU	Bridgelip sucker	*Catostomus columbianus*
BT	Bull trout	*Salvelinus confluentus*
C	Minnow (General)	*Cyprinid spp.*
CAL	Coastrange sculpin	*Cottus aleuticus*
CAS	Prickly sculpin	*Cottus asper*
CC	Sculpin (General)	*Cottus* spp.
CCG	Slimy sculpin	*Cottus cognatus*
CCT	Coastal cutthroat trout	*Oncorhynchus clarki clarki*
CH	Chinook salmon	*Oncorhynchus tshawytscha*
CLA	Pacific staghorn sculpin	*Leptocottus armatus*
CM	Chum salmon	*Oncorhynchus keta*
CMC	Chiselmouth	*Acrocheilus alutaceus*
CO	Coho salmon	*Oncorhynchus kisutch*
CP	Carp	*Cyprinus carpio*
CRH	Torrent sculpin	*Cottus rhotheus*
CSU	Largescale sucker	*Catostomus macrocheilus*
CT	Cutthroat trout (General)	*Oncorhynchus clarki*
DC	Dace (General)	*Rhinichthys* spp.
DV	Dolly Varden	*Salvelinus malma*
EB	Brook trout	*Salvelinus fontinalis*
ESC	Emerald shiner	*Notropis atherinoides*
EU	Eulachon	*Thaleichthys pacificus*
GSG	Green sturgeon	*Acipenser medirostris*
KO	Kokanee	*Oncorhynchus nerka*
L	Lamprey (General)	*Lampetra* spp.
LDC	Leopard dace	*Rhinichthys falcatus*
LKC	Lake chub	*Couesius plumbeus*
LNC	Longnose dace	*Rhinichthys cataractae*
LSM	Longfin smelt	*Spirincus thaleichthys*
LSU	Longnose sucker	*Catostomus catostomus*
LT	Lake trout	*Salvelinus namaycush*
LW	Lake whitefish	*Coregonus clupeaformis*
MSU	Mountain sucker	*Catostomus platyrhyncus*
MW	Mountain whitefish	*Prosopium williamsoni*
NDC	Nooksack dace	*Rhinichthys sp.*
NP	Northern pike	*Esox lucius*
NSC	Northern pikeminnow	*Ptychocheilus oregonensis*
PCC	Peamouth chub	*Mylocheilus caurinus*
PK	Pink salmon	*Oncorhynchus gorbuscha*
PL	Pacific lamprey	*Lampetra tridentata*
PW	Pygmy whitefish	*Prosopium coulteri*
RB	Rainbow trout	*Oncorhynchus mykiss*
RL	River lamprey	*Lampetra ayresi*
RSC	Redside shiner	*Richardsonius balteatus*

Fish Species Acronym List		
Acronym[1]	**Common Name**	**Scientific Name**
RW	Round whitefish	*Prosopium cylindraceum*
SB	Stickleback (General)	*Gasterosteus* spp.
SFL	Starry flounder	*Platichthys stellatus*
SG	Sturgeon (General)	*Acipenser* spp.
SH	American shad	*Alosa sapidissima*
SK	Sockeye salmon	*Oncorhynchus nerka*
SSM	Surf smelt	*Hypomesus pretiosus*
ST	Steelhead	*Oncorhynchus mykiss*
SST	Summer steelhead	*Oncorhynchus mykiss*
SSU	Salish sucker	*Catostomus* sp.
STC	Spottail shiner	*Notropis hudsonius*
SU	Sucker (General)	*Catostomus* spp.
TSB	Threespine stickleback	*Gasterosteus aculeatus*
WCT	Westslope cutthroat trout	*Oncorhynchus clarki lewisi*
WF	Whitefish (General)	*Prosopium* spp.
WSG	White sturgeon	*Acipenser transmontanus*
WSU	White sucker	*Catostomus commersoni*

Source: 1 Mackay *et al.* 1990

1.0 INTRODUCTION

1.1 Project Overview

Trans Mountain Pipeline ULC (Trans Mountain) is a Canadian corporation with its head office located in Calgary, Alberta. Trans Mountain is a general partner of Trans Mountain Pipeline L.P., which is operated by Kinder Morgan Canada Inc. (KMC), and is fully owned by Kinder Morgan Energy Partners, L.P. Trans Mountain is the holder of the National Energy Board (NEB) certificates for the Trans Mountain pipeline system (TMPL system).

The TMPL system commenced operations 60 years ago and now transports a range of crude oil and petroleum products from Western Canada to locations in central and southwestern British Columbia (BC), Washington State and offshore. The TMPL system currently supplies much of the crude oil and refined products used in BC. The TMPL system is operated and maintained by staff located at Trans Mountain's regional and local offices in Alberta (Edmonton, Edson, and Jasper) and BC (Clearwater, Kamloops, Hope, Abbotsford, and Burnaby).

The TMPL system has an operating capacity of approximately 47,690 m^3/d (300,000 bbl/d) using 23 active pump stations and 40 petroleum storage tanks. The expansion will increase the capacity to 141,500 m^3/d (890,000 bbl/d).

The proposed expansion will comprise the following.

- Pipeline segments that complete a twinning (or "looping") of the pipeline in Alberta and BC with about 987 km of new buried pipeline.
- New and modified facilities, including pump stations and tanks.
- Three new berths at the Westridge Marine Terminal in Burnaby, BC, each capable of handling Aframax class vessels.

The expansion has been developed in response to requests for service from Western Canadian oil producers and West Coast refiners for increased pipeline capacity in support of growing oil production and access to growing West Coast and offshore markets. NEB decision RH-001-2012 reinforces market support for the expansion and provides Trans Mountain the necessary economic conditions to proceed with design, consultation, and regulatory applications.

Application is being made pursuant to Section 52 of the *National Energy Board Act* (*NEB Act*) for the proposed Trans Mountain Expansion Project (referred to as "TMEP" or "the Project"). The NEB will undertake a detailed review and hold a Public Hearing to determine if it is in the public interest to recommend a Certificate of Public Convenience and Necessity (CPCN) for construction and operation of the Project. Subject to the outcome of the NEB Hearing process, Trans Mountain plans to begin construction in 2016 and go into service in 2017.

Trans Mountain has embarked on an extensive program to engage Aboriginal communities and to consult with landowners, regulatory authorities (*e.g.*, regulators and municipalities), stakeholders, and the general public. Information on the Project is also available at www.transmountain.com.

The scope of the Project will involve:

- using existing active 610 mm (NPS 24) and 762 mm (NPS 30) OD buried pipeline segments;
- constructing three new 914 mm (NPS 36) OD buried pipeline segments totalling approximately 987 km:
  - Edmonton to Hinton – 339.4 km;
  - Hargreaves to Darfield – 279.4 km;

  - Black Pines to Burnaby – 367.9 km;

- reactivating two 610 mm (NPS 24) OD buried pipeline segments that have been maintained in a deactivated state:

  - Hinton to Hargreaves – 150 km;

  - Darfield to Black Pines – 43 km;

- constructing two, 3.6 km long 762 mm (NPS 30) OD buried delivery lines from Burnaby Terminal to Westridge Marine Terminal (the Westridge delivery lines);

- installing 23 new sending or receiving traps (16 on the Edmonton-Burnaby mainlines), for in-line inspection tools, at nine existing sites and one new site;

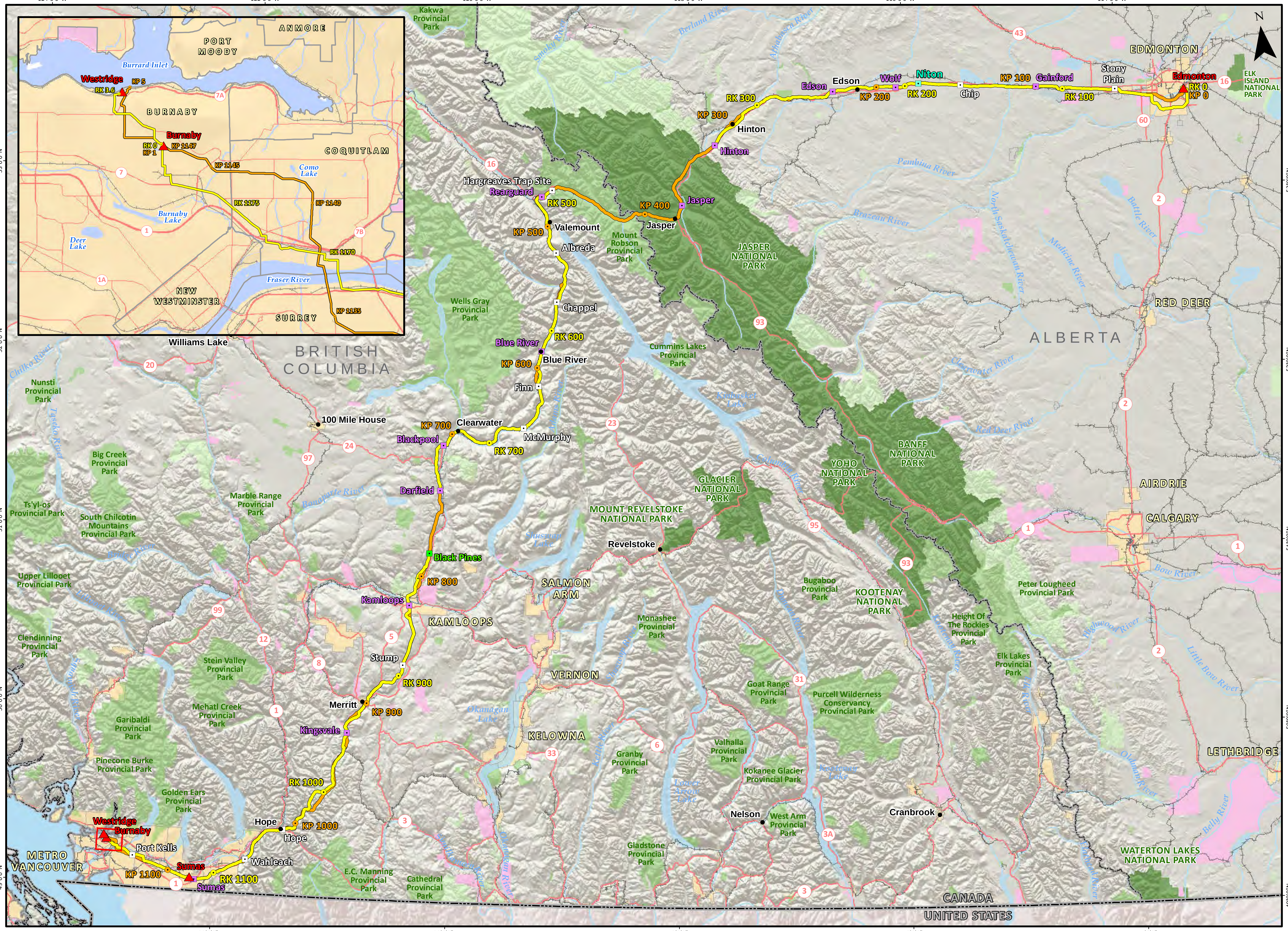
- adding 35 new pumping units at 12 locations (*i.e.*, 11 existing and one new pump station site);

- reactivating the existing Niton Pump Station that has been maintained in a deactivated state;

- constructing 20 new tanks located at the Edmonton (5), Sumas (1) and Burnaby (14) Terminals, preceded by demolition of 2 existing tanks at Edmonton (1) and Burnaby (1), for a net total of 18 tanks to be added to the system; and

- constructing one new dock complex, with a total of three Aframax-capable berths, as well as a utility dock (for tugs, boom deployment vessels, and emergency response vessels and equipment) at Westridge Marine Terminal, followed by the deactivation and demolition of the existing berth.

Figure 1.1 provides the location of the proposed Project.



TRANS MOUNTAIN

FIGURE 1.1

PROJECT OVERVIEW
ALBERTA AND BRITISH COLUMBIA

TRANS MOUNTAIN EXPANSION PROJECT

- Kilometre Post (KP)
- Reference Kilometre Post (RK)
- Trans Mountain Pipeline (TMPL)
- Trans Mountain Expansion Project Proposed Pipeline Corridor
- Terminal
- Pump Station (Pump Additions, Station Modifications and/or Scraper Facilities)
- New Pump Station (Proposed)
- Pump Station (Reactivated)
- Existing Pump Station
- Highway
- Railway
- City / Town / District Municipality
- Indian Reserve / Métis Settlement
- National Park
- Provincial Park
- Protected Area / Natural Area / Provincial Recreation Area / Wilderness Provincial Park / Conservancy Area
- Provincial Boundary
- International Boundary

Projection: LCC Modified. Routing: Baseline TMPL & Facilities: provided by KMC, 2012; Proposed Pipeline Corridor V6: provided by UPI, Aug. 23, 2013; Transportation: IHS Inc., 2013, BC Forests, Lands and Natural Resource Operations, 2012 & Natural Resources Canada, 2012; Geopolitical Boundaries: Natural Resources Canada, 2003, AltaLIS, 2013, IHS Inc., 2011, BC FLNRO, 2007 & ESRI, 2005; First Nation Lands: Government of Canada, 2013, AltaLIS, 2010 & IHS Inc., 2011; Hydrology: Natural Resources Canada, 2007 & BC Crown Registry and Geographic Base Branch, 2008; Parks and Protected Areas: Natural Resources Canada, 2012, AltaLIS, 2012 & BC FLNRO, 2008; ATS Grid: AltaLIS, 2009; Edmonton TUC: Alberta Infrastructure, 2011; Canadian Hillshade: TERA Environmental Consultants, 2008; US Hillshade: Copyright:© 2009 ESRI.

This document is provided by Kinder Morgan Canada Inc. (KMC) for use by the intended recipient only. This information is confidential and proprietary to KMC and is not to be provided to any other recipient without the written consent of KMC. It is not to be used for legal, engineering or surveying purposes, nor for doing any work on or around KMC's pipelines and facilities, all of which require KMC's prior written approval.

tera ENVIRONMENTAL CONSULTANTS

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

MAP NUMBER		PAGE
201307_MAP_TERA_ESA_00341_REV0		SHEET 1 OF 1
DATE December 2013	TERA REF. 7894	REVISION 0
SCALE 1:2,250,000	PAGE SIZE 11x17	DISCIPLINE ESA
DRAWN AJS	CHECKED TGG	DESIGN TGG

0 25 50 75 100 km

ALL LOCATIONS APPROXIMATE

201307_MAP_TERA_ESA_00341_Rev0.mxd

1.2 Fish and Fish Habitat Assessments

Triton Environmental Consultants Ltd. (Triton) and Estsek` Environmental Services LLP (Estsek`), on behalf of Trans Mountain, conducted an extensive background literature review and field investigations to develop a comprehensive database comprised of relevant historic and existing fish and fish habitat information. The purpose of the fish and fish habitat assessments was to: satisfy application and regulatory requirements for the Project's components occurring in BC; support an environmental assessment of the Project; and to inform technically sound and relevant recommendations.

During most field surveys, fish and fish habitat assessments occurred in conjunction with a complementary Traditional Ecological Knowledge (TEK) program. However, only the technical fish and fish habitat data, presented as the primary focus of this report, was collected exclusively by Qualified Environmental Professionals (QEP) and were reviewed and assessed by senior aquatic biologists.

1.3 Traditional Ecological Knowledge

Trans Mountain has engaged with Aboriginal communities and organizations that may be affected by the Project or that may have an interest in the Project based on the proximity of their community and their assertion of traditional and cultural use of the land along the proposed pipeline corridor to maintain a traditional lifestyle.

TERA Environmental Consultants (TERA) was commissioned to facilitate the participation of potentially affected Aboriginal communities during the fish and fish habitat surveys conducted for the Project. The purpose is to incorporate Aboriginal views and the experiential knowledge of the land that has accumulated over generations and passed down from the Elders into the consideration of potential Project-related environmental effects. The collection of fisheries related TEK focused on Aboriginal experiential knowledge of the land and field reconnaissance was conducted along Crown lands potentially disturbed by Project construction, including associated physical works and activities. To complement the technical fish and fish habitat data collected by QEP-led crew, this report also includes the results of the Aboriginal participation occurring during the fisheries field surveys. For ease of reference and focus, the fisheries related TEK collected by TERA facilitators is presented under distinct headings throughout this report. Approval to treat collected TEK within this report as public knowledge was received by the participating Aboriginal communities listed herein.

1.4 Objectives

The primary objectives of the fish and fish habitat assessments were to:

- investigate all potential watercourse crossings along the proposed pipeline corridor during open water conditions (summer/fall 2012 and winter/spring/summer 2013);
- document fish use, aquatic and riparian habitat quality and sensitivity generally at and adjacent to (upstream and downstream from) the centre of the proposed pipeline corridor;
- document any fish species at risk or of special concern and to determine the sensitivity of fish habitats to disturbance associated with the pipeline construction and operation; and
- provide written recommendations from a Qualified Aquatic Environmental Scientist (QAES)/Qualified Environmental Professional (QEP) to help ensure the quantity and productive capacity of the aquatic environment is maintained and not reduced by the proposed Project.

The objectives of Aboriginal participation during the fish and fish habitat assessments were to:

- document the TEK of Aboriginal communities;
- augment the design and execution of the field surveys;

- inform existing (baseline) environmental conditions;
- identify potential effects of the Project on environmental resources;
- integrate TEK into the consideration and mitigation of environmental effects; and
- contribute to final Project design.

Information collected during the fish and fish habitat assessments is provided in this technical report and within the following volumes:

- Appendix A - Watercourse Crossing Summary Table;
- Appendix B - Fish-Bearing Atlas;
- Appendix C - Nonfish-Bearing Atlas;
- Appendix D - Distribution and Sensitivity of Fish-Bearing Watercourses;
- Appendix E - Standardized Drawings for Reclamation Measures; and
- Appendix F - Watercourses Requiring Supplemental Studies.

This report describes the approach and methods used for fish and fish habitat assessments and interprets the results of the literature search and fieldwork, as well as identifies potential effects and general freshwater fish habitat mitigation recommendations for the construction and reclamation phases of the Project. The results of this report do not identify any potential residual environmental or socio-economic effects nor provide conclusions regarding significance. Volume 5A Environmental and Socio-economic Assessment (ESA) – Biophysical Assessment provides the potential residual and cumulative effects of pipeline and facilities components of the Project on freshwater fisheries, including an evaluation of significance.

1.5 Regulatory Standards

1.5.1 Federal Standards

1.5.1.1 Fisheries and Oceans Canada

Fisheries and Oceans Canada (DFO) is the federal agency responsible for administering the *Fisheries Act* and ensuring compliance with it. The Department of Fisheries and Oceans' long-term policy objective is the achievement of an overall net gain of the productive capacity of fish habitats (DFO 1986). This policy objective is guided by the “no net loss” principle where DFO strives to balance unavoidable habitat losses with habitat replacement on a project-by-project basis.

Pipeline activities in Canada that have the potential to impact fish or fish habitat must be constructed and operated in compliance with the federal *Fisheries Act.* It is the responsibility of the proponent to ensure the proposed works or activity are not likely to result in serious harm to fish or any permanent alteration to, or destruction of, fish habitat; specifically, serious harm to fish that are part of a commercial, recreational or Aboriginal fishery, or to fish that support such a fishery. If these conditions cannot be met, a proponent requires authorization under the *Fisheries Act* to proceed with the works proposed. Where a proponent or DFO determines that the works proposed would comply with the *Fisheries Act*, an authorization under the *Fisheries Act* will not be required.

The *Fisheries Act* (S. 36(1)) also prohibits the deposition of deleterious substances into waters frequented by fishes and also has provisions to: ensure the safe passage of fishes; require flow of water and passage of fishes; require water intakes and diversions to have a fish guard or fish screen; and require proponents to submit plans of specification of their works to DFO for review.

In recent years, DFO has initiated measures to streamline its review and approval process. Routine reviews of lower risk activities have been replaced by guidelines in the form of Operational Statements (OSs). The OSs have been developed separately among regions and are different between provinces; they outline the conditions and mitigation measures that a proponent must meet to protect fish and fish habitat, and remain in compliance with the *Fisheries Act.* Proponents are allowed to proceed with a project without DFO review if they meet the conditions in the applicable OS. Advanced notification of the proposed activities is requested by DFO.

In 2012, amendments to the *Fisheries Act* received Royal Assent. Policy and regulations have now been developed to support the new fisheries protection provisions of the *Fisheries Act*, which will focus on the protection and productivity of recreational, commercial and Aboriginal fisheries. In November 2013, amendments proposed to the *Fisheries Act* came in to force. New guidance and policy that accompanies these changes to the *Act* now apply (DFO 2013a).

In addition to the changes to policy related to the *Fisheries Act*, it is anticipated that a memorandum of understanding (MOU) between DFO and the NEB will be established before the NEB review of the Project is complete, and that the MOU will outline responsibilities of the NEB with respect to the review of fish and fish habitat to be crossed by the Project. It is further expected that this MOU will prescribe the appropriate *Fisheries Act* referral review tools (*e.g.*, OSs) relevant to the NEB's review of potential effects to fish and fish habitat. Because the MOU is not currently in place and in consideration of the Project's submission timeline, the current review process and policy are referenced in this document. Should an MOU be provided after November 15th, 2013, reference to the current DFO review process and tools may need to be re-examined.

1.5.1.2 Transport Canada

Prior to changes made under Bill C-38 in June 2012, Section 108 of the *NEB Act* previously required the proponent to obtain approval from Transport Canada for works crossing navigable waters in all instances. A determination of navigability was first typically required for all of the proposed watercourse crossings. Following the results of the determination, relevant information related to all navigable watercourses crossed by a Project were to be submitted to Transport Canada as part of an application for Approval under the *Navigable Waters Protection Act* (now the *Navigation Protection Act*). Following changes to the *NEB Act*, a memorandum of understanding (MOU) was established between the NEB and Transport Canada outlining the responsibility of the NEB with respect to the review of navigability for watercourses to be crossed by NEB regulated projects (NEB 2013a,b). As part of this MOU:

> "...*the responsibilities for approving pipelines and power lines subject to the NEBA that pass in, on, over, under, through or across navigable waters was transferred to the NEB*..." (NEB 2013a).

New NEB policy/processes related to review of projects, with specific relevance to the crossing of potentially navigable waters, are currently being developed but are not yet publicly available.

1.5.1.3 National Energy Board Filing Manual

The assessment of fish and fish habitat was designed to meet the requirements of an application under Section 52 of the *National Energy Board Act*, as outlined in Guide A.2 of the NEB *Filing Manual* (2013b). In particular, the fish and fish habitat assessment was conducted in accordance with NEB filing requirements for the fish and fish habitat and species at risk elements as outlined in Table A-2 of the NEB *Filing Manual*. This report considers Aboriginal Traditional Knowledge (ATK) from the NEB *Filing Manual* (2013b) and Section 19(3) of the *Canadian Environmental Assessment* (*CEA*) *Act, 2012*.

1.5.1.4 Canadian Environmental Assessment Act, 2012

The assessment has been conducted so that other federal requirements pertaining to fisheries are also satisfied, including those in the legislation, regulations and guidance documents pertaining to the *CEA Act, 2012*. In particular, the assessment considers the change that may be caused to fish, as defined in Section 2 of the *Fisheries Act*, and fish habitat, as defined in subsection 34(1) of the *Fisheries Act*, as well as aquatic species defined in subsection 2(1) of the *SARA*.

1.5.2 Provincial Standards in British Columbia

The *Forest and Range Practices Act* (*FRPA*) regulates the construction, maintenance, and deactivation of Forest Service Road stream crossings on forested Crown land in BC and depending on the nature of the activities, other provincial acts may include the *Oil and Gas Activities Act*, *Water Act*, *Land Act*, *Mines Act* and *Drinking Water Protection Act* (BC Ministry of Forests, Lands and Natural Resource Operations [BC MFLNRO] 2004).

The *FRPA* governs the activities of forest and range licensees in BC including stream crossings on fish streams. Regulations under this *Act* specify that forest and range activities must not result in material adverse effects to fish or disrupt passage in fish streams. Prior to the implementation of the *FRPA* in 2004, the Forest Practices Code (FPC) contained requirements for maintenance of fish passage at forestry road crossings on all fish streams. To meet requirements for fish passage and protection of fish and fish habitat, under the *FRPA*, the BC Fish-stream Crossing Guidebook (BC MFLNRO 2012) provides current legislative and technical reference materials pertaining to the location, design, installation, maintenance, and deactivation of stream crossings. This guidebook is recognized by DFO and generally used by other resource managers and practitioners for planning and implementation of stream crossings in BC.

The *Land Act* regulates the issuance of right-of-ways and linear corridors for oil and gas operations. The *Water Act* (Section 9) and its regulations (Part 7) are administered by BC MFLNRO and protect the quality and quantity of water resources in BC, including “changes in and or about a stream” and the protection of water quality, fish and wildlife. An “Approval” or a “Notification” may be required under this *Act* depending on the nature of the activity; although, certain exemptions can be made under the *Water Act*, whereby certain standards or regulations are covered under other acts including the *FRPA*, *Forest Act*, *Range Act*, *Forest Practices Code of British Columbia Act*, *Oil and Gas Activities Act* and *Mines Act*.

Data collection standards and procedures for inventories of aquatic resources and ecosystems have been developed in BC through the Resources Inventory Standards Committee (RISC) and the FPC. Although BC does not have a Practices Code for pipeline crossings, inventory standards have been established for land management and these standards are generally accepted by the Government of BC and DFO, Pacific Region. The BC Oil and Gas Commission (OGC), *Environmental Protection and Management Guide* v 1.9 (BC OGC 2012) also provides direction and requirements concerning oil and gas development in BC. Guidebooks and key publications used in the implementation of the fish and fish habitat field data collection program are presented in Table 1.1.

The conservation of species and aquatic ecosystems in BC is directed by the BC Ministry of Environment (BC MOE) through the Conservation Framework (BC MOE 2009a) and BC Conservation Data Centre (BC CDC). Species at Risk and ecosystems of conservation concern are tracked and ranked for management action depending on species status, population threats and feasibility of recovery (BC MOE 2012). Sensitive fish species are listed under the Vertebrate Track Group in the BC Species and Ecosystem Explorer (BC CDC 2012). Red-listed species are Extirpated, Endangered or Threatened in BC. Blue-listed species are of Special Concern or Vulnerable in BC.

TABLE 1.1

SUMMARY OF DATA COLLECTION STANDARDS

Standard	Date	Source
Environmental Protection and Management Guide	2013	BC Oil and Gas Commission
Fish-stream Crossing Guidebook	2012	BC Ministry of Forests, Lands and Natural Resource Operations; BC Ministry of Environment; and Fisheries and Oceans Canada
Fish Habitat Assessment Procedures	1996	N.T. Johnston and P.A. Slaney, Watershed Restoration Program, Ministry of Environment, Lands and Parks; and Ministry of Forests
FPC Riparian Management Area Guidebook	1995	Forest Practices Codes of BC, Ministry of Forests
FPC Fish-stream Identification Guidebook	1998	Forest Practices Codes of BC, Ministry of Forests

TABLE 1.1 Cont'd

Standard	Date	Source
FPC Channel Assessment Procedure Field Guidebook	1996	Forest Practices Codes of BC, Ministry of Forests
Field Key to Freshwater Fishes of BC	1994	J.D. McPhail and R. Carveth, Resources Inventory Committee
Fisheries Information Summary System: Data Compilation and Mapping Procedures	1997	B. Desrochers, Enviro-Links
Fish Collection Methods and Standards	1997	BC Ministry of Environment, Lands and Parks, Fish Inventory Unit for the Aquatic Ecosystems Task Force, Resources Inventory Committee
Overview Fish and Fish Habitat Inventory Methodology	1999	BC Ministry of Fisheries for the Resources Inventory Committee
Reconnaissance (1:20 000) Fish and Fish Habitat Inventory: Fish Collection Form (and Individual Fish Data Form) Field Guide	2008a	BC Ministry of Environment for the Resources Inventory Standards Committee
Reconnaissance (1:20 000) Fish and Fish Habitat Inventory: Site Card Field Guide	2008b	BC Ministry of Environment for the Resources Inventory Standards Committee
Reconnaissance (1:20 000) Fish and Fish Habitat Inventory Standards and Procedures	2001	BC Fisheries Information Services Branch for the Resources Inventory Committee

2.0 CONSULTATION AND ENGAGEMENT

Trans Mountain and its consultants have conducted a number of consultative activities to inform Aboriginal communities, stakeholders, the public and regulatory authorities about the approach to assessing potential environmental and socio-economic effects of the Project, and to seek input throughout the Project planning process. This section summarizes consultation activities that have focused on identifying and assessing potential issues and concerns related to fish and fish habitat which may be affected by the construction and operation of the Project.

2.1 Public Consultation, Aboriginal Engagement and Landowner Relations

Trans Mountain has implemented and continues to conduct an open, extensive and thorough public consultation, Aboriginal engagement and landowner relations programs. These programs were designed to reflect the unique nature of the Project as well as the diverse and varied communities along the proposed pipeline and marine corridors. These programs were based on Aboriginal communities, landowner and stakeholder groups' interests and inputs, knowledge levels, time and preferred method of engagement. In order to build relationships for the long-term, these programs were based on the principles of accountability, communication, local focus, mutual benefit, relationship building, respect, responsiveness, shared process, sustainability, timeliness, and transparency. The full description of the Public Consultation, Aboriginal Engagement and Landowner Relations programs are located in Volumes 3A, 3B and 3C, respectively.

Feedback related to fish and fish habitat that was raised through various Aboriginal engagement and public consultation activities including public open houses, ESA Workshops, Community Workshops and one-on-one meetings, is summarized below and was considered in the development of this technical report, and the assessment of fish and fish habitat in Volume 5A:

- watercourse crossing methods and disturbance to fish habitat at select watercourses;
- protection of inland fisheries;
- effects to the regenerated herring fishery and newly returned resident populations;
- disturbance of salmon habitat (*e.g.*, spawning habitat at Nathan Creek, Vedder Creek, Blue River, Albreda and Thompson River Chinook and coho runs);
- potential effects to species at risk (*e.g.*, nooksack dace);
- the value of riparian habitat; and
- maintaining access to recreational fishing locations during construction.

In addition, concerns related to the potential effects of spills on fish and fish habitat were also raised and detailed information on pipeline spills is provided in Volume 7A.

The full description of the public consultation, Aboriginal engagement and landowner relations programs are located in Volumes 3A, 3B and 3C, respectively. Section 3.0 of Volume 5A summarizes the consultation and engagement activities that have focused on identifying and assessing potential issues and concerns related to fish and fish habitat which may be affected by the construction and operation of the Project. Information collected through the public consultation, Aboriginal engagement and landowner relations programs for the Project was considered in the development of this technical report, and the assessment of fish and fish habitat in Volume 5A.

2.2 Regulatory Consultation

Consultation with regulators and key stakeholder groups commenced in May, 2012 and continued through October, 2013. Consultation involved either direct communications and/or participation in ESA Workshops. A summary of this consultation is presented in Table 2.1 below.

TABLE 2.1

SUMMARY OF REGULATORY CONSULTATION ACTIVITIES RELATED TO FISH AND FISH HABITAT IN BRITISH COLUMBIA

Stakeholder Group/Agency Name	Name and Title of Contact	Method of Contact	Date of Consultation Activity	Reason For Engagement	Issues/Concerns	Commitments/ Follow-Up Actions/ Comments
FEDERAL CONSULTATION						
Fisheries and Oceans Canada	Jennifer Simpson, Team Leader Brenda Andres, Environmental Assessment Analyst	Meeting	September 14, 2012	Project introduction. Outline methods and approach to fish and fish habitat investigations along the Project length. Brief review of regulatory changes.	No concerns with general methodology. Data will be collected as per provincial standards.	None.
Fisheries and Oceans Canada	Dave Pehl, Habitat Protection Officer, Oil and Gas Unit	Meeting	September 25, 2013	Project introduction. Outline methods and approach to fish and fish habitat investigations along the Project length. Brief review of regulatory changes.	No concerns with the general methodology. Need to ensure that compensation projects have high probability of success.	Engage DFO at the time of developing Fish Habitat Compensation. Ensure Aboriginal communities are involved in development and implementation.
PROVINCIAL CONSULTATION – BC						
Ministry of Forests, Lands and Natural Resource Operations (MFLNRO)	Christian St. Pierre, Ecosystems Technician; John Surgenor, Wildlife Biologist	Meeting	March 6, 2013	Kamloops ESA Workshop.	Suggested use of ATV fords as an indicator.	Access at watercourses created by linear disturbances is being used as an indicator.
BC Parks	--	Meeting	March 6, 2013	Kamloops ESA Workshop.	Participants noted that riparian habitat is of concern.	Ensure that appropriate buffers are retained and that restoration programs adequately replace riparian vegetation.
BC Lake Stewardship Society	--	Meeting	March 6, 2013	Kamloops ESA Workshop.	Questioned use of benthic invertebrates as an indicator.	Justification for not using benthic invertebrates was provided; alternative indicators used instead.
Fraser Basin Council	Mike Simpson, Senior Regional Manager	Meeting	March 6, 2013	Kamloops ESA Workshop.	Watercourse crossing disturbances.	Ensure appropriate crossing methods, timing and mitigation are developed, along with monitoring programs.
Pacific Salmon Foundation	--	Meeting	June 17, 2013 October 2, 2013	To review overall strategy for compensation and net benefits.	Projects should be strategic to yield the maximum benefit.	Ensure Foundation is engaged on the development of compensation plans.
BC Wildlife Federation	--	Meeting	June 17, 2013	Chilliwack Open House.	Watercourse crossing disturbances.	Ensure appropriate crossing methods, timing and mitigation are developed, along with monitoring programs.

TABLE 2.1 Cont'd

Stakeholder Group/Agency Name	Name and Title of Contact	Method of Contact	Date of Consultation Activity	Reason For Engagement	Issues/Concerns	Commitments/ Follow-Up Actions/ Comments
Steelhead Society of BC	Poul Bech, Director	Meeting	March 7, 2013	Surrey ESA Workshop.	Ensure that works in key areas for steelhead adequately address the species; ensure that access for recreational users is maintained.	Ensure appropriate crossing methods, timing and mitigation are developed along with restoration.
Fraser Valley Regional District	--	Meeting	March 7, 2013; June 11, 2013	Surrey ESA Workshop; Hope.	Approach for future compensation ideas.	At time of developing compensation plans, ensure FVRD are consulted.
Fraser Valley Watershed Coalition;	John Vissers	Meeting	March 7, 2013; June 18, 2013	Surrey ESA Workshop; Abbotsford.	Consider forage species as well as sportfishes; emphasised the value of riparian habitat.	Forage fish are not being used as indicator species However, instream habitat investigations provide an assessment of the instream habitat for all fish species; riparian disturbance is being used as an indicator in cumulative effects analysis.
City of Surrey – Engineering, Design and Construction, Drainage and Management, Parks Planning and Design	Stephen Godwin	Meeting	March 7, 2013; June 20, 2013	Surrey ESA Workshop; Surrey.	Ensure that adequate flood estimates are used in models for engineering design.	Crossing design will use appropriate depth of cover and instream/bank restoration.
City of Coquitlam	--	Meeting	March 7, 2013; June 25, 2013	Surrey ESA Workshop; Coquitlam.	Watercourse crossing disturbances.	Ensure appropriate crossing methods, timing and mitigation are developed, along with monitoring programs.

3.0 METHODS

3.1 Study Area Boundaries and Project Footprint

3.1.1 Study Area Boundaries

The Project has the potential to directly affect freshwater fish and fish habitats primarily through construction related activities (*e.g.*, site preparation, clearing and grubbing) and indirectly through potential physical infilling of downstream habitats and temporal delays in fish migration during construction. Indirect effects may include isolation, fragmentation and sedimentation of habitats (loss of migration corridors). The effects assessment for fish and fish habitat, therefore, considers the following areas:

- Footprint Study Area (FSA);
- Local Study Area (LSA); and
- Regional Study Area (RSA).

3.1.1.1 Footprint Study Area

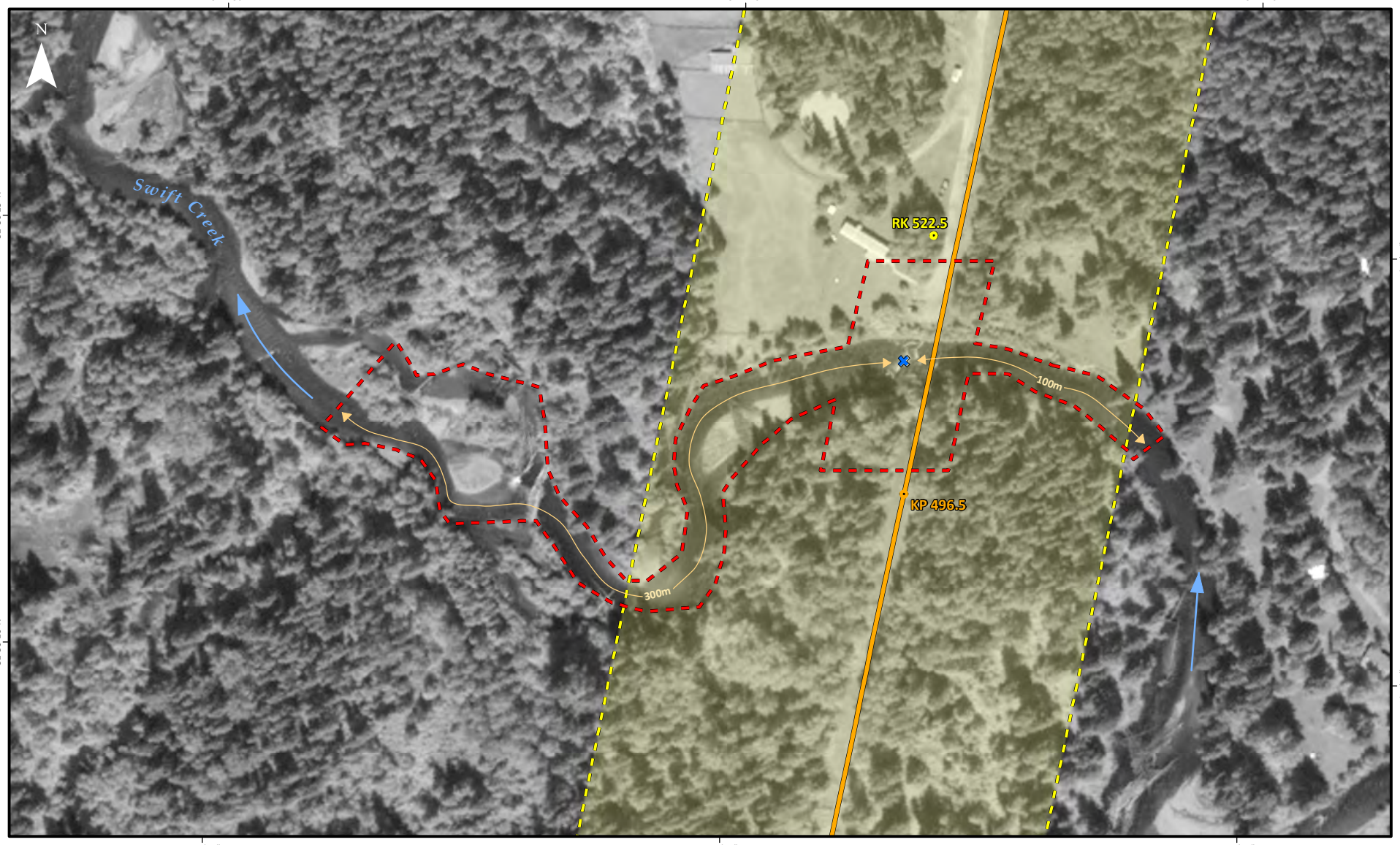
The FSA is defined as the area directly disturbed by physical works and activities such as sites preparation (clearing, grubbing), construction and clean-up along the pipeline corridor, pump stations, tanks, temporary construction workspace, temporary stockpile sites, temporary staging sites, camps, access routes, power lines, etc.) located within the riparian area.

3.1.1.2 Local Study Area

The LSA is defined for each watercourse crossed by the proposed pipeline corridor. With the exception of non-classified drainages (NCDs) which are less than 100 m in length, the LSA encompassed the area from 100 m upstream to 300 m downstream from the crossing centreline. The LSA also includes a 30 m wide riparian area along both channel banks. The downstream LSA boundary was based largely on the zone-of-influence (ZOI) likely to be affected by direct disturbance and sediment deposition during construction and operations. The ZOI is typically defined as that area downstream from the crossing (or other type of construction/instream disturbance) within which 90% of the sediment load is expected to fall out of suspension (AENV 2000a,b). As such, the LSAs are typically 400 m unless confirmed otherwise by the field QAES/QEP, who took into account a variety of factors (*e.g.*, stream gradient, channel width, channel depth, substrate composition, channel morphology, flow velocity and discharge, and instream cover). Because of variable drainage patterns along the corridor, it was not feasible to accurately map the LSA using the above-mentioned definition. A 'typical' fish and fish habitat LSA is shown in Figure 3.1 while a 'extended' fish and fish habitat local study area is shown in Figure 3.2**.**

3.1.1.3 Regional Study Area

The RSA comprises freshwater fish habitats beyond the LSA, where any potential residual effects (if any) of the Project can be assessed in a wider context. The RSA, therefore, considers the area where potential Project-related residual effects (*i.e.*, immitigable and non-compensable Project effects) may interact in a cumulative fashion with residual effects on fish and fish habitat from previous, current or foreseeable developments. Specifically, the RSA includes all watersheds within which the proposed pipeline corridor is located and, therefore, potentially affected by the Project. The aquatics RSA is shown in Figure 3.2.



ENVIRONMENTAL CONSULTANTS

0 20 40 60 80 m

ALL LOCATIONS APPROXIMATE

MAP NUMBER: 201309_MAP_TERA_AQ_00430_REV0_03		PAGE: SHEET 1 OF 2
DATE: December 2013	TERA REF.: 7894	REVISION: 0
SCALE: 1:2,000	PAGE SIZE: 8.5 x 11	DISCIPLINE: AQ
DRAWN: AJS	CHECKED: TGG	DESIGN: TGG

- Kilometre Post (KP)
- Trans Mountain Pipeline (TMPL)
- Reference Kilometre Post (RK)
- Trans Mountain Expansion Project Proposed Pipeline Corridor
- Approximate Watercourse Crossing Location
- Flow Direction
- Approximate Fish and Fish Habitat Local Study Area at Swift Creek

Projection: NAD83 UTM Zone 10N. Routing: Baseline TMPL & Facilities: provided by KMC, 2012; Proposed Pipeline Corridor V6: provided by UPI, Aug. 23, 2013; Facilities: Provided by KMC, 2012; Transportation: IHS Inc., 2013, BC Forests, Lands and Natural Resource Operations, 2012 & Natural Resources Canada, 2012; Geopolitical Boundaries: Natural Resources Canada, 2003, IHS Inc., 2011, BC FLNRO, 2007 & ESRI, 2005; First Nation Lands: Government of Canada, 2013 & IHS Inc., 2011; Hydrology: Natural Resources Canada, 2007 & BC Crown Registry and Geographic Base Branch, 2008; Wildlife: BC Ministry of Environment, 2005; Colour Imagery: KMC, 2012, NASA Geospatial Interoperability Program 2005 & ESRI, 2005.

This document is provided by Kinder Morgan Canada Inc. (KMC) for use by the intended recipient only. This information is confidential and proprietary to KMC and is not to be provided to any other recipient without the written consent of KMC. It is not to be used for legal, engineering or surveying purposes, nor for doing any work on or around KMC's pipelines and facilities, all of which require KMC's prior written approval.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

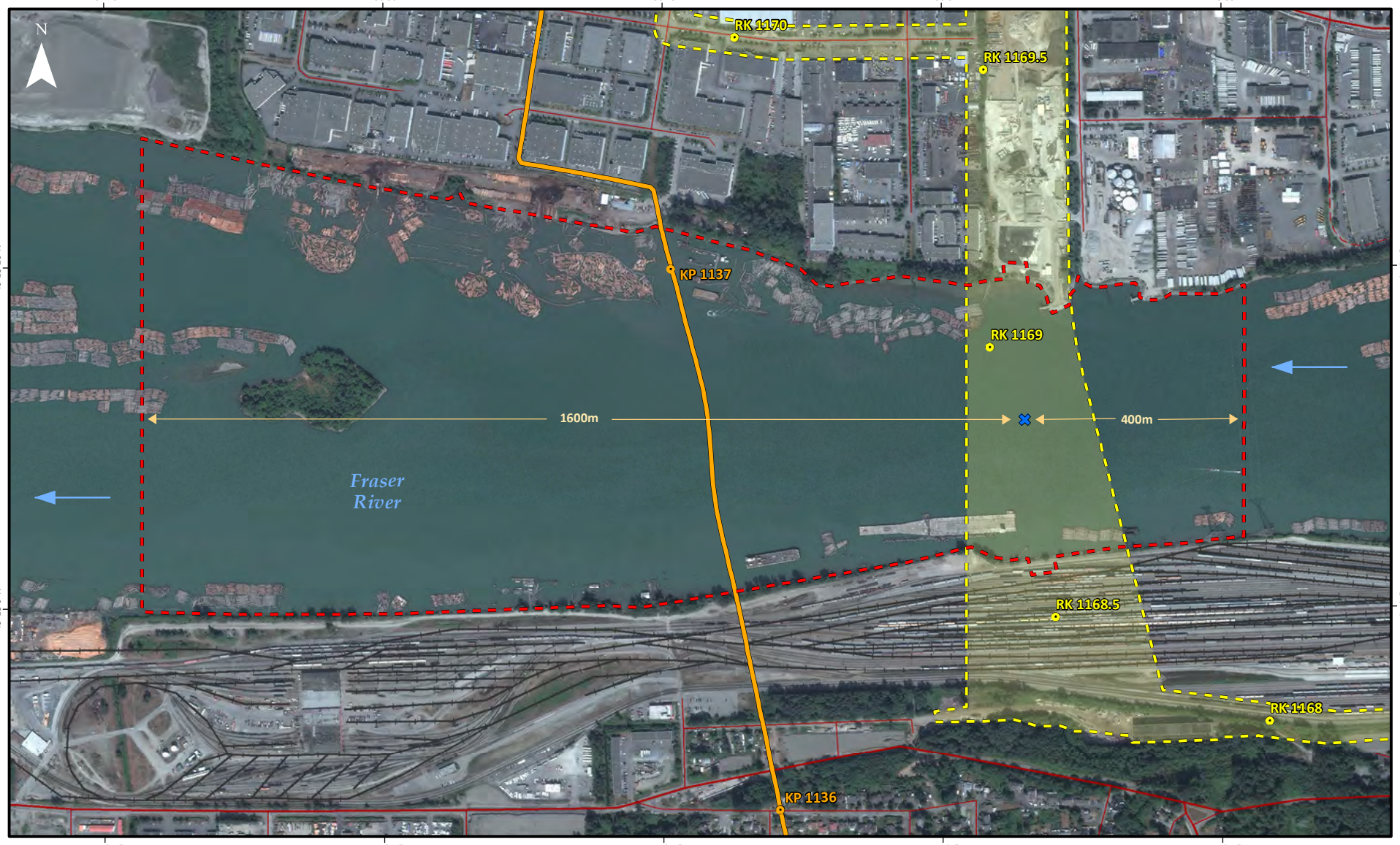
TRANS MOUNTAIN

FIGURE 3.1

EXAMPLE TYPICAL FISH AND FISH HABITAT LOCAL STUDY AREA – SWIFT CREEK

TRANS MOUNTAIN EXPANSION PROJECT

201309_MAP_TERA_AQ_00430_Rev0_03.mxd



tera ENVIRONMENTAL CONSULTANTS

0 100 200 300 400 m

ALL LOCATIONS APPROXIMATE

MAP NUMBER: 201309_MAP_TERA_AQ_00430_REV0_04		PAGE: SHEET 2 OF 2
DATE: December 2013	TERA REF.: 7894	REVISION: 0
SCALE: 1:10,000	PAGE SIZE: 8.5 x 11	DISCIPLINE: AQ
DRAWN: AJS	CHECKED: TGG	DESIGN: TGG

- Kilometre Post (KP)
- Trans Mountain Pipeline (TMPL)
- Reference Kilometre Post (RK)
- Trans Mountain Expansion Project Proposed Pipeline Corridor
- Approximate Watercourse Crossing Location
- Flow Direction
- Approximate Fish and Fish Habitat Local Study Area at Fraser River

Projection: NAD83 UTM Zone 10N. Routing: Baseline TMPL & Facilities: provided by KMC, 2012; Proposed Pipeline Corridor V6: provided by UPI, Aug. 23, 2013; Facilities: Provided by KMC, 2012; Transportation: IHS Inc., 2013, BC Forests, Lands and Natural Resource Operations, 2012 & Natural Resources Canada, 2012; Geopolitical Boundaries: Natural Resources Canada, 2003, IHS Inc., 2011, BC FLNRO, 2007 & ESRI, 2005; First Nation Lands: Government of Canada, 2013 & IHS Inc., 2011; Hydrology: Natural Resources Canada, 2007 & BC Crown Registry and Geographic Base Branch, 2008; Wildlife: BC Ministry of Environment, 2005; Colour Imagery: KMC, 2012, NASA Geospatial Interoperability Program 2005 & ESRI, 2005.

This document is provided by Kinder Morgan Canada Inc. (KMC) for use by the intended recipient only. This information is confidential and proprietary to KMC and is not to be provided to any other recipient without the written consent of KMC. It is not to be used for legal, engineering or surveying purposes, nor for doing any work on or around KMC's pipelines and facilities, all of which require KMC's prior written approval.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

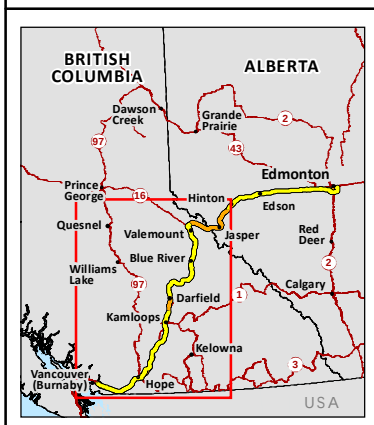
TRANS MOUNTAIN

FIGURE 3.2

EXAMPLE EXTENDED FISH AND FISH HABITAT LOCAL STUDY AREA – FRASER RIVER

TRANS MOUNTAIN EXPANSION PROJECT

201309_MAP_TERA_AQ_00430_Rev0_04.mxd



tera ENVIRONMENTAL CONSULTANTS

- Reference Kilometre Post (RK)
- Trans Mountain Pipeline (TMPL)
- Trans Mountain Expansion Project Proposed Pipeline Corridor
- Proposed Power Line
- Terminal
- Highway
- Railway
- Aquatics Regional Study Area
- Watershed Boundary
- City / Town / District Municipality
- Indian Reserve / Métis Settlement
- National Park
- Provincial Park
- Protected Area / Natural Area / Provincial Recreation Area / Wilderness Provincial Park / Conservancy Area
- Provincial Boundary
- International Boundary

Projection: NAD 1983 UTM 10N. Routing:Baseline TMPL & Facilities: provided by KMC, 2012; Proposed Pipeline Corridor V6: provided by UPI, Aug. 23, 2013; Facilities: Provided by KMC, 2012; Transportation: IHS Inc., 2013, BC Forests, Lands and Natural Resource Operations, 2012 & Natural Resources Canada, 2012; Geopolitical Boundaries: Natural Resources Canada, 2003, AltaLIS, 2013, IHS Inc., 2011, BC FLNRO, 2007 & ESRI, 2005; First Nation Lands: Government of Canada, 2013, AltaLIS, 2010 & IHS Inc., 2011; Hydrology: Natural Resources Canada, 2007 & BC Crown Registry and Geographic Base Branch, 2008; Parks and Protected Areas: Natural Resources Canada, 2012, AltaLIS, 2012 & BC FLNRO, 2008; ATS Grid: AltaLIS, 2009; Edmonton TUC: Alberta Infrstructure, 2011; Canadian Hillshade: TERA Environmental Consultants, 2008; US Hillshade: ESRI, 2009; World Shaded Relief: Copyright:© 2013 Esri

This document is provided by Kinder Morgan Canada Inc. (KMC) for use by the intended recipient only. This information is confidential and proprietary to KMC and is not to be provided to any other recipient without the written consent of KMC. It is not to be used for legal, engineering or surveying purposes, nor for doing any work on or around KMC's pipelines and facilities, all of which require KMC's prior written approval.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

TRANS MOUNTAIN

FIGURE 3.3

AQUATICS REGIONAL STUDY AREA - BRITISH COLUMBIA

TRANS MOUNTAIN EXPANSION PROJECT

MAP NUMBER: 201309_MAP_TERA_AQ_00428_REV0_02		PAGE: SHEET 1 OF 1
DATE: December 2013	TERA REF.: 7894	REVISION: 0
SCALE: 1:1,600,000	PAGE SIZE: 11x17	DISCIPLINE: AQ
DRAWN: AJS	CHECKED: TGG	DESIGN: TGG

0 10 20 30 40 50 Km

ALL LOCATIONS APPROXIMATE

3.1.2 Project Interactions and Identification of Potential Effects

Pipeline construction and operation activities have the potential to interact with fish and fish habitat. These interactions may directly or indirectly affect the productive capacity of fish habitat at and near watercourse crossing locations (includes all stream channels, waterbodies and wetlands). Productive capacity is defined as the natural capacity of aquatic habitats to produce healthy fish, safe for human consumption, or to support or produce the aquatic organisms that occur naturally on which fish depend (DFO 2010a).

3.1.2.1 Riparian Removal

Both the clearing and disturbance of riparian habitat occurring from pipeline construction methods may reduce the productive capacity of the aquatic environment in the FSA (Section 3.1.1). Clearing or disturbance of riparian habitat will occur within the construction right-of-way and temporary workspace at all trenched (*i.e.*, isolated or open-cut) watercourse crossings and watercourses where a temporary vehicle crossing will be installed. Trenchless crossings (*i.e.*, HDD) may require vegetation clearing but depending on the location, are more likely not to affect the riparian vegetation as clearing is usually set back from the watercourse. Riparian clearing can affect fish and fish habitat through an increase in sedimentation in the watercourse, decreases in bank and approach stability, reductions in stream shading potential and the loss of instream and overhead cover elements. The degree to which fish and fish habitat can be affected depends on, among other influences, the total area of disturbed riparian habitat. Clearing or disturbance of riparian vegetation and soils may also be required during maintenance activities (*e.g.*, integrity digs) and instream activities may disturb instream habitat during pipeline operations. The effects of these activities may be similar to the effects caused by construction.

3.1.2.2 Instream Habitat

Instream habitat can also be temporarily altered during pipeline construction. Pipeline construction and temporary vehicle crossing methods have the potential to alter the physical characteristics of a watercourse's bed and banks. The degree to which instream habitat and fish can be affected depends on several factors, including species, life stage, the duration and timing of instream work, the volume and extent of contamination or sedimentation and the type of habitat lost or altered and its use by each species. Water quality can also be affected by increased sedimentation during construction activities (*i.e.*, isolated or open-cut crossings), contamination due to minor spills or leaks during construction (*e.g.*, fuel leak) or accidental release of drilling mud that may occur during trenchless crossings. The introduction of fine sediment to watercourses can have sub-lethal (*e.g.*, irritation of gill tissues) and lethal (*e.g.*, suffocation of developing embryos) effects on fish and can also cause downstream sediment deposition that alters substrate composition and modifies the availability and suitability of habitat (Newcombe and MacDonald 1991, Anderson *et al.* 1996).

Water extraction required for additional physical works and activities during pipeline construction (*e.g.*, hydrostatic testing, drilling and right-of-way construction, stockpile sites, camps, and staging areas) may also result in direct effects to instream fish habitat.

3.1.2.3 Habitat Fragmentation

Temporary habitat fragmentation may also occur during construction of the proposed pipeline. Improper installation of closed bottom culvert for permanent vehicle crossings can create barriers to fish passage (*e.g.*, perched culverts) and contribute to habitat fragmentation for fish communities (Marshall 1996, Harper and Quigley 2000, Scrimgeour *et al*. 2003, Johns and Ernst 2007, Park *et al*. 2008). Although bridges and open bottom arches are, in general, able to provide satisfactory fish passage, several investigators have reported fish passage problems are frequently associated with culvert crossings (*e.g.*, corrugated metal pipes) (*e.g.*, 50% in Park *et al*. 2008, 53% in Gibson *et al.* 2005, 57% in Johns and Ernst 2007). These fish passage problems are typically associated with poor design (*e.g.*, under-sizing) and/or installation, culvert age, reach slope, debris blockages and increased flow velocity (Marshall 1996, Harper and Quigley 2000, Scrimgeour *et al.* 2003, Johns and Ernst 2007, Park *et al.* 2008). Moreover, several perched culverts within a local area could act cumulatively to fragment fish communities within the greater regional area.

3.1.2.4 Direct Mortality

Potential fish injury or mortality may result from several activities associated with construction of the proposed pipeline. The level of injury or mortality that may occur as a result of the proposed pipeline construction may depend on the timing of construction activities, the duration of instream activities, species presence and the overall sensitivity to disturbance, and the effectiveness of a salvage program. As previously discussed, the alteration of instream habitat may result in fish injury or mortality. Successful mitigation measures (*e.g.*, site isolation and fish salvage), best management practices and contingency plans could further eliminate potential effects or the degree to which certain fish species may be impacted by immediate habitat loss or alteration.

3.1.2.5 Indirect Mortality

The construction of new rights-of-way (*i.e.*, pipeline or power line) can result in increased access along the corridor for a variety of other resource user groups (*e.g.*, anglers). In turn, this can potentially result in negative impacts on fishes and their habitat either through direct harvesting or indirect impacts such as degradation to fish habitat from damages to watercourses including erosion and sedimentation resulting from vehicle fording. Off-Highway Vehicle travel, increased access for anglers and right-of-way use by other resource development sectors can potentially impact aquatic habitat and species. Species of special concern or sensitive watersheds and fish populations are at a greater risk for overexploitation.

3.1.3 Assessment Indicators and Measurement Endpoints

Field investigations and the assessment of potential environmental effects focused on indicators (sometimes called Valued Ecosystem Components [VECs]) that are of particular value or interest to regulators, Aboriginal communities or other interested groups. One or more 'measurement endpoints' (*i.e.*, measurable ecological characteristics) are identified for each indicator to allow quantitative or qualitative measurement of potential Project effects. The degree of change in these measurable parameters is used to characterize and evaluate the magnitude of Project-related environmental and socio-economic effects. A selection of the measurement endpoints may also be the focus of monitoring and follow-up programs, where applicable.

Field surveys and measurements using indicators and measurement endpoints must not only include the direct FSA of the Project but also the LSA and RSA (Section 3.1.1). The indicators described below are directly related to potential Project effects as described in Section 3.1. The assessment of the following indicators for fish and fish habitat are proposed to fulfill filing requirements in the NEB *Filing Manual*:

- instream fish habitat (m^2); where fish are defined as species of recreational, commercial, ecological, and Aboriginal importance;
- riparian habitat (m^2);
- fish mortality or injury; and
- five BC indicator species (as discussed below).

When measuring potential habitat loss and effects on fish populations, fish species such as char, pike, salmon, trout, add whitefish are selected as indicators because they provide valuable recreational, commercial and subsistence opportunities for a variety of user groups. The measureable parameter for potential project effects for this assessment considers the areal (m^2) loss or alteration of instream and riparian habitats crossed by the pipeline corridor.

Federal species of special conservation status were also considered during the evaluation of potential project effects. Some fish species may be protected federally under the *SARA 2002* or listed by the Committee for the Status of Endangered Wildlife in Canada (COSEWIC). The process used by COSEWIC to assess the risk of extinction for wildlife species is based on science, ATK and community knowledge without consideration of political, social or economic factors (COSEWIC 2009). A COSEWIC listing is the first step towards possible legal protection under the *SARA* (COSEWIC 2009). The *SARA*

protects threatened and endangered species and their critical habitat (Government of Canada [GOC] 2012b).

Provincial species of management concern are ranked using different classification systems. In BC, fish species may be listed as Endangered or Threatened under the *Wildlife Act* (BC MOE 2013). Fish are also ranked based on their Provincial Conservation Status, with Red-listed species as candidates for Extirpated, Endangered or Threatened status, while Blue-listed species are considered to be of Special Concern (BC CDC 2013). Watercourses crossed by the proposed pipeline corridor were reviewed for species of special conservation status prior to the field surveys (Section 4.0). The distribution (presence/absence) of species of special conservation concern within the Project watercourse crossings was determined during pre-field literature reviews and confirmed during the field investigations. In the field, fish habitat potential was assessed at each watercourse location to derive the total number of crossings with potential for species of special conservation status (Section 5.0); a general qualitative effects assessment was then conducted based on the total number of watercourses crossed by the proposed pipeline corridor.

The potential for long-term cumulative effects (*i.e.*, compounding residual effects [if any]) within the FSA (Section 3.1.1) will also be assessed using indicators and watershed assessment models. Salmo Consulting Inc. (Salmo) *et al.* (2003) reported that stream crossing density and total disturbance within riparian areas are commonly used for determining potential for cumulative effects, these assessment methods have been successfully used in western North America (*e.g*., Scrimgeour *et al.* 2003, Sawyer and Mayhood 1998). Salmo *et al.* (2003) also reported that disturbances in riparian areas (*e.g.*, clearings, seismic cutlines, pipeline rights-of-way, and road/trail networks) can contribute to increased sediment yields (*e.g.*, Anderson 1998, Beaudry 1998, Canadian Association of Petroleum Producers [CAPP] *et al*. 2005, Scrimgeour *et al.* 2003) and affect fish community assemblages (*e.g.*, Haas 2001, Sloat *et al.* 2001). Since the same information required to calculate stream crossing densities is necessary to calculate total disturbance in riparian areas, total disturbance in riparian areas was considered an appropriate measurement endpoint to evaluate the significance of Project-related effects on the fish and fish habitat indicator of riparian habitat (see Volume 5A, Sections 7.0 and 8.0).

It was determined by the assessment team that each province traversed by the proposed pipeline corridor (*i.e.*, Alberta and BC) should have its own set of fish species indicators because of differences in fish distributions and assemblages in each province.

Indicator species in BC include important species of recreational, cultural, ecological, aboriginal concern that are distributed widely throughout the province and encountered frequently in watercourses along the proposed pipeline corridor and areas downstream, as supported by fish and fish habitat assessments and/or literature reviews. Additional *SARA*, COSEWIC and provincially-listed species found within local and regional study areas are also included for the BC portion of the FSA. The BC indicator species and other listed species are described below. Information about each species and their distribution can be found in Sections 4.3 -4.5.

3.1.3.1 Indicator Species

- Bull trout and Dolly Varden (*Salvelinus confluentus* and *Salvelinus malma*) – fish species of management concern found throughout the FSA and bull trout is provincially Blue-listed as a Species of Special Concern.

- Chinook salmon (*Oncorhynchus tshawytscha*) – sportfish species of management concern found throughout the FSA.

- Coho salmon (*Oncorhynchus kisutch*) – fish species of management concern found throughout the FSA.

- Cutthroat trout (Coastal) (*Oncorhynchus clarki clarki*) and (Westslope) (*Oncorhynchus clarki lewisi*) – fish species of management concern found within the Lower Mainland regional study area. Westslope cutthroat is listed in BC as a Species of Special Concern under *SARA* and COSEWIC; although introduced to the RSA so they are not a conservation concern.

- Rainbow trout/steelhead (*Oncorhynchus mykiss*) – sportfish species of management concern found throughout the FSA.

Listed Species

- Cultus Lake sockeye (*Oncorhynchus nerka*) – listed as a Species of Special Concern under COSEWIC (2013).
- Eulachon (*Thaleichthys pacificus*) – Blue-listed (BC CDC 2013) and Threatened and Endangered (based on population, see Section 4.5.2) under COSEWIC (2013).
- Green sturgeon (*Acipenser medirostris*) – listed as a Species of Special Concern under *SARA* and COSEWIC (GOC 2012a, COSEWIC 2013); although occurrences in fresh water are extremely rare.
- Interior Fraser coho (*Oncorhynchus kisutch*) salmon – listed as Endangered by COSEWIC (2013) in interior BC.
- Mountain sucker (*Catostomus platyrhyncus*) – listed as a Species of Special Concern under COSEWIC (2013).
- Nooksack dace (*Rhinichthys sp.*) – Very limited distribution, is Red-listed in BC (BC CDC 2013) and is listed as Endangered under COSEWIC (2013) and *SARA* (GOC 2012).
- Salish sucker (*Catostomus sp.*) – Ranked as Critically Imperilled by BC Ministry of Environment because of their extreme rarity (BC MELP 1993), also has a COSEWIC (2013) status of Threatened and a *SARA* status of Endangered (GOC 2012a).
- White sturgeon (*Acipenser transmontanus*) – *SARA* and COSEWIC-listed (GOC 2012a, COSEWIC 2013) (Upper Fraser River Population is Endangered; refer to Section 4.4.1 for rankings by population).

3.1.4 Existing Conditions

Fish and fish habitat existing (baseline) conditions for the LSA and RSA are presented in Sections 4.0 and 5.0 and represent the current state of the environment. The assessment of baseline conditions considered existing land uses, watershed boundaries, known fish distributions, barriers to migration, potential presence for species of recreational, commercial, ecological, and Aboriginal concern, and known geographical stock information for Pacific salmon species.

3.2 Field Data Collection

The following subsections describe the field methodologies for the fish and fish habitat assessments, and include the incorporation of TEK, development of a watercourse crossing database, review of historical information, fish and fish habitat field data collection, preliminary navigability determinations and an aquatic effects assessment to determine fish habitat sensitivity for watercourse crossings along the proposed pipeline corridor.

3.2.1 Watercourse Crossing Database

Potential watercourse crossings (including NCD/NVCs and wetlands) within the proposed pipeline corridor were identified using GIS and 1:20,000 Terrain Resource Information Management (TRIM 1) data for BC. Each potential watercourse was assigned a unique crossing number to be used for all field programs throughout 2012 and 2013 and a base crossing list was assembled for compilation of historical fish and fish habitat information and collection of fisheries-related field data. Once all potential watercourses were mapped, they were then assessed in the field and the exact crossing location for each was then spatially verified using hand-held GPS units and plotted using GIS software. The watercourse crossing database was subsequently revised to include all unmapped watercourse crossings (those not shown on TRIM 1) that had been identified in the field and to reflect addition and removal of crossings

during route revisions. Watercourse crossings associated with access roads, terminals, power lines or other ancillary sites were also added to the database.

3.2.2 Review of Historical Fish and Fish Habitat Related Information

A data search of historical fish and aquatic resources was carried out and background information at each watercourse was compiled. Relevant existing Trans Mountain fish and fish habitat data were also collected for both the proposed pipeline corridor in 2005, and remediation projects on the existing pipeline at Baer Creek, Moonbeam Creek, and Thunder River crossings completed in 2012 and 2013. These data were used as part of the historical review and included, where applicable (AAR 2005; Triton 2012, 2013).

The following general sources were used to compile information for the fish and fish habitat assessments:

- Habitat Wizard and other electronic records compiled from the Fisheries Information Summary System (FISS), Consolidated Waterbody Surveys and Fisheries Inventory Data Queries (FIDQ);
- Ecological Reports Catalogues (EcoCat);
- additional higher level regional, municipal and land development plans, maps and aerial photos; and
- consultant reports, databases and files stored at Triton and BC MOE libraries.

Each reference was reviewed and relevant information incorporated into the database, including known fish species presence and distribution, existing habitat features such as migration barriers, provincial construction timing windows of least risk and other site-specific characteristics. A review of historical literature for this report focused primarily on named watercourse crossings; however, applicable information collected for potential unnamed watercourse crossings was also included.

Historical information was reviewed and cross-referenced with the information collected during the 2012 and 2013 field programs and included:

- watercourse crossing location details (*i.e.*, name of watercourse, GIS reference location, drainage or watershed size, month and year of study) and data source;
- watercourse parameters (*i.e.*, stream classification, water velocity and discharge, water quality [temperature, dissolved oxygen (DO), pH, conductivity, etc.], channel morphology, substrate composition, bed and bank structure and stability);
- fish and fish habitat information (*i.e.*, fish species and life stages, recreational and commercial use comments, traditional importance comments, habitat features, bank vegetation, and potential habitat use by each species);
- additional related information such as riparian and bank characteristics, bank material and stability, erosion potential, evidence of groundwater, hydrological parameters; and
- information sources such as year of publication, document number (if available), title, author, keywords and overall comments.

Details outlining the data collection methodology for field programs are presented in Section 3.2.5. Named watercourses with available historical information on fish and fish habitat are listed in Table 3.1; the results of the historical literature review are presented in Section 4.0.

TABLE 3.1

NAMED WATERCOURSE CROSSING HISTORICAL INFORMATION

Watercourse Crossing Names			
Albreda River	Crossing Creek	Ladner Creek	Robina Creek
Anderson Creek (Region 3)	Dairy Creek	Lanes Creek	Sager Creek
Anderson Creek (Region 2)	Darlington Creek	Lemieux Creek	Salmon River
Avola Creek	Davidson Creek	Lindquist Creek	Semmihault Creek
Baer Creek	Dewdney Creek	Lorenzetta Creek	Serpentine Creek
Bill Creek	Dominion Creek	Mad River	Silverhope Creek
Blue River	Dora Creek	Mann Creek	Stewart Slough
Bon Accord Creek	Dunville Creek	Marathon Creek	Stoney Creek
Boston Bar Creek	Eagle Creek	McLennan Creek	Street Creek
Bridal Creek	Eakin Creek	McQueen Creek	Sumas Lake Canal
Camp Creek	Elk Creek	Miledge Creek	Sumas River
Canoe River	Fallslake Creek	Mine Creek	Sundt Creek
Cedar Creek	Finn Creek	Montigny Creek	Swift Creek
Chappell Creek	Foam Creek	Moonbeam Creek	Teepee Creek
Chawuthen Creek	Fraser River	Moore Creek	Terry Fox Creek
Chilliwack Creek	Froth Creek	Nathan Creek	Thompson River
Chilliwack/Vedder River	Gillis Creek	Nehalliston Creek	Thunder River
Clapperton Creek	Godey Creek	Nelson Creek	Thuya Creek
Clayburn Creek	Goose Creek	Nevin Creek	Tumtum Creek
Clearwater River	Hamilton Creek	Nicola River	Voght Creek
Clemina Creek	Howarth Creek	Nilsson Creek	Wahleach Creek
Coldwater River	Hunter Creek	Noblequartz Creek	West Creek
Como Creek	Jamieson Creek	North Thompson River	Whitewater Creek
Cook Creek	Juliet Creek	Peterson Creek	Yorkson Creek
Coquihalla River	Kanevale Creek	Raft River	
Crooked Creek	Karen Creek	Railway Creek	

3.2.3 Permits and Conditions

3.2.3.1 Federal

DFO issued a total of four licences to allow fish sampling within the Fraser and Interior Regions in 2012 and 2013. The licence number, sampling period by region, and licence amendments are detailed in Table 3.2. Licence amendments were granted in order to extend the sampling season for XHAB 109 2012, and to account for site additions due to changes in proposed alignment (XHAB 16 2013).

Activities permitted under the licence include assessing fish presence by means of minnow trapping, electrofishing, dip-netting, angling, and beach/pole seine. The DFO licences list terms and conditions for fish sampling in BC and have reporting requirements of 90 days after the licence expiration date. All terms and conditions outlined on the licences were adhered to during fish sampling and habitat data collection activities.

TABLE 3.2

SUMMARY OF FEDERAL FISH COLLECTION PERMITS

Year	Region	Licence Number	Permitted Sampling Period
2012	Fraser	XSA 17 2012	August 15, 2012 to June 30, 2013
	Interior	XHAB 109 2012	July 1 to October 31, 2012
		Amendment #1	July 1 to December 31, 2012
2013	Fraser	XSA 1 2013	March 1 to December 31, 2013
	Interior	XHAB 16 2013	March 12 to December 31, 2013
		Amendment 1	March 12 to December 31, 2013
		Amendment 2	March 12 to December 31, 2013
		Amendment 3	March 12 to December 31, 2013

3.2.3.2 Provincial

Three Fish Collection Permits were issued each year (2012 and 2013) by the BC MFLNRO for scientific fish inventory of non-tidal waters. The permit number, sampling period, and amendments are detailed in Table 3.3. Permit amendments were required to accommodate additional watercourses pursuant to corridor revisions.

Activities permitted under this licence include assessing fish presence by means of minnow trapping, electrofishing, dip-netting, angling, and beach/pole seine. The terms and conditions outlined in the each of the six Fish Collection Permits in addition to any region specific conditions such as the Omineca Region's requirement to follow the Didymo Advisory were adhered to. As detailed in the terms and condition, reports of fish collection activities are submitted to BC MFLNRO within 90 days after the permit expiration date.

TABLE 3.3

SUMMARY OF PROVINCIAL FISH COLLECTION PERMITS

Year	Region	Permit Number	Permitted Sampling Period
2012	2 - South Fraser	SU12-79995	August 15, 2012 to June 30, 2013
	3 - Thompson/Okanagan	KA12-79996	July 23, 2012 to June 30, 2013
	7 - Omineca	PG12-79997	July 18 to December 30, 2012
2013	2 - South Fraser	SU13-85408	March 1 to December 31, 2013
		Amendment	April 3 to December 31, 2013
		Amendment	June 6 to December 31, 2013
	3 - Thompson/Okanagan	KA13-85314	March 1 to December 31, 2013
		Amendment	March 26 to December 31, 2013
		Amendment	June 5 to December 31, 2013
	7 - Omineca	PG13-85197	March 1 to December 31, 2013
		Amendment	April 5 to December 31, 2013

A Park Use Permit (PUP) is required by the BC MOE Parks and Protected Areas Division for research activities within lands designated as parks, protected areas or Ecological Reserves. A PUP was issued on November 15, 2013 which did not afford the opportunity to sample streams in the parks. Information collected for sites within parks is based solely on passive observations. The proposed pipeline corridor passes through the following parks and protected areas:

- Finn Creek Provincial Park;
- North Thompson River Provincial Park;
- Lac Du Bois Grassland Protected Area; and

- Coquihalla Summit Recreation Area.

3.2.4 Field Crew Orientations

Senior fisheries personnel and field crews attended a pre-field Project orientation meeting prior to the start of each field program. The meeting took place in various locations as follows.

- Trans Mountain Expansion Project Summer 2012 Field Orientation Program (July 4, 2012. Kamloops).
- Trans Mountain Expansion Project Summer 2012 Field Orientation Program (July 19, 2012. Simpcw First Nation).
- Trans Mountain Expansion Project Summer 2013 Field Orientation Program (August 21, 2012. Stó:Lō First Nation, [Chilliwack]).
- Trans Mountain Expansion Project Summer 2013 Field Orientation Program (April 5, 2013. Calgary and Kamloops).

Orientations included a review of the field program and Project-specific information, safety considerations and safety procedures (daily tailgate meetings, incident reporting, weekly call-ins, etc.), data collection standards, and recording procedures developed for the Project (including photo naming conventions and reporting requirements). Fish and fish habitat assessment methods followed those described in the Resource Inventory Committee's (RIC; now Resource Inventory Standards Committee [RISC] *Reconnaissance (1:20 000) Fish and Fish Habitat Inventory: Standards and Procedures* (RIC, 2001). Quality Assurance/Quality Control (QA/QC) protocols and previous lessons learned were discussed to ensure reporting consistency among crew members over the duration of the field programs.

All field crew members were required to obtain Kinder Morgan Canada Contractor Orientation training, Level 1 First Aid training (BC), a valid Electrofishing Certification, ATV and/or UTV operation certification, and Bear Awareness training prior to starting the field program. Additionally, site-specific training (Canadian National [CN] Railway Safety Orientation, Ajax Mine Site Safety Orientation, avalanche safety training, and snowmobile operation certification) were completed on an as-needed basis for each crew. All training information and presentations of the orientation were documented and uploaded to the Project SharePoint site.

3.2.5 Fish and Fish Habitat Data Collection

Fish and fish habitat investigations were completed from 2012 and 2013 to gather current information on fish species, habitat potential, existing site conditions and management concerns along the proposed pipeline corridor. Field investigations identified/confirmed species distribution and existing habitat values at watercourse crossings. Results from the literature review and from data collected during the field investigations will support the decision making processes, regulatory filing, and will assist construction with the appropriate crossing structures, techniques, timing windows and crossing locations. The field programs were designed to meet current regulatory expectations and to address all issues related to fish and fish habitat.

From July 25, 2012 to November 8, 2013, 771 potential watercourse crossings were investigated as part of the fish and fish habitat data collection program. Sites were accessed by foot, boat and ATV and 4WD vehicles. Field data were collected by Triton and Estsek' teams, which consisted of a lead fisheries biologist and fisheries technician. Assistant fisheries technicians from the Stó:Lō Tribal Council also worked with Triton when working within their traditional territories. Fisheries teams would often include a TERA TEK facilitator and local participants from Aboriginal communities along the proposed pipeline corridor (Section 3.3). BC watercourse crossings assessed during the field program are listed in Appendix A.

The objectives of the fish and fish habitat field surveys were to:

- evaluate baseline fish habitat within the Project area (FSA, LSA and RSA), including fish species distribution, spawning, rearing, overwintering migration and staging/holding habitat quality as these relate to fish and habitat risk potential (*e.g.*, fish salvage, water quality monitoring or avoidance);
- update fish and fish habitat information for all watercourses to be crossed or potentially affected by the proposed pipeline corridor;
- collect information on sensitive habitats upstream, downstream, and in riparian areas to facilitate the identification of mitigation, restoration and potential compensation measures;
- obtain site characterizations including water quality, discharge, channel and terrain, gradient, approach slopes, etc. to inform watercourse crossing design;
- assist in supporting the aquatic effects assessment, which includes evaluating fish habitat sensitivity and potential effects of pipeline construction (extent, duration and timing) on watercourses;
- support the watercourse crossing methodologies and mitigation measures (as per DFO OSs);
- identify areas of hydrologic concern, slope stability, and erosion concern and specific crossing locations that will require special crossing designs;
- conduct winter fish and fish habitat surveys within select areas of the proposed pipeline corridor with proposed winter construction spread and/or to determine fish overwintering potential, where applicable; and
- identify areas with slope instability and erosion/hydrologic concern, including specific crossing locations that will require site-specific designs.

Specific tasks conducted during the fish and fish habitat assessments were as follows:

- classification of stream/watercourse at/near pipeline crossings (see Section 3.2.6 for specific parameters and methodology);
- confirmation of potential fish overwintering, spawning, rearing, holding/staging and migration habitat (Section 3.2.7);
- fish sampling and an inventory of species and habitat potential during spring, summer and fall conditions (Section 3.2.8);
- collection of biophysical parameters by completing a detailed habitat assessment;
- collection of discharge and basic water quality parameters;
- a description of construction access constraints and additional site comments such as barriers to fish migration, beaver activity, erosion features and sedimentation concerns etc.;
- a brief description of recommended reclamation and restoration opportunities;
- a brief description of recommended mitigation measures; and
- representative photos at each location.

A small subset of watercourse crossings were also investigated from January 22 to March 1, 2013 during winter conditions. These sites were accessed by foot, snowmobile and vehicle. Watercourses selected for

winter habitat assessments included crossings that were proposed for winter construction, and crossings that occurred within steep high elevation areas through the Coquihalla Pass. Field data were used to identify potential for overwintering habitat and evaluate perrenial habitat use for indicator species. Information was also used to corroborate data collected during second season sampling events carried out in summer/fall months in 2012/2013. As a condition of the BC MFLNRO sampling permit, electrofishing was not conducted during winter conditions when water temperatures were less than 5 ^{0}C. Winter habitat comments were incorporated into the Watercourse Crossing Summary Table (Appendix A) and atlases (Appendices B and C), where applicable.

3.2.6 Stream Classification

The Fish-Stream Identification Guidebook of BC defines a stream (watercourse as referred to in the remainder of the report) as:

> "*a reach, flowing on a perennial or seasonal basis having a continuous channel bed, whether or not the bed or banks of the reach are obscured locally by overhanging or bridging vegetation or soil mats, if the channel bed is scoured by water or contains observable deposits of mineral alluvium*". (BC Ministry of Forests [BC MOF] 1998a).

This definition of a stream (*i.e.*, watercourse) was used for the Project.

Watercourses were classified into two broad categories, fish-bearing and nonfish-bearing, based on fish presence and whether the watercourse is part of a community watershed. Fish-bearing and nonfish-bearing watercourses were further classified based on mean channel width and fish presence/absence measured in the field (Table 3.4; BC Oil and Gas Commission [OGC] 2012). Watercourses are classified as S1 (A or B), S2, S3 or S4 if they are fish-bearing or within a community watershed, or they are classified as S5 or S6 if they are nonfish-bearing and are not in a community watershed.

An NCD (non-classified drainage) is a drainage less than 100 m in length and not connected directly to a fish-bearing watercourse, and lacking defined bed and banks, and does not satisfy the Forest Practices Code of BC definition of a watercourse provided above (BC MOF 1998a, BC MOE 1998). An NVC (no visible channel) is an area that does not contain evidence of a channel, alluvial deposits or scour (BC MOF 1995).

Field crews determined whether proposed crossings were at watercourses with defined beds and banks (*i.e.*, streams; as defined in the Fish-Stream Identification Guidebook) or were waterbodies (lake and wetlands) or non-classified drainages (*i.e.*, NCD/NVCs). Those determined to be streams were investigated further and were classified based on channel width and fish presence. A classification of NCD-W was assigned to waterbodies with wetland characteristics which may or may not contain fish. This includes fish sensitive zones (FSZ) which is a flooded depression, pond or swamp which contains water either perennially or seasonally and is occupied seasonally by fish.

TABLE 3.4

BRITISH COLUMBIA STREAM CLASSIFICATION CODES
RESPECTIVE MEAN CHANNEL WIDTH AND FISH-BEARING STATUS

Stream/Watercourse Class	Mean Channel Width (m)
S1A (fish-bearing large rivers)	> 100 m
S1B (fish-bearing)	> 20-100 m
S2 (fish-bearing)	> 5-20 m
S3 (fish-bearing)	1.5-5 m
S4 (fish-bearing)	< 1.5 m
S5 (nonfish-bearing)	> 3 m
S6 (nonfish-bearing)	≤ 3 m

Source: BC MOF 1995

Multiple seasons of sampling may be required to confirm fish presence or absence. In the absence of visible barriers to fishes, complete assessments of the entire watercourse system are required to classify watercourses or waterbodies as confirmed nonfish-bearing (*e.g.*, S5 and S6). Watercourses with no visible barriers, where only one season of sampling was carried out and that did not result in any fish capture or have historical fish presence, have their classifications as to be determined (TBD) and are not included in the final tally in the results section of this report (Section 5.0). These watercourses were assigned an interim classification with an asterisk in the Watercourse Crossing Summary Table (Appendix A). Additional second season sampling will be conducted in supplemental field surveys to conclude the interim classification status and conclude fish presence or absence where warranted (Section 6.8). Watercourses where two seasons of sampling were not completed and no fish were captured during the first season, but there is known historical fish presence, were included in the final tally in the results.

Information collected to support nonfish-bearing classification included:

- no documented historical fish presence data;
- existence of known downstream (from proposed watercourse crossing) permanent barriers (bedrock drops, waterfalls, cascades, subsurface flow, etc.);
- overall lack of fish habitat (poor channel definition, steep gradients, poor dissolved oxygen, no suitable wintering or holding/staging pools, etc.);
- lack of depth and flow to support perennial habitat use;
- presence of multiple temporary or permanent migration obstructions (debris jams, beaver dams, poorly defined channel characteristics, culvert barriers, subsurface and overland flow, etc.); and
- absence of headwater lakes or instream habitat capable of supporting fish.

3.2.7 Fish Habitat Assessments

Data collection procedures followed those described in Reconnaissance (1:20 000) Fish and Fish Habitat Inventory Standards and Procedures (RIC 2001) which are reiterated in Triton's Field Crews Technical Orientation Inventory Standards and Procedures (Triton 2012a) and reviewed with field crews prior to the start of work.

Fish habitat data were collected at each proposed watercourse crossing and recorded on a site card. The date, time, location (using Universal Traverse Mercator [UTM] coordinates), access method, and crew members for each site assessment were recorded prior to conducting the survey. A total of six transects were established for each watercourse: two upstream from the general centre of the proposed pipeline corridor, one at the general centre of the proposed pipeline corridor, and three downstream from the general centre of the proposed pipeline corridor. For watercourses greater than 1.5 m wide, transects were established 50 m and 100 m upstream, at the general centre of the proposed pipeline corridor, and 100 m, 200 m, and 300 m downstream from the general centre of proposed pipeline corridor. For watercourses less than 1.5 m wide, or where the channel was entirely dry at the time of survey, a standard site length of 100 m was adopted. Site length was measured in the field using a handheld Geographic Positioning System (GPS) unit distance odometer.

Channel characteristics were recorded at each watercourse crossing. Channel and wetted width and bankfull depth were measured at each of the six transects. Residual pool depths were also measured at each transect where possible. The composition of habitat units (*e.g.*, riffle, pool or run) were assessed according to RIC (BC Ministry of Fisheries 1999) and recorded as a percentage of the total habitat. Bed material and substrate composition were also recorded at each transect based on substrate sizes listed in RIC (BC Ministry of Fisheries 1999).

Watercourse banks were referred to as left and right when facing downstream. Left and right bank height were measured at each of the six transects. The dominant bank shape was recorded as well as bank

texture, slope, and stability. At each transect the percentage of each bank covered by vegetation and the dominant type of vegetative cover was recorded.

Channel gradient was measured with a clinometer at a minimum of two locations at each watercourse. Water depth was measured with a meter stick at three locations across the channel width (25%, 50% and 75% from the left bank) over three different transects (50 m upstream, 50 m downstream and 100 m downstream), where possible. Flow stage at the time of the assessment was classified as low, medium, or high, based on the proportion of flow observed relative to bankfull depth.

Water quality data were collected at each study site. Water temperature (°C), DO (mg/L), pH and conductivity (µS/cm) were measured using a multiple parameter digital water quality meter. Digital water quality meters were calibrated as specified by the manufacturer. Water clarity was estimated visually.

Discharge was measured for each watercourse where it was suitable to wade across the channel. Two methods for recording discharge included the Swoffer and Floating Chip method. The Swoffer method was used for larger streams and flow transects were completed following Environment Canada's "Hydrometric Field Manual – measurement of Streamflow" (Environment Canada, 1981) and BC MOE document "Manual of British Columbia Hydrometric Standards" (BC MOE 2009b). The Floating Chip method was used for smaller streams with low depths and velocities. The average width (W) and depth (D) of the channel was measured using a meter stick and the velocity (V) of the channel was determined using a stopwatch and recording the time in seconds that it took a floating object to travel a predetermined length. Discharge was then calculated as follows (W x D x V).

Characteristics and features of the watercourse were described at the crossing location and within a study area estimated to affect fish habitat. These included, but were not limited to, tributaries, flood signs, channel pattern, potential barriers to fish passage, instream cover, crown closure, and riparian vegetation characteristics. The location of described features was recorded as a distance generally from the centre of the proposed pipeline corridor.

Each study site was photo-documented with a digital camera. A minimum of four photos were taken at each site to show general watercourse characteristics of the proposed watercourse crossing. Photos were taken from the general centre of the proposed pipeline corridor showing the view upstream, downstream and toward each of the left and right banks. Additional photos were taken to document representative habitat and features within the study area as well as any fish captured. Photos had a standard object (*e.g.*, notebook) in the frame to act as reference to size.

Fish habitat quality was evaluated for rearing, spawning, overwintering, and migration habitat values. Habitat was rated for target game species or species at risk known to reside in the area. Each habitat parameter was rated as excellent, good, moderate, poor, or nil based on limiting factors and features of habitat value. The proportion of suitable spawning habitat was recorded as a percentage of the total assessment area. Overwintering habitat was described and rated as abundant, limited or no suitable overwintering habitat observed, based on presence/absence, size and depth of pool habitat within the assessment area. Migration potential was evaluated using gradient, water velocity and the number of barriers observed, while staging/holding habitat was evaluated as a function of available pool habitat and instream velocity breaks.

A modified survey was completed for all crossings classified as NVC/NCD/NCD-Ws. The unique site identification number and location were recorded as well as the date and time of the survey. NVC/NDC/NCD-Ws were documented with a minimum of two photos (primarily upslope and downslope) and the confinement and coupling were recorded. Written descriptions of the characteristics at each site were also recorded.

3.2.8 Fish Sampling

Fish capture techniques were site-specific based on habitat type (*e.g.*, water velocity and depth). Where a single sampling approach was considered inadequate to capture all probable species and life stages present (*e.g.*, none or few fish captured despite good habitat), multiple sampling methods were employed. Care was taken to ensure minimum effects to fish communities, and special measures (*i.e.*, disinfection of gear) were used to prevent the transfer of invasive aquatic vegetation (*e.g.*, Didymo algae).

Backpack electrofishing (BPEF) was the primary fish capture method used during both years. BPEF was completed at all sites where there was sufficient water depth, and sampling effort was spent evenly across a variety of habitat types. BPEF was conducted using a Smith-Root™ Model 12 B POW or LR-24 unit, and settings varied slightly depending on expected fish size and water conductivity values. The common setting, ideal for juvenile salmonids, was a frequency of 60 Hz at a pulse of 6 ms. Voltages used varied between 100-500 V depending on the conductivity of the watercourse.

Where electrofishing was not feasible (*i.e.*, water depth too deep or velocity too swift), or where multiple sampling techniques were warranted, other methods of sampling were used. These included setting baited minnow traps, seining, angling and visual observation. Baited minnow traps were a common method used to capture juvenile fish. Minnow traps were set in the area of the channel with sufficient depth (*i.e.*, > 25 cm) and low velocity (*i.e.*, < 20 cm/s), and in habitat units with moderate to abundant fish cover. As directed by water clarity (*i.e.*, turbidity) visual observations of rearing, staging or spawning fish were also recorded.

Fish that were captured by net or immobilized with the electrofisher were placed in a bucket to recover. Detailed information was recorded for each fish including species, life history stage, sex (if discernible), maturity, length (to nearest mm), and weight (to nearest gram) in accordance with the RIC standards (BC MOE 1997). Once fully recovered, fish were photographed and released carefully back to the watercourse in a similar habitat unit from which they were captured.

Detailed counts for different fish species, and life history stages from fish sampling were used to evaluate the fish presence/absence and diversity. Where no fish were captured, these results were also recorded and used to infer important information about the quality of fish habitat.

3.2.9 Data Management

Data management and QA/QC procedures for the Project were outlined in the Trans Mountain Expansion Project – QA/QC Standards (Triton 2012b).

Prior to the commencement of field work, Project personnel attended a pre-job orientation. The purpose of the orientation was to ensure that all crew members were knowledgeable of the Project health and safety and data collection requirements. A manual outlining the methodology for field data collection and submission was prepared and presented to field crews during the orientation. The manual also contained contact information for the logistics and fisheries teams, the field work schedule, field guidebooks, and all required forms (data and safety forms). Each crew was provided with a manual to refer to in the field. Regular (bi-weekly in 2012, weekly in 2013) team meetings were held to review data collection procedures, to address any identified deficiencies or modifications to the sampling procedures and review any safety findings and/or incidents/near misses.

Fish habitat assessment data were collected on standardized field forms. Upon completion of a field site assessment, all data recorded on the site card were reviewed to ensure all applicable fields were complete, clear and correct before leaving the site.

All field crews used the same handheld GPS model, the Garmin™ GPS 60CSx, with the same settings, in order to ensure consistent GPS data collection and formatting. The UTM coordinates of site locations, potential barriers and other notable features were recorded on site cards and digitally on GPS units with a waypoint. Each waypoint was saved with a unique name to identify which site the points were associated with. At the end of each field day, each crew supervisor downloaded all waypoints from the handheld GPS unit to a laptop computer.

Each photo taken in the field was recorded on the site card with the photo number and comments. At the end of each field day, crew supervisors downloaded photos to a laptop computer and renamed the files using a standard naming convention. Photo files were saved in folders identifying the site number and date, within the Project data folder.

Field data were backed up daily by scanning Triton's data sheets and field notes. These files were saved on a laptop computer and uploaded to the Project SharePoint site along with the site photos and GPS data. Field data were also saved on a portable hard drive. Field crews completed a daily progress

tracking spreadsheet at the end of each field day, which was sent to Triton's Project Coordinator for review.

Upon completion of the field program, all data were entered into a database by experienced personnel familiar with the Project and data collection standards. QA procedures were used to identify specific errors or omissions within the database. QA reports were generated and all identified issues were addressed. Data entered were reviewed by field staff to validate that the raw data were transcribed accurately into the digital format.

A final review of database completeness and data accuracy was conducted by Project biologists to ensure that transcription and interpretation errors were not made during data entry. The review procedure was based on the RIC standards (BC Fisheries 2000) *Reconnaissance 1:20,000 Fish and Fish Habitat Inventory: Quality Assurance Procedures*. Under this procedure, data were randomly selected for review and *Fish Inventory Quality Assurance Check Forms* (BC Fisheries 2000) were used to compare data on site cards and fish collection forms with those entered into the database.

3.3 Navigability

The navigability criteria outlined in the *Minor Works and Waters Ministerial Order* of the *NWPA* (Government of Canada 2009) and the *Minor Waters User Guide* (Transport Canada 2010) were used as the basis for determining whether each watercourse crossed by the Project could be classed as a minor navigable water and, therefore, unlikely to be navigable. In addition to the *Minor Works* criteria, a supplemental benchmark based on industry experience was also used to further expand classification of presumably non-navigable watercourses.

Results from field investigations were used to screen watercourses against the following criteria to determine if each watercourse could be defined as a minor navigable water (*i.e.*, non-navigable). Class 1 or Class 2 non-navigable waters, meet the conditions in either Section 11(2) or 11(3), respectively, of the Minor Navigable Waters of the *Minor Works and Waters* (*NWPA*) *Ministerial Order* (Government of Canada 2009). In addition to Class 1 and 2 non-navigable waters, a third class (Class 3) was added to include minor watercourses up to 5 m wide. Experience has also shown that watercourses between 3 m and 5 m wide, and with one or more of the criteria used to categorize Class 2 non-navigable water, are also likely to be deemed "non-navigable". The classes of non-navigable minor waters for the Project are defined as follows:

- Class 1: Watercourses that have one of the following:
  - an average width measured at the high water level that is less than 1.20 m; or
  - an average depth measured at the high water level that is less than 0.30 m;
- Class 2: Watercourses that have an average width measured at the high water level that is greater than 1.2 m and less than 3 m and at least one of the following:
  - an average depth at the high water level that is greater than 0.30 m but not more than 0.60 m;
  - a slope measured at high water level that is greater than 4%;
  - a sinuosity ratio that is greater than 2; or
  - more than two natural obstacles with at least one upstream and another downstream from the crossing; and
- Class 3: Watercourses that have an average width measured at the highwater level that is > 3 m but less than 5.0 m and at least one of the criteria of a Class 2 minor navigable water (above).

Watercourses that did not meet the criteria of any of these three classifications were assumed to be navigable for recreational or commercial purposes.

3.4 Fish and Fish Habitat Sensitivity

The overall fish habitat potential for spawning, rearing, overwintering and migration was evaluated for each potential watercourse crossing (Table 3.5). A score for the sensitivity of fish and fish habitat was then derived for each potential crossing based on the species present and the overall habitat potential rating(Table 3.5). Sensitivity ratings were established based on the species present or documented within a given system, flow regime (seasonal vs. perennial) and the habitat available for each life history stage of the key species present. This closely follows criteria defined by DFO in the *Practitioners Guide to the Risk Management Framework* (DFO 2013a) and Pipeline Associated Watercourse Crossings, 3rd Edition (CAPP *et al.* 2005). A sensitivity ranking allows the use of a risk assessment approach to determine the overall risk to fishes and their habitat at a given watercourse crossing. The evaluation criteria and corresponding sensitivity rankings are presented in Table 3.5.

From the Sensitivity of Fish and Fish Habitat scores, regulators and the proponent can then determine the levels of risk associated with pipeline construction activities (Pathway of Effects) and methods/designs for pipeline and vehicle crossings for each proposed watercourse crossing. Once an appropriate construction method and construction timing has been selected, the associated impacts or Scale of Negative Effects can then be evaluated to define the Categories of Risk (*i.e.*, Significant Negative Effects, High Risk, Medium Risk and Low Risk). In some cases, the Scale of Negative Effects for a particular crossing cannot be fully determined until the Project is complete (*i.e.*, contingency open-cut crossing of sensitive fish habitat may be required where a proposed horizontal directional drill [HDD] or isolation is not feasible).

Appropriate crossing designs and recommendations for instream construction and timing will be used to mitigate any effects on fish and fish habitats, and DFO OS, environmental protection plans and best management practices will be applied where possible. Where fish habitat has been ranked as sensitive and the level of risk to fish and fish habitat has been determined to be high, *Fisheries Act* authorizations and associated habitat compensation may be required.

TABLE 3.5

RANKING CRITERIA FOR FISH HABITAT POTENTIAL

Ranking Criteria					
Habitat	**High**	**Moderate-High**	**Moderate**	**Low**	**Nil**
Spawning	Considerable accumulation of course substrates (*i.e.*, gravel/cobble) for indicator species; > 50% of the total area; spawning fish or redds observed; low substrate embeddedness; perennial flow, suitable velocity and moderate gradient; important for salmonid production; known DFO/Ministry spawning areas.	Adequate accumulation of course substrate to support spawning for indicator species; 20-30% of the total area; perennial flow, suitable velocity and moderate gradient; mixture of course and fine substrate; overall spawning may be limited by substrate embeddedness or overall substrate size (*i.e.*, large cobble and boulder).	Occasional accumulation of course substrate to support spawning for indicator species; 10-20% of the total area; factors such as gradient, discharge, water velocity, water quality, barriers, connectivity, embeddedness, turbulent flows or movement of bedload material may limit overall spawning potential.	Limited accumulation of course substrate suitable for spawning; high proportions of fines mixed with gravels, high gradient; low discharge volume; low average water velocity or high average water velocity, turbulent flows and high bedload movement.	No accumulation of course substrates for spawning; limited by high gradient and seasonal flows; lack of channel definition or too small to support spawning adults; ephemeral or seasonal flows; insufficient discharge during optimal flow periods; steep waterfalls or other barriers downstream which prevent upstream migration.

TABLE 3.5 Cont'd

Ranking Criteria					
Habitat	**High**	**Moderate-High**	**Moderate**	**Low**	**Nil**
Rearing	Abundant cover; diverse habitats and instream complexity; low gradient channel riffle-pool complexes, perennial flow and frequent habitat units for juvenile fish; important nursery habitat for salmonids; abundant juvenile fish captured or observed throughout; multiple game fish species.	Suitable cover, moderate habitat complexity and continual flow to support juvenile salmonids; occasional deep pools and suitable habitat units throughout; overall habitat is important for salmonid production although habitat may be somewhat limited by channel size, discharge and distribution of cover; juvenile salmonids captured or observed in relatively high abundance.	Seasonal rearing potential; moderate discharge and suitable depths but may be limited at certain times of year; has capability to support games species but species density is relatively low given aspects such as gradient, lack of instream cover, potential barriers or high velocities; provides seasonal rearing habitat during the spring/summer but systems may dry up by fall/winter.	Limited by lack of perennial flow, low summer flows, low channel and habitat complexity, lack of cover, limited by gradient; lack of coarse substrates or predominance of fines with large average substrate size (*i.e.*, fines with cobble and boulder), lack of pools (> 20 cm), limited by high summer water temperatures and/or low DO during the winter; temperatures; limited connectivity; low potential for salmonids.	Limited by seasonal or ephemeral flow, no defined channel or lack of channel development, intermittent channel, poorly-defined channel, low habitat complexity, lack of connectivity to downstream fish habitat; lack of cover, shallow average water depths (< 10 cm), lack of pools (> 10 cm), predominance of fine and organic substrates, anoxic conditions, high gradient; no fish habitat potential.
Overwintering	Large perennial channels (*i.e.*, S1 and large S2s); suitable discharge to provide habitat and adequate DO underneath ice during freeze-up; frequent deep pools (> 1 m depth and >1 m diameter), occasional very large deep pools (> 1.5 m depth and 5 m dia.); occasional log jams, off-channel habitats (with deep ponds and oxbows); potential to support juvenile and adult fish year-round; habitat may remain ice free year-round.	Intermediate sized channels (small S2s and large S3s); perennial channels with adequate discharge and pool depth to support juvenile salmonids year-round; overall drainage area, channel size and discharge may limit flow and spatial requirements during frozen conditions; average pool depths range from 0.5-1.0 m.	Small S3s and S4s; occasional deep pools throughout but wintering potential is limited by regional climate, drainage area, discharge and overall channel size and depth; sections of channel may freeze to bottom during the winter; residual pool depth, interstitial flow and DO is still sufficient to support juvenile salmonids.	Limited suitable overwintering attributed to a small drainage area, seasonal flow; insufficient discharge and lack of suitable depth to support fish year-round and no connectivity to lake; DO is limiting for salmonids; may be suitable for non-game species; pool habitat is < 10% of the total habitat area; channel has high potential to be dry or frozen to bottom during winter conditions.	No suitable overwintering habitat observed; channel size and discharge not suitable to support fish during winter conditions; lack of headwater lake; lack of channel definition or channel predominately subsurface; ephemeral or seasonal flow; low winter DO and high Biological Oxygen Demand (BOD) associated with a high percentage of organic substrate.
Migration	Large perennial channels with low gradients and no obstructions to fish passage.	Perennial channels with relatively low gradients; no definitive barriers to fish migration but instream channel features such as high velocity riffles, instream debris and cascades may limit instream migration for certain life history stages or for adults at certain times of year.	No definitive barriers to fish migration; however, certain instream features such as chutes, falls, cascades, beaver dams, steeper gradient section, culverts and high velocities may have potential to limit fish passage during certain times of the year.	Fish migration potential is limited by gradient (15-20% sections); by lack of suitable channel definition, limited discharge and suitable depth to support fish passage; and multiple observed barriers which would restrict fish passage (*i.e.*, bed drops; steep cascade sections; perched culvert; discontinuous channel sections; subsurface flow and beaver dams).	Entire channel reach is greater than 25% gradient (absence of well-stepped pools); channel lacks suitable size, depth, discharge and reasonable definition to permit fish migration; channel is predominately subsurface; large waterfall at start of reach obstructs all fish passage as supported by multiple seasons of sampling; channel lacks all connectivity to potential fish habitat downstream.

TABLE 3.6

SENSITIVITY RANKING FOR SPECIES AND HABITAT PRESENT

Evaluation Criteria			Rank
Species present: • nonfish-bearing; or • species present are non-sportfish and exclude species of management concern or cultural or commercial significance [Fish Salvage Only].	OR	Habitat potential: • Low to Nil fish habitat potential (*i.e.*, None); or • Low or Moderate overall habitat potential (*i.e.*, nonfish-bearing within proposed pipeline corridor; moderate potential for fish to use habitat downstream within LSA.	Low (Green)
Species present: • sportfish or species of cultural or commercial significance present, including - salmon, trout, char, burbot and whitefish (*i.e.*, potential for direct or mortality); or • species present are highly sensitive to perturbations; or • species present include Species at Risk or Species of Conservation Concern (includes management species).	OR	Habitat potential: • the potential of two or more fish habitat categories, from either spawning, rearing or wintering, ranked Moderate-High or High; or • habitat identified as critical to the continued existence of a population is present.	High (Red)
(Potential compensation/offset required; Fish Salvage and/or Water Quality Monitoring)			

3.5 Aboriginal Traditional Knowledge

ATK is typically documented as a means to "preserve" historical and familial connections, territorial occupation, land and resource use, and temporal execution strategies. ATK includes, but is not limited to, the collection of TEK during biophysical field survey participation for the Project and Traditional Land Use (TLU) study information from potentially affected Aboriginal communities. Prior to TEK field data collection, preliminary background ATK data was compiled. The following sources were used:

- publically available ATK, TEK and TLU reports;
- open houses and community gatherings;
- meetings and conversations with Aboriginal community representatives;
- published record of comparable past projects of previous environmental assessments;
- published reports from regulatory authorities involved in administering or regulating a specified area or resource (*e.g.*, integrated resource plans, land and resource management plans, etc.); and
- Geographical Information System (GIS) tools to determine spatial relationships of source data to the Project.

The preliminary background ATK data was verified and augmented as a result of the TEK field data collection.

3.5.1 Collection of Traditional Ecological Knowledge

TERA, on behalf of Trans Mountain, facilitated the participation of potentially affected Aboriginal communities during the fish and fish habitat field surveys conducted for the Project. Opportunities for Project participation were made available to potentially affected Aboriginal communities that have an interest in the Project, based on their proximity to the Project and/or their assertion of traditional and

cultural rights of the land. All Aboriginal communities potentially affected by the Project were invited to participate in the fish and fish habitat field surveys conducted for the Project to allow for the collection of TEK.

Engagement for the Project was initiated in the spring of 2012 and continued throughout 2013. The methods used to determine how participants were to be involved in Project field surveys were the same for all Aboriginal communities. Each field survey was discussed with the individual community, usually with staff from the community lands department. This discussion included details regarding the type, timing and locations of work to be conducted and, based on this information, each community chose which of their members would participate in each field survey. The participating Aboriginal communities are listed in Table 3.7 from east to west in relation to the Project.

TABLE 3.7

ABORIGINAL AQUATICS FIELD SURVEY PARTICIPATION FOR THE PROJECT IN BRITISH COLUMBIA

Aboriginal Community	Winter Aquatics	Open Water Aquatics	Results Review
Hargreaves to Darfield Segment			
Lheidli T'enneh	-	June 4 to 11, 2013 June 18 to 20, 2013 July 17 to 24, 2013 August 9 to 10, 2013	November 28, 2013
Aseniwuche Winewak Nation	--	June 4 to 11, 2013 June 18 to 19, 2013 August 9 to 10, 2013	November 28, 2013
Simpcw First Nation	--	June 4 to 11, 2013 June 18 to 21, 2013 July 4 to 11, 2013 July 17 to 24, 2013 August 9 to 14, 2013	N/A
Tk'emlúps te Secwépemc	--	April 12 to 19, 2013	To be determined
Black Pines to Hope Segment			
Lower Nicola Indian Band	--	April 8 to 12, 2013 May 7 to 16, 2013 July 10 to 12, 2013 August 7 to 14, 2013	November 28, 2013
Nicola Tribal Association	---	July 10 to 12, 2013 July 18 to 20, 2013 August 7 to 14, 2013	November 28, 2013
Hope to Burnaby Segment			
Yale First Nation	---	April 9 to 17, 2013 May 1 to 2, 2013 May 7 to 13, 2013 May 24 to 29, 2013 July 23, 2013	November 28, 2013
Chawathil First Nation	--	April 9 to 17, 2013 April 25 to 28, 2013 May 7 to 13, 2013 May 24 to 29, 2013 July 12 to 23, 2013	November 28, 2013
Shxw'ow'hamel First Nation	--	April 9 to 17, 2013 April 25 to 28, 2013 May 24 to 29, 2013 July 15 to 17, 2013 July 23, 2013	November 28, 2013
Cheam First Nation	November 3 to 9, 2012 November 20-21, 2012	April 9 to 17, 2013 April 25 to 28, 2013	November 28, 2013
Seabird Island Band	November 3-9, 2012 November 20-21, 2012	April 9 to 17, 2013 April 25 to 28, 2013	November 28, 2013

TABLE 3.7 Cont'd

Aboriginal Community	Winter Aquatics	Open Water Aquatics	Results Review
Popkum First Nation	--	April 9 to 17, 2013 April 25 to May 2, 2013 July 15 to 17, 2013	November 28, 2013
Scowlitz First Nation	--	April 9 to 17, 2013 April 25 to 26, 2013 May 24 to 29, 2013	November 28, 2013
Le'qa:mel First Nation	--	April 9 to 17, 2013 April 25 to 28, 2013 May 24 to 29, 2013	November 8, 2013
Kwantlen First Nation	November 20-21, 2012	April 9 to 17, 2013 April 25 to 28, 2013 May 24 to 29, 2013	November 28, 2013

A Band Counsel Resolution letter was received by Trans Mountain which delegated authority to the Nicola Tribal Association to act on behalf of Nooaitch Indian Band, Nicomen Indian and Shackan Indian Band for Project engagement. TERA understands that Simpcw First Nation field participants were directed by their respective community not to share TEK with TERA for the purpose of the Project; however, all field participants contributed to the discussion of potential Project-related effects on resources and participated in the discussion of potential mitigation measures to reduce potential Project-related effects.

3.5.2 Field Reconnaissance

In 2012 and 2013, TEK was gathered and recorded during the fish and fish habitat field surveys (Table 3.5). The dates provided may not correspond to the dates noted elsewhere in this report since additional time was spent in the field with the Aboriginal participants for mobilization and demobilization to the field, pre-field work meetings and wrap-up meetings. The field crew consisted of aquatics specialists, Aboriginal participants and a TERA facilitator. Translators were available in the field upon the request of a community. TERA facilitators accompanied participants during the field surveys to identify potential effects of the Project on environmental resources, to explain potential construction techniques, to describe Project specifications, to document TEK and to ensure that proprietary information was kept in confidence.

During the field surveys, traditional methods of resource procurement were discussed, as well as modern methods currently employed. Seasonality of resource harvesting was also important information shared by the Aboriginal participants. Geographical locations were identified, as were areas that are not used and the reasons why. Participants assisted in the identification of potential fish species within each watercourse crossed. At each investigation site, discussions were held with participants about the seasonality of fish, aquatic habitat, water quality and quantity, suitability for navigation and any changes to fish and fish habitat and water resources over time. Potential mitigation measures to reduce any Project-related effects on a resource were also discussed during the fish and fish habitat field surveys. Open discussions occurred regularly between participants and aquatics specialists regarding the resources present and available to Aboriginal communities. These discussions were important to help build relationships among the field crews. Aboriginal participants spoke about aspects of the environment that were important to them and the importance of the resource from a western science perspective was also discussed. The fisheries TEK collected during the biophysical field surveys has added results that western science may not have gathered or considered, confirmed results that had been collected through the field surveys, as well as has identified and confirmed issues of concern to be addressed in Volume 5A. The TEK collected is also used to assist in the review of potential Project-related effects on fish and fish habitat.

3.5.3 Results Review/Reporting

Review of collected TEK and discussions of potential Project-related effects and mitigation strategies described in this report were conducted directly with participating community members during the field

surveys. Confirmation of the accuracy of information incorporated, and approval of the inclusion of confidential and proprietary information in Project planning occurred during community results review follow-up (Table 3-5). Information collected during the field surveys that relate primarily to traditional land and resource use or to other elements has been incorporated into the following reports with permission of the participating communities:

- Traditional Land and Resource Use Technical Report (Volume 5D);
- Socio-Economic Technical Report (Volume 5D);
- Community Health Technical Report (Volume 5D);
- Screening Level Human Health Risk Assessment of Pipeline and Facilities (Volume 5D).

A detailed summary of Trans Mountain's engagement activities with each potentially affected Aboriginal community is provided in Volume 3B of the application.

4.0 RESULTS OF LITERATURE REVIEW

The quality and quantity of the background information presented in the following subsections guided the decision on intended sampling intensity (or lack of sampling) at each watercourse crossing (Section 5.0) and several aspects of the aquatic effects assessment.

4.1 General Information

The proposed pipeline corridor has been separated into the following construction segments:

- Hargreaves to Darfield;
- Black Pines to Hope;
- Hope to Burnaby; and
- Burnaby to Westridge.

Each pipeline segment has further been divided into respective watersheds, management regions, major river systems, Project-specific reference kilometres (RKs) and watercourse crossings. Table 4.1 describes the breakdown of each segment into watershed and river system. Two power lines are also proposed within the Black Pines to Hope Segment to facilitate the operation of pump stations including the Black Pines power line (Section 4.2.4) and the Kingsvale power line (Section 4.2.5). Fish and fish habitat assessments were also completed for the Burnaby Terminal since the headwaters to Eagle Creek are located along the southwest corner of the proposed expansion boundary. No additional watercourse crossings were identified within the FSA of the pump stations associated with the Project.

A general overview of fish species of conservation concern and provincial windows of least risk relative to the FSA is presented in Sections 4.1.3 and 4.1.4. Details concerning the environmental setting, background information, land uses, major river systems and corresponding fish distributions for each pipeline segment are presented in Section 4.2.

Section 4.3 provides details concerning the information and distribution of select indicator fish species and Section 4.4 and 4.5 provide details concerning federally and provincially-listed species in BC which are distributed within the Project area.

4.1.1 Background

The proposed pipeline corridor will span two major drainage basins in BC, the Fraser River system (232,300 km^2) for much of its length, and small sections of the Columbia River system (102,800 km^2) between Cedarside and Albreda (Natural Resources Canada [NRC] 2012). The easternmost portions of the Kingsvale power line also fall within the Columbia River system (NRC 2012). Within these two basins, 13 watersheds are crossed which include: upper Fraser River; Canoe Reach; upper North Thompson River; Clearwater River; lower North Thompson River; Thompson River; South Thompson River; lower Nicola River; Fraser Canyon; Harrison River; Chilliwack/Vedder River; Lower Fraser; and Squamish (Figure 3.2).

Several major river systems within the Project watersheds support important escapements of two or more fish species of recreational, commercial, ecological, and/or Aboriginal concern. These rivers include: upper Fraser River; Canoe River; North Thompson River; Clearwater River; Thompson River; South Thompson River, Nicola River; Coldwater River; Coquihalla River; Chilliwack/Vedder River; and lower Fraser River.

The three provincial fish and wildlife management regions in BC that pertain to the RSA are Region 7 (Omineca), Region 3 (Thompson-Nicola) and Region 2 (Lower Mainland).

TABLE 4.1

MAJOR WATERSHEDS AND RIVERS ALONG THE PROPOSED PIPELINE CORRIDOR

Pipeline Segment	BC Watershed	River System	Provincial Region	Master Crossing Numbers	RKs
Hargreaves to Darfield (RK 489.6 to RK 769.0)	Upper Fraser River (RK 489.6 to RK 527.9)	Fraser River	7	BC-1 to BC-35	489.7 to 525.7
	Canoe Reach (RK 527.9 to RK 547.7)	Canoe River		BC-36 to BC-56	531.3 to 547.6
	Upper North Thompson River (RK 547.67 to RK 722.91)	North Thompson River	3	BC-57 to BC-311	548.5 to 721.3
	Clearwater River (RK 723.1 to RK 725.9)	Clearwater River		BC-312	725.5
	Lower North Thompson River (RK 725.9 to RK 840.9)	North Thompson River		BC-313 to BC-344	728.8 to 768.5
Black Pines to Hope (RK 811.8 to RK 1043.7)				BC-345 to BC-408	811.8 to 839.9
	Thompson River (RK 840.9- to RK 853.2)	Thompson River		BC-409 to BC-419	841.5 to 850.1
	South Thompson River (RK 853.2 to RK 875.6)	South Thompson River		BC-419a to BC-442	853.6 to 874.4
	Lower Nicola River (RK 875.6 to RK 991.4)	Nicola River		BC-443 to BC-582	875.8 to 990.0
		Coldwater River			
	Fraser Canyon (RK 991.4 to RK 1057.6)	Coquihalla River	2	BC-583 to BC-654	992.9 to 1043.2
Hope to Burnaby (RK 1043.7 to RK 1179.8)		Lower Fraser River		BC-655 to BC-663	1045.3 to 1056.7
	Harrison River (RK 1057.6 to RK 1081.1)	Lower Fraser River		BC-664 to BC-707	1057.5 to 1080.0
	Chilliwack River (RK 1081.1 to RK 1117.4)	Chilliwack/Vedder River		BC-708 to BC-728	1083.4 to 1116.5
		Lower Fraser River			
	Lower Fraser (RK 1117.4 to RK 1181.6)	Lower Fraser River		BC-729 to BC-785	1118.8 to 1176.5
Burnaby to Westridge (RK 1179.8 to RK 1182.5)	Squamish (RK 1181.6 to RK 1183.6)	Lower Fraser River		BC-786	1182.5

The Water Survey of Canada monitors discharge at hydrological stations year-round on several watercourses crossed by the proposed pipeline corridor. The mean monthly discharge for the lowest and highest flow periods from watercourses with hydrological stations near the proposed pipeline corridor is provided in Table 4.2. Mean flows are calculated monthly from all data available for each station. Low flow periods are usually during the winter (January through March) or summer (August through September). Peak flows usually occur during the spring/summer months during freshet, with the exception of West Creek which shows a winter high flow.

TABLE 4.2

HYDROLOGICAL STATIONS AT IMPORTANT FISH-BEARING WATERCOURSES CROSSED OR ADJACENT TO THE PROPOSED PIPELINE CORRIDOR

Watercourse Name	Station Name, Station Number	Years Station Data Available	Approximate Location of Station Relative to the Proposed Pipeline Corridor	Month and Mean Monthly Discharge (m^3/s) During Lowest Flow Period	Month and Mean Monthly Discharge (m^3/s) During Highest Flow Period
Upper Fraser River	Fraser River at Red Pass 08KA007	1955 to 2011	25.3 km upstream from BC-10	March 5.31 m^3/s	June 153 m^3/s
Canoe River	Canoe River below Kimmel Creek 08NC004	1971 to 2010	9.4 km upstream from BC-36	February 1.66 m^3/s	July 43.8 m^3/s
Blue River	Blue River near Blue River 08LB038	1926 to 2011	0.2 km upstream from BC-178	February 1.63 m^3/s	June 37.1 m^3/s
North Thompson River	North Thompson River at Birch Island 08LB047	1960 to 2010	59.4 km downstream from BC-236	February 28.1 m^3/s	June 444 m^3/s
Clearwater River	Clearwater River near Clearwater Station 08LA001	1914 to 2011	2.3 km upstream from BC-312	February 45.1 m^3/s	June 717 m^3/s
Thompson River	Thompson River at Kamloops 08LF023	1911 to 2010	5.7 km upstream from BC-413	February 137 m^3/s	June 2070 m^3/s
Nicola River	Nicola River at Outlet of Nicola Lake 08LG065	1983 to 2011	7.2 km upstream from BC-504	January 1.53 m^3/s	June 16.6 m^3/s
Coldwater River	Coldwater River near Brookmere 08LG048	1965 to 2010	4.9 km downstream from BC-559	September 1.15 m^3/s	May 23.5 m^3/s
Coquihalla River	Coquihalla River below Needle Creek 08MF062	1965 to 2011	13 km upstream from BC-631	September 0.826 m^3/s	May 9.91 m^3/s
Coquihalla River	Coquihalla River above Alexander Creek 08MF068	1987 to 2011	2.6 km upstream from BC-654	September 9.07 m^3/s	May 68.5 m^3/s
Coquihalla River	Coquihalla River Near Hope 08MF003	1911 to 1983	0.6 km upstream from BC-654	March 19.9 m^3/s	June 78.5 m^3/s
Chilliwack/Vedder River	Chilliwack River at Vedder Crossing 08MH001	1911 to 2011	4.0 km upstream from BC-717	September 34.4 m^3/s	June 137 m^3/s
West Creek	West Creek near Fort Langley 08MH098	1960 to 2011	Within the proposed pipeline corridor (BC-749)	August 0.034 m^3/s	January 0.981 m^3/s
Fraser River	Lower Fraser River at Mission 08MH024	1965 to 2011	44 km upstream from BC-780	February 1400 m^3/s	June 8180 m^3/s
Lower Fraser River	Fraser River at Port Mann Pumping Station 08MH126	1965 to 2006	0.5 km upstream from BC-780	January 1780 m^3/s	June 8590 m^3/s

Source: Water Survey of Canada 2013

4.1.2 Community Watersheds

Special designated community watersheds in BC are the responsibility of the Deputy Minister of BC MFLNRO and protected under the *Forest and Range Practices Act*, formally the *Forest Practices Code Act of British Columbia* (BC MOE 2013). Community watersheds have special water quality and management objectives as the upstream drainage area and point of diversion downstream are important for community drinking water purposes (BC OGC 2013). An Order has also been established under the *Oil and Gas Activities Act (OGAA)* and the *Environmental Protection and Management Regulation* which also designates community watersheds in connection with oil and gas development in BC (BC MOE 2013). Under BC OGC's *Environmental Protection and Management Regulation*, classes S1-S4 are fish-bearing streams or streams located within a community watershed and classes S5-S6 are nonfish-bearing streams located outside a community watershed.

Two designated community watersheds occur within the RSA which includes the Kwinshatin and Skuagam community watersheds in the Nicola Provincial Forest region southeast from the Coldwater Indian Reservation (Table 4.3).

TABLE 4.3

DESIGNATED COMMUNITY WATERSHEDS ALONG THE PROPOSED PIPELINE CORRIDOR

Pipeline Segment	Community Watershed	BC Watershed	River System	Provincial Region	Master Crossing Numbers	RK
Black Pines to Hope (RK 811.8 to RK 1044.2)	Kwinshatin	Lower Nicola River	Coldwater River	3	BC-531 to BC-533	941.5 to 941.7
	Skuagam	Lower Nicola River	Coldwater River		BC-534	943.0

4.1.3 Fish Species of Concern

Five federally-listed fish species (*SARA*) of special concern occur within BC portions of the FSA and are listed in Schedule 1 of *SARA* (Table 4.4). These species are also Red or Blue-listed by the BC CDC's Vertebrate Tracking List (BC CDC 2011). Red-listed species are Extirpated, Endangered or Threatened in BC and Blue-listed species are of Special Concern or Vulnerable in BC. Eight fish species are also ranked provincially (Red or Blue-listed), or by COSEWIC as sensitive populations that may be of some risk of Extinction or Extirpation from Canada (COSEWIC 2012) (Table 4.5).

TABLE 4.4

FEDERALLY-LISTED SPECIES (SCHEDULE 1 OF *SARA*)

Species	BC Rank[1]	*SARA* – Schedule 1	Red or Blue-Listed	River Systems	Pipeline Segment
Green sturgeon	S1	Special Concern	Red	Lower Fraser River	Hope to Burnaby
Nooksack dace	S1	Endangered	Red	Lower Fraser River	Hope to Burnaby
Salish sucker	S1	Endangered	Red	Lower Fraser River	Hope to Burnaby
Westslope cutthroat trout * (BC population)	S3	Special Concern	Blue	Lower Fraser River (*introduced)	Hope to Burnaby
White sturgeon (Upper Fraser River population)	S1	Endangered	Red	Upper Fraser River	Hargreaves to Darfield

Notes: 1 S1 – Critically Imperiled (Red-Listed); S3 – Special Concern, Vulnerable (Blue-Listed).
* Westslope cutthroat have been introduced to drainages in the Lower Mainland (Hope to Burnaby Segment), and therefore, are not considered to be a conservation concern within the RSA and LSA.

TABLE 4.5

PROVINCIALLY-LISTED SPECIES AND/OR COSEWIC SPECIES

Species	BC Rank1	COSEWIC Status	Red or Blue-Listed	River Systems	Pipeline Segment
Bull trout	S3S4	Special Concern	Blue	Upper Fraser River Canoe River North Thompson River Clearwater River Thompson River South Thompson River Nicola River Coldwater River Coquihalla River Chilliwack/Vedder River Lower Fraser River	Hargreaves to Darfield Black Pines to Hope Hope to Burnaby
Chiselmouth	S3S4	Not At Risk	Blue	Nicola River Lower Fraser River	Black Pines to Hope Hope to Burnaby

TABLE 4.5 Cont'd

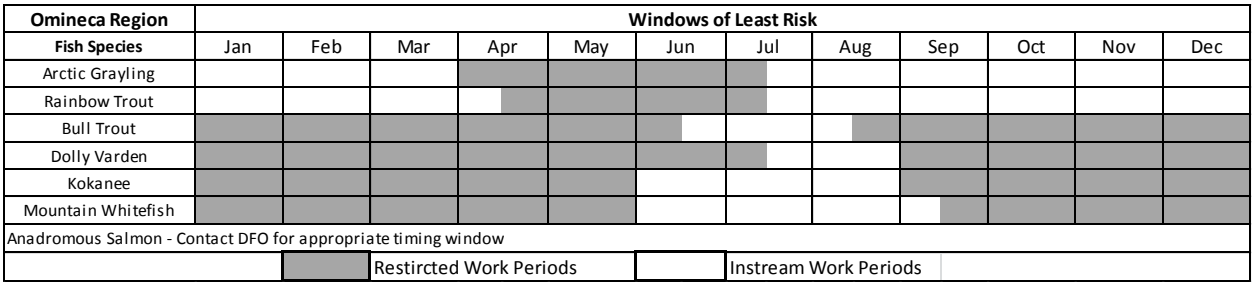
Species	BC Rank1	COSEWIC Status	Red or Blue-Listed	River Systems	Pipeline Segment
Eulachon (Fraser River population)	S2S3 (General)	Endangered (Fraser River population)	Blue (General)	Lower Fraser River	Hope to Burnaby
Interior Fraser River coho salmon	S4 (General)	Endangered (Interior Fraser population)	Yellow (General)	North Thompson River Clearwater River Thompson River South Thompson River Nicola River Coldwater River	Hargreaves to Darfield Black Pines to Hope
Mountain sucker	S2S3	Special Concern	Blue	North Thompson River Lower Fraser River	Hargreaves to Darfield Hope to Burnaby
Sockeye salmon (Cultus Lake population)	S4 (General)	Endangered (Cultus Lake population)	Yellow (General)	Chilliwack/Vedder River Lower Fraser River	Hope to Burnaby
White sturgeon (Middle Fraser River population)	S2	Non-Active	Red	Thompson River	Black Pines to Hope
White sturgeon (Lower Fraser River population)	S2	Threatened	Red	Chilliwack/Vedder River Lower Fraser River	Hope to Burnaby

Note: 1 S2 – Imperiled, Threatened (Red-Listed); S3 – Special Concern, Vulnerable (Blue-Listed); S4 – Apparently Secure.

4.1.4 Windows of Least Risk

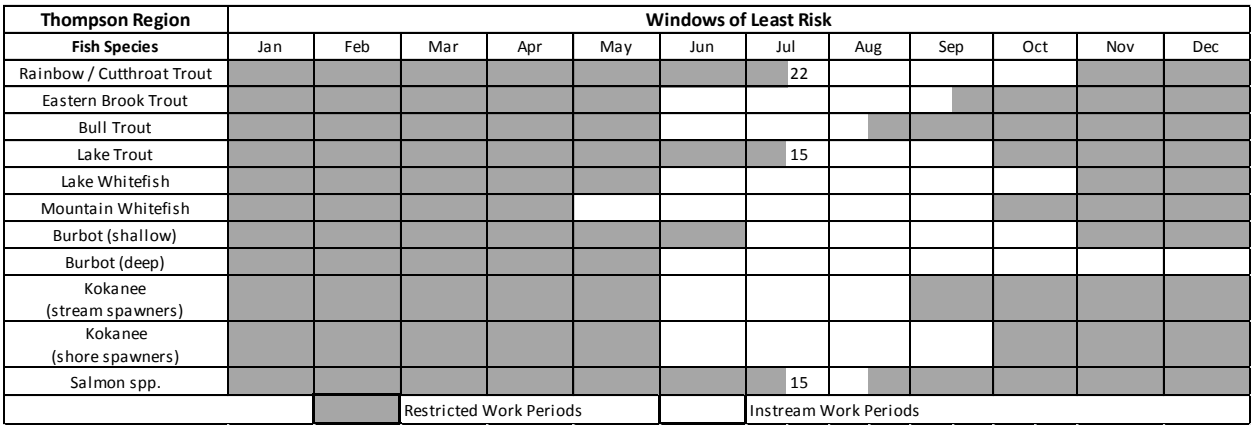
Provincial windows of least risk or "instream construction timing windows" are species- and region-specific and are established to protect sensitive life history stages of species of management concern including their eggs, juveniles, spawning adults and/or the organisms upon which they feed. Instream construction timing windows for fish species of conservation concern within the Omineca (Region 7), Thompson-Nicola (Region 3) and Lower Mainland (Region 2) regions are presented and referenced for each of the proposed pipeline segments (Figures 4.1 to 4.4).

Figure 4.1 Timing Windows for Fish Species of Management Concern within the Omineca Region (Region 7 - Fraser and Columbia Drainages)



Source: BC MOE 2004

Figure 4.2 Timing Windows for Fish Species of Management Concern within the Thompson-Nicola Region (Region 3 – North Thompson, Thompson, South Thompson, Nicola and Coldwater Drainages)



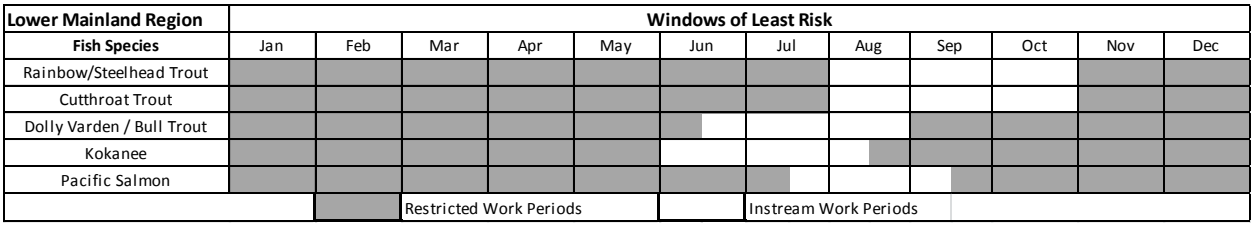
Source: BC MOE 2007

Figure 4.3 Specific Watercourse Timing Windows within the Thompson-Nicola Region (Region 3)

Thompson Region	Specific Watercourse Windows of Least Risk											
Watercourse Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Headwaters Forest District												
Albreda River							22					
Avola Creek							22					
Blackberg Creek							22					
Blue River								7				
Cedar Creek												
Chappell Creek												
Clearwater River								7				
Clemina Creek												
Cook Creek								7				
Crossing Creek								7				
Dominion Creek												
Finn Creek							22					
Foam Creek								7				
Froth Creek								7				
Gill Creek								7				
Mad River								7				
Mann Creek							22	20				
Miledge Creek								7				
Moonbeam Creek												
Nobelquartz Creek								7				
Raft River							22					
Robina Creek							22					
Sager Creek								7				
Serpentine Creek								7				
Sundt Creek								7				
Thunder River												
Whitewater Creek								7				
Kamloops Forest District												
Anderson Creek							22					
Lemiuex Creek							22					
Noth Thompson River							22					
North Thompson River (Medium Tributaries*)							22					
Thompson River							22					
Cascades Forest District												
Clapperton Creek							22					
Coldwater River (above Kingsvale)								7 10				
Coldwater River (below Kingsvale)							22					
Nicola River							22					
		Restricted Work Periods					Instream Work Periods					

Source: BC MOE 2007
Note: * Medium Tributaries to the North Thompson River include Jamieson Creek, Lane Creek, Dairy Creek and McQueen Creek.

Figure 4.4 Timing Windows for Fish Species of Management Concern within the Lower Mainland Region (Region 2 – Coquihalla, Chilliwack and Fraser Drainages)



Source: BC MOE 2006

Note: Windows of least risk are developed for salmonids and do not consider other coarse fish species of concern (*e.g.*, salish sucker, nooksack dace). Final instream work windows will be developed in consultation with regulatory authorities.

4.2 Environmental Setting and Fish Species Distribution

4.2.1 Aboriginal Traditional Knowledge

Fishing remains an important traditional and commercial activity for Aboriginal communities residing in BC. Aboriginal people fish seasonally depending on the species and in general, once caught, fish may be smoke-dried or frozen (Archaeo Research Limited 2002). Traditional fishing has influenced Aboriginal communities such that seasonal movements and the location of habitation sites were selected based on the movement of salmon upstream to spawning areas. A variety of fish species are caught throughout the traditional territories transected by the proposed pipeline corridor in BC (Pacific Trails Pipeline Ltd Partnership 2007; Archaeo Research Limited 2002).

Where available, background ATK information collected for each component of the Project is included in the corresponding subsections below.

4.2.2 Hargreaves to Darfield Segment (RK 489.6 to RK 769.0)

The Hargreaves to Darfield Segment originates in the Upper Fraser River watershed east from Rearguard Falls and west from Mount Robson Provincial Park. The initial portion of the proposed pipeline corridor in the Hargreaves to Darfield Segment parallels the existing TMPL right-of-way for approximately 6 km where it then incorporates a tie-in to the Rearguard Pump Station which includes two adjacent crossings of the Upper Fraser River.

South from this upper Fraser River crossing, the proposed pipeline corridor continues west for approximately another 5 km, where it traverses a steep bench along the upper Fraser River above the CN rail tracks and eventually meets up again with existing TMPL right-of-way. From this point, the pipeline corridor veers southeast along Highway 5 towards the town of Valemount. Important fish-bearing tributaries along this segment include Baer Creek, Marathon Creek, Terry Fox Creek, upper Fraser River, Teepee Creek, Crooked Creek and Swift Creek.

South from the Town of Valemount, the pipeline corridor continues along Highway 5, where it intersects drainages to the Columbia River (Canoe Reach watershed) for approximately 19 km before reaching the Village/Hamlet of Albreda. Important fish-bearing tributaries to the Columbia River include the Canoe River and Camp Creek.

South from the Village/Hamlet of Albreda, the proposed pipeline corridor continues south along Highway 5 through the Upper North Thompson River watershed for approximately 177 km to the District of Clearwater, BC, where it crosses the Clearwater River at RK 725.5. Throughout this segment, the pipeline corridor generally follows the existing TMPL right-of-way which crosses and parallels both the Albreda and North Thompson rivers. A number of important fish-bearing tributaries to the North Thompson River in this segment also include Robina Creek, Clemina Creek, Dora Creek, Dominion Creek, Moonbeam Creek, Serpentine Creek, Chappell Creek, Miledge Creek, Thunder River, Whitewater Creek, Cook Creek, Cedar Creek, Blue River, Goose Creek, Froth Creek, Foam Creek, Finn Creek, Sundt Creek,

Tumtum Creek, Avola Creek, Sager Creek, Mad River, Crossing Creek, Noblequartz Creek and Raft River.

South from the District of Clearwater, the proposed pipeline corridor follows existing TMPL right-of-way through the Lower North Thompson Watershed for approximately 43 km to the town of Darfield, BC. Important fish-bearing tributaries to the lower North Thompson River in this segment include Mann Creek, Lemieux Creek, Nehalliston Creek, Eakin Creek, Montigny Creek, Thuya Creek, Darlington Creek and Lindquist Creek.

4.2.2.1 Background Information and Existing Land Uses

Common Biogeoclimatic Zones (BGC) occurring throughout the Hargreaves to Darfield Segment includes the Interior Cedar-Hemlock and Sub-boreal Spruce zones north from Vavenby and the Interior Douglas-fir zone between Vavenby and Darfield. Climate in the Interior Cedar-Hemlock zone is described as wet and cool, with abundant rain and heavy winter snows (BC MOF 2005). Plant productivity is high in this region and old growth forests are abundant (BC MOF 2005). Comparatively, the Sub-boreal Spruce zone is slightly drier and more prone to fire and stand initiating events (BC MOF 1998b). Summers are short, warm and moist and winters are typically long with most of the zone covered by snow from November to March (BC MOF 1998b). Annual mean total precipitation for this region is 600-1200 mm with some areas receiving upwards of 1600 mm (NRC 2012). Wetland ecosystems including marshes, fens and swamps are common in this zone. The Interior Douglas-fir zone receives less rain and snowfall with the annual mean total precipitation for the region being 401-800 mm (NRC 2012). Wildfires are common to this area and climate is warm and dry in the short summer season and cool in winter (BC MOF 1998b).

The Hargreaves to Darfield Segment follows the existing TMPL right-of-way for much of its length. Substantial deviations from the existing TMPL right-of-way occur from RK 500.5 to RK 506.1 in the Upper Fraser watershed and from RK 567 to RK 582 and RK 627 to RK 638 in the Upper North Thompson watershed.

The predominant land use in this area is forestry with several cut-blocks and logging roads located throughout. Impacts of forestry development on fisheries values include road and slope failure, degraded riparian habitat, channel bank erosion, road encroachments, increased suspended sediment loads and channel instability (Komori 1997). CN rail tracks and other utility corridors commonly parallel portions of the proposed pipeline corridor in this segment. Existing vehicle crossing structures are also common at road, railway and existing pipeline watercourse crossings (*e.g.*, perched culverts) which can result in barriers to fish migration. Other land uses in this region include agriculture, livestock grazing, some mining, hunting and trapping, recreational fishing and backcountry hiking, cross country skiing and off-highway vehicle use. Residential areas include Valemount, Albreda, Blue River, Vavenby, Clearwater, Little Fort and Darfield. Primary agricultural areas are located near Valemount and between Vavenby and Darfield. Extensive agricultural development can impact fisheries resources through the following: extraction of surface and groundwater which can change the hydrologic regime; loss of riparian habitat and the input of nutrients and pesticides which can affect water quality (Komori 1997).

Aboriginal Traditional Knowledge

Along the Hargreaves to Darfield Segment, the desktop review identified that fish are still harvested by many Aboriginal communities. Fish species caught in the area include Dolly Varden, northern pike, rainbow trout, whitefish, char, suckerfish, sturgeon, spring salmon, tsulba, kokanee, and ling (L'heidli T'enneh n.d.; Pacific Trails Pipeline 2007; Archaeo Research Limited 2002). Some species are fished in the summer, while others are caught through the ice in the winter. Once caught, fish may be smoke-dried or frozen. Trout Lake and Pelican Lake are fished by Lhtako Dene First Nation members, and the rivers and tributaries of the Thompson River are also fished (Archaeo Research Limited 2002; Golder Associates 2008). L'heidli T'enneh operates a fisheries program in conjunction with provincial and federal fisheries agencies, with emphasis on salmon due to their high consumption, social, and ceremonial value (L'heidli T'enneh n.d.).

Concerns recorded through engagement on other development projects focus on impacts to water quality affecting local wildlife that is harvested for consumption, and the subsequent effects this may have on human health. Concerns about the anticipated disruption of fish-bearing watercourse crossings and

altered fishing practices due to changes in fish populations were also recorded (Taseko Mines Limited 2009).

4.2.2.2 Fish Species Distribution

Upper Fraser River (RK 489.6 to RK 528.8)

The Fraser River is the longest river in BC, originating at the base of Cube Ridge in Mount Robson Provincial Park and flowing approximately 1,370 km to the Strait of Georgia near the City of Vancouver (NRC 2012). The Fraser River Watershed provides spawning and rearing habitat for steelhead and all five species of Pacific salmon and is the largest salmon producing river in BC (DFO 2012). The Upper Fraser River Watershed includes the Nechako River and Fraser River mainstem and tributaries upstream from Prince George. Chinook salmon are the only known Pacific salmon species to spawn and rear in the upper Fraser River mainstem and tributaries (Fedorenko *et al*. 1983). Important mainstem spawning areas for Chinook include the "Tete Jaune Islands" area downstream from Highway 5 and near the mouth of Swiftcurrent Creek, approximately 17 km upstream from Rearguard Falls (Fedorenko *et al.* 1983). Important tributaries to the upper Fraser River watershed for Chinook spawning also include Swift Creek and McLennan River. Other important sportfish species in the upper Fraser include rainbow trout, bull trout, lake whitefish, pygmy whitefish, mountain whitefish, burbot and potentially white sturgeon. Non-sportfish species include slimy sculpin, lake chub, longnose dace, longnose sucker, northern pikeminnow, peamouth chub and redside shiner (Table 4.6).

There is anecdotal evidence that the geographic distribution of white sturgeon (SG4) may include the upper Fraser River mainstem, upstream from Prince George past the Morkill River and potentially Rearguard Falls (Hatfield *et al*. 2004, McPhail 2007); this population is listed in Schedule 1 of *SARA* as Endangered.

TABLE 4.6

FISH SPECIES RECORDED PREVIOUSLY IN THE UPPER FRASER RIVER AND ITS TRIBUTARIES, HARGREAVES TO DARFIELD SEGMENT

Master Crossing Number	RK	Watercourse Name	Fish Species Present[1]	Provincial Instream Work Window
BC-3	490.5	Baer Creek	BT and RB	July 15 to August 15
BC-5	491.6	Marathon Creek	RB	July 15 to April15
BC-8	495.8	Terry Fox Creek	BT and RB	July 15 to August 15
BC-10	499.7	Fraser River	BB, BT, CCG, CH, LKC, LNC, LSU, LW, MW, NSC, PCC, PW, RB, RSC and WSG	July 15 to August 15 (Contact DFO for anadromous salmon)
BC-27	515.5	Teepee Creek	BT and CCG	June 15 to August 15
BC-28	517.8	Crooked Creek	BT and RB	July 15 to August 15
BC-32	522.5	Swift Creek	BT, CCG, CH and RB	July 15 to August 15 (Contact DFO for anadromous salmon)

Note: 1 Fish species acronym list is provided at the beginning of the report.

Canoe River (RK 527.9 to RK 547.7)

Canoe River originates in the South Canoe Glacier near Mount Sir John Thompson in the Caribou Mountains. The Canoe River flows east for approximately 40 km before discharging into Kinbasket Lake. This arm of Kinbasket Lake is referred to as Canoe Reach which was previously the lower reach of the Canoe River; Canoe Reach was created when lower portions of the Canoe River were flooded during the Mica Dam installation in 1973. Fish species found in Canoe River include bull trout, rainbow trout, mountain whitefish, pygmy whitefish, longnose sucker and slimy sculpin. Kokanee also migrate through the lower reaches of Canoe River to access Camp Creek, an important spawning and rearing tributary for kokanee, bull trout and rainbow trout, slimy sculpin, prickly sculpin and lake chub.

The proposed pipeline corridor traverses the Canoe River Watershed for approximately 19 km between Cedarside and Albreda, which includes one crossing of the Canoe River and three crossings of Camp Creek (Table 4.7).

TABLE 4.7

FISH SPECIES RECORDED PREVIOUSLY IN CANOE RIVER AND CAMP CREEK, HARGREAVES TO DARFIELD SEGMENT

Master Crossing Number	RKs	Watercourse Name	Fish Species Present[1]	Provincial and Federal Instream Work Window
BC-36	531.3	Canoe River	BT, CCG, KO, LSU, MW, PW, and RB	July 15 to August 15
BC-38, BC-52 and BC-56	534.5, 545.9 and 547.6	Camp Creek	BT, CAS, CCG, KO, LKC, and RB	July 15 to August 15

Note: 1 Fish species acronym list is provided at the beginning of the report.

North Thompson River (RK 548.0 to RK 769.0)

The headwaters to North Thompson River originate in the Caribou Mountains at the foot of the Thompson Glacier, east from Wells Gray Provincial Park. The North Thompson River flows east towards Highway 5 and south for approximately 325 km before joining up with South Thompson River at Kamloops. The confluence between the North and South Thompson rivers marks the beginning of the mainstem Thompson River, which then shortly drains into Kamloops Lake. The North Thompson River and tributaries provide important spawning and nursery habitat for Chinook and coho salmon (Sections 4.3.2.1 and 4.3.3.1). Important spawning areas for early summer-run Fraser sockeye within the Project area includes the North Thompson mainstem and tributaries such as Lemieux Creek, Mann Creek, Clearwater River, Raft River and Finn Creek (Langer 2010). Other fish species include pink salmon (records from lower North Thompson sub-basin only [Knapp *et al*. 1982]) bull trout, mountain whitefish, round whitefish, rainbow trout, western brook lamprey, bridgelip sucker, largescale sucker, longnose sucker, prickly sculpin, slimy sculpin, torrent sculpin, lake chub, northern pikeminnow, peamouth chub, redside shiner, leopard dace and longnose dace. Mountain sucker is known to reside in the North Thompson River mainstem and is Blue-listed as a species of Special Concern.

The Hargreaves to Darfield Segment is located in the upper North Thompson River watershed for approximately 280 km, and includes three crossings of the North Thompson and Albreda rivers. Other large river crossings include Thunder River, Blue River, Mad River, Raft River and Clearwater River. The lower North Thompson River watershed is traversed for approximately 43 km. Fish species found in the North Thompson River and important watercourse crossed by the proposed pipeline corridor in upper and lower portions of the watershed are presented in Table 4.8 and Table 4.9.

TABLE 4.8

FISH SPECIES RECORDED PREVIOUSLY IN THE UPPER NORTH THOMPSON RIVER AND ITS TRIBUTARIES, HARGREAVES TO DARFIELD SEGMENT

Master Crossing Number	RKs	Watercourse Name	Fish Species Present[1]	Provincial Instream Work Window
BC-65, BC-82 and BC-85	552.1, 561.2 and 563.6	Albreda River	BT, CC, CO, RB and WF	July 22 to August 15
BC-66	552.9	Robina Creek	BT	July 22 to August 15
BC-76	559.0	Clemina Creek	BT	June 1 to August 15
BC-78	559.4	Dora Creek	BT and CO	July 15 to August 15
BC-93	567.6	Dominion Creek	BT, CO and MW	June 1 to August 15
BC-94	571.9	Moonbeam Creek	BT	June 1 to August 15
BC-110	580.4	Serpentine Creek	BT, CH, MW, and CCG	August 7 to 15
BC-111, BC-182 and BC-236	581.2, 619.9 and 651.6	North Thompson River	BL, BSU, BT, CCG, CH, CO, CRH, CSU, LDC, LKC, LNC, LSU, MSU, MW, NSC, PCC, RB, RSC, RW and SK	July 22 to August 15

TABLE 4.8 Cont'd

Master Crossing Number	RKs	Watercourse Name	Fish Species Present[1]	Provincial Instream Work Window
BC-112	582.0	Chappell Creek	BT and CCG	June 1 to August 15
BC-151	592.9	Miledge Creek	BT and CO	August 7 to 15
BC-168	600.2	Thunder River	BT, CCG, CO and MW	June 1 to August 15
BC-173	605.2	Whitewater Creek	BT, CRH and RB	August 7 to 15
BC-176	609.4	Cook Creek	BT, CH, CO, MW, CC and RB	August 7 to 15
BC-177	611.6	Cedar Creek	BT, CO, CRH, MW and RB	June 1 to August 15
BC-178	613.8	Blue River	BT, CAS, CCG, CH, CO, LNC, MW, RB and RSC	August 7 to 15
BC-180	616.9	Goose Creek	CO, MW, RB and BT	July 22 to August 15
BC-189	626.6	Froth Creek	BT and RB	August 7 to 15
BC-193	633.9	Foam Creek	RB	August 7 to 15
BC-201	638.8	Finn Creek	BT, CAS, CCG, CH, CO, MW, RB and SK	July 22 to August 15
BC-224	648.0	Sundt Creek	CO and MW	August 7 to 15
BC-227	648.9	Tumtum Creek	CH, CO and RB	July 22 to August 15
BC-242	656.1	Avola Creek	CO and RB	July 22 to August 15
BC-249	664.3	Sager Creek	CO	August 7 to 15
BC-275	683.4	Mad River	CCG, CH, CO, LNC and RB	August 7 to September 30
BC-279	688.2	Bill Creek (Blackberg Creek)	CO	July 22 to August 15
BC-302	707.9	Crossing Creek	CO	August 7 to 15
BC-305	710.9	Noblequartz Creek	CO	August 7 to 15
BC-309	717.7	Raft River	BT, CAS, CH, CO, CSU, L, LNC, MW, RB and SK	July 22 to August 15

Note: 1 Fish species acronym list is provided at the beginning of the report.

TABLE 4.9

FISH SPECIES RECORDED PREVIOUSLY IN THE LOWER NORTH THOMPSON RIVER AND ITS TRIBUTARIES, HARGREAVES TO DARFIELD SEGMENT

Master Crossing Number	RK	Watercourse Name	Fish Species Present[1]	Provincial Instream Work Window
BC-315	735.0	Mann Creek	BT, CH, CO, CRH, EB, LSU, PK, RB, SK and WF	July 22 to August 20
BC-330	749.3	Lemieux Creek	CH, CO, KO, LNC, MW, NSC, RB, and SK	July 22 to August 15
BC-331	751.0	Nehalliston Creek	RB	July 22 to October 31
BC-332	752.3	Eakin Creek	CCG, CO and RB	July 22 to August 15
BC-336	757.9	Montigny Creek	RB	July 22 to October 31
BC-338	761.1	Thuya Creek	RB	July 22 to October 31
BC-343	768.2	Darlington Creek	CO	July 22 to August 15
BC-344	768.5	Lindquist Creek	CO, LSU and RB	July 22 to August 15

Note: 1 Fish species acronym list is provided at the beginning of the report.

Clearwater River (RK 725.5)

The Clearwater River is the largest tributary to the upper North Thompson River, flowing south for approximately 200 km from its headwaters to the confluence with the upper North Thompson River. It originates from glacier-fed Clearwater and Hobson lakes which are nourished by smaller lakes and tributaries in the Cariboo Mountains (Harding *et al.* 1994). Most of the Clearwater River (except the lower 5 km) is within Wells Gray Provincial Park and its confluence is within the North Thompson River Provincial Park. Recreation, logging and agriculture, particularly around Mahood Creek which is a major tributary to the middle reach of the river, may have minor impact on the Clearwater River (Harding *et al.* 1994). Other major tributaries are (from source to mouth) Hobson Creek, Goat Creek, Lickskillet Creek, Azure Creek, Falls Creek, Murtle River, Hemp Creek, Grouse Creek and Spahats Creek.

The Clearwater River is a major Chinook spawning system (July/August) and also provides important spawning and rearing habitat for sockeye and coho. It is probable that salmon can only migrate as far upstream as the barrier at Bailey's Chute (approximately 56 km upstream from the confluence) and fish passage may be partially impeded by a canyon and chute 7 km upstream from the confluence with the North Thompson River. The Clearwater and Mahood rivers contain some of the best rainbow trout sportfishing in the upper North Thompson watershed (Harding *et al.* 1994). Other resident fish species in the Clearwater River include bull trout, mountain whitefish, redside shiner, slimy sculpin and longnose dace.

The proposed pipeline corridor crosses the Clearwater River mainstem at RK 725.5, near the confluence with the upper North Thompson River and the District of Clearwater. Fish species recorded previously in the Clearwater River are presented in Table 4.10.

TABLE 4.10

FISH SPECIES RECORDED PREVIOUSLY IN THE CLEARWATER RIVER

Master Crossing Number	RK	Watercourse Name	Fish Species Present[1]	Provincial Instream Work Window
BC-312	725.5	Clearwater River	BT, CCG, CH, CO, LNC, MW, RB, RSC and SK	August 7 to 15

Note: 1 Fish species acronym list is provided at the beginning of the report.

4.2.2.3 Fish Species of Concern

Listed fish species of special concern within the Hargreaves to Darfield Segment includes bull trout, coho, sockeye and mountain sucker (Table 4.4 and Table 4.5). While anecdotal reports list Rearguard Falls in the upper Fraser River as the extent of white sturgeon range it is generally accepted that McBride, BC (Morkill River) is the northernmost limit of their current distribution (Hatfield *et al*. 2004. White sturgeon are not expected to inhabit smaller tributaries crossed by the proposed pipeline corridor (Baer Creek, Marathon Creek, Terry Fox Creek etc.). Furthermore, there are no historical records of white sturgeon in the North Thompson or Clearwater rivers.

4.2.3 Black Pines to Hope Segment (RK 811.8 to RK 1043.7)

The Black Pines to Hope Segment originates in the Black Pines area approximately 20 km north from the City of Kamloops. The proposed Black Pine power line is located at the beginning of this segment and ties into the proposed pipeline corridor at the proposed Black Pines Pump Station (RK 811.8). From the proposed Black Pines Pump Station, the proposed pipeline corridor continues south following the existing TMPL right-of-way and parallels the Westsyde Road towards Kamloops. Important fish-bearing tributaries to the lower North Thompson River north from Kamloops include Jamieson Creek, Lanes Creek, Dairy Creek and McQueen Creek. North from the Kamloops city limits, the proposed pipeline corridor traverses through the Lac du Bois Grasslands Protected Area and benchland areas, crossing the Thompson River upstream from Kamloops Lake.

South from Kamloops, the proposed pipeline corridor deviates from the existing TMPL right-of-way to the east around Jacko Lake and Ajax Mine, passing through high elevation areas of the South Thompson River watershed and into the Lower Nicola River watershed. This area is encompassed by dry rolling grasslands, Ponderosa pine and Douglas-fir; crossings of Peterson Creek, Anderson Creek and Droppingwater Creek are located in this segment.

The proposed pipeline corridor continues to follow the existing TMPL right-of-way through the Lower Nicola River watershed. Northwest from Nicola Lake, the pipeline intersects and parallels Highway 5 through to the City of Merritt. Important watercourses along this segment include Moore Creek, Clapperton Creek, Nicola River and Hamilton Creek.

The proposed pipeline corridor continues south from Merritt, where at approximately RK 937 there is a deviation from the existing TMPL right-of-way to the southeast around the Coldwater Indian Reserve. Further south, the pipeline generally follows Highway 5 and the Spectra gas pipeline right-of-way through

mountainous areas of the Lower Nicola River and Fraser Canyon watersheds to the junction of Highway 5 and Shylock Road (confluence of Boston Bar Creek and the Coquihalla River). Through this portion, the proposed pipeline corridor crosses and parallels keys drainages to the Coldwater River, Coquihalla River and Boston Bar Creek. Important fish-bearing tributaries include Godey Creek, Coldwater River, Gillis Creek, Juliet Creek, Fallslake Creek and Boston Bar Creek. The proposed Kingsvale power Line is located within the Lower Nicola River watershed and ties into the proposed pipeline corridor at the Kingsvale Pump Station (RK 955.6).

South from Shylock Road and the Boston Bar Creek confluence, the proposed pipeline corridor continues parallel to Highway 5 and the Coquihalla River through to the District of Hope. Steep mountain approaches span both sides of the proposed pipeline corridor within this section. Important fish habitat in this segment includes the Coquihalla River, Ladner Creek, Dewdney Creek, Karen Creek and Railway Creek.

4.2.3.1 Background Information and Existing Land Uses

Common BGC zones between the Black Pines Pump Station and the City of Merritt, and to approximately 15 km south from the Coquihalla Summit Recreation Area include the Ponderosa Pine, Bunchgrass and Interior Douglas-fir. These zones are generally dry, and can be hot or cool depending on the elevation and local site conditions. Ponderosa Pine and Interior Douglas-fir zones consist largely of mosaics of forest and grassland; fire is important for succession in this region (BC MOF 1998b). Ponderosa Pine zones are generally drier than Interior Douglas-fir zones and alkaline ponds are more prevalent. Bunchgrass Zones are extremely dry and grasses form the dominant vegetation cover as summer droughts are too severe for trees to become established (BC MOF 1998b). Consequently, given the arid climate and low rainfall, many streams have potential to dry up in this area during the summer and fall months. Annual mean total precipitation for this region is 201-800 mm (NRC 2012).

The Montane Spruce zone comprises higher elevation areas to the immediate north from the Coquihalla Summit Recreation Area, whereas the Coastal Western Hemlock is the dominant BGC zone south from the Coquihalla Summit Recreation Area. Climate is generally cooler in the Montane Spruce zone, with cold winters and short, dry summers. Precipitation is also higher and annual mean total precipitation is 801-1200 mm (NRC 2012). The lower elevations of the Coquihalla Pass in the Coastal Western Hemlock zone are subject to temperate climates, old growth rainforests and high precipitation (BC MOF 1998b). Annual mean total precipitation ranges from 1201-2000 mm depending on the local site area (NRC 2012).

The Black Pines to Hope Segment generally follows existing linear corridors, the existing TMPL right-of-way and Highway 5 for much of its length. Substantial deviations from the existing TMPL right-of-way includes RK 820.5 to RK 837 in the Lower North Thompson Watershed; RK 855 to RK 861.5 in the South Thompson Watershed; RK 937 to RK 947 and RK 957 to RK 966.5 in the Lower Nicola River Watershed and RK 970 to RK 1023 in the Lower Nicola River and Fraser Canyon watersheds.

Most of this proposed pipeline segment, particularly the Coquihalla Pass and the segment between the Black Pines Pump Station and City of Merritt, is comprised of high elevation areas with steep terrain. Existing land uses include agriculture, livestock grazing, forestry, hunting and trapping, recreational fishing, hiking, cycling, camping, horseback riding, cross country skiing, off-highway vehicle use. Large residential areas include the City of Kamloops and the City of Merritt. Existing vehicle crossing structures occur along existing linear corridors and road grades. Irrigation withdrawal and the loss of riparian vegetation associated with ranching and agriculture have contributed to several water quality problems and impacts to salmon spawning and rearing in the Lower Nicola Watershed (Millar *et al.* 1997). Other activities may affect the fish resources in the Lower Nicola River Watershed include logging in headwater regions (Spius Creek and Coldwater River), effluent loading from industrial activities and mining (Millar *et al*. 1997). Linear development has had the greatest impact on fisheries resources in the Coquihalla Watershed including Highway 5, industrial roads, existing pipeline rights-of-way and power lines (Komori, 1997). Natural slides and sidecast failures from the old railway have also contributed to the loss of riparian area and fish habitat within the Coquihalla pass (Komori 1997).

Aboriginal Traditional Knowledge

Along the Black Pines to Hope segment, the desktop review identified that fish are still harvested by many Aboriginal communities. Kokanee, steelhead, rainbow trout, cutthroat trout, suckerfish, whitefish, burbot, sturgeon and salmon are among the fish caught in this region. Migrating salmon are caught in the Thompson River and the Nicola River (AMEC 2010). Bull trout and Dolly Varden are fished at the Coldwater River and at the Fraser River (Katzie Development Corporation 2011).

Previously recorded concerns within the Black Pines to Hope Segment have included the protection of habitat for fish species. Skeetchestn First Nation has taken measures to ensure the persistence of the natural environment through self-imposed closures along the Deadman River, riverbank restoration, and fish hatchery construction (First Nations Environmental Contaminants Program n.d.). These concerns stem, in part, from a rockslide in 1913 due to railway construction in the Fraser Canyon. This event nearly stopped the Pacific salmon run through the asserted traditional territory of Skeetchestn First Nation (Skeetchestn Indian Band n.d.).

4.2.3.2 Fish Species Distribution

North Thompson River (RK 811.8 to RK 841.0)

The Black Pines to Hope Segment occurs within the lower North Thompson River Watershed for approximately 29 km. A description of the North Thompson River was provided in Section 4.2.2.2; Table 4.11 shows fish species recorded previously in the lower North Thompson River and important fish-bearing tributaries crossed by the proposed pipeline corridor.

TABLE 4.11

FISH SPECIES RECORDED PREVIOUSLY IN THE LOWER NORTH THOMPSON RIVER AND ITS TRIBUTARIES, BLACK PINES TO HOPE SEGMENT

Master Crossing Number	RK	Watercourse Name	Fish Species Present[1]	Provincial Instream Work Window
Parallels	811.8 to 841.0	North Thompson River	BL, BSU, BT, CCG, CH, CO, CP, CRH, CSU, LDC, LKC, LNC, LSU, MSU, MW, NSC, PCC, PK, RB, RW and SK	July 22 to August 15
BC-371	820.2	Jamieson Creek	BT, CO and RB	July 22 to September 30
BC-376	825.5	Lanes Creek	RB	July 22 to September 30
BC-381	828.3	Dairy Creek	RB	July 22 to September 30
BC-382	829.0	McQueen Creek	EB and RB (reported in Griffin Lake located upstream)	July 22 to September 30

Note: 1 Fish species acronym list is provided at the beginning of the report.

Thompson River (RK 840.9 to RK 853.2)

The Thompson River drains Kamloops Lake near the Town of Savana and flows southwest for approximately 120 km before reaching its confluence with the Fraser River. Major tributaries to the Thompson River include the North Thompson, South Thompson, Tranquille, Deadman, Bonaparte, Nicola, and Nicoamen rivers.

The Thompson River is the largest tributary to the Fraser River and supports five species of Pacific salmon including Chinook, coho, sockeye, pink and steelhead (DFO 2011b). Thompson River steelhead is of important conservation status to recreational anglers and Aboriginal groups (Simon Fraser University (SFU) 1998). Interior Summer Thompson steelhead stocks, which include Nicola, Coldwater, Deadman, and Bonaparte river systems, have declined in recent decades (Simon Fraser University [SFU] 1998). Thompson River summer-run steelhead are among the largest and longest-migrating steelhead in BC, supporting a renown catch and release fishery near Spences Bridge, BC (SFU 1998). Aboriginal communities of the lower Thompson and Nicola rivers have also traditionally fished for Thompson steelhead and they represent a winter food source (SFU 1998).

Other important fish species include burbot, bull trout, lake trout, kokanee, mountain whitefish, rainbow trout, lamprey, sculpin, northern pikeminnow, largescale sucker and redside shiner. White sturgeon (Endangered, *SARA* – Schedule 1) have also been recorded previously in the Thompson River mainstem (Scott and Crossman 1973).

The proposed pipeline corridor passes through the Thompson River watershed for approximately 12 km, crossing several unnamed tributaries and the Thompson River mainstem at RK 846.8 (crossing located upstream from Kamloops Lake and approximately 6.5 km downstream from the confluence between the North and South Thompson rivers). Fish species recorded previously in the Thompson River are presented in Table 4.12.

TABLE 4.12

FISH SPECIES RECORDED PREVIOUSLY IN THE THOMPSON RIVER, BLACK PINES TO HOPE SEGMENT

Master Crossing Number	RK	Watercourse Name	Fish Species Present[1]	Provincial Instream Work Window
BC-413	846.8	Thompson River	BB, BT, CC, CH, CO, CSU, KO, L, LNC, LT, MW, NSC, PK, RB, RSC, SK, ST, SU and WSG	July 22 to August 15

Note: 1 Fish species acronym list is provided at the beginning of the report.

South Thompson River (RK 853.2 to RK 875.6)

The South Thompson River flows from Little Shuswap Lake in east central BC, and extends 56 km in a southwest direction to its junction with the Thompson River at Kamloops (DFO 1998a). The South Thompson watershed contains several large lakes (*e.g.*, Adams, Shuswap, Mara, and Mabel lakes) which provide important rearing habitat for pacific salmon (*e.g.*, Russell *et al*. 1980). The South Thompson mainstem and tributaries provide important spawning and rearing habitat for sockeye, Chinook, coho, and pink salmon. Major tributaries include Campbell, Monte and Chase creeks. Impacts from urbanized areas (Kamloops, Salmon Arm, Sicamous and Chase), forestry, agriculture, industry, and linear developments including major corridors for roads, rail and power lines are major causes of concern and the sediment load is relatively high (DFO 1998a). Coho populations have decreased at steeper rates in the South Thompson Watershed when compared to other portions of the Thompson system since the mid 1970s (Irvine *et al*. 1999). Coho salmon populations have been enhanced, especially in the Salmon and Eagle rivers, by a number of hatcheries (*e.g.*, Eagle River Hatchery, Spius Creek facility, and Shuswap River Hatchery), some of which are no longer in operation (Irvine *et al*. 1999).

Other fish species in the South Thompson River include rainbow trout, bull trout, lake trout, mountain whitefish, chub, dace, sculpin, largescale sucker, northern pikeminnow and redside shiner.

The proposed pipeline corridor occurs within the South Thompson River watershed for approximately 22 km and will cross several unnamed tributaries and three named watercourses including Peterson Creek, Anderson Creek and Droppingwater Creek. Peterson and Anderson creeks (McConnell Lake and Hull Lake) have previous rainbow trout records. Fish species recorded previously in the South Thompson River and its tributaries are presented in Table 4.13.

TABLE 4.13

FISH SPECIES RECORDED PREVIOUSLY IN THE SOUTH THOMPSON RIVER AND ITS TRIBUTARIES, BLACK PINES TO HOPE SEGMENT

Master Crossing Number	RK	Watercourse Name	Fish Species Present[1]	Provincial Instream Work Window
Not Crossed	Not Crossed	South Thompson River	BT, CBC, CH, CO, CSU, DC, LT, MW, NSC, PK, RB, RSC, SK and SU	July 22 to August 15
BC-426	858.4	Peterson Creek	RB	July 22 to October 31
BC-433	865.2	Anderson Creek	RB (reported in McConnell Lake and Hull Lake)	July 22 to August 15

Note: 1 Fish species acronym list is provided at the beginning of the report.

Nicola River (RK 875.6 to RK 931.0)

The Nicola River is a major tributary to the Thompson River which drains west from the Thompson Plateau and feeds both Douglas and Nicola lakes. From the outlet to Nicola Lake, the Nicola River meanders northwest for approximately 85 km where it reaches the Fraser River near the Town of Spences Bridge. Major tributaries to the Nicola River include Coldwater River and Spius Creek.

The Nicola River provides important spawning and rearing habitat for Pacific salmon including Chinook, coho, sockeye, pink and steelhead. The Nicola River is an indicator stock for spring-run age 4_2 Chinook (reporting units are described in Section 4.3.2.1) of the Lower Thompson River and Louis Creek and extremely important for coho and steelhead production (DFO 2011a). The Spius Creek hatchery releases approximately 200,000 Chinook smolts into the Nicola River annually (DFO 2011a). Annual Chinook escapement estimates for the Nicola River range from 461 to 16,400 fish (1995-2010) (DFO 2011a). Most Chinook spawning in the Nicola mainstem (75%) occurs between the confluences of Spius Creek and the Coldwater River, with the remainder generally distributed equally in the reach downstream from the Spius confluence and in the reach upstream from the Coldwater confluence to Nicola Lake (LGL Ltd. Environmental Research Associates (LGL) 2007). Nicola River steelhead are an important component of the Thompson River stocks, and regarded as an extreme conservation concern by BC MOE (LGL 2007); adult returns for steelhead in the Nicola River watershed have ranged from 549 to 3,284 (1975-present) (LGL 2007). Annual Nicola River coho returns from 1975 to present have ranged from 598 to 11,455 fish with most spawning occurring in the Coldwater River (66%) and Spius Creek (32%) (LGL 2007).

Other important fish species include burbot, bull trout, kokanee, mountain whitefish, lake whitefish, lake trout, rainbow trout, western brook lamprey, river lamprey, Pacific lamprey, redside shiner, peamouth chub, northern pikeminnow, bridgelip sucker, longnose sucker, white sucker, chiselmouth, leopard dace, prickly sculpin and slimy sculpin. Chiselmouth is known to reside in the Nicola River mainstem and is Blue-listed as a species of Special Concern.

The proposed pipeline corridor crosses Nicola River drainages for approximately 56 km, which includes Nicola River, Moore Creek and the Clapperton Creek drainages (*e.g.*, Clapperton, Shuta and Zoht creeks). The upper headwaters of the Clapperton Creek drainage are known to support rainbow trout, while the lower sections have potential for Chinook, coho and steelhead; barriers to fish migration have been identified in Clapperton Creek, near the confluence with Shuta Creek, which restrict potential for upstream anadromous salmon migration. Hamilton Creek, near the City of Merritt, also has records of rainbow trout upstream from the LSA near Hamilton Lake and Lundbom Lake; although there are no records of rainbow trout in Hamilton Creek near the proposed pipeline corridor. Fish species recorded previously in the Nicola River and important fish-bearing watercourses crossed by the proposed pipeline corridor are presented in Table 4.14.

TABLE 4.14

FISH SPECIES RECORDED PREVIOUSLY IN THE NICOLA RIVER AND ITS TRIBUTARIES, BLACK PINES TO HOPE SEGMENT

Master Crossing Number	RK	Watercourse Name	Fish Species Present[1]	Provincial Instream Work Window
BC-459	892.8	Moore Creek	EB, KO, LSU and RB	July 22 to August 31
BC-482	915.9	Clapperton Creek	CH, CO, RB and ST	July 22 to August 1
BC-504	928.0	Nicola River	BB, BL, BSU, BT, CAS, CCG, CH, CMC, CO, KO, LDC, LNC, LSU, LT, LW, MW, NSC, PCC, PK, PL, RB, RL, RSC, SK, ST and WSU	July 22 to August 1
BC-505	928.7	Hamilton Creek	RB (no records near the proposed pipeline corridor; historical RB records are associated with upper stream reaches near Hamilton Lake)	July 22 to October 31

Note: 1 Fish species acronym list is provided at the beginning of the report.

Coldwater River (RK 931.0 to RK 991.4)

The headwaters to the Coldwater River originate in the Cascade Mountains at the base of Zupjok and Llama peaks near the Coquihalla Summit Recreation Area. The Coldwater River drains an area of approximately 914 km^2 and flows for 95 km, mostly paralleling Highway 5, before it drains into the Nicola River near the City of Merritt.

The Coldwater River is the most important contributor of coho, early-run Chinook 4_2 and steelhead in the Nicola River Watershed (LGL 2007). It is estimated that the Coldwater River may account for 23-42% of the annual estimated steelhead returns to the Nicola River watershed (LGL 2001). Most coho spawning in the Nicola River Watershed also occurs in the Coldwater River (66%) with many coho spawners utilizing the area upstream from the confluence with Juliet Creek (DFO 2012, LGL 2007). Estimates of wild coho smolt production in the Coldwater River ranged from 16,134 to 26,651 fish between 2002 and 2006 and hatchery releases has contributed substantially to smolt production which is estimated to be approximately 60,000 fish (LGL 2007). Adult returns for coho ranged from 394 to 3,288 fish (1996-2001) (LGL 2007). In the past, the Coldwater River has been the focus of a number of salmon conservation initiatives and was selected by the Pacific Salmon Endowment Fund Society as the first watershed to receive attention in the Thompson-Nicola region for recovery of coho and steelhead (LGL 2007). The Spius Creek hatchery releases approximately 65,000 Chinook smolts into the Coldwater River annually (DFO 2011a). Annual Chinook escapement estimates for the Coldwater River range from 26 to 1,500 fish (1995-2010) (DFO 2011a).

Other important sportfish include bull trout, mountain whitefish and rainbow trout. Non-sportfish species include longnose dace, leopard dace, bridgelip sucker, longnose sucker, slimy sculpin, prickly sculpin, redside shiner and Pacific lamprey.

The proposed pipeline corridor spans the Coldwater River Watershed for approximately 60 km, which includes four crossings of the Coldwater River and important fish-bearing tributaries such as Juliet Creek and Mine Creek (Table 4.15). The headwaters to Godey Creek has historical fish records for Garcia Lake and Mathew Lake (approximately 8.5 km upstream) which includes rainbow trout, brook trout, coho salmon, cutthroat trout (westslope), redside shiner and emerald shiner. However, there are no records of fish in Godey Creek near the proposed pipeline corridor.

TABLE 4.15

FISH SPECIES RECORDED PREVIOUSLY IN THE COLDWATER RIVER AND ITS TRIBUTARIES

Master Crossing Number	RKs	Watercourse Name	Fish Species Present[1]	Provincial Instream Work Window
BC-512	931.0	Godey Creek	CO, CT, EB, ESC, RB, RSC and WCT (no previous fish records near the proposed pipeline corridor; fish records are from Garcia Lake and Mathew Lake upstream from the LSA).	July 22 to August 15
BC-548	957.9	Coldwater River	BT, C, CC, CH, CO, L, LDC, LNC, MW, PL, RB, RSC, ST and SU	August 7 to 10
BC-549	958.1	Gillis Creek	RB (no previous fish records near the proposed pipeline corridor; RB records are from Gillis Lake upstream from the LSA)	July 22 to October 31
BC-559, BC-570 and BC-582	970.3, 980.0, and 990.0	Coldwater River	BT, C, CC, CH, CO, L, LDC, LNC, MW, PL, RB, RSC, ST and SU	July 22 to August 1
BC-571	980.8	Juliet Creek	BT, CH, CO and RB	July 22 to August 15
BC-579	987.1	Mine Creek	RB	July 22 to October 31

Note: 1 Fish species acronym list is provided at the beginning of the report.

Coquihalla River (RK 991.0 to RK 1044.0)

Coquihalla River originates near the Coquihalla Lakes on Highway 5, winding through a steep valley of the Cascade Mountains and following Highway 5 and Old Coquihalla Road for approximately 56 km before discharging into the Fraser River near the District of Hope.

The Coquihalla River is a major tributary to the lower Fraser River and is known to support steelhead and all five species of Pacific salmon. Coquihalla summer-run steelhead reared at Abbotsford and Chehalis hatcheries (approximately 24,000) are released annually into the Coquihalla River near the District of Hope (DFO 2012). Escapement estimates for summer-run Coquihalla River wild steelhead range from 200 to 500 fish and stocks are of conservation concern; winter-run wild steelhead are believed to be less than 50 fish and are of special conservation concern (Lill 2002). Other important fish species include Dolly Varden/bull trout, mountain whitefish, coastal cutthroat trout, rainbow trout, coastrange sculpin, largescale sucker and leopard dace.

Although it is recognized that there is a wide diversity of Pacific salmon and other species in the lower portions of the Coquihalla River, the upper reaches near the Coquihalla summit are reported to contain only rainbow trout (Whelen 1998).

Boston Bar Creek (RK 1003.0 to RK 1018.0)

Boston Bar Creek is a major tributary to the Coquihalla River and is known to support Dolly Varden/bull trout, rainbow trout and anadromous summer-run steelhead in the lower reaches near its confluence with the Coquihalla River. The lower 1 km section of Boston Bar Creek provides quality spawning and rearing habitat for summer-run steelhead. Summer-run steelhead migrate through the Coquihalla River in the early summer during high water periods and can reach the lower falls at 1 km in Boston Bar Creek (Whelen M.A. and Associates Ltd. [Whelen] 1998). Other Pacific salmon species are unable to pass the falls at Othello in the Coquihalla Canyon, just east of Hope. Therefore, with the exception of summer-run steelhead, it is generally accepted that there are no occurrences of other anadromous Pacific salmon species in the Coquihalla River and tributaries beyond Othello Canyon.

Two large falls within Boston Bar Creek, at 1 km and 4 km upstream from the confluence with the Coquihalla River, prevent upstream access of all fish species (Table 4.16; Whelen 1998). Resident rainbow trout were captured above the falls at 1 km; however, no fish were captured or observed in Boston Bar Creek beyond the large waterfall documented at 4 km upstream from the confluence with the Coquihalla River (Whelen 1998). Subsequently, a nonfish-bearing status was assigned to reaches in Boston Bar Creek beyond this location (includes BC-591 to BC-616; RK 1003.1 to RK 1015.5). Findings

from Whelen (1998) were supported further by the 2013 fish and fish habitat assessments of Boston Bar Creek and unnamed tributaries for the Project.

TABLE 4.16

DOCUMENTED FISH BARRIERS IN BOSTON BAR CREEK

Barrier Information	UTM Easting	UTM Northing
Anadromous fish barrier – falls 1 km upstream from confluence with Coquihalla River.	629945 E	5483896 N
Resident fish barrier – falls 4 km upstream from confluence with Coquihalla River; Sites BC-591 to BC-616 are presumed to be nonfish-bearing.	629993 E	5486590 N

Sources: Arc Environmental Ltd. 2005, Whelen 1998

The proposed pipeline corridor parallels the Coquihalla River and Boston Bar Creek for approximately 53 km through the Fraser Canyon watershed including two crossings of Boston Bar Creek and five crossings of the Coquihalla River. Other important fish-bearing tributaries to the Coquihalla River include Fallslake Creek, Ladner Creek, Dewdney Creek, Karen Creek and Railway Creek (Table 4.17).

TABLE 4.17

FISH SPECIES RECORDED PREVIOUSLY IN THE COQUIHALLA RIVER AND ITS TRIBUTARIES, BLACK PINES TO HOPE SEGMENT

Master Crossing Number	RKs	Watercourse Name	Fish Species Present[1]	Provincial Instream Work Window
BC-588	997.3	Fallslake Creek	RB	August 1 to October 31
BC-591 and BC-596	1003.1 and 1011.0	Boston Bar Creek	DV/BT, RB and SST	August 1 to 31
BC-629	1020.3	Ladner Creek	DV/BT, RB and SST	August 1 to 31
BC-631, BC-636, BC-639, BC-645 and BC-654	1021.8, 1026.5, 1028.6, 1032.6 and 1043.2	Coquihalla River	DV/BT, CAL, CCT, CH, CM, CO, CSU, LDC, MW, PK, RB, SK, SST and ST	August 1 to 31
BC-632	1022.9	Dewdney Creek	DV/BT, RB and SST	August 1 to 31
BC-634	1024.5	Karen Creek	DV/BT and RB	August 1 to 31
BC-646	1033.2	Railway Creek	CM	July 15 to September 15

Note: 1 Fish species acronym list is provided at the beginning of the report.

4.2.3.3 Fish Species of Concern

Listed fish species of special concern within the Black Pines to Hope Segment include bull trout, coho, sockeye, white sturgeon, mountain sucker and chiselmouth (Tables 4.4 and 4.5).

4.2.4 Black Pines Power Line

The Black Pines power line occurs at the north end of the Black Pines to Hope Segment, roughly 20 km north from Kamloops. The approximately 2.2 km long proposed power line extends from an existing BC Hydro 500 kV right-of-way along the east side of Highway 5. From its point of origin, the proposed power line will cross the North Thompson River (east to west) and follows the existing TMPL right-of-way for 1 km south before it ties-in to the proposed Black Pines Pump Station at RK 811.85.

4.2.4.1 Background Information and Existing Land Uses

The proposed power line is located along the west boundary of the existing TMPL right-of-way and crosses through open forested and grassland areas of the Kamloops Forest District. The proposed Black Pines power line is located in the Black Pines to Hope Segment which is described in Section 4.2.3.

4.2.4.2 Fish Species Distribution

The Black Pines power line crosses the lower North Thompson River and seven potential unnamed watercourses with no previous fish records. Fish species distribution in the lower North Thompson River include sockeye, coho, Chinook, pink salmon (records from lower North Thompson sub-basin only [Knapp *et al*. 1982]), bull trout, mountain whitefish, round whitefish, rainbow trout, western brook lamprey, bridgelip sucker, largescale sucker, longnose sucker, prickly sculpin, slimy sculpin, torrent sculpin, lake chub, mountain sucker, northern pikeminnow, peamouth chub, redside shiner, leopard dace and longnose dace.

4.2.4.3 Fish Species of Concern

Listed fish species of special concern in the North Thompson River include bull trout, coho, sockeye and mountain sucker (Tables 4.4 and 4.5).

4.2.5 Kingsvale Power Line

The Kingsvale power line originates in the Fairweather Hills region south from Merritt and northeast from the Municipality of Aspen Grove; southeast from the junction between Highway 5A and 97C. The proposed power line corridor crosses Highway 5 and heads west for approximately 5.5 km, where it passes from the Upper Similkameen River watershed to the Lower Nicola River watershed. Within the Lower Nicola River watershed the proposed power line crosses through the upper headwaters of Voght Creek for approximately 18 km to the Kingsvale Pump Station (RK 955.6). This region is comprised of high elevation, open forest and grassland areas. Important watercourse crossings within the Voght Creek headwaters include Kanevale Creek, Kimble Creek, Howarth Creek and Nilsson Creek.

4.2.5.1 Background Information and Existing Land Uses

The west portion of the proposed power line will follow an existing BC Hydro 500 kV transmission corridor (*i.e.*, west from Howarth Creek); however, there is no pre-existing transportation or utility corridor along the east portion of the proposed power line between Howarth Creek and Fairweather Hills. The proposed Kingsvale power line is located in the Black Pines to Hope Segment which is described in Section 4.2.3.

4.2.5.2 Fish Species Distribution

<u>Voght Creek (Lower Nicola River Watershed)</u>

Voght Creek is a tributary to the Coldwater River. The upper headwaters to Voght Creek originate from a series of lakes in the Lower Nicola River watershed which includes Kane Lake, Harmon Lake and Englishmen Lake to the north from the power line corridor and Shea Lake to the south.

The lower portions of Voght Creek are known to support Chinook, coho, rainbow trout, steelhead and redside shiner. Two falls have been identified on Voght Creek near the confluence with the Coldwater River (approximately 850 and 1300 m upstream) which may limit anadromous salmon migration upstream from Highway 5.

Upper portions of the Voght Creek watershed have potential for rainbow trout and redside shiner. The creek is lake headed and the upper portions are surrounded by mature forest and flow over a low gradient. Rainbow trout have been recorded previously in the upper Voght Creek mainstem, Nilsson Creek, Kanevale Creek and abundant lakes including Seymour, Shea, Englishmen, Harmon and Kane.
Table 4.18 summarizes fish species presence for Voght Creek and other important tributaries along the proposed Kingsvale power line corridor.

TABLE 4.18

FISH SPECIES RECORDED PREVIOUSLY IN VOGHT CREEK AND ITS TRIBUTARIES

Master Crossing Number	Watercourse Name	Fish Species Present[1]	Provincial Instream Work Window	Pipeline Segment
BCT-14	Voght Creek	CH, CO, RB, RSC and ST	July 22 to October 31	Black Pines to Hope/Kingsvale power line
BCT-16	Kanevale Creek	RB and RSC	July 22 to October 31	Black Pines to Hope/Kingsvale power line
BCT-21	Howarth Creek	RB	July 22 to October 31	Black Pines to Hope/Kingsvale power line
BCT-28	Nilsson Creek	RB	July 22 to October 31	Black Pines to Hope/Kingsvale power line

Note: 1 Fish species acronym list is provided at the beginning of the report.

Kidd Lake (Similkameen Watershed)

The east portion of the Kingsvale power line passes through the Similkameen watershed and includes Otter Creek and four other unnamed tributaries north from Kidd Lake. Kidd Lake and Otter Creek downstream from the lake are known to support rainbow trout but there are no previous records of fish within any of the tributaries including Otter Creek, upstream from the lake.

4.2.5.3 Fish Species of Concern

There are no listed fish species of special concern within the upper portions of Voght Creek or within any of the named or unnamed tributaries.

4.2.6 Hope to Burnaby Segment (RK 1043.7 to RK 1179.5)

The Hope to Burnaby Segment originates south from the District of Hope. The proposed pipeline corridor parallels the Fraser River and follows the existing TMPL right-of-way along Highway 1 through to Chilliwack. Key fish habitat in this segment includes Silverhope Creek, Chawuthen Creek, Hunter Creek, Lorenzetta Creek, Wahleach Creek, Anderson Creek, Bridal Creek, Nevin Creek and Dunville Creek. West from Chilliwack, the proposed pipeline corridor traverses the existing TMPL right-of-way along the south side of Highway 1, largely through private land and agricultural areas through to Abbotsford. Main tributaries to the lower Fraser River in this segment include Elk Creek, Semmihault Creek, Chilliwack Creek, Chilliwack/Vedder River and side channels, Street Creek, Stewart Slough, Sumas Lake Canal and Sumas River.

Between Abbotsford and Burnaby, the proposed pipeline corridor passes through urban and industrial areas along the north side of Highway 1. West from the Salmon River, the proposed pipeline corridor deviates north from the existing TMPL right-of-way and parallels close to the Fraser River for approximately 17 km, crossing the Fraser River just west from the Port Mann Bridge. North from the proposed Fraser River crossing, the proposed pipeline corridor diverges from the existing TMPL right-of-way and parallels Highways 1 and 7 through to Burnaby.

A number of important watercourses in this segment include the Fraser River and fish-bearing tributaries such as Unnamed Tributary to Marshall Creek, Clayburn Creek, Unnamed Tributary to Gifford Slough, McLennan Creek, Nathan Creek, West Creek, Davidson Creek, Salmon River, Yorkson Creek and unnamed tributaries, Bon Accord Creek, Como Creek, Nelson Creek and Stoney Creek.

4.2.6.1 Background Information and Existing Land Uses

The Lower Mainland area falls within the Coastal Western Hemlock zone and is described by moderate climates. This area receives high rainfall and temperatures vary relatively little from summer to winter (BC MOF 1998b). Annual mean total precipitation for this region is 1601-2000 mm (NRC 2012). As a result of the moderate seasonal climate, watercourses generally flow year-round and salmon spawning and rearing in this region is prevalent (BC MOF 1998b).

This segment of the proposed pipeline corridor traverses through the Lower Mainland area which includes a network of urban and rural infrastructure, farmland, private land, roads, railways, power lines, oil and gas and other utility crossings. Communities and urban centers include Hope, Chilliwack, Abbottsford and the Greater Vancouver area between Abbotsford and Burnaby. Several Indian Reserves are also located along Highway 1 between the District of Hope and the City of Chilliwack. The Hope to Burnaby Segment generally follows the existing TMPL right-of-way with deviations west from the Salmon River between Langley and Burnaby (RK 1148 to RK 1179.8).

Urban development throughout the Lower Mainland area has adversely affected stream and riparian habitats through channelization, pollution, loss of stream complexity, stream encroachment, loss of riparian vegetation, habitat fragmentation, alteration of the streambed and banks for flood control works, and culvert placement that creates migration barriers (Komori 1997). Lower Fraser Valley streams have been subjected to intense urban and rural development for many decades; many pre-settlement streams in the Greater Vancouver area have been buried or culverted and ultimately lost (Komori 1997). Water quality and pollution from upstream river sources has long been a concern for the lower Fraser River and estuary, which includes municipal and industrial waste, sewage treatment plants and pulp and paper mills (Langer 2010). Several non-native fish introductions have also been made to the lower Fraser River Watershed (*e.g.*, American shad, catfish, carp and black crappie). Other prevalent land uses in the Lower Mainland area include agriculture, transportation, recreational and subsistence fishing and other activities including hiking, camping and wildlife viewing (BC MOF 1998b).

The lower Fraser River mainstem is subjected to a number of recreational, Aboriginal and DFO test fisheries, as well as commercial and recreational fishing opportunities for Fraser River salmon in the Strait of Georgia that are migrating back to the Fraser River (DFO 2011b). The Chilliwack/Vedder River also has large recreational openings that target Chinook, coho and steelhead.

Aboriginal Traditional Knowledge

Along the Hope to Burnaby Segment, the desktop review identified that fish are still harvested by many Aboriginal communities. In particular, salmon fishing is of great importance to the Aboriginal communities in the region. The timing and location of the salmon runs historically dictated seasonal movements and locations of habitation sites for many communities. While salmon such as Chinook, coho and kokanee constitute the main fishery for the region, steelhead, rainbow trout, cutthroat trout, and burbot are also fished (AMEC 2010). Members of the Stó:Lō Nation have noticed marked effects of human population growth on the surrounding environment, including adverse effects on fish and fish habitat (Carlson 2001).

4.2.6.2 Fish Species Distribution

Lower Fraser River (RK 1045.0 to RK 1179.8)

The lower Fraser River mainstem and its estuary provide critical rearing, staging and migratory habitat for adult and juvenile salmon. This portion of the Fraser River is also important as Pacific salmon species and steelhead undergo physiological changes in this region to acclimatize from a saline to freshwater environment (adult) and from a freshwater to saline existence (juvenile) (Langer 2010).

Lower Fraser tributaries also provide key spawning areas for Pacific salmon. One major group of Fraser River coho occupies coastal and lower Fraser tributaries (Simpson *et al.* 2001), while the other is an interior population aggregate that use tributaries above the District of Hope (Irvine *et al.* 2001). Coho that utilize lower Fraser tributaries are often subject to greater urban and agricultural impacts; they also spawn later in the fall and are frequently a mix of wild and hatchery-produced fish (Labelle 2009). Spawning for pink and chum salmon tend to be concentrated in Fraser River tributaries below the District of Hope and chum have been reported to spawn in at least 120 tributaries to the lower Fraser River (Labelle 2009). A major fall-run Chinook population spawns in the Chilliwack/Vedder and Harrison rivers (DFO 1999). Sockeye are distributed throughout much of the lower Fraser River; key habitat includes the Chilliwack/Vedder River watershed and microhabitats within freshwater and tidal areas of the lower Fraser River which are used for rearing and migration (Johannes *et al.* 2011). Steelhead are also common to lower Fraser tributaries and some key spawning areas include the Coquihalla River, Chilliwack/Vedder River, Salmon River and Silverhope Creek (Lill 2002).

The Fraser River is also one of three major rivers on the Pacific coast that supports spawning populations of white sturgeon (Hanson and Cochnauer 1992). Key spawning and rearing areas for white sturgeon have been identified upstream from the proposed Fraser River crossing location, between the district of Mission and the Town of Yale (Perrin *et al.* 1999). One important spawning site is the Fraser mainstem downstream (0.5 km) from the confluence with the Coquihalla River (COSEWIC 2003a). Triton also documented white sturgeon spawning and rearing in the Herrling side channel (near Waleach Pump Station) (Triton 2011, 2013). The importance of the Herrling side channel is highlighted because it is the only location where eggs were found despite substantial time fishing elsewhere in the lower Fraser River (Triton 2013). The lower reaches of the Fraser River are used predominantly for feeding and migration which may also include lower portions of the Sumas and Chilliwack/Vedder rivers. Green sturgeon observations are rare in freshwater and there are no known spawning sites in BC; however, there are some historical records in the lower Fraser River (the most recent was near Fort Langley in 2005) (McPhail 2007).

Listed species of management concern in the lower Fraser River and its tributaries include white sturgeon, green sturgeon, eulachon, Dolly Varden/bull trout, chiselmouth, mountain sucker, nooksack dace and salish sucker. Other fish species include coastal cutthroat trout, westslope cutthroat trout (introduced), rainbow trout, mountain whitefish, pygmy whitefish, kokanee, burbot, black crappie, brown bullhead, brassy minnow, coastrange sculpin, slimy sculpin, pacific staghorn sculpin, carp, largescale sucker, emerald shiner, leopard dace, lake chub, longnose sucker, longnose dace, longfin smelt, northern pikeminnow, peamouth chub, Pacific lamprey, river lamprey, western brook lamprey, redside shiner, starry flounder, American shad, surf smelt and white sucker.

The proposed pipeline corridor parallels the lower Fraser River for approximately 140 km, passing through the Fraser Canyon, Harrison River, Chilliwack/Vedder River, Lower Fraser and Squamish watersheds. Large river crossings include the Fraser and Chilliwack/Vedder rivers, as well as a number of other important fish-bearing tributaries (Table 4.19).

TABLE 4.19

FISH SPECIES RECORDED PREVIOUSLY IN THE LOWER FRASER RIVER AND ITS TRIBUTARIES, HOPE TO BURNABY SEGMENT

Master Crossing Number	RKs	Watercourse Name	Fish Species Present[1]	Provincial Instream Work Window
BC-657	1047.2	Silverhope Creek	DV/BT, CAL, CCT, CM, CO, CSU, MW, PK, RB, SST and ST	August 1 to 31
BC-658	1051.5	Chawuthen Creek	CCT and SB	August 1 to October 31
BC-662	1055.5	Hunter Creek	CCT, CM, CO, PK, RB, SH and ST	August 1 to September 15
BC-666	1060.9	Lorenzetta Creek	CC, CCT, CM, CO, PK, RB and ST	August 1 to September 15
BC-668	1061.5	Wahleach Creek	CCT,CM, CO, KO, PK, RB, SK and ST	August 1 to 15
BC-705	1078.2	Anderson Creek	BCB, BNH, CC, CH, CM, CO, CCT, DV/BT, KO, L, PK, RB, SG, SK, TSB and ST	August 1 to 15
BC-706	1079.8	Bridal Creek	CCT,CM, CO, CP, MW, PCC, RB and SB	August 1 to September 15
BC-731 and BC-732	1122.4 and 1123.4	Clayburn Creek	CAS, CCT, CT, CH, CO, CM, DV/BT, KO, L, PK, RB, SG, SK, ST and TSB	August 1 to 15
BC-733	1125.2	Unnamed Tributary to Gifford Slough	CCT, CO, RSC and TSB	August 1 to September 15
BC-734	1127.8	McLennan Creek	BNH, CCG, CCT, CH, CM, CO, DV/BT, KO, L, PK, RB, RSC, SG, SK, ST and TSB,	August 1 to 15
BC-747	1138.0	Nathan Creek	CC, CCT, CH, CM, CO, L, PCC, PK, RB, SB, SK and ST	August 1 to September 15
BC-749	1143.0	West Creek	BNH, CAS, CCT, CH, CO, CM, L, RB, ST and TSB	August 1 to September 15
BC-751	1145.6	Davidson Creek	CC, CCT,CO, CM, L, RB and TSB	August 1 to September 15
BC-753	1147.4	Salmon River	BCB, BMC, BNH, CAS, CC, CCT, CH, CM, CO, CP, CSU, DV/BT, L, LSU, NDC, NSC, PCC, RB, RSC, SFL, SK, SSU, ST, TSB and WCT	August 1 to 31

TABLE 4.19 Cont'd

Master Crossing Number	RKs	Watercourse Name	Fish Species Present[1]	Provincial Instream Work Window
BC-766	1152.4	Unnamed Tributary to Yorkson Creek	CCT and CO	August 1 to September 15
BC-768	1154.3	Yorkson Creek	CCT, CM, CO, CP, L, PL, PK, RB, ST and TSB	August 1 to September 15
BC-773	1161.7	Unnamed Tributary to Fraser River	CCT, CO and TSB	August 1 to September 15
BC-779	1166.9	Bon Accord Creek	CAS, CCT, CO, RB and TSB	August 1 to September 15
BC-780	1168.9	Fraser River	BB, BCB, BMC, BNH, BSU, CAL, CAS, CCG, CCT, CH, CLA, CO, CM, CMC, CP, CSU, DV/BT, ESC, EU, GSG, KO, LDC, LKC, LNC, LSM, LSU, MSU, MW, NSC, PCC, PK, PL, PW, RB, RL, RSC, SFL, SH, SK, SST, SSM, ST, STC, TSB, WCT, WSG and WSU	August 1 to 15
BC-781	1171.1	Como Creek	BL, CAS, CCT, CH, CM, CO, CP, CSU, NSC, PCC, RB, RL and TSB	August 1 to September 15
BC-782	1172.2	Nelson Creek	BMC, CAS, CCT, CM, CO, CP, PCC, RSC, SB, ST, SU and TSB,	August 1 to September 15
BC-785	1176.5	Stoney Creek	BL, CCT, CM, CO, NDC, PMB, RB, ST and TSB	August 1 to September 15

Note: 1 Fish species acronym list is provided at the beginning of the report.

4.2.6.3 Chilliwack/Vedder River (RK 1102 to RK 1118)

The Chilliwack/Vedder River originates in Washington's North Cascades National Park and flows north into Chilliwack Lake and then west for about 61 km to its confluence with the Fraser River. Below the Vedder Crossing, the Chilliwack River becomes the Vedder River. This drainage includes both the Fraser Lowlands and the Cascade Mountains physiographic regions. In the upstream reaches (above Slesse Creek), the river is confined, while in the downstream reaches it is wider, braided and meandering (Van Dishoeck 2001). The Chilliwack/Vedder River converges with the Sumas River approximately 3.5 km upstream from the confluence with the lower Fraser River. Other major tributaries to the Chilliwack/Vedder Rivers are Centre, Nesakwatch, Foley, Chipmunk, Slesse, Tamihi, Liumchen, and Sweltzer creeks (on the Canadian side of the border).

The Chilliwack/Vedder River provides valuable spawning and rearing habitat for steelhead and all five species of Pacific salmon. Other fish species include coastal cutthroat trout, rainbow trout, Dolly Varden/bull trout, mountain whitefish, pygmy whitefish, kokanee and burbot. White Sturgeon is known to reside in the Sumas River and mouth of the Chilliwack River (Vedder Canal).

An estimate of mean annual Pacific salmon production for the Chilliwack/Vedder River is approximately 5,500 steelhead, 270,000 coho, 342,000 chum, 21,000 Chinook and 406,000 pink of which hatchery returns account for a majority of the total production (Dishoeck *et al.* 1998). The Chilliwack hatchery is used for major production and enhancement of the Chilliwack/Vedder River and other lower Fraser tributaries.

Sockeye production within the Chilliwack/Vedder River watershed is less known but consists of Chilliwack Lake populations and Cultus Lake populations. Early-run 2012 Chilliwack/Vedder River sockeye escapements were estimated at approximately 207,064 fish (Pacific Salmon Commission 2013). However, late-run Cultus sockeye have experienced substantial declines in recent years and are identified by COSEWIC as Endangered. Migratory and migratory fish enter and exit Cultus Lake from the Chilliwack/Vedder River by way of Sweltzer Creek. Historically, Cultus Lake supported an average of 20,000 sockeye spawners, although the recent generational (4-year) average is approximately 1,000 fish (DFO 2010b).

Fish species recorded previously in the Chilliwack/Vedder River and important fish-bearing tributaries crossed by the proposed pipeline corridor (RK 1102 to RK 1118) are listed in Table 4.20.

TABLE 4.20

FISH SPECIES RECORDED PREVIOUSLY IN THE CHILLIWACK/VEDDER RIVER WATERSHED, HOPE TO BURNABY SEGMENT

Master Crossing Number	RK	Watercourse Name	Fish Species Present[1]	Provincial Instream Work Window
BC-708	1083.4	Nevin Creek	C, CAS, CCT, CO, CM and SB	August 1 to September 15
BC-709	1083.9	Dunville Creek	CC, CCT, CO, L, RB, SB and SU	August 1 to September 15
BC-713	1087.6	Elk Creek	CC, CCT, CM, CO, CP, PK, RB, SB and SU	August 1 to September 15
BC-714	1092.7	Semmihault Creek	CCT, CO, CP, LSU, PCC, RSC, SB and SSU	August 1 to September 15
BC-715	1094.0	Chilliwack Creek	BCB, BT/DV, CAS, CCT, CH, CM, CO, CP, CSU, NSC, PMB, SB, SSU, ST and WSG	August 1 to September 15
BC-716	1102.1	Chilliwack/Vedder River Side Channel	CO and CM	July 15 to September 15
BC-717	1102.3	Chilliwack/Vedder River	CCT, CH, CM, CO, DV/BT, KO, MW, PK, RB, SK, ST, SU, WF and WSG	August 1 to 15
BC-720	1103.2	Street Creek	CC, CCT, CM, CO, L, PK, RB, SB and ST	August 1 to September 15
BC-722	1106.0	Stewart Slough	BH, CC, CCT, CM, CO, L, NP, RB, RSC and TSB	August 1 to September 15
BC-725	1110.7	Sumas Lake Canal	CAS, CM, CO and RSC	July 15 to September 15
BC-726	1114.6	Sumas River	BCB, BH, BNH, CBC, CC, CCT, CH, CM, CO, CP, DC, DV/BT, KO, L, MW, NSC, PK, RB, RSC, SB, SK, ST, SU, WCT, WF and WSG	August 1 to 15
BC-728	1116.5	Unnamed Tributary to Marshall Creek	CCT	August 1 to October 31

Note: 1 Fish species acronym list is provided at the beginning of the report.

4.2.6.4 Fish Species of Concern

Listed fish species of special concern within the Hope to Burnaby Segment include white sturgeon, green sturgeon, salish sucker, nooksack dace, eulachon, bull trout, interior Fraser River coho, sockeye (Cultus Lake population) and mountain sucker (Tables 4.4 and 4.5).

4.2.7 Burnaby Terminal (RK 1179.5)

The Burnaby Terminal is located at the west end of the Hope to Burnaby Segment (Section 4.2.6), approximately 1.5 km southwest from Simon Fraser University and east from the Burnaby Mountain Golf Course.

4.2.7.1 Background Information and Existing Land Uses

Portions of the Eagle Creek headwaters are located along the southwest boundary of the Burnaby Terminal. The Burnaby Terminal is located within the Hope to Burnaby Segment.

4.2.7.2 Fish Species Distribution

<u>Eagle Creek</u>

Eagle Creek is a tributary to the Brunette River. The upper headwaters to Eagle Creek originates from two small waterbodies, including Squint Lake and another small lake to the north from Shellmont Street, located along the southwest corner of the Burnaby Terminal. The east (Burnaby Terminal) and west (Squint Lake) branches of the Eagle Creek headwaters converge inside Burnaby Mountain Golf Course, approximately 500 m downstream where the mainstem then flows for another 2.6 km south towards its confluence with the Brunette River.

The lower portions of Eagle Creek are known to support coastal cutthroat trout, rainbow trout, chum and coho. Squint lake has records of coastal cutthroat trout and stickleback. Spawning surveys conducted in Eagle Creek in 2012 by the Environmental Protection Club of West Vancouver Secondary and West Vancouver Streamkeepers Society counted approximately 67 chum and 2 coho (West Vancouver Streamkeepers Society, 2012). Eagle Creek holds an annual chum salmon release event; in 2013 approximately 50,000 chum salmon fry were released to Eagle Creek at Charles Rummel Park (City of Burnaby 2013).

Most salmon spawning in Eagle Creek is reported to occur south from Lougheed Highway (Highway 7), approximately 1 km downstream from the Burnaby Terminal. Fish species recorded previously in Eagle Creek are presented in Table 4.21.

TABLE 4.21

FISH SPECIES RECORDED PREVIOUSLY IN EAGLE CREEK

Master Crossing Number	Watercourse Name	Fish Species Present[1]	Provincial Instream Work Window	Pipeline Segment
BC-785a	Eagle Creek	CCT, CM, CO and RB	August 1 to September 15	Burnaby to Westridge

Note: 1 Fish species acronym list is provided at the beginning of the report.

4.2.7.3 Fish Species of Concern

There are no listed fish species of special concern in Eagle Creek, although there are records of nooksack dace and Dolly Varden/bull trout in the Brunette River.

4.2.8 Burnaby to Westridge Segment (RK 1179.8 to RK 1182.5)

Within the last 3.6 km of the Project area, the proposed pipeline corridor ties into the Westridge Marine Terminal at Burrard Inlet and is referred to collectively as the Burnaby to Westridge Segment.

4.2.8.1 Background Information and Existing Land Uses

Northeast from the existing Burnaby Terminal, the proposed pipeline corridor follows Burnaby Mountain Parkway where it crosses Highway 7A and continues north along Cliff Avenue to the Westridge Marine Terminal. The Burnaby to Westridge Segment passes through a mixture of residential, industrial and forested areas and parallels Burrard Inlet (Vancouver Harbour) for approximately 150 m to the west from the Westridge Marine Terminal.

Refer to Section 4.2.3.1 for background information and existing land uses through the Greater Vancouver area. There is one potential unmapped watercourse crossing located at approximately RK 1182.5 which drains into Burrard Inlet.

Aboriginal Traditional Knowledge

Along the Burnaby to Westridge Segment, the desktop review identified that fish are still harvested by many Aboriginal communities. In particular, salmon fishing is of great importance to the Aboriginal communities in the region. The timing and location of the salmon runs historically dictated seasonal movements and locations of habitation sites for many communities. Fluctuations in salmon runs are still affecting communities today. In 2007, the salmon stocks were so low in the Fraser River that Kwikwetlem families were unable to provide enough salmon for their own use (Kwikwetlem First Nation 2007). Concerns about aquatic habitat degradation and restrictions on the type of fishing permitted (*e.g.*, bottom trawling and reef netting) have been voiced by Aboriginal harvesters (Kwikwetlem First Nation 2007).

To Kwantlen First Nation, salmon are considered a sacred gift (Kwantlen First Nation 2013). Traditionally, the Katzie First Nation people fished sockeye and other salmon at numerous seasonal villages along the Fraser River (crossed at RK 1118.8), the Pitt River (approximately 3 km north of RK 1164), and the Alouette River (approximately 7.2 km north of RK 1154) (Katzie First Nation 2013).

Kwikwetlem First Nation members historically moved to the Lower Fraser River area in the summer to fish for salmon and sturgeon. A fishing camp on the south shore of the Fraser River near the Pattullo Bridge (approximately 4 km west of RK 1168.3) was used by a number of communities. Villages and fishing camps were also located along the north Fraser River shoreline from the Pitt River to New Westminster approximately from 3 km north of RK 1164 to 5 km south of RK 1178 (Kwikwetlem First Nation 2007). In addition to salmon, the Kwikwetlem fish for eulachon, trout, catfish, and carp in the Fraser River (crossed at RK 1118.8) and the Pitt River (approximately 3 km north of RK 1164) (Kwikwetlem First Nation 2007). Sites at the mouth of the Coquitlam and Pitt rivers, at Douglas Island and Tree Island in Georgia Strait, at and from Barnston Island (approximately 500 m north of RK 1159) downstream to the Pattullo Bridge (approximately 4 km west of RK 1169) are used for fishing. Xvmuthkvi'um creek on the south bank of the Fraser River under the Port Mann Bridge (approximately 1 km east of RK 1169), the south side of the Fraser River between the Pattullo and Golden Ears bridges (approximately 4 km west of RK 1169) and the north Fraser River shoreline from the Pitt River to New Westminster (approximately 4 km north of RK 1164) are also used (Kwikwetlem First Nation 2007). Musqueam First Nation members established village sites along the Fraser River, and fished the lowlands and the highlands of the Fraser Delta up to Fraser Canyon.

Salmon fishing is also important to the Semiahmoo First Nation, and is complemented by crabbing. The community has raised concerns about municipal outflow and its detrimental effects on bivalve fisheries. Due to the close proximity of this community to cities on the Lower Mainland, public use of community fishing areas is also of concern (Semiahmoo First Nation 2001). An elaborate reef-net system is used to catch sockeye salmon as they enter the Juan de Fuca Strait and the Strait of Georgia on their migration to spawning grounds. Semiahmoo First Nation has fished in Boundary Bay (approximately 30.4 km south of RK 1180) for centuries but in the last 40 years, the community has resorted to fishing in the Fraser River. Prior to development, more than one million sockeye salmon could be caught in Boundary Bay annually. Other Aboriginal communities would travel to the area to take part in the reef-net fishery and to trade (Semiahmoo First Nation 2010). Howe Sound on the northern coast of the mouth of the Fraser River was once an important site for fishing activities but commercial fishing, dredging, pollution, overfishing, flood-control works have combined to deplete resources, and to degrade spawning grounds and fish habitat in general (Squamish Nation 2001).

While salmon such as Chinook, coho and kokanee constitute the main fishery for the region, steelhead, rainbow trout, cutthroat trout, and burbot are also fished (AMEC 2010). Shellfish are gathered in coastal areas: the shoals off of Port Hammond (approximately 2.4 km north of RK 1155) are an important location for harvesting clams (Kwantlen First Nation 2013, Neary 2011). Currently, the mouth of the Pitt River is fished (approximately 4 km north of RK 1164); sturgeon are caught in Pitt Lake (approximately 21.4 km north of RK 1144); sucker fish are sought at Sheridan Hill (located approximately 12.1 km from RK 1156); and a variety of species are fished from the Alouette and North Alouette rivers (approximately 7.2 km from RK 1154) (Katzie Development Corporation 2011).

4.2.8.2 Fish Species Distribution

There are no previous fish records for the unnamed watercourse.

4.2.8.3 Fish Species of Concern

There are no previous fish records for the unnamed watercourse.

4.3 Indicator Fish Species

Life history, distribution and habitat requirements for key indicator fish species found within the Project area are presented in the discussion below. Indicator species tend to describe important species of recreational, commercial, ecological, and Aboriginal concern that are frequently encountered in watercourses within the proposed pipeline corridor, as supported by fish and fish habitat assessments and/or historical reviews. Indicator fish for the portion of the Project in BC include Chinook salmon, coho salmon, bull trout/Dolly Varden, rainbow trout/steelhead and cutthroat trout (coastal and westslope). General water quality and habitat requirements for these indicator species are presented in Section 4.3.1.

4.3.1 General Water Quality and Habitat Requirements for Indicator Species

Water quality and habitat requirements, with respect to the life histories of Chinook salmon, coho salmon, bull trout/Dolly Varden, rainbow trout/steelhead and cutthroat trout (Coastal and Westslope) are presented in the following subsections. These sportfish are important spring and fall spawning species and have specific water quality and habitat requirements. All indicator species require clean gravel for spawning, cool water temperatures and high DO levels, as well as adequate pools for overwintering combined with other fish cover attributes (boulders, cutbanks, large woody debris, etc.). Indicator species are sensitive to increases in sediment concentrations as this can result in direct mortality, and/or cause a reduction in survival and growth rates, affect natural movements and migration, result in gill damage and abrasion, and prevent successful development of fish eggs and larvae. Species-specific data for tolerable total suspended solids (TSS) levels is lacking; however, Servizi and Martens (1991) determined that the short-term lethal effects of sediment on Fraser River coho salmon in relation to temperature (*i.e.*, concentration of sediment that did not result in direct mortality) was 8,100 mg/L at 7°C and as low as 2,000 mg/L at 18°C. However, sub-lethal responses, which also pose a risk to survival, can begin to occur at much lower sediment concentrations (Allen and Hassler 1986).

Birtwell (1999) concluded that elevated levels of sediment (typically over background) may pose harmful risks to fish (*e.g.*, acutely lethal or sub-lethal responses that compromises survival) or negatively impacts their habitat. The effects of elevated sediment concentrations can vary depending on several factors including the composition, size and angularity of particles, as well as the duration in which sediment is introduced. DFO has defined 'levels of risk' associated with increases in sediment concentration in watercourses: an increase of less than 25 mg/L above background concentration poses a very low risk to fish and their habitat; an increase of 25-100 mg/L is low risk; an increase of 100-200 mg/L is moderate risk; an increase of 200-400 mg/L is high risk; and an increase in excess of 400 mg/L is unacceptable risk (Birtwell 1999). Effects of sediment are more pronounced during winter months or when flow conditions are reduced. Newcombe and MacDonald (1991) stated that high turbidity during winter has the potential to affect the feeding ability of juvenile salmonids and the longer the duration of elevated turbidity, the more damage is likely to occur to fish and other aquatic organisms.

Water quality guidelines for the protection of aquatic life in clear flowing watercourses cite a biologically significant increase in TSS concentration at 25 mg/L above background for short-term (24 hour) exposure (Canadian Council of Ministers of the Environment [CCME] 2002). A maximum average increase of 5 mg/L from background levels is cited for longer term exposures (*e.g.*, TSS inputs lasting between 24 h and 30 days) (CCME 2002).

Water quantity is also critical; the loss of flow or inadequate discharge can severely reduce the availability of habitat and instream flow requirements for overwintering or rearing fishes, especially during winter months. An estimation of stream flow requirements for juvenile salmonids is extremely complex (Allen and Hassler 1986); however, maintenance of water quality and quantity is critical for stream fish populations, as available pool habitat and the need to minimize energy expenditure are important factors governing fish survival (Cunjak 1996).

Water chemistry is another important parameter to consider within an aquatic ecosystem; and temperature is one of the most important environmental variables (Moyle and Cech 2004). Salmon and trout respond to changes in water temperature during their upstream migrations, and unsuitable temperatures will delay or accelerate maturation at all life stages (Bjornn and Reiser 1991). Temperature also affects the properties of water, most notably DO. There is generally an inverse relationship between temperature and DO (Moyle and Cech 2004). Fish metabolic rates are affected directly and indirectly by fluctuations in DO solubility and availability. Low DO concentrations affect all life stages of fish, and can affect benthic invertebrates which are an important nutrient source for fish. The recommended DO concentrations for the protection of aquatic life are presented in Table 4.22 (BC MOE 1997).

TABLE 4.22

RECOMMENDED DISSOLVED OXYGEN CRITERIA FOR THE PROTECTION OF AQUATIC LIFE

Life Stages	All Life Stages Other than Buried Embryo/Alevin	Buried Embryo/Alevin Life Stages	Buried Embry/Alevin Life Stages
Concentration	Water Column mg/L O_2*	Water Column mg/L O_2*	Interstitial Water mg/L O_2*
Instantaneous Minimum	5	9	6
30 day mean	8	11	8

Source: BC MOE 1997

Note: * Lowest acceptable dissolved oxygen concentration.

4.3.2 Chinook Salmon

4.3.2.1 Life History and Habitat

Chinook salmon are the largest anadromous species to spawn and rear in the Fraser River mainstem and its tributaries. They reach a fork length of approximately 450 mm by their second year (McPhail 2007). Spawning takes place primarily from August to December; spawning fish are approximately three to five years of age (DFO 1999). Fraser-origin Chinook commonly spawn in the middle and upper regions of the watershed and the Fraser River is the largest Canadian producer of Chinook salmon (DFO 1999).

DFO (1999) has divided Fraser River Chinook into four major geographical stock complexes and three timing groups (spring-run, summer-run and late-run). The four main geographical stock areas include: the upper Fraser River (those upstream from the City of Prince George), the middle Fraser River (downstream from Prince George but excluding the Thompson River), the Thompson River and the lower Fraser River (dominated by fall-returning Harrison River Chinook) (DFO 1999). Seasonally, the early or spring-run migrates through the lower Fraser River before July 15; the summer-run migrates through the lower Fraser between July 15 and August 31; and the late or fall-run, which consist mostly of Harrison and Chilliwack/Vedder river fish, enters the lower Fraser after September 1 (DFO 1999). Pacific Salmon Treaty escapement reporting units have been created for Fraser River Chinook, which includes the run timing, the estimated age of the fish and a smaller subscript number to indicate the approximate number of years that juvenile fish spend in freshwater. Fraser River escapement groups relative to the Project area are listed below (DFO 2011a):

- spring 4_2 Chinook includes the Coldwater River and Nicola River;
- spring 5_2 Chinook includes the upper Fraser and North Thompson River, Swift Creek, Blue River, Finn Creek and Raft River;
- summer 5_2 Chinook includes the Chilliwack/Vedder River, Clearwater River, Blue River, North Thompson River, Lemieux Creek;
- summer 4_1 Chinook includes the lower and South Thompson River near Kamloops; and
- late-fall 4_1 Chinook typically include original natural populations of fall-run Chinook to the Harrison River, and transplanted Harrison origin populations returning to the Chilliwack, Stave, and various other smaller rivers.

Typically, Chinook salmon spawning grounds include larger and faster tributaries and often those with coarser substrate. However, it is also common for Chinook to spawn in small shallow streams approximately 2-3 m wide and in mainstems and side channels of the upper Fraser River (McPhail 2007). Sub-gravel flow of well-oxygenated water appears to be a primary factor in governing spawning site selection (McPhail 2007). Fry emerge from redds the following spring and are categorized as either “stream type” spending one or more years in freshwater or “ocean type” spending less than one year in freshwater (DFO 1999). Winter habitat preference for juvenile Chinook consists of slower water velocities, which are close to the bottom and often in association with abundant cover (*i.e.*, boulders, rip-rap, and

woody debris; [McPhail 2007]). The diet of juvenile Chinook consists primarily of terrestrial and aquatic insects (McPhail 2007).

Known Chinook salmon-bearing watercourses and respective instream construction timing windows (all species) are presented in the subsections below for each pipeline segment, the Burnaby Terminal and power line corridors.

4.3.2.2 Water Quality and Habitat

Water quality and habitat requirements for Chinook salmon are presented in Table 4.23.

TABLE 4.23

WATER QUALITY AND HABITAT REQUIREMENTS FOR CHINOOK SALMON

Stage/Activity	Preferred Temperature (°C)	Preferred DO Concentration (mg/L)	Preferred Current Velocity (m/s)	Depth Preference (m)	Preferred Substrate	Preferred Channel Morphology and Habitat Attributes
Incubation	5.0-14.4	Near saturation (> 90%)	< 0.14	0.15-0.30	Gravels to small cobble (1.3-10 cm).	Lower lip of pools above riffles.
Rearing and Overwintering	5.6-14.0	> 3.0	0.06-0.24	0.3-1.22	Large boulders (overwintering).	Low water velocity areas.
Adults	10.6-19.4	> 5.0	< 2.44	> 0.24	Large gravels and cobble (1.3-14 cm).	Deep rocky habitats, with fast current.
Spawning	5.6-13.9		0.3-0.91			

Sources: Allen and Hassler 1986; Bjornn and Reiser 1991

4.3.2.3 Hargreaves to Darfield Segment

Table 4.24 provides known Chinook salmon-bearing watercourses and respective instream construction timing windows for the Hargreaves to Darfield Segment.

TABLE 4.24

KNOWN CHINOOK-BEARING WATERCOURSES WITHIN THE HARGREAVES TO DARFIELD SEGMENT

Species	Master Crossing Number	RKs	Watercourse Name	Region	Provincial Instream Work Window [1]
CH	BC-10	499.7	Fraser River	7	July 15 to August 15 (Contact DFO for Anadromous Salmon Window)
	BC-32	522.5	Swift Creek		
	BC-111, BC-182 and BC-236	581.2, 619.9 and 651.6	North Thompson River	3	July 22 to August 15
	BC-110	580.4	Serpentine Creek		August 7 to 15
	BC-176	609.4	Cook Creek		August 7 to 15
	BC-178	613.8	Blue River		August 7 to 15
	BC-201	638.8	Finn Creek		July 22 – August 15
	BC-227	648.9	Tumtum Creek		July 22 – August 15
	BC-275	683.4	Mad River		August 7 – September 30
	BC-309	717.7	Raft River		July 22 – August 15
	BC-312	725.5	Clearwater River		August 7 to 15
	BC-315	735.0	Mann Creek		July 22 – August 20
	BC-330	749.3	Lemieux Creek		July 22 – August 15

Note: 1 Instream construction timing windows are watercourse specific and/or reflective of all species of conservation concern.

4.3.2.4 Black Pines to Hope Segment

Table 4.25 provides known Chinook salmon-bearing watercourses and respective instream construction timing windows for the Black Pines to Hope Segment.

TABLE 4.25

KNOWN CHINOOK-BEARING WATERCOURSES WITHIN THE BLACK PINES TO HOPE SEGMENT

Species	Master Crossing Number	RKs	Watercourse Name	Region	Provincial Instream Work Window [1]
CH	Parallels	--	North Thompson River	3	July 22 to August 15
	BC-413	846.8	Thompson River		July 22 to August 15
	Not crossed	--	South Thompson River		July 22 to August 15
	BC-482	915.9	Clapperton Creek		July 22 to August 1
	BC-504	928.0	Nicola River		July 22 to August 1
	BC-548	957.9	Coldwater River		August 7 to 10
	BC-559, BC-570 and BC-582	970.3, 980.0 and 990.0	Coldwater River		July 22 to August 1
	BC-571	980.8	Juliet Creek		July 22 to August 15
	BC-631, BC-636, BC-639, BC-645 and BC-654	1021.8, 1026.5, 1028.6, 1032.6 and 1043.2	Coquihalla River	2	August 1 to 31

Note: 1 Instream construction timing windows are watercourse specific and/or reflect all species of conservation concern.

4.3.2.5 Black Pines Power Line

There are records of Chinook salmon in the North Thompson River (Table 4.25).

4.3.2.6 Kingsvale Power Line

There are records of Chinook salmon in the lower reaches of Voght Creek below Highway 5; there are no records of Chinook in the upper tributaries to Voght Creek within the proposed power line corridor (Section 4.2.5).

4.3.2.7 Hope to Burnaby Segment

Table 4.26 provides known Chinook salmon-bearing watercourses and respective instream construction timing windows for the Hope to Burnaby Segment (Section 4.2.6).

TABLE 4.26

KNOWN CHINOOK-BEARING WATERCOURSES WITHIN THE HOPE TO BURNABY SEGMENT

Species	Master Crossing Number	RKs	Watercourse Name	Region	Provincial Instream Work Window [1]
CH	BC-705	1078.2	Anderson Creek	2	August 1 to 15
	BC-715	1094.0	Chilliwack Creek		August 1 to September 15
	BC-717	1102.3	Chilliwack/Vedder River		August 1 to 15
	BC-726	1114.6	Sumas River		August 1 to 15
	BC-731 and BC-732	1122.4 and 1123.4	Clayburn Creek		August 1 to 15
	BC-734	1127.8	McLennan Creek		August 1 to 15
	BC-747	1138.0	Nathan Creek		August 1 to September 15
	BC-749	1143.0	West Creek		August 1 to September 15
	BC-753	1147.4	Salmon River		August 1 to 31
	BC-780	1168.9	Fraser River		August 1 to 15
	BC-781	1171.1	Como Creek		August 1 to September 15

Note: 1 Instream construction timing windows are watercourse specific and/or reflect all species of conservation concern.

4.3.2.8 Burnaby Terminal

There are no previous records of Chinook salmon in the unnamed tributary to Eagle Creek (Section 4.2.7).

4.3.2.9 Burnaby to Westridge Segment

There are no previous records of Chinook salmon in the unnamed tributary to Burrard Inlet (Section 4.2.8).

4.3.3 Coho Salmon

4.3.3.1 Life History and Habitat

Coho salmon spawn and rear in many coastal streams of BC; their distribution is especially extensive throughout the Lower Mainland portion of the Project area, which includes many tributaries to the lower Fraser River (Chilliwack/Vedder River, Sumas River and McLennan Creek) (DFO 2013b). The upper and middle Fraser River watershed, particularly the Thompson River and tributaries to the Thompson River are also extremely important for coho reproduction in BC. Coho do not migrate as far up the Fraser River system as Chinook or sockeye but reach the headwaters of the North and South Thompson rivers, and as far upstream in the upper Fraser River as the Nechako River (Sandercock 1991). Interior Fraser River coho have been identified by COSEWIC as Endangered (Table 4.4).

Interior Fraser River coho (above Hells Gate) have been divided into five sub-population groups based on genetics including the Fraser Canyon, upper Fraser, North Thompson, South Thompson and Lower Thompson; important Thompson River sub-groups relative to the Project area are listed below (DFO 2008).

- North Thompson sub-population group which includes North Thompson River, Albreda River and tributaries, Miledge Creek, Thunder River, Cook Creek, Blue River, Finn Creek, Avola Creek, Mad River, Raft River, Clearwater River, Mann Creek and Lemieux Creek.

- Lower Thompson sub-population group including Thompson River and Kamloops Lake, South Thompson River, Nicola River and Coldwater River.

The timing for coho river entry and spawning is variable and influenced by water temperature and flow (McPhail 2007). Early runs typically enter freshwater in September or October and spawn in late October through December; while late runs usually enter freshwater in December or January and spawn shortly thereafter (McPhail 2007). Some exceptionally late runs have been noted in the lower Fraser valley and spawning coho have been observed in late March (Elk Creek near Chilliwack) (McPhail 2007). Coho prefer spawning sites with sub-gravel water flow, which includes areas with upwellings or pool tail-outs immediately above riffles (McPhail 2007). Eggs hatch the following spring between 36 to 167 days depending on water temperature. Juvenile coho are primarily drift feeders and consume a wide variety of aquatic insects; however, as they get older they become piscivorous and commonly consume sockeye and pink fry (McPhail 2007). Woody debris, undercut banks, cobble, root wads and off-channel overwintering areas such as beaver pond and flooded wetlands are important habitat components for juvenile coho (McPhail 2007).

Juvenile coho typically spend one to two years in freshwater before emigrating from their natal areas to estuaries typically between April and June (DFO 2008). Once in the ocean, juvenile coho rapidly disperse in the marine environment, but are thought to remain largely in coastal waters (Sandercock 1991). Coho typically spend 18 months at sea before returning to freshwater to spawn (McPhail 2007).

Known coho salmon-bearing watercourses and respective instream construction timing windows (all species) are presented in the subsections below for each pipeline segment, Burnaby Terminal and the power line corridors.

4.3.3.2 Water Quality and Habitat

Water quality and habitat requirements for coho salmon are presented in Table 4.27.

TABLE 4.27

WATER QUALITY AND HABITAT REQUIREMENTS FOR COHO SALMON

Stage/Activity	Preferred Temperature (°C)	Preferred DO Concentration (mg/L)	Preferred Current Velocity (m/s)	Depth Preference (m)	Preferred Substrate	Preferred Channel Morphology and Habitat Attributes
Incubation	4.4-13.3	> 5.0	0.09-0.30	0.30-1.22	Clean gravel with minimal fines.	Riffle-run-pool morphology.
Rearing and Overwintering	7.2-15.6	> 9.0	0.09-0.24	0.18	Cobbles, boulders and gravels.	Slow flow runs and deep pools.
Adults	11.8-14.6 d	> 9.0	1.04-3.23	0.18	1.3-10.2 cm small to large gravel.	Small to medium-sized streams, laminar flows and run-type habitats.
Spawning	4.4-9.4		0.31			

Source: Laufle *et al.* 1986

4.3.3.3 Hargreaves to Darfield Segment

Table 4.28 provides known coho salmon-bearing watercourses and respective instream construction timing windows for the Hargreaves to Darfield Segment.

TABLE 4.28

KNOWN COHO-BEARING WATERCOURSES WITHIN THE HARGREAVES TO DARFIELD SEGMENT

Species	Master Crossing Number	RKs	Watercourse Name	Region	Provincial Instream Work Window [1]
CO	BC-65, BC-82 and BC-85	552.1, 561.2 and 563.6	Albreda River	3	July 22 to August 15
	BC-78	559.4	Dora Creek		July 15 to August 15
	BC-93	567.6	Dominion Creek		June 1 to August 15
	BC-111, BC-182 and BC-236	581.2, 619.9 and 651.6	North Thompson River		July 22 to August 15
	BC-151	592.9	Miledge Creek		August 7 to 15
	BC-168	600.2	Thunder River		June 1 to August 15
	BC-176	609.4	Cook Creek		August 7 to 15
	BC-177	611.6	Cedar Creek		June 1 to August 15
	BC-178	613.8	Blue River		August 7 to 15
	BC-180	616.9	Goose Creek		July 22 to August 15
	BC-201	638.8	Finn Creek		July 22 to August 15
	BC-224	648.0	Sundt Creek		August 7 to 15
	BC-227	648.9	Tumtum Creek		July 22 to August 15
	BC-242	656.1	Avola Creek		July 22 to August 15
	BC-249	664.3	Sager Creek		August 7 to 15
	BC-275	683.4	Mad River		August 7 to September 30
	BC-279	688.2	Bill Creek (Blackberg Creek)		July 22 to August 15
	BC-302	707.9	Crossing Creek		August 7 to 15
	BC-305	710.9	Noblequartz Creek		August 7 to 15
	BC-309	717.7	Raft River		July 22 to August 15
	BC-312	725.5	Clearwater River		August 7 to 15
	BC-315	735.0	Mann Creek		July 22 to August 20
	BC-330	749.3	Lemieux Creek		July 22 to August 15

TABLE 4.28 Cont'd

Species	Master Crossing Number	RKs	Watercourse Name	Region	Provincial Instream Work Window [1]
CO (cont'd)	BC-332	752.3	Eakin Creek	3	July 22 to August 15
	BC-343	768.2	Darlington Creek		July 22 to August 15
	BC-344	768.5	Lindquist Creek		July 22 to August 15

Note: 1 Instream construction timing windows are watercourse specific and/or reflect all species of conservation concern.

4.3.3.4 Black Pines to Hope Segment

Table 4.29 provides known coho salmon-bearing watercourses and respective instream construction timing windows for the Black Pines to Hope Segment.

TABLE 4.29

KNOWN COHO-BEARING WATERCOURSES WITHIN THE BLACK PINES TO HOPE SEGMENT

Species	Master Crossing Number	RKs	Watercourse Name	Region	Provincial Instream Work Window [1]
CO	Parallels	--	North Thompson River	3	July 22 to August 15
	BC-371	820.2	Jamieson Creek		July 22 to September 30
	BC-413	846.8	Thompson River		July 22 to August 15
	Not crossed	--	South Thompson River		July 22 to August 15
	BC-482	915.9	Clapperton Creek		July 22 to August 1
	BC-504	928.0	Nicola River		July 22 to August 1
	BC-512	931.0	Godey Creek		July 22 to August 15
	BC-548	957.9	Coldwater River		August 7 to 10
	BC-559, BC-570 and BC-582	970.3, 980.0 and 990.0	Coldwater River		July 22 to August 1
	BC-571	980.8	Juliet Creek		July 22 to August 15
	BC-631, BC-636, BC-639, BC-645 and BC-654	1021.8, 1026.5, 1028.6, 1032.6 and 1043.2	Coquihalla River	2	August 1 to 31

Note: 1 Instream construction timing windows are watercourse specific and/or reflect all species of conservation concern.

4.3.3.5 Black Pines Power Line

There are records of coho in the North Thompson River (Table 4.29).

4.3.3.6 Kingsvale Power Line

There are records of coho in the lower reaches of Voght Creek below Highway 5; there are no records of coho in the upper tributaries to Voght Creek within the proposed power line corridor (Section 4.2.5).

4.3.3.7 Hope to Burnaby Segment

Table 4.30 provides known coho salmon-bearing watercourses and respective instream construction timing windows for the Hope to Burnaby Segment.

TABLE 4.30

KNOWN COHO-BEARING WATERCOURSES WITHIN THE HOPE TO BURNABY SEGMENT

Species	Master Crossing Number	RKs	Watercourse Name	Region	Provincial Instream Work Window [1]
CO	BC-657	1047.2	Silverhope Creek	2	August 1 to 31
	BC-662	1055.5	Hunter Creek		August 1 to September 15
	BC-666	1060.9	Lorenzetta Creek		August 1 to September 15
	BC-668	1061.5	Wahleach Creek		August 1 to 15
	BC-705	1078.2	Anderson Creek		August 1 to 15
	BC-706	1079.8	Bridal Creek		August 1 to September 15
	BC-708	1083.4	Nevin Creek		August 1 to September 15
	BC-709	1083.9	Dunville Creek		August 1 to September 15
	BC-713	1087.6	Elk Creek		August 1 to September 15
	BC-714	1092.7	Semmihault Creek		August 1 to September 15
	BC-715	1094.0	Chilliwack Creek		August 1 to September 15
	BC-716	1102.1	Chilliwack/Vedder River Side Channel		July 15 to September 15
	BC-717	1102.3	Chilliwack/Vedder River		August 1 to 15
	BC-720	1103.2	Street Creek		August 1 to September 15
	BC-722	1106.0	Stewart Slough		August 1 to September 15
	BC-725	1110.7	Sumas Lake Canal		July 15 to September 15
	BC-726	1114.6	Sumas River		August 1 to 15
	BC-731 and BC-732	1122.4 and 1123.4	Clayburn Creek		August 1 to 15
	BC-733	1125.2	Unnamed Tributary to Gifford Slough		August 1 to September 15
	BC-734	1127.8	McLennan Creek		August 1 to 15
	BC-747	1138.0	Nathan Creek		August 1 to September 15
	BC-749	1143.0	West Creek		August 1 to September 15
	BC-751	1145.6	Davidson Creek		August 1 to September 15
	BC-753	1147.4	Salmon River		August 1 to 31
	BC-766	1152.4	Unnamed Tributary to Yorkson Creek		August 1 to September 15
	BC-768	1154.3	Yorkson Creek		August 1 to September 15
	BC-773	1161.7	Unnamed Tributary to Fraser River		August 1 to September 15
	BC-779	1166.9	Bon Accord Creek		August 1 to September 15
	BC-780	1168.9	Fraser River		August 1 to 15
	BC-781	1171.1	Como Creek		August 1 to September 15
	BC-782	1172.2	Nelson Creek		August 1 to September 15
	BC-785	1176.5	Stoney Creek		August 1 to September 15
	BC-785a	1182.5	Eagle Creek		August 1 to September 15

Note: 1 Instream construction timing windows are watercourse specific and/or reflect all species of conservation concern.

4.3.3.8 Burnaby Terminal

Coho salmon have been recorded previously in Eagle Creek (BC-785a); the upper extent of spawning migration is reported to be below Highway 7 (Section 4.2.7). The timing window for Eagle Creek is August 1 to September 15.

4.3.3.9 Burnaby to Westridge Segment

There are no previous records of coho in the unnamed tributary to Burrard Inlet (Section 4.2.8).

4.3.4 Bull Trout and Dolly Varden

4.3.4.1 Life History and Habitat

Bull trout and Dolly Varden coexist and hybridize in Coast Mountain drainages. Where these two species distributions overlap, they are often difficult to tell apart but their morphology is different including spotting, head shape, upper jaw length, anal fin base and in the total number of branchiostegal rays (McPhail 2007). Dolly Varden are largely a coastal and anadromous species, which regularly enters the ocean and its distribution does not typically extend far inland (*i.e.*, Hope, BC) (McPhail 2007). Dolly Varden are commonly smaller than bull trout, inhabiting small streams and feeding primarily on drift; bull trout are typically larger, piscivorous, and distributed in cool waters throughout the interior and are absent from many shorter coastal rivers (McPhail 2007). This species discussion focuses more on bull trout as it is more widely distributed in BC; overlap and distribution of Dolly Varden is generally limited to the Lower Mainland and southern portions of the RSA (*i.e.*, Black Pines to Hope, Hope to Burnaby and Burnaby to Westridge segments).

Bull trout within the LSA and RSA may display three life history patterns common in BC: stream resident, which spends its entire life within smaller streams sometimes isolated by barriers; fluvial, which spends its adult life within large rivers and spawns and rears in smaller tributary streams; and adfluvial, which migrate between lakes and rivers (McPhail 2007).

Sexual maturity for bull trout is reached in five to seven years (Post and Johnston 2009). Some populations of bull trout are known to make long distance migrations to and from spawning areas. A study conducted in the Peace River region found the largest range in seasonal movement for bull trout to be 275 km (Burrows *et al.* 2001). Bull trout spawn during the fall from September to November (Scott and Crossman 1973) in flowing water, preferring spawning sites in smaller streams with coarse cobble or gravel substrate and moderate flows (Baxter and McPhail 1996). Instream cover associated with deep pools and/or velocity breaks has also been found to be an important characteristic of bull trout spawning streams and an important variable affecting stream resident juvenile bull trout densities (Baxter and McPhail 1996).

Fry emerge during the spring and reside in their natal streams for one to four years until they are large enough to move downstream into larger rivers or lakes (Ford *et al.* 1995). Juvenile bull trout are often associated with areas of high stream channel complexity and cover (Baxter and McPhail 1996). Bull trout fry and juveniles have also been found to prefer large diameter substrate, probably due to its ability to provide cover and refuge from predators and fast currents (Baxter and McPhail 1996). The diet of juvenile bull trout generally consists of the larvae and nymphs of aquatic insects until they are large enough to feed on small fish (McPhail 2007).

Bull trout are Blue-listed as a Species of Special Concern in BC and are particularly vulnerable to angling pressure and poaching (McPhail 2007). Hybridization and competitive interactions with introduced brook trout (*Salvelinus fontinalis*) can also cause declines in bull trout populations (McPhail 2007). The typically low densities of bull trout, low reproductive capacity, susceptibility to angling pressure, and sensitivity to changes in water quality support the provincial listing of bull trout. Increased awareness of declining bull trout populations has led to increased levels of inventory, research and management considerations.

Known bull trout/Dolly Varden habitat and respective instream construction timing windows are presented in the subsections below for each pipeline segment, the Burnaby Terminal and the power line corridors.

4.3.4.2 Water Quality and Habitat

Water quality and habitat requirements for bull trout/Dolly Varden are similar and presented in Table 4.31.

TABLE 4.31

WATER QUALITY AND HABITAT REQUIREMENTS FOR BULL TROUT/DOLLY VARDEN

Stage/Activity	Preferred Temperature (°C)	Preferred DO Concentration (mg/L)	Preferred Current Velocity (m/s)	Depth Preference (m)	Preferred Substrate	Preferred Channel Morphology and Habitat Attributes
Incubation	2.0-4.0	> 9.5	< scour velocity	Below level causing scour	No fines.	Clean gravel substrates in pools and tail-outs,
Rearing and Overwintering	< 12.0	7.75	0.1-0.5	< 1.0	Cobble and boulder.	Large, woody debris; deep pools,
Adults	< 9.0	0.25-0.65	None	≤ 18	Cobble and gravel with minimal fines (< 6.35 mm).	Gravel tail-outs within and downstream from pools.
Spawning		7.75		0.15-0.84		

Sources: Ford *et al.* 1995; Berman 1998

Note: * Bull trout freshwater habitat requirements are thought to be similar to those of Dolly Varden.

4.3.4.3 Hargreaves to Darfield Segment

Table 4.32 provides known bull trout habitat and respective instream construction timing windows for the Hargreaves to Darfield Segment.

TABLE 4.32

KNOWN BULL TROUT HABITAT WITHIN THE HARGREAVES TO DARFIELD SEGMENT

Species	Master Crossing Number	RKs	Watercourse Name	Region	Provincial Instream Work Window [1]
BT	BC-3	490.5	Baer Creek	7	July 15 to August 15
	BC-8	495.8	Terry Fox Creek		July 15 to August 15
	BC-10	499.7	Fraser River		July 15 to August 15 (Contact DFO for anadromous salmon)
	BC-27	515.5	Teepee Creek		June 15 to August 15
	BC-28	517.8	Crooked Creek		July 15 to August 15
	BC-32	522.5	Swift Creek		July 15 to August 15 (Contact DFO for anadromous salmon)
	BC-36	531.3	Canoe River		July 15 to August 15
	BC-38, BC-52 and BC-56	534.5, 545.9 and 547.6	Camp Creek		July 15 to August 15
	BC-65, BC-82 and BC-85	552.1, 561.2 and 563.6	Albreda River	3	July 22 to August 15
	BC-66	552.9	Robina Creek		July 22 to August 15
	BC-76	559.0	Clemina Creek		June 1 to August 15
	BC-78	559.4	Dora Creek		July 15 to August 15
	BC-93	567.6	Dominion Creek		June 1 to August 15
	BC-94	571.9	Moonbeam Creek		June 1 to August 15
	BC-110	580.4	Serpentine Creek		August 7 to 15
	BC-111, BC-182 and BC-236	581.2, 619.9 and 651.6	North Thompson River		July 22 to August 15
	BC-112	582.0	Chappell Creek		June 1 to August 15
	BC-151	592.9	Miledge Creek		August 7 to 15
	BC-168	600.2	Thunder River		June 1 to August 15
	BC-173	605.2	Whitewater Creek		August 7 to 15
	BC-176	609.4	Cook Creek		August 7 to 15
	BC-177	611.6	Cedar Creek		June 1 to August 15

TABLE 4.32 Cont'd

Species	Master Crossing Number	RKs	Watercourse Name	Region	Provincial Instream Work Window [1]
BT (cont'd)	BC-178	613.8	Blue River	3	August 7 to 15
	BC-180	616.9	Goose Creek		July 22 to August 15
	BC-189	626.6	Froth Creek		August 7 to 15
	BC-201	638.8	Finn Creek		July 22 to August 15
	BC-309	717.7	Raft River		July 22 to August 15
	BC-312	725.5	Clearwater River		August 7 to 15
	BC-315	735.0	Mann Creek		July 22 to August 20

Note: 1 Instream construction timing windows are watercourse specific and/or reflect all species of conservation concern.

4.3.4.4 Black Pines to Hope Segment

Table 4.33 provides known bull trout/Dolly Varden habitat and respective instream construction timing windows for the Black Pines to Hope Segment.

TABLE 4.33

KNOWN BULL TROUT/DOLLY VARDEN HABITAT WITHIN THE BLACK PINES TO HOPE SEGMENT

Species	Master Crossing Number	RKs	Watercourse Name	Region	Provincial Instream Work Window [1]
BT	Parallels	--	North Thompson River	3	July 22 to August 15
	BC-371	820.2	Jamieson Creek		July 22 to September 30
	BC-413	846.8	Thompson River		July 22 to August 15
	Not Crossed	--	South Thompson River		July 22 to August 15
	BC-504	928.0	Nicola River		July 22 to August 1
	BC-548	957.9	Coldwater River		August 7 to 10
	BC-559, BC-570 and BC-582	970.3, 980.0 and 990.0	Coldwater River		July 22 to August 1
	BC-571	980.8	Juliet Creek		July 22 to August 15
DV/BT	BC-591 and BC-596	1003.1 and 1011.0	Boston Bar Creek	2	August 1 to 31
	BC-629	1020.3	Ladner Creek		August 1 to 31
	BC-631, BC-636, BC-639, BC-645 and BC-654	1021.8, 1026.5, 1028.6, 1032.6 and 1043.2	Coquihalla River		August 1 to 31
	BC-632	1022.9	Dewdney Creek		August 1 to 31
	BC-634	1024.5	Karen Creek		August 1 to 31

Note: 1 Instream construction timing windows are watercourse specific and/or reflect all species of conservation concern.

4.3.4.5 Black Pines Power Line

There are records of bull trout in the North Thompson River (Table 4.33).

4.3.4.6 Kingsvale Power Line

There are no previous records of bull trout in Voght Creek or unnamed tributaries (Section 4.2.5).

4.3.4.7 Hope to Burnaby Segment

Table 4.34 provides known Dolly Varden/bull trout habitat and respective instream construction timing windows for the Hope to Burnaby Segment.

TABLE 4.34

KNOWN BULL TROUT/DOLLY VARDEN HABITAT WITHIN THE HOPE TO BURNABY SEGMENT

Species	Master Crossing Number	RKs	Watercourse Name	Region	Provincial Instream Work Window [1]
DV/BT	BC-657	1047.2	Silverhope Creek	2	August 1 to 31
	BC-705	1078.2	Anderson Creek		August 1 to 15
	BC-715	1094.0	Chilliwack Creek		August 1 to September 15
	BC-717	1102.3	Chilliwack/Vedder River		August 1 to 15
	BC-726	1114.6	Sumas River		August 1 to 15
	BC-731 and BC-732	1122.4 and 1123.4	Clayburn Creek		August 1 to 15
	BC-734	1127.8	McLennan Creek		August 1 to 15
	BC-753	1147.4	Salmon River		August 1 to 31
	BC-780	1168.9	Fraser River		August 1 to 15

Note: 1 Instream construction timing windows are watercourse specific and/or reflect all species of conservation concern.

4.3.4.8 Burnaby Terminal

There are no previous records of Dolly Varden/bull trout in Eagle Creek (Section 4.2.7).

4.3.4.9 Burnaby to Westridge Segment

There are no previous records of Dolly Varden/bull trout in the unnamed tributary to Burrard Inlet (Section 4.2.8).

4.3.5 Rainbow Trout/Steelhead

4.3.5.1 Life History and Habitat

Rainbow trout are a cool water salmonid species that is widespread throughout BC and may occur both as freshwater resident and anadromous (steelhead) populations within the RSA and LSA (McPhail 2007). Resident rainbow trout live entirely in freshwater with possible short periods of time spent in estuarine or near-shore marine waters (Alaska Department of Fish and Game [ADFG] 2013). It is suggested that there are two sub-species of resident rainbow trout in BC, which includes the coastal (*O.m.irideius*) and interior (*O.m.gairdneri*) (Kamloops trout) forms (McPhail 2007). Rainbow trout are known to hybridize commonly with cutthroat trout (McPhail 2007).

Resident rainbow trout populations spawn in the spring, from late April to July, typically in streams with small gravel. Egg deposition and fertilization occurs in excavated nests or redds; incubation periods range between 32 to 42 days depending on water temperatures (Murray 1980). Following emergence, juvenile rainbow trout often spend several years in natal streams before moving into more productive habitats in larger rivers and lakes, or they can form resident populations in streams, usually when in isolated habitats (McPhail 2007). Channel complexity (*i.e.*, riffles, runs and pools) and instream cover (*i.e.*, cobble, boulders and woody debris) are important habitat components for adult and juvenile rainbow trout; juvenile trout are often found in shallower and slower water than adults (McPhail 2007). The primary diet of rainbow trout in streams and rivers includes floating and benthic aquatic insects and invertebrates.

Juvenile rainbow trout and steelhead occupy the same habitat, display similar foraging characteristics and are not distinguishable within the first few years of their life (McPhail 2007). However, juvenile steelhead as with all anadromous species will undergo a process called smoltification prior to seaward migration, which causes them to lose their parr marks and become silvery in the process (ADFG 2013). Juvenile steelhead will spend two to three summers in freshwater before migrating to the ocean where they grow to maturity and migrate back to their natal streams (ADFG 2013). BC steelhead spend one to four years at sea before returning to freshwater as either winter-run fish (November to early April) or summer-run fish (May to September) (McPhail 2007). Winter-run steelhead tend to spawn right away, while summer-run fish may hold in freshwater for up to one year before spawning (May-Sept.) (McPhail 2007). There are

two major groups of steelhead that are recognized within the Project area; a southern coastal group which includes the lower Fraser River and Vancouver Island; and a southern interior group that includes rivers associated with the middle Fraser River (McPhail 2007).

Known rainbow trout and steelhead habitat and respective instream construction timing windows (all species) are presented in the subsections below for each pipeline segment, the Burnaby Terminal and the power line corridors.

4.3.5.2 Water Quality and Habitat

Water quality and habitat requirements for rainbow trout and steelhead are similar and presented in Table 4.35.

TABLE 4.35

WATER QUALITY AND HABITAT REQUIREMENTS FOR RAINBOW TROUT/STEELHEAD

Stage/Activity	Preferred Temperature (°C)	Preferred DO Concentration (mg/L)	Preferred Current Velocity (m/s)	Depth Preference (m)	Preferred Substrate	Preferred Channel Morphology and Habitat Attributes
Incubation	11.0	> 5.3	0.02	≥ 0.18	Gravel with < 5% fines.	Shallow, slow-moving streams.
Rearing and Overwintering	10-14	> 7.0	0.08-0.20	0.3-1.2 m in streams	Cobble/boulder and rubble.	Glides and pools with overhead cover.
Adults	10-14	7-9	0.20-0.30	≥ 0.18	Cobble to boulder.	Riffles and runs with overhead cover.
Spawning	10-15.5				Gravel to cobble, 0.6-5.2 cm.	

Sources: Bjornn and Reiser 1991, Ford *et al.* 1995, McPhail 2007

Note: * Rainbow trout and steelhead have similar freshwater habitat requirements.

4.3.5.3 Hargreaves to Darfield Segment

Table 4.36 provides known rainbow trout habitat and instream construction timing windows for the Hargreaves to Darfield Segment. Steelhead are not known to migrate through Kamloops Lake. An escapement of large rainbow trout to the Barrier River are thought to be resident fish from Kamloops Lake. Therefore, all rainbow trout upstream from Kamloops Lake should be considered non-anadromous (resident or adfluvial populations).

TABLE 4.36

KNOWN RAINBOW TROUT HABITAT WITHIN THE HARGREAVES TO DARFIELD SEGMENT

Species	Master Crossing Number	RKs	Watercourse Name	Region	Provincial Instream Work Window [1]
RB (ST not recorded previously)	BC-3	490.5	Baer Creek	7	July 15 to August 15
	BC-5	491.6	Marathon Creek		July 15 to April15
	BC-8	495.8	Terry Fox Creek		July 15 to August 15
	BC-10	499.7	Fraser River		July 15 to August 15 (Contact DFO for anadromous salmon)
	BC-28	517.8	Crooked Creek		July 15 to August 15
	BC-32	522.5	Swift Creek		July 15 to August 15 (Contact DFO for anadromous salmon)
	BC-36	531.3	Canoe River		July 15 to August 15
	BC-38, BC-52 and BC-56	534.5, 545.9 and 547.6	Camp Creek		July 15 to August 15
	BC-65, BC-82 and BC-85	552.1, 561.2 and 563.6	Albreda River	3	July 22 to August 15

TABLE 4.36 Cont'd

Species	Master Crossing Number	RKs	Watercourse Name	Region	Timing Window[1]
RB (ST not recorded previously) (cont'd)	BC-111, BC-182 and BC-236	581.2, 619.9 and 651.6	North Thompson River	3	July 22 to August 15
	BC-173	605.2	Whitewater Creek		August 7 to 15
	BC-176	609.4	Cook Creek		August 7 to 15
	BC-177	611.6	Cedar Creek		June 1 to August 15
	BC-178	613.8	Blue River		August 7 to 15
	BC-180	616.9	Goose Creek		July 22 to August 15
	BC-189	626.6	Froth Creek		August 7 to 15
	BC-193	633.9	Foam Creek		August 7 to 15
	BC-201	638.8	Finn Creek		July 22 to August 15
	BC-227	648.9	Tumtum Creek		July 22 to August 15
	BC-242	656.1	Avola Creek		July 22 to August 15
	BC-275	683.4	Mad River		August 7 to September 30
	BC-309	717.7	Raft River		July 22 to August 15
	BC-312	725.5	Clearwater River		August 7 to 15
	BC-315	735.0	Mann Creek		July 22 to August 20
	BC-330	749.3	Lemieux Creek		July 22 to August 15
	BC-331	751.0	Nehalliston Creek		July 22 to October 31
	BC-332	752.3	Eakin Creek		July 22 to August 15
	BC-336	757.9	Montigny Creek		July 22 to October 31
	BC-338	761.1	Thuya Creek		July 22 to October 31
	BC-344	768.5	Lindquist Creek		July 22 to August 15

Note: 1 Instream construction timing windows are watercourse specific and/or reflect all species of conservation concern.

4.3.5.4 Black Pines to Hope Segment

Table 4.37 provides known rainbow trout and steelhead habitat and instream construction timing windows for the Black Pines to Hope Segment.

TABLE 4.37

KNOWN RAINBOWTROUT/STEELHEAD HABITAT WITHIN THE BLACK PINES TO HOPE SEGMENT

Species		Master Crossing Number	RKs	Watercourse Name	Region	Timing Window[1]
RB		Parallels	--	North Thompson River	3	July 22 to August 15
		BC-371	820.2	Jamieson Creek		July 22 to September 30
		BC-376	825.5	Lanes Creek		July 22 to September 30
		BC-381	828.3	Dairy Creek		July 22 to September 30
		BC-382	829.0	McQueen Creek		July 22 to September 30
	ST	BC-413	846.8	Thompson River		July 22 to August 15
		Not crossed	--	South Thompson River		July 22 to August 15
		BC-426	858.4	Peterson Creek		July 22 to October 31
		BC-433	865.2	Anderson Creek		July 22 to August 15
		BC-459	892.8	Moore Creek		July 22 to August 31
	ST	BC-482	915.9	Clapperton Creek		July 22 to August 1
	ST	BC-504	928.0	Nicola River		July 22 to August 1
		BC-505	928.7	Hamilton Creek		July 22 to October 31
		BC-512	931.0	Godey Creek		July 22 to August 15
	ST	BC-548	957.9	Coldwater River		August 7 to 10
	ST	BC-559, BC-570 and BC-582	970.3, 980.0 and 990.0	Coldwater River		July 22 to August 1
		BC-571	980.8	Juliet Creek		July 22 to August 15
		BC-579	987.1	Mine Creek		July 22 to October 31

TABLE 4.37 Cont'd

Species		Master Crossing Number	RKs	Watercourse Name	Region	Provincial Instream Work Window [1]
RB (cont'd)		BC-588	997.3	Fallslake Creek	2	August 1 to October 31
	SST	BC-591 and BC-596	1003.1 and 1011.0	Boston Bar Creek		August 1 to 31
	SST	BC-629	1020.3	Ladner Creek		August 1 to 31
	SST, ST	BC-631, BC-636, BC-639, BC-645 and BC-654	1021.8, 1026.5, 1028.6, 1032.6 and 1043.2	Coquihalla River		August 1 to 31
	SST	BC-632	1022.9	Dewdney Creek		August 1 to 31
		BC-634	1024.5	Karen Creek		August 1 to 31

Note: 1 Instream construction timing windows are watercourse specific and/or reflect all species of conservation concern.

4.3.5.5 Black Pines Power Line

There are records of rainbow trout in the North Thompson River (Table 4.37).

4.3.5.6 Kingsvale Power Line

There are records of rainbow trout in the upper Voght Creek mainstem, including Nilsson Creek, Kanevale Creek and lakes such as Seymour, Shea, Englishmen, Harmon, Kane and Kidd (Section 4.2.5). The instream construction timing window for rainbow trout-bearing watercourses within the proposed power corridor is July 22 to October 31.

4.3.5.7 Hope to Burnaby Segment

Table 4.38 provides known rainbow trout and steelhead habitat and instream construction timing windows for the Hope to Burnaby Segment.

TABLE 4.38

KNOWN RAINBOW TROUT/STEELHEAD HABITAT WITHIN THE HOPE TO BURNABY SEGMENT

Species		Master Crossing Number	RKs	Watercourse Name	Region	Provincial Instream Work Window [1]
RB	SST, ST	BC-657	1047.2	Silverhope Creek	2	August 1 to 31
	ST	BC-662	1055.5	Hunter Creek		August 1 to September 15
	ST	BC-666	1060.9	Lorenzetta Creek		August 1 to September 15
	ST	BC-668	1061.5	Wahleach Creek		August 1 to 15
	ST	BC-705	1078.2	Anderson Creek		August 1 to 15
		BC-706	1079.8	Bridal Creek		August 1 to September 15
		BC-709	1083.9	Dunville Creek		August 1 to September 15
		BC-713	1087.6	Elk Creek		August 1 to September 15
	ST	BC-715	1094.0	Chilliwack Creek		August 1 to September 15
	ST	BC-717	1102.3	Chilliwack/Vedder River		August 1 to 15
	ST	BC-720	1103.2	Street Creek		August 1 to September 15
		BC-722	1106.0	Stewart Slough		August 1 to September 15
	ST	BC-726	1114.6	Sumas River		August 1 to 15
	ST	BC-731 and BC-732	1122.4 and 1123.4	Clayburn Creek		August 1 to 15
	ST	BC-734	1127.8	McLennan Creek		August 1 to 15
	ST	BC-747	1138.0	Nathan Creek		August 1 to September 15
	ST	BC-749	1143.0	West Creek		August 1 to September 15
		BC-751	1145.6	Davidson Creek		August 1 to September 15
	ST	BC-753	1147.4	Salmon River		August 1 to 31
	ST	BC-768	1154.3	Yorkson Creek		August 1 to September 15
		BC-779	1166.9	Bon Accord Creek		August 1 to September 15
	SST, ST	BC-780	1168.9	Fraser River		August 1 to 15

TABLE 4.38 Cont'd

Species		Master Crossing Number	RKs	Watercourse Name	Region	Provincial Instream Work Window [1]
RB (cont'd)		BC-781	1171.1	Como Creek	2	August 1 to September 15
	ST	BC-782	1172.2	Nelson Creek		August 1 to September 15
	ST	BC-785	1176.5	Stoney Creek		August 1 to September 15

Note: 1 Instream construction timing windows are watercourse specific and/or reflect all species of conservation concern.

4.3.5.8 Burnaby Terminal

Rainbow trout have been recorded previously in Eagle Creek (BC-785a) (Section 4.2.7). The construction timing window for Eagle Creek is August 1 to September 15.

4.3.5.9 Burnaby to Westridge Segment

There are no previous records of rainbow trout in the unnamed tributary to Burrard Inlet.

4.3.6 Coastal Cutthroat Trout/Westslope Cutthroat Trout

4.3.6.1 Life History and Habitat

Cutthroat trout are distributed widely throughout coastal BC and are known to coexist with rainbow trout (McPhail 2007). Cutthroat trout are identified generally by its distinctive red slash under each side of the lower jaw. Cutthroat trout is a polytypic species and two native subspecies are common to BC, which includes the coastal cutthroat trout (*O. clarki clarki*) and the westslope cutthroat trout (*O. clarkia lewisi*) (McPhail 2007). The main external difference between coastal and westslope cutthroat trout is the pattern of black spots on the body; however, these two sub-species also differ in their morphology, genetics, chromosome number, biology and geographic distributions (McPhail 2007).

The coastal cutthroat trout is the most common sub-species within the RSA and LSA. In the Fraser system, they occur as far upstream as the District of Hope, BC and there is an old unverified record from the Thompson River near the Village of Ashcroft, BC (McPhail 2007). Westslope cutthroat trout are *SARA*-listed and Blue-listed as a Species of Special Concern in BC (Table 4.5), although they have limited distribution within the RSA and LSA and are confined primarily to the South Thompson and Fraser River drainage systems (*e.g.*, tributaries to the Eagle River and Mabel Lake) (McPhail 2007). Westslope cutthroat trout are most common to the Kootenay and Pend d'Oreille river systems (Columbia Drainage) in the southeastern portion of BC, while a few rare introductions of westslope cutthroat have been made into the lower Fraser River system (McPhail 2007) and a historic record from Garcia Lake, which is the headwaters to Godey Creek. Moreover, because of its introduced status within the RSA, non-native westslope cutthroat trout are not considered a sub-species of special conservation concern.

There are three general life history forms of coastal cutthroat trout within the RSA: a non-migratory freshwater-resident form; a migratory (often adfluvial) freshwater-resident form; and a sea-run form (anadromous) (McPhail 2007). Sexual maturity for coastal cutthroat trout is typically reached in three to six years of age. Adult fish generally prefer to spawn in small streams with low gradients; females dig redds in gravel at pool tail-outs and in some cases they may select areas of gravel deposition in large rivers, which includes side channels of the lower Fraser River (McPhail 2007). There is much inter-population variation in stream entry and spawning time, but spawning usually peaks in February and extends into the spring; some populations of coastal cutthroat trout can begin spawning as early as late October (McPhail 2007). Depending on the water temperature, fry will generally emerge from the gravel between March and June or approximately 35 to 190 days after fertilization. Physical characteristics of coastal cutthroat trout spawning are similar to those of westslope cutthroat trout; although westslope cutthroat trout normally spawn later (May to August) (McPhail 2007).

Pools, shallow riffles and low velocity glide areas along stream margins are important for fry, whereas low gradient reaches (0-5%) with pools, large woody debris and gravel are important habitat requirements for

juvenile and adult cutthroat trout (McPhail 2007). Diet is variable; non-migratory forms feed primarily on insects (includes westslope cutthroat trout); whereas migratory adfluvial and anadromous forms are highly piscivorous. Sea-run populations spend one to four summers in freshwater before migrating to the sea to forage; although fish return each fall to overwinter in freshwater (McPhail 2007). Anadromous forms are generally larger (23-30 cm) which is attributed primarily to a marine diet (McPhail 2007). Stream-resident forms rarely reach lengths greater than 20 cm although some adfluvial forms in lakes can reach weights of 3 kg and lengths of over 60 cm (McPhail 2007).

Known coastal cutthroat trout habitat (includes records for introduced westslope cutthroat) and respective instream construction timing windows (all species) are presented in the subsections below for each pipeline segment, the Burnaby Terminal and power line corridors.

4.3.6.2 Water Quality and Habitat

Water quality and habitat requirements for coastal and westslope cutthroat trout are similar and presented in Table 4.39.

TABLE 4.39

WATER QUALITY AND HABITAT REQUIREMENTS FOR CUTTHROAT TROUT (COASTAL AND WESTSLOPE)

Stage/Activity	Preferred Temperature (°C)	Preferred DO Concentration (mg/ L)	Preferred Current Velocity (m/s)	Depth Preference (m)	Preferred Substrate	Preferred Channel Morphology and Habitat Attributes
Incubation	10	6-8.2	0.20-0.55	0.17-0.20	< 5% fines and 2-64 mm gravel.	Riffle and glide habitat.
Rearing and Overwintering	9-13	9-11	0.07-0.13	≤ 0.40	Gravel/cobble.	Stream margins, backwaters and pool habitats.
Adults	6.1-17.2*	9	0.11-0.72*	0.50*	Small gravel 0.6-10.2 cm*.	Riffle pool complexes.

Sources: Berman 1998, Ford *et al.* 1995

Note: * Life history requirements for westslope and coastal cutthroat are similar; an asterisk * represents coastal cutthroat trout.

4.3.6.3 Hargreaves to Darfield Segment

There are no confirmed records of cutthroat trout within this pipeline segment; cutthroat trout are restricted to primarily to lower Fraser and upper South Thompson drainages.

4.3.6.4 Black Pines to Hope Segment

Coastal cutthroat trout have been recorded previously in the Coquihalla River (Table 4.40). It is also recognized that there are anecdotal records of introduced westslope cutthroat trout in Garcia Lake (1950 to 1960), which is located in the upper headwaters of Godey Creek (RSA). However, it should be noted that there are no previous records of westslope cutthroat trout in Godey Creek near the proposed pipeline corridor (LSA).

TABLE 4.40

KNOWN CUTTHROAT TROUT HABITAT WITHIN THE BLACK PINES TO HOPE SEGMENT

Species	Master Crossing Number	RKs	Watercourse Name	Region	Provincial Instream Work Window[1]
WCT	BC-512	931.0	Godey Creek (Introduced historically to Garcia Lake)	3	July 22 to August 15
CCT	BC-631, BC-636, BC-639, BC-645 and BC-654	1021.8, 1026.5, 1028.6, 1032.6 and 1043.2	Coquihalla River	2	August 1 to 31

Note: 1 Instream construction timing windows are watercourse specific and/or reflect all species of conservation concern.

4.3.6.5 Black Pines Power Line

There are no confirmed records of cutthroat trout in the North Thompson River system; cutthroat trout are restricted to primarily to lower Fraser and upper South Thompson drainages (Table 4.41).

4.3.6.6 Kingsvale Power Line

There are no records of coastal cutthroat trout in Voght Creek or unnamed tributaries (Section 4.2.5).

4.3.6.7 Hope to Burnaby Segment

Table 4.41 provides known coastal cutthroat trout habitat (also includes records for introduced westslope cutthroat) and instream construction timing windows for the Hope to Burnaby Segment.

TABLE 4.41

KNOWN CUTTHROAT TROUT HABITAT WITHIN THE HOPE TO BURNABY SEGMENT

Species		Master Crossing Number	RKs	Watercourse Name	Region	Timing Window[1]
CCT		BC-657	1047.2	Silverhope Creek	2	August 1 to 31
		BC-658	1051.5	Chawuthen Creek		August 1 to October 31
		BC-662	1055.5	Hunter Creek		August 1 to September 15
		BC-666	1060.9	Lorenzetta Creek		August 1 to September 15
		BC-668	1061.5	Wahleach Creek		August 1 to 15
		BC-705	1078.2	Anderson Creek		August 1 to 15
		BC-706	1079.8	Bridal Creek		August 1 to September 15
		BC-708	1083.4	Nevin Creek		August 1 to September 15
		BC-709	1083.9	Dunville Creek		August 1 to September 15
		BC-713	1087.6	Elk Creek		August 1 to September 15
		BC-714	1092.7	Semmihault Creek		August 1 to September 15
		BC-715	1094.0	Chilliwack Creek		August 1 to September 15
		BC-717	1102.3	Chilliwack/Vedder River		August 1 to 15
		BC-720	1103.2	Street Creek		August 1 to September 15

TABLE 4.41 Cont'd

Species		Master Crossing Number	RKs	Watercourse Name	Region	Provincial Instream Work Window [1]
CCT (cont'd)		BC-722	1106.0	Stewart Slough	2	August 1 to September 15
	WCT*	BC-726	1114.6	Sumas River		August 1 to 15
		BC-728	1116.5	Unnamed Tributary to Marshall Creek		August 1 to October 31
		BC-731 and BC-732	1122.4 and 1123.4	Clayburn Creek		August 1 to 15
		BC-733	1125.2	Unnamed Tributary to Gifford Slough		August 1 to September 15
		BC-734	1127.8	McLennan Creek		August 1 to 15
		BC-747	1138.0	Nathan Creek		August 1 to September 15
		BC-749	1143.0	West Creek		August 1 to September 15
		BC-751	1145.6	Davidson Creek		August 1 to September 15
	WCT*	BC-753	1147.4	Salmon River		August 1 to 31
		BC-766	1152.4	Unnamed Tributary to Yorkson Creek		August 1 to September 15
		BC-768	1154.3	Yorkson Creek		August 1 to September 15
		BC-773	1161.7	Unnamed Tributary to Fraser River		August 1 to September 15
		BC-779	1166.9	Bon Accord Creek		August 1 to September 15
	WCT*	BC-780	1168.9	Fraser River		August 1 to 15
		BC-781	1171.1	Como Creek		August 1 to September 15
		BC-782	1172.2	Nelson Creek		August 1 to September 15
		BC-785	1176.5	Stoney Creek		August 1 to September 15

Notes: 1 Instream construction timing windows are watercourse specific and/or reflect all species of conservation concern.

* Westslope cutthroat trout are not native to lower Fraser River drainages.

4.3.6.8 Burnaby Terminal

Coastal cutthroat trout have been recorded previously in Eagle Creek (BC RA183.1) (Section 4.2.7). The instream construction timing window for Eagle Creek is August 1 to September 15.

4.3.6.9 Burnaby to Westridge Segment

There are no previous records of coastal cutthroat trout in the unnamed tributary to Burrard Inlet (Section 4.2.8).

4.4 Federally-Listed Species (Schedule 1 of *Species at Risk Act*)

Descriptions of federally-listed species at risk (Schedule 1 of *SARA*), including distribution throughout the RSA and LSA, are presented below for the following species: white sturgeon; green sturgeon; salish sucker; and nooksack dace.

4.4.1 White Sturgeon

4.4.1.1 Life History and Habitat

White sturgeon are indigenous to the Pacific Coast of North America where they occur sporadically in the sea from California to the Gulf of Alaska (McPhail 2007). Freshwater distributions are much narrower than

marine distributions and self-sustaining populations occur in the Sacramento-San Joaquin, Columbia and Fraser River systems, and there are possibly small populations in the Nass and Skeena Rivers (McPhail 2007). White sturgeon occasionally show up in other small coastal rivers but these occurrences are rare which suggests that these fish likely do not reproduce in these rivers (McPhail 2007). White sturgeon are facultatively anadromous and often migrate to estuaries; they can also spend prolonged periods in marine environments (Scott and Crossman 1973, Vienott *et al.* 1999). Tagging programs have also shown that white sturgeon occasionally move between river systems.

There are six genetically identifiable white sturgeon populations in BC, which includes lower, middle upper Fraser River populations; a Nechako River population and a Kootenay River Population (Hatfield *et al.* 2004). Within the Fraser River drainage, white sturgeon can occur in the mainstem from the estuary to as far upstream as Rearguard Falls (Hatfield *et al.* 2004). They are also found in the mainstem of the Nechako River and many of the large lakes associated with the Fraser and Nechako River. In the Thompson River, white sturgeon are reported to be as far upstream as Kamloops, BC. Fraser River white sturgeon are divided into four distinct stock groups.

- SG1 includes the lower Fraser River upstream from the estuary to Hells Gate; this population is stable and not listed in Schedule 1 of *SARA* but is listed by COSEWIC as Threatened.

- SG2 includes the middle Fraser River upstream from Hells Gate to Prince George and the Thompson River; this population is not listed in Schedule 1 of *SARA* and are non-active under COSEWIC.

- SG3 includes the Nechako and Stuart River systems upstream from Prince George; this population is listed in Schedule 1 of *SARA* as Endangered.

- SG4 includes the upper Fraser River upstream from Prince George past the Morkill River and potentially Rearguard Falls (Hatfield *et al*. 2004, McPhail 2007); this population is listed in Schedule 1 of *SARA* as Endangered.

White sturgeon mature slowly and have a long life-span with some fish over 100 years of age (BC MOE 2013). White sturgeon do not typically spawn until the females are over 18 years of age and males are at least 14 years of age; however, once mature, adult fish are capable of spawning many times throughout their life (BC MOE 2013). White sturgeon usually begin spawning shortly after the freshet period in the spring but spawning is primarily driven by temperature. In the lower Fraser River spawning occurs in mid-June to early July when water temperatures reach a daily mean of 12^0C–17^0C (Triton 2011). White sturgeon are broadcast spawners; females can release as many as 100,000 to 3,000,000 eggs into the water current but only a small number of eggs may actually get fertilized (BC MOE 2013). Fertilized eggs become sticky and attach to the river bottom; mature larvae form in approximately eight to 15 days and remain nestled in the river bed for another 20 to 30 days before developing into free-swimming young sturgeon (BC MOE 2013). Juvenile white sturgeon feed on amphipods, chironomids, freshwater clams, aquatic nymphs and young fish and grow rapidly, reaching a length of almost 30 cm in their second growing season and often exceed 1 m by the age of 12. Adults forage primarily on fish (eulachon, sculpins, sticklebacks and lamprey), large crustaceans (crayfish) and spawning adult salmon (McPhail 2007).

The quality and quantity of white sturgeon habitat has declined in BC which could primarily affect recruitment success (Hatfield *et al.* 2004). The largest contributing factor is likely the regulation of river flows through dams; however, dredging, gravel extraction, channelization and dyking are also common and may be especially important on the lower Fraser River (Hatfield *et al.* 2004).

4.4.1.2 Hargreaves to Darfield Segment

White sturgeon occur in the upper Fraser River mainstem although their abundance may be naturally low (Hatfield *et al.* 2004); records in the upper Fraser River past the Morkill River are not confirmed.

4.4.1.3 Black Pines to Hope Segment

There are anecdotal records of white sturgeon in the Thompson River and Kamloops Lake although their abundance has not been confirmed.

4.4.1.4 Black Pines Power Line

Not recorded previously in the North Thompson River.

4.4.1.5 Kingsvale Power Line

Not recorded previously in the Lower Nicola River and Upper Similkameen River watersheds near the proposed power line corridor.

4.4.1.6 Hope to Burnaby Segment

The lower Fraser River white sturgeon population is relatively stable supporting a popular catch and release fishery in BC. Recent tagging and monitoring programs for Fraser River white sturgeon generated a populations estimate of approximately 49,000 fish with fork lengths ranging from 40-280 cm (Nelson *et al.* 2013). White sturgeon commonly inhabit lower reaches of smaller tributaries to the lower Fraser River (*i.e.*, near confluences) and there are records of white sturgeon (*e.g.*, WSG, SG) in Anderson Creek, Chilliwack Creek, lower Chilliwack/Vedder River (Vedder Canal), Sumas River, McLennan Creek and in Willaband Creek at the confluence with Clayburn Creek upstream from the proposed pipeline corridor Table 4.42.

TABLE 4.42

PREVIOUS RECORDS OF WHITE STURGEON IN THE HOPE TO BURNABY SEGMENT

Species	Master Crossing Number	RK	Watercourse Name	Region	Provincial Instream Work Window [1]
WSG or SG	BC-705	1078.2	Anderson Creek	2	August 1 to 15
	BC-715	1094.0	Chilliwack Creek		August 1 to September 15
	BC-717	1102.3	Chilliwack/Vedder River		August 1 to 15
	BC-726	1114.6	Sumas River		August 1 to 15
	BC731	1122.4	Clayburn Creek		August 1 to August 15
	BC-734	1127.8	McLennan Creek		August 1 to 15
	BC-780	1168.9	Fraser River		August 1 to August 15

Note: 1 Instream construction timing windows are watercourse specific and/or reflect all species of conservation concern.

4.4.1.7 Burnaby Terminal

White Sturgeon have not been recorded previously in Eagle Creek or the Brunette River.

4.4.1.8 Burnaby to Westridge Segment

White Sturgeon have not been recorded previously in this segment.

4.4.2 Green Sturgeon

4.4.2.1 Life History and Habitat

Green sturgeon is listed under *SARA* and COSEWIC as a Species of Special Concern. This species occupies marine waters on both sides of the North Pacific Ocean but not much is known about their marine habitat requirements (McPhail 2007). Most incidental catches at sea are by trawlers and long-line gear and it is speculated that they remain close to the ocean bottom (McPhail 2007). They typically inhabit brackish waters of estuarine areas at the mouths of large rivers and are typically only found only in freshwater during the spawning season.

BC records are either from the ocean off the west coast of Vancouver Island or from northern estuaries of the Skeena, Nass and Taku rivers. The most recent records (2005) of green sturgeon in BC are in the Fraser River within the Lower Mainland but they are not known to spawn in BC rivers (McPhail 2007). The nearest known spawning sites are the Sacramento and Klamath rivers of northern California and the Rogue River of southern Oregon (McPhail 2007).

Spawning generally peaks in the spring from March to July at water temperatures ranging from 8-14^{0}C; green sturgeon generally prefer deep, fast mainstem channels (McPhail 2007). Similar to white sturgeon, green sturgeon are broadcast spawners; females seek out locations with suitable substrate and eggs are fertilized in the water current as they are released. Fertilized eggs are dense and become lodged in the substrate along the river bottom; eggs hatch in approximately seven to nine days with metamorphosis into juvenile free-swimming fish occurring in approximately 45 days (McPhail 2007). Juvenile fish grow rapidly and can reach 30 cm in their first year or life and 60 cm after two or three years (McPhail 2007). However, green sturgeon is slow to mature; typically the age of maturity for males is between the ages of 11 to 22, and 14 to 34 for females (Government of Canada 2012). Juvenile green sturgeon spends one to four years in freshwater where they forage primarily at night and their diet consists of mysids and amphipods (McPhail 2007). Adult fish do not feed in freshwater but they tend to aggregate in the estuaries of major non-natal rivers in the late summer and fall including the Fraser Estuary; marine diet of adult green sturgeon includes crabs, shrimps, isopods, amphipods and small fish (McPhail 2007).

4.4.2.2 Hargreaves to Darfield Segment

Not recorded previously within this segment.

4.4.2.3 Black Pines to Hope Segment

Not recorded previously within this segment.

4.4.2.4 Black Pines Power Line

Not recorded previously in the North Thompson River.

4.4.2.5 Kingsvale Power Line

Not recorded previously in the Lower Nicola River and Upper Similkameen River watersheds near the proposed power line corridor.

4.4.2.6 Hope to Burnaby Segment

There are incidental records of green sturgeon in the lower Fraser River mainstem, although their occurrence in freshwater is rare and there are no known spawning sites in BC rivers (McPhail 2007).

4.4.2.7 Burnaby Terminal

Not recorded previously in Eagle Creek or the Brunette River.

4.4.2.8 Burnaby to Westridge Segment

Not recorded previously in this segment.

4.4.3 Salish Sucker

4.4.3.1 Life History and Habitat

The salish sucker is a genetically distinctive, semi-dwarf form of the longnose sucker; these two species are separated geographically by a distance of approximately 45 km (BC MELP 1993]). Populations of salish sucker occur only in BC in a few small streams in the vicinity of Langley and Aldergrove, in the heavily settled Fraser Valley area (BC MELP 1993). Salish sucker populations are red listed by BC MOE (BC CDC 2013). Moreover, salish sucker are listed in Schedule 1 of *SARA* as Endangered, and by COSEWIC as threatened. In 1992, the Habitat Conservation Fund of BC funded a survey of 34 streams west from Hope and south from the Fraser River; salish sucker were recorded in only five streams, one which included the Salmon River (BC MELP1993).

Salish suckers prefer the upper reaches of small, gently-flowing streams, with cool, clear water, approximately 40-110 m above sea level (BC MELP 1993). Typical habitat includes slow velocity channels which are normally 2-7 m wide, less than 1 m deep and have silt, sand or gravel bottoms (BC

MELP 1993). Adults typically prefer glide and pool habitat, while juvenile fish can be found in faster riffle habitat; both generally occur amongst instream vegetation or along stream banks with overhanging vegetation. Riffles with fine gravel bottoms are preferred for spawning (BC MELP 1993).

Salish suckers in the Fraser Valley typically spawn in April when water temperatures reach 7 ^{0}C to 8 ^{0}C but can also occur as late as July or August (BC MELP 1993). Salish suckers broadcast spawn and reproduction is similar to that of a longnose sucker; the female releases thousands of eggs into the water, a few at a time, while one or more males release sperm to fertilize the eggs (BC MELP1993). The eggs adhere to the gravel and hatch approximately two weeks later; fry remain among the gravel for another one to two weeks thereafter (BC MELP 1993). The diet of salish suckers is not well known and is interpreted based on the diet of longnose suckers, which likely includes chironomids, snails, small crustaceans, insect larvae, worms and fish eggs (BC MELP 1993).

4.4.3.2 Hargreaves to Darfield Segment

Not recorded previously within this segment.

4.4.3.3 Black Pines to Hope Segment

Not recorded previously within this segment.

4.4.3.4 Black Pines Power Line

Not recorded previously in the North Thompson River

4.4.3.5 Kingsvale Power Line

Not recorded previously in the Lower Nicola River and Upper Similkameen River watersheds near the proposed power line corridor.

4.4.3.6 Hope to Burnaby Segment

Salish sucker are currently recorded in Semmihault Creek, Chilliwack Creek and the Salmon River Table 4.43.

TABLE 4.43

PREVIOUS SALISH SUCKER RECORDS IN THE HOPE TO BURNABY SEGMENT

Species	Master Crossing Number	RK	Watercourse Name	Region	Provincial Instream Work Window [1]
SSU	BC-714	1092.7	Semmihault Creek	2	August 1 to September 15
	BC-715	1094.0	Chilliwack Creek		August 1 to September 15
	BC-753	1147.4	Salmon River		August 1 to 31

Note: 1 Instream construction timing windows are watercourse specific and/or reflect all species of conservation concern.

4.4.3.7 Burnaby Terminal

Salish sucker has not been recorded previously in Eagle Creek or the Brunette River.

4.4.3.8 Burnaby to Westridge Segment

Salish sucker has not been recorded previously within this segment.

4.4.4 Nooksack Dace

4.4.4.1 Life History and Habitat

Nooksack dace are distributed in rivers and streams in northwestern Washington State and four streams in the Fraser Valley of BC (COSEWIC 2007). The four streams in BC with confirmed populations are

Bertrand Creek, Pepin Creek, Fishtrap Creek and the Brunette River. As a result of an extremely narrow distribution and disruption of habitat, the nooksack dace is Red-listed in BC and listed in Schedule 1 of *SARA* and by COSEWIC as Endangered. (COSEWIC 2007, BC CDC 2013). The decline of nooksack dace habitat has been attributed primarily to urban development; factors include riparian removal, siltation, pollution and stream flow alteration from ditching, diversion and water extraction (BC MELP 1995).

Adult nooksack dace depend on streams with riffle habitat where the water is 10 to 20 cm deep, the velocities are 20 to 35 cm/s and the substrate is loose gravel, cobble or boulder (COSEWIC 2007). Juveniles live in calm pools located at the downstream end of riffles with 10 to 20 cm of water and sand or mud substrates (COSEWIC 2007). Nooksack dace spawn at the upstream end of riffles over course substrate between April and early July (COSEWIC 2007). Adults spawn annually and females may spawn multiple egg clutches during the long spawning period (COSEWIC, 2007). Male and female nooksack dace establish small breeding territories at the upstream end of riffles and females leave their territories at night to spawn with territorial males. Females release adhesive eggs that stick to the gravel substrate and incubate for seven to ten days (Inglis 1995). After hatching, the larvae spend another week in the gravel until the yolk sac is absorbed, then move to calm pools downstream from riffles (COSEWIC 2007). Juvenile nooksack dace feed on zooplankton and chironomid larvae and adults feed on insects (COSEWIC 2007). Nooksack dace typically live four to six years and reach sexual maturity at the end of their second summer (COSEWIC 2007).

4.4.4.2 Hargreaves to Darfield Segment

Not recorded previously within this segment.

4.4.4.3 Black Pines to Hope Segment

Not recorded previously within this segment.

4.4.4.4 Black Pines Power Line

Not recorded previously in the North Thompson River

4.4.4.5 Kingsvale Power Line

Not recorded previously in the Lower Nicola River and Upper Similkameen River watersheds near the proposed power line corridor.

4.4.4.6 Hope to Burnaby Segment

There are previous records of nooksack dace in Salmon River and they are assumed to be present in Stoney Creek which is a tributary to the Brunette River (Table 4.44). Nooksack dace are known to occur in the Brunette River; the first 825 m of Stoney Creek also provides suitable habitat and there are no barriers to migration (COSEWIC 2007).

TABLE 4.44

PREVIOUS NOOKSACK DACE RECORDS IN THE HOPE TO BURNABY SEGMENT

Species	Master Crossing Number	RK	Watercourse Name	Region	Provincial Instream Work Window[1]
NDC	BC-753	1147.4	Salmon River	2	August 1 to 31
	BC-785	1176.5	Stoney Creek		August 1 to September 15

Note: 1 Instream construction timing windows are watercourse specific and/or reflect all species of conservation concern.

4.4.4.7 Burnaby Terminal

There are no previous records of nooksack dace in Eagle Creek; although there are records of nooksack dace in the Brunette River.

4.4.4.8 Burnaby to Westridge Segment

Nooksack dace have not been recorded previously within this segment.

4.5 Provincially-Listed Species or Committee for the Status of Endangered Wildlife in Canada

Descriptions of provincially-listed species (Red or Blue-listed) or those identified by COSEWIC, including distribution throughout the Project area, are presented below for the following species: mountain sucker; eulachon; chiselmouth; and sockeye (Cultus population). Interior Fraser River coho salmon are discussed in Section 4.3.3.

It is acknowledged that localized populations of western brook lamprey (Morrison Creek Population) (*Lampetra richardsoni*) are Red-listed in BC (BC CDC 2013), and while coastrange sculpin (Cultus Lake Population) (*Cottus aleuticus*) are secure and not at risk, both species are Threatened or Endangered under COSEWIC (2010b, 2013) and *SARA* (GOC 2012) and occur within the RSA. Although these fish species may reside regionally, habitat descriptions have not been included as Endangered sub-populations are not known to occur within the LSA.

Coastrange sculpin are found throughout the Lower Mainland in both the lower Fraser River and Coquihalla River and are not considered to be at risk. The Threatened Cultus Lake sub-population is endemic to the deep waters of Cultus Lake, BC and does not undergo stream migration into the LSA of the Project. Populations of western brook lamprey also occur within the lower Fraser River and are not considered to be at risk. The Endangered Morrison Creek population is exclusive to the Morrison Creek watershed on Vancouver Island, BC and does not occur within the RSA or LSA.

4.5.1 Mountain Sucker

4.5.1.1 Life History and Habitat

The mountain sucker has a scattered distribution in southern BC but are most abundant in the gravel deposition region of the lower Fraser River (near the District of Hope downstream to roughly the mouth of the Sumas River), the North Thompson River in the region of Heffley, and the Similkameen River system from above Princeton to the US border (McPhail 2007). In the lower Fraser River, mountain suckers commonly coexist with bridgelip suckers. Mountain sucker are Blue-listed in BC and identified by COSEWIC as a Species of Special Concern as their limited distribution makes them vulnerable to disturbance (COSEWIC 2010a). They are particularly sensitive to habitat degradation from both agricultural and industrial development and from the introduction of non-native exotic species (BC Ministry of Fisheries 1997).

Mountain suckers prefer rivers and streams with cool water, moderate velocities and rocky substrates; often associated with some kind of cover such as deep water, aquatic vegetation or overhanging vegetation (McPhail 2007). In the North Thompson and Similkameen rivers, adult mountain suckers occur in deep (greater than 1.5 m) glides and pools whereas in the Fraser River, the adults are observed on the lee sides of gravel bars in areas with moderate depth (up to 1.5 m) and current velocities less than 0.7 m/s (McPhail 2007). Juvenile mountain suckers in the Fraser River are found around mid-river gravel bars in shallower (less than 1 m) and slower water (less than 0.5 m/s) than the adults (McPhail 2007). In the North Thompson and Similkameen rivers, juveniles are typically found where tributary streams enter the main rivers (McPhail 2007). In the summer and fall, mountain sucker fry in the Fraser River are common in shallow bays and blind side-channels associated with mid-river gravel bars; fry in the North Thompson and Similkameen rivers aggregate in warm shallow bays and near tributary streams out of the main current (McPhail 2007).

Mountain sucker prefer gravel substrate for spawning and reproduce in the spring when water temperatures are approximately 10^0C (McPhail 2007). Spawning sites are typically situated in shallow riffles with 11 to 30 cm water depth and 0.06 to 0.20 m/s water velocities (McPhail 2007). The diet of the mountain sucker is dependent on the turbidity of the water; in clear streams they scrape periphyton off substrate with their specialized lower jaw. In turbid waters, mountain sucker commonly ingest material

directly off of the substrate including silt, filamentous algae, *Closterium* and some larval insects (McPhail 2007). In the Fraser River, juvenile fish were found to ingest diatoms and *Closterium* (McPhail 2007).

4.5.1.2 Hargreaves to Darfield Segment

There are records of mountain sucker in the North Thompson River.

4.5.1.3 Black Pines to Hope Segment

There are records of mountain sucker in the North Thompson River near the region of Heffley.

4.5.1.4 Black Pines Power Line

There are records of mountain sucker in the North Thompson River near the region of Heffley; the proposed Black Pines power line corridor is located approximately 11.5 km north from Heffley.

4.5.1.5 Kingsvale Power Line

Not recorded previously in the Lower Nicola River or Upper Similkameen River watersheds near the proposed power line corridor.

4.5.1.6 Hope to Burnaby Segment

There are records of mountain sucker in the Lower Fraser River.

4.5.1.7 Burnaby Terminal

Mountain sucker have not been recorded previously in Eagle Creek or the Brunette River.

4.5.1.8 Burnaby to Westridge Segment

Mountain sucker have not been recorded previously in this segment.

4.5.2 Eulachon

4.5.2.1 Life History and Habitat

Eulachon inhabit the west coast of North America from northern California to the eastern Bering Sea, spending the majority of their lives at sea (COSEWIC 2011). In BC, eulachon are found in large inlets along the coast and are known to occur in at least 38 rivers but most of these rivers do not have regular spawning runs (Scott and Crossman 1998, COSEWIC 2011). Based on genetic information, run timing and location of source waters, three units are recognized in Canada: the Nass/Skeena; the Central Pacific Coast; and the Fraser River (COSEWIC 2011). The eulachon is Blue-listed in BC and COSEWIC has listed the Nass/Skeena population as Special Concern and the Central Pacific Coast and Fraser River populations as Endangered (COSEWIC 2011, BC CDC 2013). All three populations have recorded declines in population numbers with the Fraser River and Central Pacific Coast populations experiencing substantial declines.

The eulachon is an anadromous smelt that travels short distances up coastal freshwater streams to spawn (Scott and Crossman 1998). The spawning migration begins in mid-March during ice breakup and lasts until mid-May. In the lower Fraser River, most eulachon spawning is confined to the lower 110 kilometres of the river (limit of tidal influence), which also overlaps with a substantial portion of rearing habitat for lower Fraser white sturgeon that are known to feed intensively on eulachon (DFO 2013d). Eulachon spawning occurs typically over gravel and course sand in water that is approximately 25 feet deep and has a temperature of 4.4°C-7.8°C (Scott and Crossman 1998). The rivers that the eulachon spawn in have variable characteristics with some being large or turbid and others being small and clear. One common characteristic between all of the spawning rivers is that they have spring freshets draining large snow packs or glaciers (COSEWIC 2011).

A female eulachon produces 17,000 to 40,000 eggs (Scott and Crossman 1998). The mildly adhesive fertilized eggs stick to sand and gravel particles and incubate for approximately 2-8 weeks before

hatching (COSEWIC 2011). The incubation time is dependent on temperature; after hatching the larvae are carried downstream and out to coastal waters where they spend most of their lives (Scott and Crossman 1998). Adults join the spawning migration when they are three years old and typically die after spawning for the first time but a few survive and return to the sea where they are then able to spawn for a second time (Scott and Crossman 1998).

In the ocean, adult and juvenile eulachons compete with other plankton feeders that feed primarily on euphausiids, crustaceans and cumaceans (Scott and Crossman 1998). Adults do not feed during migration into freshwater and the larvae likely do not feed when they emigrate downstream. Eulachon are an important food item in the sea for many intermediate and terminal predators including fish species, marine mammals and sea birds (Scott and Crossman 1998).

4.5.2.2 Hargreaves to Darfield Segment

Not recorded previously within this segment.

4.5.2.3 Black Pines to Hope Segment

Not recorded previously within this segment.

4.5.2.4 Black Pines Power Line

Not recorded previously in the North Thompson River.

4.5.2.5 Kingsvale Power Line

Not recorded previously in the Lower Nicola River or Upper Similkameen River watersheds.

4.5.2.6 Hope to Burnaby Segment

There are records of eulachon in the Lower Fraser River. The proposed instream construction timing window for the lower Fraser River is August 1 to August 15.

4.5.2.7 Burnaby Terminal

Eulachon have not been recorded previously in Eagle Creek or the Brunette River.

4.5.2.8 Burnaby to Westridge Segment

Eulachon have not been recorded previously within this segment.

4.5.3 Chiselmouth

4.5.3.1 Life History and Habitat

Chiselmouth are Blue-listed in BC as they have a fragmented distribution with little to no migration between the populations; however, their populations appear to be stable (McPhail 2007, BC CDC 2013). In BC, Chiselmouth are found in the drainage systems of the Fraser and Columbia rivers, including the Okanagan, Kettle, Similkameen, and Kootenay rivers as well as in the Fraser River system above the Fraser Canyon (McPhail 2007, Scott and Crossman 1998). In the Fraser system, chiselmouth are separated into a north and south cluster. The northern cluster includes the Chilcotin, Nazko and Euchiniko rivers; the southern cluster in the Thompson River system has populations in Nicola, Vidette and Mara lakes (McPhail 2007).

Chiselmouth typically occur more often in lakes than rivers, they prefer warmer waters associated with low velocity and dense vegetation with water temperature being the main factor influencing distribution in BC (McPhail 2007). Adult chiselmouth have been found in rivers with a bankfull width over 10 m; in a range of habitats including runs, riffles, glides, backwaters and pools but commonly occur in water deeper than 1 m, a velocity of 0.4 to 0.8 m/s with a cobble and boulder substrate (McPhail 2007). Juvenile chiselmouth use habitat with low water velocities and dense vegetation; fry are found in shallow backwaters and pools with low water velocities (less than 0.04 m/s) and cobble or large gravel substrates

(McPhail 2007). Chiselmouth spawn in streams and lakes from mid-June to August when the water temperature is warmer than 17°C (McPhail 2007). Lake populations will spawn at inlet or outlet streams; eggs are scattered across the gravel substrate or buried among boulders (Scott and Crossman 1998). Males and females reach sexual maturity at three and four years of age respectively (McPhail 2007).

During summer months, juveniles and young-of-the-year chiselmouth consume insects; adults typically consume diatoms and algae (McPhail 2007). Feeding on algae and diatoms by adult chiselmouth is accomplished by scraping the chisel-like lower jaw along rocks and other algae-covered substrates. During the winter, the adult chiselmouth become omnivorous and eat non-algal plants, chironomid larvae and pupae and other animal matter. The diet of fluvial adults is more restricted than that of lacustrine adults but young chiselmouths in both habitats are similar (McPhail 2007).

4.5.3.2 Hargreaves to Darfield Segment

Not recorded previously within this segment.

4.5.3.3 Black Pines to Hope Segment

Chiselmouth have been recorded previously in the Nicola River. The proposed timing window for the Nicola River is July 22 to August 1.

4.5.3.4 Black Pines Power Line

Not recorded previously in the North Thompson River.

4.5.3.5 Kingsvale Power Line

Not recorded previously within the proposed power line corridor.

4.5.3.6 Hope to Burnaby Segment

There are records of chiselmouth in the Fraser River; although most distribution in BC is confined to locations above the Fraser Canyon outside of the proposed Project area.

4.5.3.7 Burnaby Terminal

Not recorded previously in Eagle Creek or Brunette River.

4.5.3.8 Burnaby to Westridge Segment

Not recorded previously in this segment.

4.5.4 Sockeye Salmon (Cultus Population)

4.5.4.1 Life History and Habitat

Sockeye salmon are the anadromous form of kokanee (Groot and Margolis 1991). Freshwater sockeye distribution ranges from the Nass and Skeena river systems in northern BC to the Thompson, Nootka, and Fraser river systems in southern BC (Agriculture and Agri-Food Canada 2009). Sockeye are the second most abundant Pacific salmon species in BC, and the Fraser River is the largest production system, usually accounting for over half of the total production of this species (Henderson and Graham 1998).

One population of pacific sockeye (Cultus Lake sockeye) are listed by COSEWIC as Endangered (COSEWIC 2003b). The Cultus population has unique genetic and biological characters including migratory delay of adults at the Fraser River estuary, protracted lake residency before spawning, exclusive lake spawning, late spawning date and deep-water life-cycle of fry (COSEWIC 2003b). Key reasons for the decline of the Cultus population include direct overexploitation and incidental catches in mixed stock fisheries and high pre-spawn mortality on adults associated with early migration into freshwater and *Parvicapsula* parasite infestation (COSEWIC 2003b). Other ecological impacts to Cultus Lake which affect sockeye production include colonization by Eurasian Watermilfoil, high predation rates

by northern pikeminnow, land development, stream channelization, nutrient input, and recreational use (COSEWIC 2003b).

Sockeye spawning occurs between August and November (McPhail 2007), with four-year cyclical species abundance fluctuations (Scott and Crossman 1998). Spawning may be variable and extend until December, but occurs generally along tributary streams, lake shores, and lake outlets (Groot and Margolis 1991) where water temperatures are between 3^0C and 7^0C (Scott and Crossman 1998). Cultus sockeye are known to spawn late and typically enter the Fraser River and Cultus Lake in September to December (COSEWIC 2003b). Adults migrate in large schools from the ocean to freshwater spawning grounds, where eggs are laid in gravel as redds (Groot and Margolis 1991, Scott and Crossman 1998). Fry emerge from the gravel between April and June, and rear primarily in lakes associated with their natal streams for two years before migrating to the ocean (Government of Canada 2012). Cultus sockeye breed exclusively in the lake and juveniles remain throughout the limnetic zone for one to two years before migrating towards the Fraser estuary (COSEWIC 2003b).

Juvenile and adult sockeye feed primarily on zooplankton and larval fishes (freshwater and marine) as well as on squid and to a lesser degree small fishes in marine habitats (McPhail and Lindsey 1970). Dominant prey is region dependant and varies between fresh and saltwater dwelling individuals (Brodeur 1990, Groot and Margolis 1991). Young sockeye are preyed upon by larger fish species, including rainbow and cutthroat trout, Dolly Varden, and coho salmon (Scott and Crossman 1998).

4.5.4.2 Hargreaves to Darfield Segment

There are records of sockeye salmon (these populations are not Endangered) in the North Thompson River, Finn Creek, Raft River, Clearwater River, Mann Creek and Lemieux Creek (Table 4.45).

TABLE 4.45

PREVIOUS SOCKEYE RECORDS IN THE HARGREAVES TO DARFIELD SEGMENT

Species	Master Crossing Number	RKs	Watercourse Name	Region	Provincial Instream Work Window[1]
SK (Not Endangered)	BC-111, BC-182 and BC-236	581.2, 619.9 and 651.6	North Thompson River	3	July 22 to August 15
	BC-201	638.8	Finn Creek		July 22 to August 15
	BC-309	717.7	Raft River	3	July 22 to August 15
	BC-312	725.5	Clearwater River		August 7 to 15
	BC-315	735.0	Mann Creek		July 22 to August 20
	BC-330	749.3	Lemieux Creek		July 22 to August 15

Note: 1 Instream construction timing windows are watercourse specific and/or reflect all species of conservation concern.

4.5.4.3 Black Pines to Hope Segment

There are records of sockeye salmon in the North Thompson, Thompson, South Thompson, Nicola and Coquihalla rivers (Table 4.46) (these populations are not Endangered).

TABLE 4.46

PREVIOUS SOCKEYE RECORDS IN THE BLACK PINES TO HOPE SEGMENT

Species	Master Crossing Number	RKs	Watercourse Name	Region	Provincial Instream Work Window[1]
SK (Not Endangered)	Not Crossed	--	North Thompson River	3	July 22 to August 15
	BC-413	846.8	Thompson River		July 22 to August 15
	Not Crossed	--	South Thompson River		July 22 to August 15
	BC504	928.0	Nicola River		July 22 to August 1

TABLE 4.46 Cont'd

Species	Master Crossing Number	RKs	Watercourse Name	Region	Provincial Instream Work Window [1]
SK (Not Endangered) (cont'd)	BC-631, BC-636, BC-639, BC-645 and BC-654	1021.8, 1026.5, 1028.6, 1032.6 and 1043.2	Coquihalla River	3	August 1 to 31

Note: 1 Instream construction timing windows are watercourse specific and/or reflect all species of conservation concern.

4.5.4.4 Black Pines Power Line

There are records of sockeye salmon in the North Thompson River (Table 4.46) (this population not endangered).

4.5.4.5 Kingsvale Power Line

No recorded previously within the proposed power line corridor.

4.5.4.6 Hope to Burnaby Segment

There are records of sockeye salmon in the Coquihalla River, Wahleach Creek, Chilliwack/Vedder River, Sumas River, Clayburn Creek, McLennan Creek, Nathan Creek, Salmon River and the lower Fraser River (Table 4.47). Cultus lake sockeye (Endangered) is exclusive to the Chilliwack/Vedder River, Sumas River (lower reaches) and lower Fraser River only.

TABLE 4.47

PREVIOUS SOCKEYE RECORDS IN THE HOPE TO BURNABY SEGMENT

Species	Master Crossing Number	RKs	Watercourse Name	Region	Provincial Instream Work Window [1]
SK	BC-668	1061.5	Whaleach Creek	2	August 1 to 31
	BC-717	1102.3	Chilliwack/Vedder River (includes Cultus Lake population)		August 1 to 15
	BC-726	1114.6	Sumas River (lower reach includes Cultus Lake population)	2	August 1 to 15
	BC-731 and BC-732	1122.4 and 1123.4	Clayburn Creek		August 1 to 15
	BC-734	1127.8	McLennan Creek		August 1 to 15
	BC-747	1138.0	Nathan Creek		August 1 to September 15
	BC-753	1147.4	Salmon River		August 1 to 31
	BC-780	1168.9	Lower Fraser River (includes Cultus Lake population)		August 1 to 15

Note: 1 Instream construction timing windows are watercourse specific and/or reflect all species of conservation concern.

4.5.4.7 Burnaby Terminal

Sockeye have not been recorded previously in Eagle Creek or the Brunette River.

4.5.4.8 Burnaby to Westridge Segment

Sockeye have not been recorded previously in this segment.

5.0 RESULTS OF FIELD DATA COLLECTION

5.1 General Information

A total of 776 (approximately 93%) of the 836 potential watercourse crossings (includes stream channels, wetlands and NCD/NVCs) were investigated along the proposed pipeline corridor during the 2012/2013 fish and fish habitat assessments. Results are provided below for each pipeline segment, proposed power line corridor and the Burnaby Terminal, which includes a summary of all fish-bearing vs. Nonfish-bearing watercourses and respective stream classifications.

In total, 60 watercourse crossings require supplemental studies (one or two seasons of sampling) to confirm fish-bearing or nonfish-bearing status within the LSA (Section 6.10 and Appendix F). These watercourse crossings were not included in the final results to date, except where definitive fish-bearing classifications could be made and habitat sensitivities could be inferred from desktop reviews (*e.g.*, Baer Creek, Terry Fox Creek, Marathon Creek). A total of 8 fish-bearing watercourse crossings requiring supplemental studies were included in the results and they are summarized in Appendix F.

Results of the fish and fish habitat field data collection (Section 5.0) and literature review (Section 4.0) were also used to derive habitat sensitivity rankings: high (red) or low (green), for each known fish-bearing watercourse. A nonfish-bearing status (S5 and S6) was assigned to those watercourses where fish absence was confirmed and habitat potential was rated as nil or low; these watercourses were also assigned a low (green) sensitivity ranking. Preliminary sensitivity rankings (high or low) were also provided for all watercourse crossings requiring supplemental studies. The preliminary rankings were derived based on inferred and historical fish presence, proximity to known fish habitat, gradient and field investigations conducted downstream from the proposed pipeline corridor (LSA).

Fish records for all indicator species and species at risk captured or observed during 2006, 2012 and 2013 Trans Mountain field programs are also provided below for each pipeline segment, proposed power line corridor, and the Burnaby Terminal. Note that these data are supplemental to the literature review (Section 4.0) and should be used as an update to the existing historical information and to provide additional watercourse crossings where indicator species were not documented previously.

The potential for indicator species and species at risk within the LSA or RSA was evaluated solely on habitat quality and potential for species distribution (historical presence). It is recognized that a lack of capture or observation data during the 2006/2012/2013 fish and fish habitat assessments does not confirm a species as absent from a system where habitat quality is optimal.

Where watercourses were assessed to be nonfish-bearing at or adjacent to the proposed pipeline corridor (*i.e.*, gradient barriers) but had potential for fish downstream within the LSA, they were assigned a low (green) sensitivity ranking but are presented in the Fish-Bearing Atlas (Appendix B) to ensure that appropriate mitigation measures will be employed to protect fish and aquatic habitat within the LSA. A dual-classification status (*i.e.*, S6/S4 or S5/S3) is used to represent these watercourses, where the first classification denotes the nonfish-bearing reach in which the proposed pipeline corridor is situated. These sites are not included in the totals of fish-bearing watercourses crossed by the proposed pipeline corridor. Crossings that require a second season of sampling to confirm fish presence within the proposed pipeline corridor are included in the supplemental studies total.

A summary of all potential watercourse crossings within the proposed pipeline corridor is presented in the Watercourse Crossing Summary Table (Appendix A). A summary of all fish-bearing watercourse crossings including stream classification, channel morphology, water quality/quantity, current and historical fish presence, habitat potential, construction recommendations, least risk window, navigability, sensitivity ranking and comments is presented in the Fish-Bearing Atlas (Appendix B). A summary of all nonfish-bearing watercourses including applicable information such as stream classification, channel width, habitat potential, sampling effort, least risk window, navigability, proximity to other watercourses and comments is presented in the Nonfish-Bearing Atlas (Appendix C).

A summary of navigable, potentially navigable, and minor navigable waters are also provided in the results below and included in the Watercourse Crossing Summary Table (Appendix A); navigable water

determinations for each watercourse are also provided in Fish-Bearing (Appendix B) and Nonfish-Bearing (Appendix C) atlases.

Results of the aquatics TEK collected during field surveys for the BC component of the Project are compiled below and organized according to proposed pipeline segment. Issues and concerns related to aquatic resources as well as proposed mitigation measures and/or response to those issues are provided below. Each Aboriginal community participated in comprehensive reviews of mitigation measures in the context of all the issues they had raised during the field surveys and follow-up review.

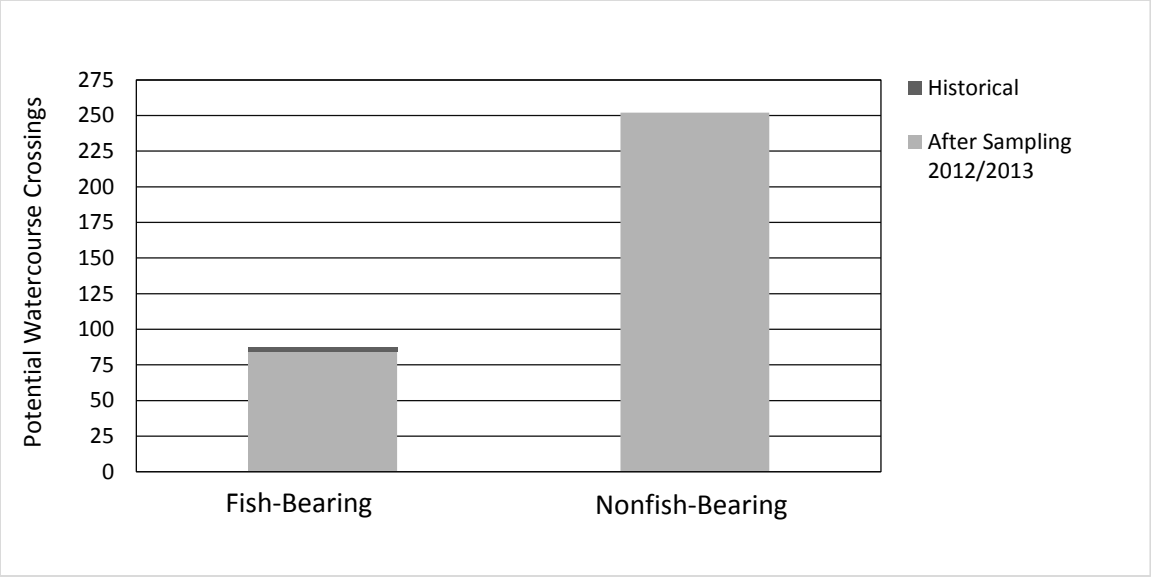
5.2 Hargreaves to Darfield Segment

5.2.1 Watercourse Crossings

5.2.1.1 Fish-Bearing versus Nonfish-Bearing Drainages

A total of 349 potential watercourse crossings were identified within the Hargreaves to Darfield Segment of the proposed pipeline corridor. Of this total, 333 potential watercourse crossings (*i.e.*, stream, wetlands and NCD/NVCs) were assessed in the field. A total of 16 watercourse crossings still require supplemental studies (Section 6.9 and Appendix F). A total of 85 are considered to be fish-bearing and 251 are considered to be nonfish-bearing (Figure 5.1) within the proposed pipeline corridor. Of the watercourses that require supplemental studies, 3 are included in the final result of 85 fish-bearing drainages (includes Baer Creek, Marathon Creek and Terry Fox Creek) as they have adequate historical information.

Figure 5.1 Fish-Bearing Status of Watercourse Crossings, Hargreaves to Darfield Segment



5.2.1.2 Summary of Classifications for Potential Watercourse Crossings

A breakdown of the number of streams of each classification for all fish-bearing and nonfish-bearing drainages within the Hargreaves to Darfield Segment is presented inTable 5.1.

TABLE 5.1

STREAM CLASSIFICATIONS OF WATERCOURSE CROSSINGS INVESTIGATED IN THE HARGREAVES TO DARFIELD SEGMENT

Classification	Total Number
Fish-Bearing	
S1A	4
S1B	9
S2	33
S3	21
S4	8
S4/NCD-W	1
S5/S2	2
S5/S3	4
S6/S3	6
S6/S4	3
NCD-W (Wetlands)	9
Nonfish-Bearing	
S5	8
S6	88
NCDs	62
NVCs	62
S6/NCD-W	2
NCD-W (Wetlands)	14

Notes: Includes interim classifications for Baer Creek, Marathon Creek and Terry Fox Creek.

Dual classifications were assigned to watercourses with low potential for fish within the proposed pipeline corridor (*i.e.*, gradient, perched culvert or intermittent flow regimes) but had potential for fish downstream within the LSA. All watercourses with dual classifications incorporate precautionary measures to protect fish and fish habitat downstream from the proposed pipeline corridor (Appendices A and B), but are not included in the totals of fish-bearing watercourses crossed by the Project.

5.2.1.3 Sensitivity of Fish-Bearing Watercourses

A summary of the sensitivity rankings, 68 high (red) and 35 low (green), for all fish-bearing watercourses within the Hargreaves to Darfield Segment is presented in Table 5.2 and shown in Appendix D.

TABLE 5.2

SENSITIVITY RANKING OF FISH-BEARING WATERCOURSES IN THE HARGREAVES TO DARFIELD SEGMENT

Sensitivity	Master Crossing number	RKs	Watercourse Name	Stream Classification	Fish Presence	Least Risk Biological Window Proposed
High	BC-3	490.5	Baer Creek	S2	BT* and RB	July 15 to August 15
	BC-5	491.6	Marathon Creek	S2	RB	July 15 to April 15
	BC-8	495.8	Terry Fox Creek	S2	BT and RB	July 15 to August 15
	BC-10	499.7	Fraser River	S1B	BB, BT, CCG, CH, LKC, LNC, LSU, LW, MW, NSC, PCC, PW, RB*, RSC and WSG	July 15 to August 15 (Contact DFO for anadromous salmon)
	BC-27	515.5	Teepee Creek	S3	BT* and CCG*	June 15 to August 15
	BC-28	517.8	Crooked Creek	S3	BT* and RB*	July 15 to August 15

TABLE 5.2 Cont'd

Sensitivity	Master Crossing number	RKs	Watercourse Name	Stream Classification	Fish Presence	Least Risk Biological Window Proposed
High (cont'd)	BC-32	522.5	Swift Creek	S1B	BT*, CCG, CH* and RB	July 15 to August 15 (Contact DFO for anadromous salmon)
	BC-36	531.3	Canoe River	S1B	BT*, CCG*, KO, LSU, MW, PW and RB	July 15 to August 15
	BC-38, BC-52 and BC-56	534.5, 545.9 and 547.6	Camp Creek	S2	BT*, CAS, CCG*, KO, LKC, RB*	July 15 to August 15
	BC-43	540.6	Unnamed Channel	S3	CCG* and RB*	July 15 to April 15
	BC-51	544.8	Unnamed Channel	S3	RB*	July 15 to April 15
	BC-55	546.9	Unnamed Channel	S3	BT* and RB*	Open
	BC-65, BC-82 and BC-85	552.1, 561.2 and 563.6	Albreda River	S2, S1B	BT*, CC, CO*, RB and WF	July 22 to August 15
	BC-71	555.5	Unnamed Channel	S4	CO*	Open
	BC-73	556.5	Unnamed Drainage (Wetland)	NCD-W	CO*, RB* and LDC	Open
	BC-76	559.0	Clemina Creek	S2	BT*, CCG* and MW*	June 1 to August 15
	BC-78	559.4	Dora Creek	S2	BT* and CO	July 15 to August 15
	BC-80	560.3	Unnamed Channel	S4	BT* and CO*	Open
	BC-84	563.5	Unnamed Channel	S4	BT* and CO*	Open
	BC-90	565.9	Unnamed Channel	S3	CO*	July 15 to August 15
	BC-93	567.6	Dominion Creek	S2	BT*, CO and MW	June 1 to August 15
	BC-94	571.9	Moonbeam Creek	S2	BT*	June 1 to August 15
	BC-110	580.4	Serpentine Creek	S2	BT*, CCG, CH and MW	August 7 to 15
	BC-111, BC-182 and BC-236	581.2, 619.9 and 651.6	North Thompson River	S1A	BL, BSU, BT, CCG, CH, CO, CRH, CSU, LDC, LKC, LNC, LSU, MSU, MW*, NSC, PCC, RB, RSC, RW and SK	July 22 to August 15
	BC-112	582.0	Chappell Creek	S2	BT* and CCG	June 1 to August 15
	BC-151	592.9	Miledge Creek	S1B	BT* and CO	August 7 to 15
	BC-168	600.2	Thunder River	S1B	BT*, CCG, CO and MW	June 1 to August 15
	BC-175	607.6	Unnamed Channel	S3	BT*, CCG*, RB*	July 22 to August 15
	BC-176	609.4	Cook Creek	S2	BT, CC, CH, CO*, MW and RB	August 7 to 15
	BC-177	611.6	Cedar Creek	S2	BT*, CCG*, CH*, CO*, CRH, MW and RB	June 1 to August 15
	BC-178	613.8	Blue River	S1B	BT, CAS, CCG*, CH*, CO*, LNC, MW, RB and RSC	August 7 to 15
	BC-180	616.9	Goose Creek	NCD-W	BT, CO*, MW and RB	Open
	BC-181	619.8	Unnamed Channel	S2	CO* and CSU*	July 15 to August 15
	BC-186	623.7	Unnamed Channel	S3	CO*	Open
	BC-189	626.6	Froth Creek	S2	BT*, CH* and RB	August 7 to 15
	BC-201	638.8	Finn Creek	S2	BT*, CAS, CCG, CH, CO, MW, RB* and SK	July 22 to August 15
	BC-214	642.8	Unnamed Drainage (Wetland)	NCD-W	CO*	Open
	BC-217	645.3	Unnamed Channel	S4	CO* and MW*	July 15 to August 15
	BC-224	648.0	Sundt Creek	S2	CO, MW and RB*	August 7 to 15
	BC-227	648.9	Tumtum Creek	S2	CC*, CH, CO* and RB	July 22 to August 15
	BC-238	652.7	Unnamed Channel	S3	BT* and RB*	July 22 to August 15
	BC-239	653.3	Unnamed Channel	S3	Unidentified salmonid	July 15 to August 15

TABLE 5.2 Cont'd

Sensitivity	Master Crossing number	RKs	Watercourse Name	Stream Classification	Fish Presence	Least Risk Biological Window Proposed
High (cont'd)	BC-240	653.9	Unnamed Channel	S3	BT* and CO*	July 15 to August 15
	BC-242	656.1	Avola Creek	S3	CO*, BT*, RB	July 22 to August 15
	BC-244	659.1	Unnamed Channel	S3	CO*, BT*	July 15 to August 15
	BC-248	663.1	Unnamed Channel	S2	RB*	July 22 to October 31
	BC-259	675.1	Hornet Creek	S3	RB*	July 22 to October 31
	BC-260	676.0	Cormet Creek	S3	RB*	July 22 to October 31
	BC-275	683.4	Mad River	S2	CCG, CH, CO*, LNC and RB*	August 7 to September 30
	BC-277	686.4	Cove Creek	S2	RB*	July 22 to October 31
	BC-296	701.9	Peavine Creek	S2	RB*	July 22 to October 31
	BC-309	717.7	Raft River	S1B	BT, CAS, CH, CO*, CSU, L, LNC, MW, RB* and SK	July 22 to August 15
	BC-312	725.5	Clearwater River	S1A	BT, CCG, CH, CO, LNC, MW, RB, RSC and SK	August 7 to 15
	BC-315	735.0	Mann Creek	S2	BT, C*, CH, CO*, CRH*, EB, LSU, PK, RB*, RSC*, SK and WF	July 22 to August 20
	BC-317	737.0	Unnamed Drainage (Wetland)	NCD-W	CO* and CH*	Open
	BC-330	749.3	Lemieux Creek	S1B	BT*, CC*, CH*, CO*, KO, LNC, NSC, MW, RB and SK*	July 22 to August 15
	BC-331	751.1	Nehalliston Creek	S2	CO* and RB*	July 22 to August 15
	BC-332	752.3	Eakin Creek	S2	CCG*, CO* and RB*	July 22 to August 15
	BC-336	757.9	Montigny Creek	S3	RB*	July 22 to October 31
	BC-338	761.1	Thuya Creek	S2	RB*	July 22 to October 31
	BC-343	768.2	Darlington Creek	S2	CO* and RB*	July 22 to August 15
	BC-344	768.5	Lindquist Creek	S2	CO*, LSU and RB*	July 22 to August 15
Low	BC-66	552.9	Robina Creek	S5/S2	BT*	July 22 to August 15
	BC-67	554.0	Unnamed Drainage (Wetland)	NCD-W	BT* and CO*	Open
	BC-69	555.0	Unnamed Channel	S6/S4	CO*	Open
	BC-70	555.1	Unnamed Channel	S4	CO*	Open
	BC-72	556.2	Unnamed Channel	S5/S3	CO*	July 15 to August 15
	BC-74	556.8	Unnamed Channel	S4	CO, RB	July 22 to August 15
	BC-89	565.3	Unnamed Channel	S6/NCD-W	BT*, CO*	Open
	BC-91	566.5	Unnamed Channel	S4	CH*, CO*	Open
	BC-92	556.8	Unnamed Drainage (Wetland)	NCD-W	CH, CO	Open
	BC-104	576.3	Unnamed Channel	S2	BT*, CCG*	June 1 to August 15
	BC-107	577.7	Switch Creek	S3	BT*, CH*	July 15 to August 15
	BC-113	582.8	Unnamed Channel	S6/S3	CO*	Open
	BC-132	587.2	Unnamed Channel	S6/NCD-W	CH*, CO*	Open
	BC-153	596.4	Unnamed Channel	S6/S3	BT*	June 1 to August 15
	BC-156	598.4	Unnamed Channel	S6/S4	BT*	June 1 to August 15
	BC-173	605.2	Whitewater Creek	S5/S2	BT, CRH and RB*	August 7 to 15
	BC-174	606.6	Unnamed Channel	S5/S3	BT*, CCG*	June 1 to August 15
	BC-185	622.9	Unnamed Drainage (Wetland)	NCD-W	CO*	Open
	BC-187	623.9	Unnamed Channel	S3	CO*	Open
	BC-193	633.9	Foam Creek	S5	RB	Open

TABLE 5.2 Cont'd

Sensitivity	Master Crossing number	RKs	Watercourse Name	Stream Classification	Fish Presence	Least Risk Biological Window Proposed
Low (cont'd)	BC-210	642.3	Unnamed Channel	S3	RB*	July 22 to October 31
	BC-213	642.6	Unnamed Drainage (Wetland)	S4/NCD-W	CO*	July 15 to August 15
	BC-215	643.8	Unnamed Drainage (Wetland)	NCD-W	CO* and CAS*	Open
	BC-217a	645.5	Unnamed Channel	S3	CO*	Open
	BC-218	646.0	Unnamed Channel	S6/S4	CO*	Open
	BC-222	647.1	Unnamed Drainage (Wetland)	NCD-W	CO*	Open
	BC-228	649.2	Unnamed Channel	S6/S3	RB* and RSC*	Open
	BC-230	649.7	Unnamed Channel	S4	CO*	Open
	BC-249	664.3	Sager Creek	S2	CO*	Open
	BC-251	666.4	Bearpark Creek	S6/S3	RB*	July 22 to October 31
	BC-276	685.2	Unnamed Channel	S5/S3	RB* and CCG*	July 22 to October 31
	BC-286	691.7	Montanna Creek	S6/S3	CO*	July 15 to August 15
	BC-302	707.9	Crossing Creek	S5/S3	CH* and CO*	August 7 to 15
	BC-310	719.8	School Creek	S3	CO*	July 15 to August 15
	BC-342	767.6	Unnamed Channel	S6/S3	CO*	July 15 to August 15

Note: * Indicates species captured or observed during 2006 or 2012-2013 field seasons.

5.2.1.4 Key Features and Observations

There are five sites within the Hargreaves to Darfield Segment that have biological timing windows and/or stream classifications proposed that differ from the general watercourse timing windows displayed in Figure 4.3 based on the records of historical fish species present. These are:

- Foam Creek (BC-193): a series of steep cascades at 450 m upstream from the confluence with the North Thompson River are a barrier to all fish species. The Foam Creek crossing is approximately 2.5 km upstream from this cascade barrier and there is low probability of fish presence within the LSA; Foam Creek has been given an S5 stream classification and an open timing window as confirmed by recent fish and fish habitat assessments, and the 1999 stream inventory of the Foam Creek watershed (Sary 1999).

- Crossing Creek (BC-302): steep gradient (30%) with numerous 1-1.3 m falls approximately 300-400 m downstream from the proposed pipeline corridor are barriers to fish passage. Juvenile coho and Chinook salmon were captured downstream from the gradient barrier. No fish were captured or observed at or adjacent to the proposed pipeline corridor over two seasons of sampling. Crossing Creek has been given an S5/S3 stream classification and an open timing window.

- Noblequartz Creek (BC-305): Noblequartz Creek historically had coho documented and a timing window of August 7 - August 15; however, this channel was dry within the LSA during 2012 and 2013 fish and fish habitat assessments. It is anticipated that this reach will be dry during the late summer/fall construction window and, therefore, a low sensitivity at the time of construction.

- Bill Creek (BC-279) and Blackberg Creek (BC-280): Bill Creek historically had coho present at 800 m downslope from the proposed pipeline corridor; however, during the 2012 and 2013 fish and fish habitat assessments this channel had no connectivity to the North Thompson River and very poor fish habitat documented throughout the LSA. No fish were captured or observed in Bill Creek or in Blackberg Creek (tributary to Bill Creek). Both streams have been classified as S6 within the LSA and sensitivities are low.

Sections within the Hargreaves to Darfield Segment in which there are numerous watercourses with dual classifications include the following.

- RK 550 to RK 650: many smaller watercourses in this section are seasonally or perennially fish-bearing within low gradient reaches and wetlands close to the North Thompson River, but become nonfish-bearing approximately 50-200 m upstream as valley walls become steep and reach gradients approach 20-25%.

- RK 660 to RK 700: watercourses in this section, including Sager Creek (BC-249), Bearpark Creek (BC-251), and Montanna Creek (BC-286) were typically dry or intermittent within the LSA. Sites often had medium-sized channels but were completely dry or had insufficient flow to support fish at or adjacent to the proposed pipeline corridor over multiple sampling seasons. Fish were often captured in lower reaches of the LSA; as such, dual classifications and precautionary measures were incorporated to protect fish and fish habitat if water is present at the time of construction.

5.2.2 Indicator Species

Table 5.3 summarizes indicator species captured and/or observation records within the Hargreaves to Darfield Segment of the proposed pipeline corridor.

TABLE 5.3

INDICATOR SPECIES CAPTURED OR OBSERVED AT WATERCOURSE CROSSINGS WITHIN THE HARGREAVES TO DARFIELD SEGMENT (2006; 2012 to 2013)

Indicator Species	Master Crossing Number	RKs	Watercourse Name	River System
bull trout	BC-3	490.5	Baer Creek	Fraser River
	BC-27	515.5	Teepee Creek	Fraser River
	BC-28	517.8	Crooked Creek	Fraser River
	BC-32	522.5	Swift Creek	Fraser River
	BC-36	531.3	Canoe River	Canoe River
	BC-38, BC-52 and BC-56	534.5, 545.9 and 547.6	Camp Creek	Canoe River
	BC-55	546.9	Unnamed Channel	Canoe River
	BC-65, BC-82 and BC-85	552.1, 561.2 and 563.6	Albreda River	North Thompson River
	BC-66	552.9	Robina Creek	North Thompson River
	BC-67	554.0	Unnamed Drainage (Wetland)	North Thompson River
	BC-76	559.0	Clemina Creek	North Thompson River
	BC-78	559.4	Dora Creek	North Thompson River
	BC-80	560.3	Unnamed Channel	North Thompson River
	BC-84	563.5	Unnamed Channel	North Thompson River
	BC-89	565.3	Unnamed Channel	North Thompson River
	BC-93	567.6	Dominion Creek	North Thompson River
	BC-94	571.9	Moonbeam Creek	North Thompson River
	BC-104	576.3	Unnamed Channel	North Thompson River
	BC-107	577.7	Switch Creek	North Thompson River
	BC-110	580.4	Serpentine Creek	North Thompson River
	BC-112	582.0	Chappell Creek	North Thompson River
	BC-151	592.9	Miledge Creek	North Thompson River
	BC-153	596.4	Unnamed Channel	North Thompson River
	BC-156	598.4	Unnamed Channel	North Thompson River
	BC-168	600.2	Thunder River	North Thompson River
	BC-174	606.6	Unnamed Channel	North Thompson River
	BC-175	607.6	Unnamed Channel	North Thompson River
	BC-177	611.6	Cedar Creek	North Thompson River
	BC-189	626.6	Froth Creek	North Thompson River
	BC-201	638.8	Finn Creek	North Thompson River
	BC-238	652.7	Unnamed Channel	North Thompson River

TABLE 5.3 Cont'd

Indicator Species	Master Crossing Number	RKs	Watercourse Name	River System
bull trout (cont'd)	BC-240	653.9	Unnamed Channel	North Thompson River
	BC-242	656.1	Avola Creek	North Thompson River
	BC-244	659.1	Unnamed Channel	North Thompson River
	BC-330	749.3	Lemieux Creek	North Thompson River
Chinook	BC-10	499.7	Fraser River	Fraser River
	BC-32	522.5	Swift Creek	Fraser River
	BC-91	566.5	Unnamed channel	North Thompson River
	BC-107	577.7	Switch Creek	North Thompson River
	BC-132	587.2	Unnamed Channel	North Thompson River
	BC-177	611.6	Cedar Creek	North Thompson River
	BC-178	613.8	Blue River	North Thompson River
	BC-189	626.6	Froth Creek	North Thompson River
	BC-302	707.9	Crossing Creek	North Thompson River
	BC-317	737.0	Unnamed Drainage (Wetland)	North Thompson River
	BC-330	749.3	Lemieux Creek	North Thompson River
coho	BC-65, BC-82 and BC-85	552.1, 561.2 and 563.6	Albreda River	North Thompson River
	BC-67	554.0	Unnamed Channel	North Thompson River
	BC-69	555.0	Unnamed Channel	North Thompson River
	BC-70	555.1	Unnamed Channel	North Thompson River
	BC-71	555.5	Unnamed Channel	North Thompson River
	BC-72	556.2	Unnamed Channel	North Thompson River
	BC-73	556.5	Unnamed Channel	North Thompson River
	BC-80	560.3	Unnamed Channel	North Thompson River
	BC-84	563.5	Unnamed Channel	North Thompson River
	BC-89	565.3	Unnamed Channel	North Thompson River
	BC-90	565.9	Unnamed Channel	North Thompson River
	BC-91	566.5	Unnamed Channel	North Thompson River
	BC-113	582.8	Unnamed Channel	North Thompson River
	BC-132	587.2	Unnamed Channel	North Thompson River
	BC-176	609.4	Cook Creek	North Thompson River
	BC-177	611.6	Cedar Creek	North Thompson River
	BC-178	613.8	Blue River	North Thompson River
	BC-180	616.9	Goose Creek	North Thompson River
	BC-181	619.8	Unnamed Channel	North Thompson River
	BC-185	622.9	Unnamed Drainage (Wetland)	North Thompson River
	BC-186	623.7	Unnamed Channel	North Thompson River
	BC-187	623.9	Unnamed Channel	North Thompson River
	BC-213	642.6	Unnamed Drainage (Wetland)	North Thompson River
	BC-214	642.8	Unnamed Channel	North Thompson River
	BC-215	643.8	Unnamed Drainage (Wetland)	North Thompson River
	BC-217	645.3	Unnamed Channel	North Thompson River
	BC-217a	645.5	Unnamed Channel	North Thompson River
	BC-218	646.0	Unnamed Channel	North Thompson River
	BC-222	647.1	Unnamed Drainage (Wetland)	North Thompson River
	BC-227	648.9	Tumtum Creek	North Thompson River
	BC-230	649.7	Unnamed Channel	North Thompson River
	BC-249	664.3	Sager Creek	North Thompson River
	BC-240	653.9	Unnamed Channel	North Thompson River
	BC-242	656.1	Avola Creek	North Thompson River
	BC-244	659.1	Unnamed Channel	North Thompson River
	BC-275	683.4	Mad River	North Thompson River
	BC-286	691.7	Montanna Creek	North Thompson River
	BC-302	707.9	Crossing Creek	North Thompson River

TABLE 5.3 Cont'd

Indicator Species	Master Crossing Number	RKs	Watercourse Name	River System
coho (cont'd)	BC-309	717.7	Raft River	North Thompson River
	BC-310	719.8	School Creek	North Thompson River
	BC-315	735.0	Mann Creek	North Thompson River
	BC-317	737.0	Unnamed Channel (Wetland)	North Thompson River
	BC-330	749.3	Lemieux Creek	North Thompson River
	BC-331	751.0	Nehalliston Creek	North Thompson River
	BC-332	752.3	Eakin Creek	North Thompson River
	BC-342	767.6	Unnamed Channel	North Thompson River
	BC-343	768.2	Darlington Creek	North Thompson River
	BC-344	768.5	Lindquist Creek	North Thompson River
rainbow trout	BC-10	499.7	Fraser River	Fraser River
	BC-28	517.8	Crooked Creek	Fraser River
	BC-38, BC-52 and BC-56	534.5, 545.9 and 547.6	Camp Creek	Canoe River
	BC-43	540.6	Unnamed Channel	Canoe River
	BC-51	544.8	Unnamed Channel	Canoe River
	BC-55	546.9	Unnamed Channel	Canoe River
	BC-175	607.6	Unnamed Channel	North Thompson River
	BC-201	638.8	Finn Creek	North Thompson River
	BC-210	642.3	Unnamed Channel	North Thompson River
	BC-224	648.0	Sundt Creek	North Thompson River
	BC-228	649.2	Unnamed Channel	North Thompson River
	BC-238	652.7	Unnamed Channel	North Thompson River
	BC-248	663.1	Unnamed Channel	North Thompson River
	BC-251	666.4	Unnamed Channel	North Thompson River
	BC-259	675.1	Hornet Creek	North Thompson River
	BC-260	676.0	Cormet Creek	North Thompson River
	BC-275	683.4	Mad River	North Thompson River
	BC-276	685.2	Unnamed Channel	North Thompson River
	BC-277	686.4	Cove Creek	North Thompson River
	BC-296	701.9	Peavine Creek	North Thompson River
	BC-309	717.7	Raft River	North Thompson River
	BC-315	735.0	Mann Creek	North Thompson River
	BC-331	751.0	Nehalliston Creek	North Thompson River
	BC-332	752.3	Eakin Creek	North Thompson River
	BC-336	757.9	Montigny Creek	North Thompson River
	BC-338	761.1	Thuya Creek	North Thompson River
	BC-343	768.2	Darlington Creek	North Thompson River
	BC-344	768.5	Lindquist Creek	North Thompson River

5.2.3 Species at Risk

SARA-listed species (*e.g.*, white sturgeon) were not captured or observed in the Hargreaves to Darfield Segment during the 2006, 2012 and 2013 fish and fish habitat assessments. Historical records for provincially-listed species included bull trout (Red-listed) and mountain sucker (Blue-listed); identified COSEWIC species included coho. Capture data for bull trout and coho is presented in Table 5.3 mountain sucker were not captured nor observed in this segment during the fish and fish habitat assessments.

5.2.4 Navigable and Potentially Navigable Waters

Table 5.4 summarizes the navigation classification for the watercourses investigated along the Hargreaves to Darfield Segment of the proposed pipeline corridor based on the criteria defined for the Project in Section 3.4 and outlined in the *Minor Works and Waters Ministerial Order* of the *NWPA.*

TABLE 5.4

NAVIGATION CLASSIFICATIONS OF THE POTENTIAL WATERCOURSE CROSSINGS INVESTIGATED IN THE HARGREAVES TO DARFIELD SEGMENT

Classification	Total Number
Class 1 Non-navigable	61
Class 2 Non-navigable	60
Class 3 Non-navigable	18
Potentially Navigable	27
Navigable	23

5.2.5 Traditional Ecological Knowledge

Participants identified several types of salmon during field surveys along the Hargreaves to Darfield Segment including: Chinook; dog (chum); Coho; and sockeye. Salmon are found in the Barriere, Raft, Blue, Fraser, Albreda, and North Thompson rivers and Lemieux, Dunn, Thuya and Finn creeks. Sockeye are typically silver and green when downstream in the Fraser River, but turn red by the time they reach their upstream spawning grounds. After spawning is complete, the salmon die. The green head of sockeye, which is boiled and eaten, is considered a delicacy for Elders. Salmon fry travel downstream after hatching. Eating along the way, they travel quickly to the ocean to avoid becoming prey to predators. At age four they migrate upstream, eating very little. Salmon begin their upstream run in the spring. Sockeye, Chinook, and dog salmon follow each other upstream as the season progresses. The salmon run occurs over the course of the entire summer. Participants reported that late summer is the best time to spot grizzly bears feeding on the salmon. Spring salmon are the biggest, need the most oxygen and are most affected by stress. Coho are more durable than the other salmon varieties and are best at adapting to changing conditions. Diseases can wipe out an entire run; often parasites that attach to the gills can affect the salmon's ability to breathe.

The most popular time to fish is during the summer and fall when the salmon runs occur. Many people primarily employ dip nets to catch fish, while others use gill nets. When fishing with a gill net, one can feel when the fish hits the net. The net is flipped around and the fish is passed to someone on the shore. The net is held on a pole in the water and tied to the shore by a string to prevent the net from floating away in the strong current. When fishing with dip nets, one stands on the shore and scoops in the same direction the water is flowing to catch the fish going the opposite direction (upstream). Salmon fishing requires cooperation and usually groups of three people work together. Fishing was described by participants as an often enjoyable family task. Low in fat, salmon are ideal for smoking. Smoking filet steaks is one preferred method of cooking salmon, using the filet still on the skin and attached by the tail. The skin is stretched to pull the fish apart a bit and then it is smoked to preserve the meat and keep the flies off. Another method is to wind dry salmon. It is typically windy down by the water and fish can be processed as caught by drying them on the rocks. A participant shared: "when you hear the frogs singing, the fish will be in the lakes and it's time to start fishing."

Other fish identified by participants during the field surveys include minnows, ling cod (burbot), suckers, redtail, whitefish (mountain whitefish), sturgeon species, char (bull trout), rainbow trout, blue trout (rainbow/bull trout), Dolly Varden trout (Dolly Varden char) and bull trout. The Barriere, Fraser, Raft, Blue, Albreda and North Thompson rivers, and Lemieux, Dunn, Moonbeam, and Finn creeks are currently fished. Dunn Lake was reported to have a large sucker population however, suckers are not preferred as a food source due to their boniness.

At pit houses near the Clearwater River, participants described the historic fishing activities in the region. People would have lived in pit houses when fish were abundant in August and September while living elsewhere to hunt and gather; some were nomadic and travelled according to the seasonal round. People would often fish at the Cascade Falls near Kettle River. Net fishing would occur at these rapids because fish jump out of the water to move upstream. Wooden, steel-tipped traditional spears would also be used to catch fish, as well as harpoon type spears which had barbed tips to prevent the fish from slipping off. When fish are caught using the harpoon spear, the handle detaches from the head of the spear, but

remains connected by a rope. If a big spring salmon is caught, it is easier to drag the fish onto shore with a rope instead of with a pole. Worms and grasshoppers were often caught and used as bait for fishing.

Participants reported that all watercourse in the region once provided drinkable water, but now water quality is steadily declining due to increased agriculture and logging activities. Water temperatures are rising in general due to climate change. Warmer water has less oxygen, making it harder for fish to swim.

Detailed TEK related to aquatic resources for the Project along the Hargreaves to Darfield Segment and any issues and concerns raised are provided in Table 5.5.

TABLE 5.5

AQUATICS TEK RECORDED ALONG THE HARGREAVES TO DARFIELD SEGMENT

Location	Watercourse	Description/Observation
RK 504.7	Unnamed Channel	Low-flow stream and dense vegetation prevents stream from being navigable.
RK 546.1	Unnamed Channel	Not navigable due to low flow and vegetation cover.
RK 550.7	Unnamed Channel	Flow levels could make watercourse navigable but wind fall and vegetation would make navigation difficult.
RK 551.5	Unnamed Channel	Deadfall would impede navigability but could be used for finding one's way.
RK 552.1 RK 561.2 RK 563.6	Albreda River	Rainbow trout, Chinook salmon, whitefish (mountain whitefish).
RK 567.6	Dominion Creek	Fish-bearing. Very high flow and is too swift for fishing or spawning.
RK 571.9	Moonbeam Creek	Whitefish (mountain whitefish), rainbow trout.
RK 613.8	Blue River	Chinook, Coho salmon and blue trout (rainbow/bull trout).
RK 581.1 RK 619.9 RK 651.6	North Thompson River	Fish-bearing and navigable. Coho salmon, bull trout, spring salmon. Fast-flowing but navigable, fish-bearing. There are fewer fish now than there used to be. One of the most frequented rivers.
RK 638.8	Finn Creek	Sockeye, spring salmon.
RK 660.3	Thunder Creek	Fish-bearing.
RK 666.6	Unnamed Drainage	Fish-bearing.
RK 717.7	Raft River	Sockeye, Chinook salmon, trout. Salmon species spawning area. A traditional fishing area. One of the most frequented rivers. Navigable.
RK 725.5	Clearwater River	Fish-bearing.
RK 749.3	Lemieux Creek	Ling cod (burbot), Coho salmon and suckers.
RK 761.1	Thuya Creek	Coho salmon .

Several concerns were raised by participants during field surveys for the Project along the Hargreaves to Darfield Segment, pertaining to all watercourses crossed by the proposed pipeline corridor (in addition to the proposed crossing locations listed in Table 5-5). Participants identified concerns related to water quality as well as the potential effects of Project construction activities on fish and fish habitat. Construction practices and measures to mitigate these identified potential effects were discussed with participants in the field and are described below. Concerns related to potential effects of spills on the aquatic environment (Section 3.0 of Volume 5A) are considered within the assessment of various onshore facility spill scenarios provided in Volume 7A.

Proposed watercourse crossing methods are selected in consideration of the size, environmental sensitivities of the watercourses (inclusive of TEK) and period of construction. Although not all watercourse crossings will be suited for a trenchless crossing, the feasibility of the trenchless crossing method must first be evaluated to determine the advantages, limitations and risks associated with each trenchless crossing compared to more traditional, trenched crossing methods. Trenchless, isolated trenched (if water is present at the time of construction), or open-cut (if dry or frozen to the bottom, throughout the entire proposed pipeline corridor, at the time of construction) installation methods recommended for each proposed watercourse crossing are identified in Section 6.0.

Water quality monitoring during watercourse crossing construction will occur at specific watercourse crossings in order to protect aquatic resources during and following construction (Section 6.0), as well as to ensure compliance with applicable water crossing permit conditions.

Concerns related to aquatic resources were addressed by the proposed mitigation measures discussed. Participants have not recommended any mitigation strategies related to aquatic resources additional to those described in the Section 7.0 to be implemented for the Project.

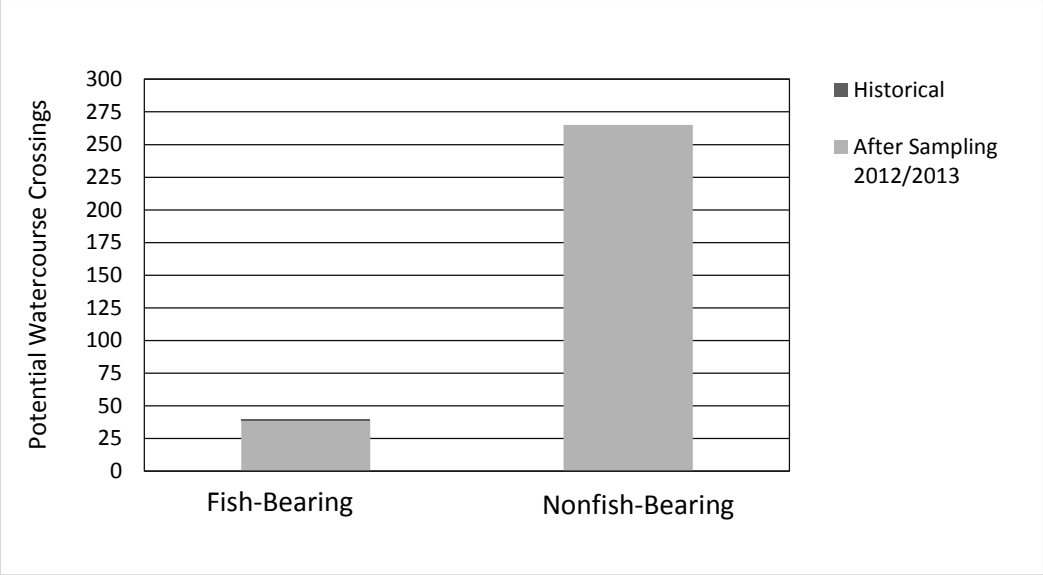
5.3 Black Pines to Hope Segment

5.3.1 Watercourse Crossings

5.3.1.1 Fish-Bearing versus Nonfish-Bearing Watercourses

A total of 318 potential watercourse crossings were identified within the Black Pines to Hope Segment of the proposed pipeline corridor. Of this total, 304 watercourse crossings were assessed in the field, and 15 potential watercourse crossings still require supplemental studies (Section 6.9 and Appendix F). Of the 318 potential watercourse crossings, 39 are considered to be fish-bearing within the proposed pipeline corridor and 265 are considered to be nonfish-bearing (Figure 5.2). One watercourse (Shuta Creek) was not assessed within the proposed pipeline corridor but is included in the final result of 39 fish-bearing watercourses as it has adequate historical information. Also included in the 39 fish-bearing watercourses are: BC-532, BC-533 and BC-534 because they are located in a community watershed and receive a default fish-bearing status as per BC OGC's *Environmental Protection and Management Regulation* (BC MOE 2013).

Figure 5.2 Fish-Bearing Status of Watercourse Crossings, Black Pines to Hope Segment



5.3.1.2 Summary of Classifications for Potential Watercourse Crossings

A breakdown of the number of streams of each classification for all fish-bearing and nonfish-bearing drainages within the Black Pines to Hope Segment is presented in Table 5.6.

TABLE 5.6

STREAM CLASSIFICATIONS OF THE POTENTIAL WATERCOURSE CROSSINGS INVESTIGATED IN THE BLACK PINES TO HOPE SEGMENT

Classification	Total Number
Fish-Bearing	
S1A	1
S1B	11
S2	10
S3	13
S4	2
S6/S4	2
NCD-W (Wetlands)	2
Nonfish-Bearing	
S5	16
S6	56
NCDs	73
NVCs	112
NCD-W (Wetlands)	6

Notes: Includes default classifications for BC-532, BC-533 and BC-534.

Dual classifications were assigned to watercourses with low potential for fish at or adjacent to the proposed pipeline corridor (*i.e.*, gradient, perched culvert or intermittent flow regimes) but had potential for fish downstream within the LSA. All watercourses with dual classifications incorporate precautionary measures to protect fish and fish habitat downstream from the proposed pipeline corridor (Appendices A and B), but are not included in the totals of fish-bearing watercourses crossed by the Project.

5.3.1.3 Sensitivity of Fish-Bearing Watercourses

A summary of the sensitivity rankings, 31 high (red) and 12 low (green), for all fish-bearing habitat within the Black Pines to Hope Segment is presented in Table 5.7 and shown in Appendix D.

TABLE 5.7

SENSITIVITY RANKING OF FISH-BEARING WATERCOURSES IN THE BLACK PINES TO HOPE SEGMENT

Sensitivity	Master Crossing Number	RKs	Watercourse Name	Stream Classification	Fish Presence	Least Risk Biological Window Proposed
High	BC-371	820.2	Jamieson Creek	S2	BT, CO* and RB	July 22 to September 30
	BC-376	825.5	Lanes Creek	S2	RB*	July 22 to September 30
	BC-381	828.3	Dairy Creek	S3	RB*	July 22 to September 30
	BC-413	846.8	Thompson River	S1A	BL, BSU, BT, CCG, CH, CO, CP, CRH, CSU, LDC, LKC, LNC, LSU, MSU, MW, NSC, PCC, PK, RB, RW and SK	July 22 to August 15
	BC-433	865.2	Anderson Creek	NCD-W	RB*	July 22 to October 31
	BC-459	892.8	Moore Creek	S2	EB, KO, LSU and RB*	July 22 to August 31
	BC-482	915.9	Clapperton Creek	S2	CH, CO, RB* and ST	July 22 to October 31
	BC-486	918.3	Shuta Creek	S3	RB*	July 22 to October 31

TABLE 5.7 Cont'd

Sensitivity	Master Crossing Number	RKs	Watercourse Name	Stream Classification	Fish Presence	Least Risk Biological Window Proposed
High (cont'd)	BC-504	928.0	Nicola River	S2	BB, BL, BSU, BT, CAS, CCG, CH, CMC*, CO, CSU* KO, LDC, LNC, LSU, LT, LW, MW, NSC, PCC, PK, PL, RB, RL, RSC*, SK, ST and WSU	July 22 to August 1
	BC-531	941.5	Kwinshatin Creek	S3 (c)	RB* and Community Watershed	July 22 to October 31
	BC-533	941.7	Unnamed Channel	S3 (c)	Community Watershed; potential for RB	July 22 to October 31
	BC-548	957.9	Coldwater River (above Kingsvale)	S1B	BT, CC, CH*, CO*, L, LDC, LNC, MW, PL, RB, ST and SU	August 7 to 10
	BC-549	958.1	Gillis Creek	S3	CO* and RB*	July 22 to August 15
	BC-559, BC-570 and BC-582	970.3, 980.0 and 990.0	Coldwater River (below Kingsvale)	S1B	BT, CC, CH*, CO*, L, LDC, LNC, MW, PL, RB*, ST and SU	July 22 to August 1
	BC-564	973.6	Unnamed Channel	S3	RB/ST* and ST*	July 22 to October 31
	BC-571	980.8	Juliet Creek	S1B	BT, CH*, CO* and RB	July 22 to August 15
	BC-579	987.1	Mine Creek	S2	BT*, CH*, CO* and RB*	July 22 to August 15
	BC-588	997.3	Fallslake Creek	S3	RB	August 1 to October 31
	BC-625	1019.1	Unnamed Channel	S3	RB*	August 1 to October 31
	BC-629	1020.3	Ladner Creek	S2	BT/DV, RB* and SST	August 1 to 31
	BC-631, BC-636, BC-639, BC-645 and BC-654	1021.8, 1026.5, 1028.6, 1032.6 and 1043.2	Coquihalla River	S1B	BT/DV*, CAL*, CCT, CH, CM, CO, CSU, LDC, MW, PK, RB*, SK, SST and ST	August 1 to 31
	BC-632	1022.9	Dewdney Creek	S1B	BT/DV, RB* and SST	August 1 to 31
	BC-634	1024.5	Karen Creek	S3	BT/DV and RB*	August 1 to 31
	BC-635	1025.4	Unnamed Channel	S3	RB*	August 1 to October 31
	BC-646	1033.2	Railway Creek	S2	CM and RB*	August 1 to September 15
Low	BC-374	824.6	Unnamed Channel	S3	RB	July 22 to October 31
	BC-414	847.4	Unnamed Drainage (Wetland)	NCD-W	NSC*, PCC* and RSC*	Open
	BC-532	941.5	Unnamed Channel	S4 (c)	Community Watershed; potential for RB	July 22 to October 31
	BC-534	943.0	Skuagam Creek	S4 (c)	Community Watershed; potential for RB	July 22 to October 31
	BC-538	949.3	Salem Creek	S3	RB*	July 22 to October 31
	BC-561	971.2	Unnamed Channel	S6/S4	CO*	Open
	BC-562	972.0	Unnamed Channel	S3	CO*	July 15 to August 15
	BC-624	1019.0	Unnamed Channel	S2	RB*	August 1 to October 31
	BC-630	1021.1	Unnamed Channel	S3	RB*	August 1 to October 31
	BC-567	976.6	Unnamed Channel	S6/S4	CO*	Open

TABLE 5.7 Cont'd

Sensitivity	Master Crossing Number	RKs	Watercourse Name	Stream Classification	Fish Presence	Least Risk Biological Window Proposed
Low (cont'd)	BC-591 and BC-596	1003.1 and 1011.0	Boston Bar Creek	S5	BT/DV, RB and SST	Open

Note: * Indicates species captured or observed during 2006 or 2012-2013 fish and fish habitat assessments.

(c) Indicates site within a community watershed

Key Features and Observations

There are nine sites within the Black Pines to Hope Segment that have biological timing windows and/or stream classifications proposed that differ from the general watercourse timing windows displayed in Figure 4.3 based on historical fish species records. These are:

- McQueen Creek (BC-382): there are historical records of rainbow trout and eastern brook trout in Griffin Lake (2 km upstream from the LSA), but no record of fish in McQueen Creek. During the 2012 and 2013 field surveys, the channel had no connectivity to the North Thompson River and very poor fish habitat throughout the LSA. Cattle use has resulted in severe channel degradation and no fish were captured or observed during two seasons of sampling. The stream has been classified as S6 within the LSA and is not included Table 5.6.

- Peterson Creek (BC-426): although there are historical records of rainbow trout in the lower reaches of Peterson Creek and Jacko Lake approximately 1.2 km downstream, Peterson Creek upstream from Jacko Creek has low potential for fish and this reach been classified as an S6. This channel was dry/intermittent in 2012 and 2013 with marginal channel definition and multiple beaver dams throughout the LSA.

- Anderson Creek (BC-433): there is low potential for anadromous salmon in the upper headwaters at or adjacent to the LSA; as such, an instream construction timing window for rainbow trout has been recommended.

- Clapperton Creek (BC-482): two large falls which are barriers to anadromous salmon migration have been identified downstream from the proposed pipeline corridor (BC Habitat Wizard 2013). Only resident rainbow trout have been captured in the Clapperton Creek LSA and an appropriate instream construction timing window has been recommended to reflect this.

- Hamilton Creek (BC-505): although there are historical records of rainbow trout in the upper reaches of Hamilton Creek, near Hamilton Lake; there is no continuous defined channel through the LSA and this drainage was dry in 2013. Hamilton Creek has been classified as an NCD and is not included in Table 5.6.

- Tributary to Kwinshatin Creek (BC-532) and Skuagam Creek (BC-534): although listed as watercourses within designated Community Watersheds, both have low potential for rainbow trout within the proposed pipeline corridor. No fish were captured or observed in the tributary to Kwinshatin Creek and channel definition is marginal. Habitat potential in Skuagam Creek is likely limited by gradient, which is approximately 22% at the centre of the proposed pipeline corridor.

- Boston Bar Creek (BC-591 and BC-596): a series of falls downstream from the LSA are barriers to upstream fish migration (Whelen 1998). The upper extent of the waterfall barrier (approximately 4 m high) was confirmed from two seasons of sampling to be located 5.4 km upstream from the mouth. No fish were captured or observed in Boston Bar Creek or any of its tributaries upstream from this upper set of falls at location (10 U 629899 5487874); Boston Bar Creek has been assigned an S5 stream classification and an open timing window. All tributaries to Boston Bar Creek upstream from the upper falls are also classified as nonfish-bearing.

TABLE 5.8

NONFISH-BEARING WATERCOURSE CROSSINGS UPSTREAM FROM UPPER FALLS ON BOSTON BAR CREEK

Master Crossing Number	RKs	Watercourse Name	Stream Classification
BC-591	1003.1	Boston Bar Creek	S5
BC-592	1004.7	Unnamed Channel	S5
BC-593	1007.6	Unnamed Channel	S6
BC-594	1008.6	Unnamed Channel	S6
BC-595	1009.3	Unnamed Channel	S5
BC-596	1011.0	Boston Bar Creek	S5
BC-597	1011.2	Unnamed Channel	S6
BC-598	1011.3	Unnamed Channel	S6
BC-599	1011.9	Unnamed Channel	S6
BC-600	1012.3	Unnamed Channel	S6
BC-601	1012.6	Unnamed Channel	S6
BC-602	1013.0	Unnamed Channel	S6
BC-603	1013.1	Unnamed Channel	S6
BC-604	1013.2	Unnamed Channel	S6
BC-605	1013.3	Unnamed Channel	S6
BC-606	1013.7	Unnamed Channel	S6

5.3.2 Indicator Species

Table 5.9 summarizes indicator species captured and/or observation records within the Black Pines to Hope Segment of the proposed pipeline corridor.

TABLE 5.9

INDICATOR SPECIES CAPTURED OR OBSERVED AT WATERCOURSE CROSSINGS WITHIN THE BLACK PINES TO HOPE SEGMENT (2012 TO 2013)

Indicator Species	Master Crossing Number	RKs	Watercourse Name	River System
Chinook	BC-548 and BC-570	957.9 and 980.0	Coldwater River	Coldwater River
	BC-571	980.8	Juliet Creek	Coldwater River
	BC-579	987.1	Mine Creek	Coldwater River
coho	BC-371	820.2	Jamieson Creek	North Thompson River
	BC-548 and BC-570	957.9 and 980.0	Coldwater River	Coldwater River
	BC-549	958.1	Gillis Creek	Coldwater River
	BC-571	980.8	Juliet Creek	Coldwater River
	BC-561	971.2	Unnamed Channel	Coldwater River
	BC-562	972.0	Unnamed Channel	Coldwater River
	BC-567	976.6	Unnamed Channel	Coldwater River
bull trout	BC-579	987.1	Mine Creek	Coldwater River
	BC-631, BC-636, BC-639, BC-645 and BC-654	1021.8, 1026.5, 1028.6, 1032.6 and 1043.2	Coquihalla River	Coquihalla River
rainbow trout	BC-376	825.5	Lanes Creek	North Thompson River
	BC-381	828.3	Dairy Creek	North Thompson River
	BC-433	865.2	Anderson Creek	South Thompson River
	BC-459	892.8	Moore Creek	Nicola River
	BC-482	915.9	Clapperton Creek	Nicola River
	BC-486	918.3	Shuta Creek	Nicola River
	BC-531	941.5	Kwinshatin Creek	Coldwater River
	BC-538	949.3	Salem Creek	Coldwater River
	BC-549	958.1	Gillis Creek	Coldwater River

TABLE 5.9 Cont'd

Indicator Species	Master Crossing Number	RKs	Watercourse Name	River System
rainbow trout (cont'd)	BC-564	973.6	Unnamed Channel	Coldwater River
	BC-579	987.1	Mine Creek	Coldwater River
	BC-624	1019.0	Unnamed Channel	Coquihalla River
	BC-625	1019.1	Unnamed Channel	Coquihalla River
	BC-629	1020.3	Ladner Creek	Coquihalla River
	BC-630	1021.1	Unnamed Channel	Coquihalla River
	BC-631, BC-636, BC-639, BC-645 and BC-654	1021.8, 1026.5, 1028.6, 1032.6 and 1043.2	Coquihalla River	Coquihalla River
	BC-632	1022.9	Dewdney Creek	Coquihalla River
	BC-634	1024.5	Karen Creek	Coquihalla River
	BC-635	1025.4	Unnamed Channel	Coquihalla River
	BC-646	1033.2	Railway Creek	Coquihalla River
cutthroat trout	None	None	None	None

5.3.3 Species at Risk

No *SARA*-listed species were captured or observed in the Black Pines to Hope Segment during 2012 and 2013 fish and fish habitat assessments. Capture or observation of provincially-listed or COSEWIC species included bull trout (Blue-listed), chiselmouth (Blue-listed), and Interior Fraser coho (Yellow-listed). Chiselmouth were capture in the Nicola River LSA; capture data for bull trout and coho are presented in Table 5.7.

5.3.4 Navigable and Potentially Navigable Waters

Table 5.10 summarizes the navigation classification for the watercourses investigated along Black Pines to Hope Segment of the proposed pipeline corridor based on the criteria defined for the Project in Section 3.4 and outlined in the *Minor Works and Waters Ministerial Order* of the *NWPA.*

TABLE 5.10

NAVIGATION CLASSIFICATIONS OF THE POTENTIAL WATERCOURSE CROSSINGS INVESTIGATED IN THE BLACK PINES TO HOPE SEGMENT

Classification	Total Number
Class 1 Non-navigable	23
Class 2 Non-navigable	43
Class 3 Non-navigable	15
Potentially Navigable	14
Navigable	15

5.3.5 Traditional Ecological Knowledge

During field surveys along the Black Pines to Hope Segment, participants reported that fish are present in the Nicola, Coldwater, Coquihalla, North Thompson, Thompson rivers and Boston Bar, Karen, Juliet and McLennan creeks. There are fish present year round but for migrating species their presence is seasonal. Fish are present year-round at the Nicola, Lumbum, Fish and Marmot lakes.

Participants reported that salmon is eaten fresh, dried, canned or smoked. Dried, canned or smoked fish can be eaten year round. Salmon fish roe is considered a delicacy; it can be boiled in a big pot or dried for up to five days before eating. After five days it becomes pungent and chewy and is a good source of fish oils which have medicinal properties and are high in vitamins. The North Thompson River was identified as a major salmon migration route. The salmon run in this river from August through September

or October, swimming upstream to Barrier Lake where they spawn. Both trout and salmon are present in the Nicola River. Steelhead salmon and early Chinook salmon come up the Nicola River in mid-April. Participants report there are fewer fish in the Nicola River now than there were several years ago. Salmon are already returning later and later. In the past they would return in late June or early July but now often not until August. Coho salmon, rainbow and bull trout are present in Juliet Creek. It was shared that water was likely safe to drink from Juliet Creek 50 to 100 years ago but since the building of the Coquihalla Highway, increased access in the region has led to increased livestock and infrastructure affecting water quality. Before this highway was built, few people used or visited this region. Juliet Creek may have once been navigable. The Nicola and Thompson rivers were also used for travel and trade.

The Coquihalla River was reported as good trout habitat but the water is not potable. Fish are healthier in the smaller fresh water watercourses in the region since the water quality in the Coquihalla is poor. The water level in this river is dangerously high from mid to late June. The Coquihalla River is traveled by kayak in late summer and by tube along the calmer areas of this river in the summer. Rainbow trout were identified at Karen Creek, a tributary to the Coquihalla River. Karen Creek is considered good trout habitat because the water is clear and clean and the grade is not too steep allowing trout to swim upstream.

Participants reported that fish are present year round in the Douglas, Lumbum, Fish and Nicola lakes. Burbot, cutthroat and rainbow trout are present in the Fish and Nicola lakes. These lakes ice over in January and burbot is found at that time of year. Kokanee, burbot and whitefish (mountain whitefish) are reported to be present year-round in the watercourses that drain into Nicola Lake.

Fishing methods were discussed by participants. Dip nets, set nets and gill nets are the primary methods of fishing in watercourses but participants also reported using beach seining. For dip netting the person is tied to something and is basically hanging out over the river to dip the net in. Alternatively, the gill net is made of four to five inches of mesh with a lead line at the bottom, floaters on top and can be from 20 to 100 feet long. When there are children around, gill netting is the preferred method, since it is considered safer. In order to use the set net method, an eddy must be present so that the water comes back towards the fisherman. An anchor is set on the land and one on a buoy and the boom is put between the two anchors. The fish swimming upstream come into the eddy to rest and then get caught in the gill net. In a span of two hours, up to 200 fish can be caught in this way. The beach seining method of fishing was also described: it is a type of net fishing that requires a crew of four or more people. A boat is taken into the river and a U-shape is made with the net. The net is pulled in to shore in one long pull and up to 1500 fish can be caught in one pull. The fish that may be kept are then taken out and the remaining fish returned to the river. The ones that are kept die from being kept out of water. There is a counter on the shore who counts the males and another who counts the females. Beach seining is common between October and November. The type of fish caught and kept is determined by DFO each year. The other fish must be thrown back. Participants report that fish numbers have declined. In the past, a 150 inch line could be cast for 20 minutes and 500-600 fish would be caught. A variety of insects are used as bait. Larvae of beetles and butterfly species found in poplar trees are used for bait. Ant larvae are used as bait for kokanee fishing. The larvae are used as bait because fish are attracted to them. Larvae are found in the middle of an ant's nest.

A participant explained the importance of water on the individual and community level: "people are 90% made of water and, therefore, it is vital to our lives. Water is cleansing and people who have bad habits or negativity can go to a natural water source and splash water over themselves to rid themselves of their negativity. Bottled water is not good, since it is contaminated by oil and other pollutants. The more we build and expand the economy the more damage we are doing to freshwater. Nature is becoming increasingly out of balance and he believes that in the future the earth will regain its balance with a natural disaster of huge proportions." Another participant described the following: "if you look after the water it will look after you. Water sources are becoming increasingly contaminated and this is leading to issues with respect to the food chain. The base of the food chain such as algae and micro-organisms has decreased and this inhibits the food chain from growing and has lead to decreasing numbers of fish in streams and rivers. If the streams are not protected the number of fish decreases."

Detailed TEK related to aquatic resources for the Project along the Black Pines to Hope Segment and any issues and concerns raised are provided in Table 5.11.

TABLE 5.11

AQUATICS TEK RECORDED ALONG THE BLACK PINES TO HOPE SEGMENT

Location	Watercourse	Description/Observation
RK 900.3	Rocky Gulch	Kokanee salmon
RK 960.5	Kingsvale Creek	Tributary to major fish-bearing watercourses
RK 1011.0	Boston Bar Creek	Steelhead trout and coho salmon spawning site
RK 1024.5	Karen Creek	Rainbow trout habitat
RK 1021.8 RK 1026.5 RK 1028.6 RJ 1032.6 RK 1040.9	Coquihalla River	Trout habitat
RK 1051.5	Chawuthen Creek	Trout habitat
RK 1127.8	McLennan Creek	Brown trout and coho salmon

Several concerns were raised by participants during field surveys for the Project along the Black Pines to Hope Segment, pertaining to all watercourses crossed by the proposed pipeline corridor (in addition to the proposed crossing locations listed in Table 5-11). Participants identified concerns related to water quality affecting the overall health of animals, fish and people who use the water in the region as well as the potential effects of Project construction activities on fish and fish habitat and the cumulative effects of industrial development on water quality and quantity. Construction practices and measures to mitigate these identified potential effects were discussed with participants in the field and are described below. Concerns related to potential effects of spills on the aquatic environment (Section 3.0 of Volume 5A) are considered within the assessment of various onshore facility spill scenarios provided in Volume 7A.

Proposed watercourse crossing methods are selected in consideration of the size, environmental sensitivities of the watercourses (inclusive of TEK) and period of construction. Although not all watercourse crossings will be suited for a trenchless crossing, the feasibility of the trenchless crossing method must first be evaluated to determine the advantages, limitations and risks associated with each trenchless crossing compared to more traditional, trenched crossing methods. Trenchless, isolated trenched (if water is present at the time of construction), or open-cut (if dry or frozen to the bottom, throughout the entire proposed pipeline corridor, at the time of construction) installation methods recommended for each proposed watercourse crossing are identified in Section 6.0.

Water quality monitoring during watercourse crossing construction will occur at specific watercourse crossings in order to protect aquatic resources during and following construction (Section 6.0), as well as to ensure compliance with applicable water crossing permit conditions.

Potential Project-related cumulative effects are mitigated with implementation of the following design and construction measures:

- align the proposed pipeline corridor to follow existing linear features such as pipelines and disturbed areas such as facilities/clearings to the extent practical;
- encourage rapid regeneration of riparian habitat;
- the use of trenchless crossings where feasible; and
- water quality monitoring where sensitive fish habitat is present.

Concerns related to aquatic resources were addressed by the proposed mitigation measures discussed. Participants have not recommended any mitigation strategies related to aquatic resources additional to those described in the Section 7.0 to be implemented for the Project.

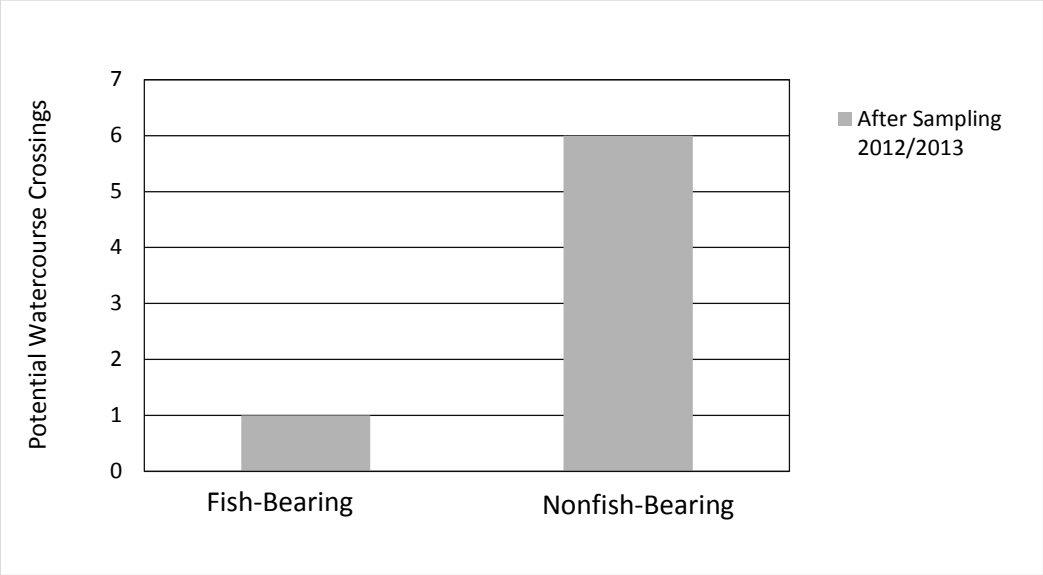
5.4 Black Pines Power Line

5.4.1 Watercourse Crossings

5.4.1.1 Fish-Bearing versus Nonfish-Bearing Watercourses

A total of eight potential watercourse crossings were identified within the proposed Black Pines power line corridor. Of this total, seven watercourse crossings were assessed in the field; the North Thompson River is the only fish-bearing watercourse and the other six watercourse crossings are considered to be nonfish-bearing (Figure 5.3). One watercourse crossing (BCT-1) will require a supplemental study (Section 6.9 and Appendix F).

Figure 5.3 Fish-Bearing Status of Watercourse Crossings, Black Pines Power Line



5.4.1.2 Summary of Classifications for Potential Watercourse Crossings

A breakdown of the number of streams of each classification for all fish-bearing and nonfish-bearing drainages within the Black Pines Power Line corridor is presented in Table 5.12.

TABLE 5.12

STREAM CLASSIFICATIONS OF THE POTENTIAL WATERCOURSE CROSSINGS INVESTIGATED IN THE PROPOSED BLACK PINES POWER LINE CORRIDOR

Classification	Total Number
Fish-Bearing	
S1A	1
Nonfish-Bearing	
NVCs	6

5.4.1.3 Sensitivity of Fish-Bearing Watercourses

The sensitivity ranking, high (red) or low (green), for the fish-bearing habitat within the Black Pines power line corridor is presented in Table 5.13 and shown in Appendix D.

TABLE 5.13

SENSITIVITY RANKING OF FISH-BEARING WATERCOURSES

Sensitivity	Master Crossing Number	Watercourse Name	Stream Classification	Fish Presence	Least Risk Biological Window Proposed
High	BCT-2	North Thompson River	S1A	BL, BSU, BT, CCG, CH, CO, CRH, CSU, LDC, LKC, LNC, LSU, MSU, MW, NSC, PCC, RB, RSC, RW and SK	July 22 to August 15

5.4.2 Indicator Species

Key indicator species within the North Thompson River include Chinook salmon, coho salmon, bull trout, and rainbow trout (Table 5.14).

TABLE 5.14

INDICATOR SPECIES CAPTURED OR OBSERVED AT WATERCOURSE CROSSINGS IN THE BLACK PINES POWER LINE CORRIDOR

Indicator Species	Master Crossing number	Watercourse Name	River System
bull trout	BCT-2	North Thompson River	North Thompson River
Chinook	BCT-2	North Thompson River	North Thompson River
coho	BCT-2	North Thompson River	North Thompson River
rainbow trout	BCT-2	North Thompson River	North Thompson River

5.4.3 Species at Risk

Records of provincially-listed species in the North Thompson River include bull trout (Blue-listed), mountain sucker (Blue-listed) and interior Fraser coho (COSEWIC).

5.4.4 Navigable and Potentially Navigable Waters

Table 5.15 summarizes the navigation classification for the watercourses investigated along Black Pines power line for based on the criteria defined for the Project in Section 3.4 and outlined in the *Minor Works and Waters Ministerial Order* of the *NWPA.*

TABLE 5.15

NAVIGATION CLASSIFICATIONS OF THE POTENTIAL WATERCOURSE CROSSINGS INVESTIGATED IN THE BLACKPINES POWER LINE

Classification	Total Number
Class 1 Non-navigable	0
Class 2 Non-navigable	0
Class 3 Non-navigable	0
Potentially Navigable	0
Navigable	1

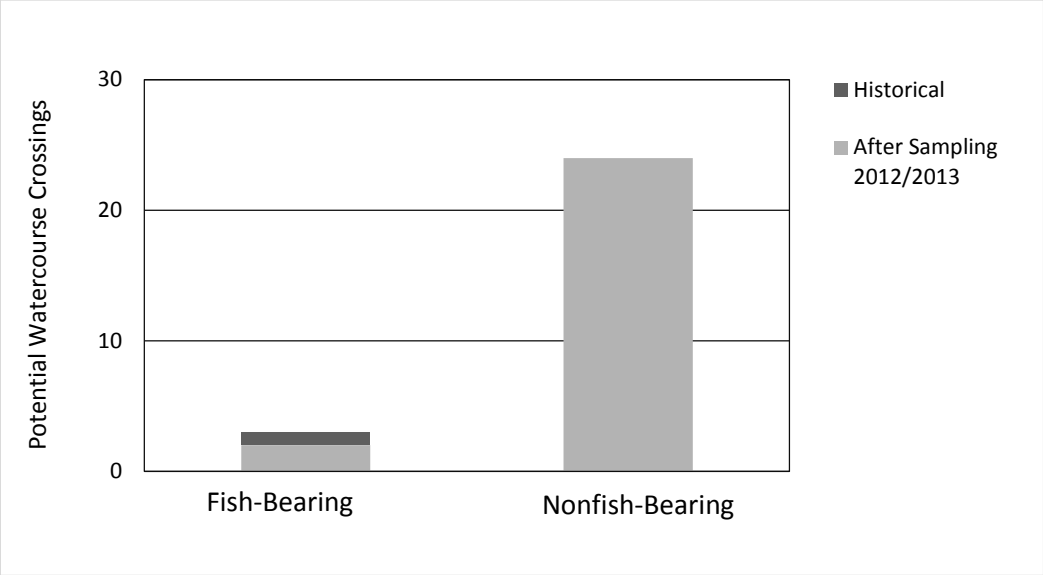
5.5 Kingsvale Power Line

5.5.1 Watercourse Crossings

5.5.1.1 Fish-Bearing versus Nonfish-Bearing Watercourses

A total of 28 potential watercourse crossings were identified within the Kingsvale power line corridor. A total of 26 watercourse crossings were assessed in the field. Of the watercourses assessed, 2 potential watercourse crossings are considered to be fish-bearing and 24 are considered to be nonfish-bearing (Figure 5.4). Supplemental studies are still required to confirm fish absence for two watercourse crossings in the upper headwaters of Voght Creek (BCT-14 and BCT-15; Section 6.9 and Appendix F).

Figure 5.4 Fish-Bearing Status of Watercourses, Kingsvale Power Line



5.5.1.2 Summary of Classifications for Potential Watercourse Crossings

A breakdown of the number of streams of each classification for all fish-bearing and nonfish-bearing drainages within the proposed Kingsvale power line corridor is presented in Table 5.16.

TABLE 5.16

STREAM CLASSIFICATIONS OF THE POTENTIAL WATERCOURSE CROSSINGS INVESTIGATED IN THE KINGSVALE POWER LINE CORRIDOR

Classification	Total Number
Fish-Bearing	
S3	2
Nonfish-Bearing	
S6	4
NCDs	7
NVCs	12
NCD-W (Wetland)	1

5.5.1.3 Sensitivity of Fish-Bearing Watercourses

A summary of the sensitivity rankings, two high (red) and one low (green), for all fish-bearing habitat within the proposed Kingsvale power line corridor is presented in Table 5.17 and shown in Appendix D.

TABLE 5.17

SENSITIVITY RANKING OF FISH-BEARING WATERCOURSES IN THE KINSGVALE POWER LINE CORRIDOR

Sensitivity	Master Crossing Number	Watercourse Name	Stream Classification	Fish Presence	Least Risk Biological Window Proposed
High	BCT-21	Howarth Creek	S3	RB*	July 22 to October 31
Low	BCT-16	Kanevale Creek	S3	RB and RSC*	Open

5.5.1.4 Key Features and Observations

- Voght Creek (BCT-14): Two falls have been identified on Voght Creek near the confluence with the Coldwater River (approximately 850 and 1300 m upstream), which may limit potential for anadromous salmon migration upstream from Highway 5. Upper Voght Creek and tributaries have potential for rainbow trout and redside shiner. One season of sampling was completed in the upper headwaters to Voght Creek (BCT-14 and BCT-15), no fish were captured or observed. A second season of sampling will be completed as part of the supplemental studies.

- Kanevale Creek (BCT-16): Rainbow trout were previously identified in Kanevale Creek and associated with lake observations upstream or downstream from the crossing. Habitat potential for rainbow trout within the proposed power line corridor is likely limited by a lack of flow, barriers to fish migration and high temperatures and low DO during summer months. Redside shiner were captured but no rainbow trout were captured during two seasons of sampling.

- Nilsson Creek (BCT-28): Rainbow trout were previously identified in the lower reaches of Nilsson Creek near the confluence with Voght Creek. The Kingsvale power line corridor passes through the upper reaches of Nilsson Creek where habitat potential for rainbow trout may be limited by a lack of cover, shallow depths, steep bed drops and poor substrate for spawning. No fish were captured or observed or two seasons of sampling.

5.5.2 Indicator Species

Table 5.18 summarizes indicator species capture and/or observation records within the proposed Kingsvale power line corridor.

TABLE 5.18

INDICATOR SPECIES CAPTURED OR OBSERVED AT WATERCOURSE CROSSINGS WITHIN THE KINGSVALE POWER LINE (2012 to 2013)

Indicator Species	Master Crossing Number	Watercourse Name	Major River
RB	BCT-21	Howarth Creek	North Thompson River

5.5.3 Species at Risk

There are no species at risk documented along the proposed power line corridor.

5.5.4 Navigable and Potentially Navigable Waters

Table 5.19 summarizes the navigation classification for the watercourses investigated along Kingsvale Power Line based on the criteria defined for the Project in Section 3.4 and outlined in the *Minor Works and Waters Ministerial Order* of the *NWPA.*

TABLE 5.19

NAVIGATION CLASSIFICATIONS OF THE POTENTIAL WATERCOURSE CROSSINGS INVESTIGATED IN THE KINGSVALE POWER LINE

Classification	Total Number
Class 1 Non-navigable	1
Class 2 Non-navigable	3
Class 3 Non-navigable	2
Potentially Navigable	0
Navigable	0

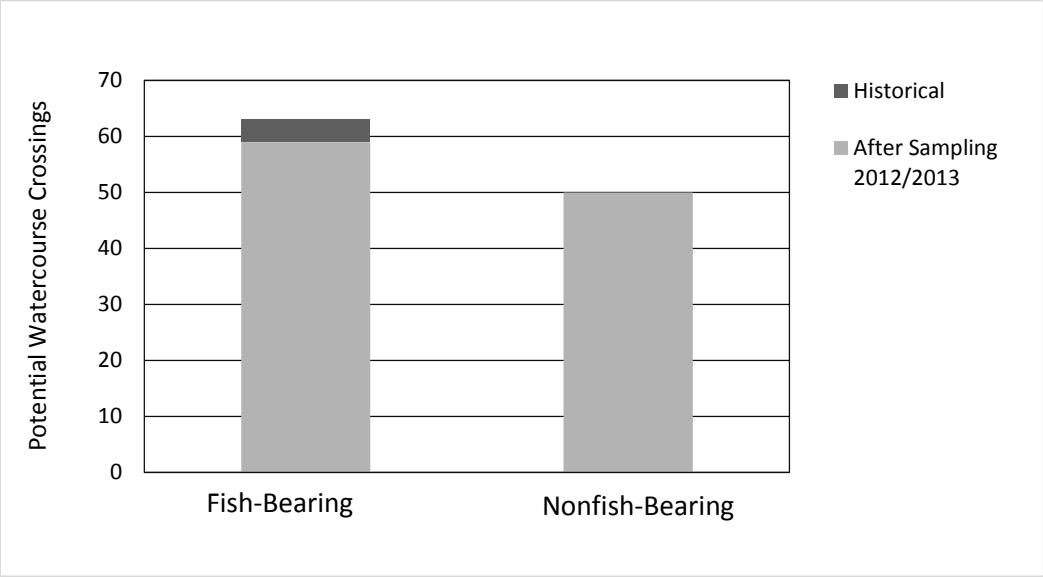
5.6 Hope to Burnaby Segment

5.6.1 Watercourse Crossings

5.6.1.1 Fish-Bearing versus Nonfish-Bearing Watercourses

A total of 131 potential watercourse crossings were identified within the Hope to Burnaby Segment of the proposed pipeline corridor. Of this total, 105 watercourse crossings were assessed in the field, and 26 potential watercourse crossings still require supplemental studies (Section 6.9 and Appendix F). Of the 131 potential watercourse crossings, 59 are considered to be fish-bearing and 50 are considered to be nonfish-bearing (Figure 5.5) within the proposed pipeline corridor. Of the watercourses that require supplemental studies, 4 (BC-766, BC-767, BC-768 and BC-773) are included in the final result of 59 fish-bearing drainages as they have adequate historical information.

Figure 5.5 Fish-Bearing Status of Watercourse Crossings, Hope to Burnaby Segment



5.6.1.2 Summary of Classifications for Potential Watercourse Crossings

A breakdown of the number of streams of each classification for all fish-bearing and nonfish-bearing drainages within the Hope to Burnaby Segment is presented in Table 5.20.

TABLE 5.20

STREAM CLASSIFICATIONS OF THE WATERCOURSE CROSSINGS INVESTIGATED IN THE BURNABY TO HOPE SEGMENT

Classification	Total Number
Fish-Bearing	
S1A	1
S1B	8
S2	19
S3	27
S4	3
S5/S2	2
S5/S3	2
S6/S3	3
S6/S4	1
S6/NCD-W	1
NCD-W (Wetlands)	1
Nonfish-Bearing	
S5	6
S6	11
NCDs	11
NVCs	11
NCD-W (Wetlands)	2

Notes: Includes interim classifications for BC-766, BC-767, BC-768 and BC-773.

Dual classifications were assigned to watercourses with low potential for fish within the proposed pipeline corridor (*i.e.*, gradient, perched culvert or intermittent flow regimes) but had potential for fish downstream within the LSA. All watercourses with dual classifications incorporate precautionary measures to protect fish and fish habitat downstream from the proposed pipeline corridor (Appendices A and B), but are not included in the totals of fish-bearing watercourses crossed by the Project.

5.6.1.3 Sensitivity of Fish-Bearing Watercourses

A summary of the sensitivity rankings, 53 high (red) and 15 low (green), for all fish-bearing watercourses within the Hope to Burnab**y** Segment is presented in Table 5.21 and shown in Appendix D.

TABLE 5.21

SENSITIVITY RANKING OF FISH-BEARING WATERCOURSES

Sensitivity	Master Crossing Number	RKs	Watercourse Name	Stream Classification	Fish Presence	Least Risk Biological Window Proposed
High	BC-657	1047.2	Silverhope Creek	S1B	CAL*, CCT, CM*, CO, CSU, DV/BT, MW, PK, RB*, SST and ST	August 1 to 31
	BC-658	1051.5	Chawuthen Creek	NCD-W	CAL*, CCT and SB	August 1 to October 31
	BC-662	1055.5	Hunter Creek	S1B	CCT, CH*, CM, CO*, PK, RB*, SH and ST	August 1 to September 15
	BC-666	1060.9	Lorenzetta Creek	S2	CAL*, CC, CCT, CH*, CM*, CO*, PK, RB* and ST	August 1 to September 15
	BC-668	1061.5	Wahleach Creek	S1B	CCT, CH*, CM*, CO, KO, PK, RB*, RSC*, SK and ST	August 1 to 15

TABLE 5.21 Cont'd

Sensitivity	Master Crossing Number	RKs	Watercourse Name	Stream Classification	Fish Presence	Least Risk Biological Window Proposed
High (cont'd)	BC-681	1069.2	Unnamed Channel	S3	CCT*	August 1 to October 31
	BC-685	1071.4	Unnamed Channel	S1B	CAL*, CM*, CO* and RB*	August 1 to September 15
	BC-688	1072.3	Unnamed Channel	S2	CH* and CCT*	August 1 to September 15
	BC-690	1072.8	Unnamed Channel	S2	CH*, CM* and RB*	August 1 to September 15
	BC-695	1074.2	Unnamed Channel	S3	CCT*	August 1 to October 31
	BC-700	1076.0	Unnamed Channel	S4	CO* and RB*	August 1 to September 15
	BC-705	1078.2	Anderson Creek	S2	BCB, BNH, CC, CCT, CH, CM, CO, CCT*, DV/BT, L, KO, PK, RB, SG, SK, ST, TSB	August 1 to 15
	BC-706	1079.8	Bridal Creek	S3	CM, CO*, CP, CCT*, MW, PCC, RB and SB	August 1 to September 15
	BC-707	1080.0	Unnamed Channel	S3	CCT*	August 1 to September 15
	BC-708	1083.4	Nevin Creek	S3	C, CAS, CCT*, CO*, CM and SB	August 1 to September 15
	BC-709	1083.9	Dunville Creek	S3	CC, CO*, CCT, L, RB, SB and SU	August 1 to September 15
	BC-712	1086.6	Unnamed Channel	S3	CO* and TSB*	July 15 to September 15
	BC-713	1087.6	Elk Creek	S3	CC, CH*, CM, CO*, CP, CCT*, PK, RB, SB and SU	August 1 to September 15
	BC-714	1092.7	Semmihault Creek	S3	CAS*, CC*, CO, CSU*, CCT, NPM*, SSU, TSB*	August 1 to September 15
	BC-715	1094.0	Chilliwack Creek	S2	BCB, BT/DV, CAS*, CCT, CH, CM, CO*, CP, CSU*, NSC, PMB, SB, SSU, ST, TSB* and WSG	August 1 to September 15
	BC-716	1102.1	Chilliwack/Vedder River Side Channel	S1B	CAS*, CH*, CM*, CO* and TSB*	July 15 to September 15
	BC-717	1102.3	Chilliwack/Vedder River	S1B	BT/DV, CAS*, CCT, CH, CM, CO, KO, MW, PK, RB*, SK, ST, SU, WF and WSG	August 1 to 15
	BC-718	1102.4	Chilliwack/Vedder River Side Channel	S2	BSB*, CAS*, CO*, CM* and RB*	August 1 to September 15
	BC-719	1102.7	Unnamed Channel	S2	BSB* and CO*	July 15 to September 15
	BC-720	1103.2	Street Creek	S3	CC, CO*, CM, CCT, L, PK, RB*, SB and ST	August 1 to September 15
	BC-721	1105.0	Unnamed Channel	S4	CO*	July 15 to September 15
	BC-722	1106.0	Stewart Slough	S3	BH, CC, CCT, CM, CO*, L, NP, RB, RSC and TSB*	August 1 to September 15
	BC-725	1110.7	Sumas Lake Canal	S2	CAS, CM, CO, NSC*, PMB*, RSC*, SA*, TSB*	July 15 to September 15

TABLE 5.21 Cont'd

Sensitivity	Master Crossing Number	RKs	Watercourse Name	Stream Classification	Fish Presence	Least Risk Biological Window Proposed
High (cont'd)	BC-726	1114.6	Sumas River	S1B	BCB, BH, BNH, CBC, CC, CCT, CH, CM, CO, CP, DC, DV/BT, KO, L, MW, NSC, PK, RB, RSC*, SB, SK, ST, SU, TSB*, WCT, WF and WSG	August 1 to 15
	BC-730	1120.2	Unnamed Channel	S3	CO* and CCT*	August 1 to September 15
	BC-731 and BC-732	1122.4 and 1123.4	Clayburn Creek	S2	CAS, CCT, CH, CO*, CM, DV/BT, KO, L, PK, RB*, SG, ST, SK and TSB*	August 1 to 15
	BC-734	1127.8	McLennan Creek	S2	BNH, CCG, CCT, CH, CM, CO*, DV/BT, KO, L, PK, RB, RSC*, SG, SK, ST and TSB*	August 1 to 15
	BC-736	1129.9	Unnamed Channel	S2	CCT*	August 1 to October 31
	BC-747	1138.0	Nathan Creek	S2	BSB*, CC, CCT, CH, CM, CO*, L, PCC, PK, RB, SB, SK, ST, TSB	August 1 to September 15
	BC-749	1143.0	West Creek	S2	BNH, CAS, CCT, CH, CM, CO*, L, RB*, ST, TSB	August 1 to September 15
	BC-751	1145.6	Davidson Creek	S3	CC, CM, CO*, CCT*, RB, L, TSB	August 1 to September 15
	BC-753	1147.4	Salmon River	S2	BCB, BMC, BNH, BT/DV, CAS, CC, CCT, CH, CM, CO*, CP, CSU, L, LSU, NDC, NSC, PCC, RB, RSC*, SFL, SK, SSU, ST, TSB*, WCT	August 1 to 31
	BC-766	1152.4	Unnamed Tributary to Yorkson Creek	S3	CCT and CO	August 1 to September 15
	BC-767	1154.0	Unnamed Tributary to Yorkson Creek	S3	CO*, CCT* and TSB*	August 1 to September 15
	BC-768	1154.3	Yorkson Creek	S3	CCT, CM, CO*, CP, PL, L, PK, RB, ST, TSB	August 1 to September 15
	BC-771	1159.6	Unnamed Channel	S4	CCT*	August 1 to October 31
	BC-773	1161.7	Unnamed Tributary to Lower Fraser River	S3	CCT, CO and TSB	August 1 to September 15
	BC-774	1163.8	Centre Creek	S3	TSB*	August 1 to September 15
	BC-775	1163.9	Centre Creek	S3	TSB*	August 1 to September 15
	BC-776	1164.6	Unnamed Channel	S3	CCT*	August 1 to October 31
	BC-777	1165.2	Unnamed Channel	S3	CCT*	August 1 to October 31
	BC-778	1166.9	Tributary to Bon Accord Creek	S3	CCT*, RB*, TSB*	August 1 to September 15
	BC-779	1166.9	Bon Accord Creek	S3	CAS, CCT*, CO, RB* and TSB*	August 1 to September 15

TABLE 5.21 Cont'd

Sensitivity	Master Crossing Number	RKs	Watercourse Name	Stream Classification	Fish Presence	Least Risk Biological Window Proposed
High (cont'd)	BC-780	1168.9	Lower Fraser River	S1A	BB, BCB, BMC, BNH, BSU, CAL, CAS, CCG, CCT, CH, CLA, CM, CMC, CO, CP, CSU, DV/BT, ESC, EU, GSG, KO, LDC, LKC, LNC, LSM, LSU, MSU, MW, NSC, PCC, PK, PL, PW, RB, RL, RSC, SFL, SH, SK, SSM , SST, ST, STC, TSB, WCT, WSG, WSU	August 1 to 15
	BC-781	1172.2	Como Creek	S2	BL, CAS*, CC* CCT,CH, CM, CO, CP, CSU, NSC, PCC, RB*, RL, TSB*	August 1 to September 15
	BC-782	1172.2	Nelson Creek	S2	BMC, CAS, CCT, CM, CO, CP, PCC, PMB*, RSC, SB, ST, SU, TSB*	August 1 to September 15
	BC-785	1176.5	Stoney Creek	S3	BL, CCT, CM*, CO, NDC, PMB, RB, ST, TSB	August 1 to September 15
Low	BC-655	1045.3	Unnamed Channel	S6/NCD- W	CAL*, RSC*	Open
	BC-678	1066.5	Unnamed Channel	S5/S2	RB*	August 1 to October 31
	BC-682	1069.6	Unnamed Channel	S5/S3	CM*, CCT* and RB*	August 1 to September 15
	BC-683	1070.8	Unnamed Channel	S6/S3	RB*	Open
	BC-684	1071.0	Unnamed Channel	S5/S3	CM* and RB*	Open
	BC-686	1072.1	Unnamed Channel	S6/S3	TSB*	Open
	BC-693	1073.2	Unnamed Channel	S6/S3	CO*	Open
	BC-689	1072.6	Unnamed Channel	S2	CO*, RB* and TSB*	August 1 to September 15
	BC-694	1073.7	Unnamed Channel	S6/S4	CCT*	August 1 to October 31
	BC-697	1074.8	Unnamed Channel	S3	CCT*, DV/BT* and RB*	August 1 to 31
	BC-710	1084.4	Unnamed Channel	S3	TSB*	Open
	BC-723	1110.1	Unnamed Channel	S3	TSB*	Open
	BC-724	1110.1	Unnamed Channel	S3	RSC and TSB*	Open
	BC-733	1125.2	Unnamed Tributary to Gifford Slough	S3	CCT, CO, RSC and TSB*	August 1 to September 15
	BC-754	1147.7	Unnamed Drainage (Wetland)	NCD-W	TSB*	Open

Note: * Indicates species captured or observed during 2006 or 2012-2013 field seasons.

Key Features and Observations

- RK 1055 to RK 1075: The proposed pipeline corridor in this segment is located along a steep valley wall upslope from the Trans-Canada Highway. Consequently, numerous watercourses in this section have dual classifications; meaning they are fish-bearing within low gradient reaches close to the Lower Fraser River, but fish presence at or adjacent to the proposed pipeline corridor is often impeded by steep gradient and/or culvert barriers underneath the highway and/or CN rail tracks.

- RK 1069.6 to RK 1073.2: The proposed pipeline corridor in this segment parallels the Herrling Island side channel in the Fraser River which is one of the few documented areas for white sturgeon spawning and rearing (Triton 2013). Watercourses that drain into the side channel (*e.g,.* BC-682 to BC-685, BC-687 to 697, and BC-700) should maintain water quality at all times.

- Unnamed Channel (BC-729): A 20 m vertical falls located 100 m upstream from the confluence with Clayburn Creek is a barrier to all fish species. The proposed pipeline corridor crosses the channel approximately 400 m upstream from the confluence and no fish were captured or observed within the LSA. Fishes downstream may still be affected by sedimentation as a result of in-stream works and isolation inside the window of least risk is still recommended.

5.6.2 Indicator Species

Table 5.22 summarizes indicator species capture and/or observation records within the Hope to Burnaby Segment of the proposed pipeline corridor.

TABLE 5.22

INDICATOR SPECIES CAPTURED OR OBSERVED AT WATERCOURSE CROSSINGS WITHIN THE HOPE TO BURNABY SEGMENT (2012 to 2013)

Species	Master Crossing Number	RKs	Watercourse Name	River System
bull trout	BC-697	1074.8	Unnamed Channel	Lower Fraser River
Chinook	BC-662	1055.5	Hunter Creek	Lower Fraser River
	BC-666	1060.9	Lorenzetta Creek	Lower Fraser River
	BC-668	1061.5	Wahleach Creek	Lower Fraser River
	BC-688	1072.3	Unnamed Channel	Lower Fraser River
	BC-690	1072.8	Unnamed Channel	Lower Fraser River
	BC-713	1087.6	Elk Creek	Lower Fraser River
	BC-716	1102.1	Chilliwack/Vedder River Side Channel	Chilliwack/Vedder River
coho	BC-662	1055.5	Hunter Creek	Lower Fraser River
	BC-666	1060.9	Lorenzetta Creek	Lower Fraser River
	BC-685	1071.4	Unnamed Channel	Lower Fraser River
	BC-689	1072.6	Unnamed Channel	Lower Fraser River
	BC-693	1073.2	Unnamed Channel	Lower Fraser River
	BC-700	1076.0	Unnamed Channel	Lower Fraser River
	BC-706	1079.8	Bridal Creek	Lower Fraser River
	BC-708	1083.4	Nevin Creek	Lower Fraser River
	BC-709	1083.9	Dunville Creek	Lower Fraser River
	BC-712	1086.6	Unnamed Channel	Lower Fraser River
	BC-713	1087.6	Elk Creek	Lower Fraser River
	BC-715	1094.0	Chilliwack Creek	Lower Fraser River
	BC-716	1102.1	Chilliwack/Vedder River Side Channel	Chilliwack/Vedder River
	BC-718	1102.4	Chilliwack/Vedder River	Chilliwack/Vedder River
	BC-719	1102.7	Chilliwack/Vedder River Side Channel	Chilliwack/Vedder River
	BC-720	1103.2	Street Creek	Chilliwack/Vedder River
	BC-721	1105.0	Unnamed Channel	Chilliwack/Vedder River
	BC-722	1106.0	Stewart Slough	Chilliwack/Vedder River
	BC-730	1120.2	Unnamed Channel	Lower Fraser River
	BC-731 and BC-732	1122.4 and 1123.4	Clayburn Creek	Lower Fraser River
	BC-734	1127.8	McLennan Creek	Lower Fraser River
	BC-747	1138.0	Nathan Creek	Lower Fraser River
	BC-749	1143.0	West Creek	Lower Fraser River
	BC-751	1145.6	Davidson Creek	Lower Fraser River
	BC-753	1147.4	Salmon River	Lower Fraser River

TABLE 5.22 Cont'd

Species	Master Crossing Number	RKs	Watercourse Name	River System
Coho (cont'd)	BC-767	1154.0	Unnamed Channel	Lower Fraser River
	BC-768	1154.3	Yorkson Creek	Lower Fraser River
cutthroat trout	BC-681	1069.2	Unnamed Channel	Lower Fraser River
	BC-682	1069.6	Unnamed Channel	Lower Fraser River
	BC-688	1072.3	Unnamed Channel	Lower Fraser River
	BC-694	1073.7	Unnamed Channel	Lower Fraser River
	BC-695	1074.2	Unnamed Channel	Lower Fraser River
	BC-697	1074.8	Unnamed Channel	Lower Fraser River
	BC-705	1078.2	Anderson Creek	Lower Fraser River
	BC-706	1079.8	Bridal Creek	Lower Fraser River
	BC-707	1080.0	Unnamed Channel	Lower Fraser River
	BC-708	1083.4	Nevin Creek	Lower Fraser River
	BC-713	1087.6	Elk Creek	Lower Fraser River
	BC-730	1120.2	Unnamed Channel	Lower Fraser River
	BC-736	1129.9	Unnamed Channel	Lower Fraser River
	BC-751	1145.6	Davidson Creek	Lower Fraser River
	BC-767	1154.0	Unnamed Channel	Lower Fraser River
	BC-768	1154.3	Yorkson Creek	Lower Fraser River
	BC-771	1159.6	Unnamed Channel	Lower Fraser River
	BC-776	1164.6	Unnamed Channel	Lower Fraser River
	BC-777	1165.2	Unnamed Channel	Lower Fraser River
	BC-778	1166.9	Bon Accord Creek	Lower Fraser River
	BC-779	1169.9	Bon Accord Creek	Lower Fraser River
rainbow trout	BC-657	1047.2	Silverhope Creek	Lower Fraser River
	BC-662	1055.5	Hunter Creek	Lower Fraser River
	BC-666	1060.9	Lorenzetta Creek	Lower Fraser River
	BC-668	1061.5	Wahleach Creek	Lower Fraser River
	BC-678	1066.5	Unnamed Channel	Lower Fraser River
	BC-682	1069.6	Unnamed Channel	Lower Fraser River
	BC-683	1070.8	Unnamed Channel	Lower Fraser River
	BC-684	1071.0	Unnamed Channel	Lower Fraser River
	BC-685	1071.4	Unnamed Channel	Lower Fraser River
	BC-689	1072.6	Unnamed Channel	Lower Fraser River
	BC-690	1072.8	Unnamed Channel	Lower Fraser River
	BC-697	1074.8	Unnamed Channel	Lower Fraser River
	BC-700	1076.0	Unnamed Channel	Lower Fraser River
	BC-717	1102.3	Chilliwack/Vedder River	Chilliwack/Vedder River
	BC-718	1102.4	Chilliwack/Vedder River	Chilliwack/Vedder River
	BC-720	1103.2	Street Creek	Chilliwack/Vedder River
	BC-731 and BC-732	1122.4 and 1123.4	Clayburn Creek	Lower Fraser River
	BC-749	1143.0	West Creek	Lower Fraser River
	BC-778	1166.9	Tributary to Bon Accord Creek	Lower Fraser River
	BC-779	1169.9	Bon Accord Creek	Lower Fraser River
	BC-781	1171.1	Como Creek	Lower Fraser River

5.6.3 Species at Risk

No confirmed *SARA*-listed species (*e.g.*, white sturgeon) were either captured or observed in the Hope to Burnaby Segment during the 2012 and 2013 fish and fish habitat assessments. There are records of nooksack dace in the Salmon River and Bruneete River (adjacent to the Project) and it is assumed they are present in Stoney Creek. None were captured in the Salmon River and no sampling was conducted in Stoney Creek in 2013 as spawning chum salmon were observed at the time of the survey. Salish sucker have been recorded previously in Semmihault Creek, Chilliwack Creek, and Salmon River. In 2013,

juvenile suckers identified as largescale suckers were captured in both Semmihault and Chilliwack Creek. However, given the difficulties associated with juvenile fish identification it is possible that one or more of these fish could be identified as salish sucker. Provincially-listed species Dolly Varden/bull trout were captured at BC-697.

5.6.4 Navigable and Potentially Navigable Waters

Table 5.23 summarizes the navigation classification for the watercourses investigated along Hope to Burnaby Segment of the proposed pipeline corridor based on the criteria defined for the Project in Section 3.4 and outlined in the *Minor Works and Waters Ministerial Order* of the *NWPA.*

TABLE 5.23

NAVIGATION CLASSIFICATIONS OF THE POTENTIAL WATERCOURSE CROSSINGS INVESTIGATED IN THE HOPE TO BURNABY SEGMENT

Classification	Total Number
Class 1 Non-navigable	11
Class 2 Non-navigable	18
Class 3 Non-navigable	11
Potentially Navigable	29
Navigable	11

5.6.5 Traditional Ecological Knowledge

During field surveys along the Hope to Burnaby Segment, participants reported that their communities depend on salmon as a food source year-round. Fish are generally harvested from the spring to the fall and each family typically harvests from 50 to 200 salmon annually. Participants also reported that there has been a shift in the way that communities practice fishing, now catching fish to sell rather than as a subsistence activity.

Coho, sockeye, spring and pink salmon, rainbow trout, sturgeon species and steelhead trout were reported at the Fraser River. The first Chinook run heads up the Fraser River in the early spring and then moves into the Coldwater River in late April and early May. Sockeye salmon is present in late July and August. Steelhead trout are present year-round, but spawning occurs from April to June. Participants have observed that every four years there is a large salmon run with numbers increasing from a few million to 13 million. The Fraser River is navigable and fishing on the Fraser River is now regulated by the DFO. Fishing methods include set net, pole fishing (for canyons) and siene (selective). The set net fishing method is used for wider parts of the river. Sick, spawning or endangered fish are released. The net is anchored at one end and is set up in eddies, because it is easier to catch fish there. Seals are abundant on the Fraser River and are sometimes hunted to protect fish caught in nets and are also a food source for some. Participants also reported once fishing for eulachon on the Fraser River and that it has been over 20 years since they were last fished. Midnight was the best time to catch euchalons.

Communities near the Fraser River often go upriver to fish starting in mid-June and stay in cabins for two months. Young people pick berries (stinging nettles, briars) while others fish for sockeye. Jacks (baby spring salmon) are eaten baked, barbecued, fried, smoked or canned. The dip net fishing technique is most commonly used. The net is dragged in the water; until fish are felt since sight alone cannot be used because the water is too brown.

Participants discussed the first fish or first salmon ceremony; it is a spiritual occasion. The first fish ceremony represents being thankful for the salmon and showing respect to the flow of water. In certain communities the first fish is given to the Elders. Some fish are given to friends and neighbours. There is only one salmon ceremony, but there are many other ceremonies and potlatches throughout the year. Once the ceremonial meal is finished, the bones are gathered and an Elder and a youth return the bones to the river together. The first fish ceremony involves cooking the fish by whatever method is preferred and then sharing the fish with family, friends and the community.

Detailed TEK related to aquatic resources for the Project along the Hope to Burnaby Segment and any issues and concerns raised are provided in Table 5.24.

TABLE 5.24

AQUATIC TEK RECORDED ALONG THE PROPOSED HOPE TO BURNABY SEGMENT

Location	Watercourse	Description/Observation
RK 1055.5	Hunter Creek	Local swimming hole in the summer.
RK 1086.6	Unnamed Channel	Potential trout species and salmonoid habitat.
RK 1147.4	Salmon River	Well-used historical travel-way and is near a trading fort.
RK 1102.4	Vedder River	Fish-bearing.
RK 1072.6	Unnamed Channel	Dog salmon (chum salmon) spawning area.
RK 1114.6	Sumas River	Not fished since the water is slough-like and since farmland surrounds the river banks through the valley; not used for navigation.
RK 1168.9	Fraser River	Coho, sockeye, spring and pink salmon, rainbow trout, sturgeon species and steelhead trout, seals; used for navigation.
RK 1122.4 RK 1123.4	Clayburn Creek	Fish-bearing, non-navigable.

Several concerns were raised by participants during field surveys for the Project along the Hope to Burnaby Segment, pertaining to all watercourses crossed by the proposed pipeline corridor (in addition to the proposed crossing locations listed in Table 5-24). Participants identified concerns related to water quality affecting the overall health of animals, fish and people who use the water in the region as well as the potential effects of Project construction activities on fish movement, fish and fish habitat and riparian habitats. Participants have also requested that community monitors be on-site during watercourse crossing construction and, in particular, at fish-bearing watercourses. Construction practices and measures to mitigate these identified potential effects were discussed with participants in the field and are described below. Concerns related to potential effects of spills on the aquatic environment (Section 3.0 of Volume 5A) are considered within the assessment of various onshore facility spill scenarios provided in Volume 7A.

Proposed watercourse crossing methods are selected in consideration of the size, environmental sensitivities of the watercourses (inclusive of TEK) and period of construction. Although not all watercourse crossings will be suited for a trenchless crossing, the feasibility of the trenchless crossing method must first be evaluated to determine the advantages, limitations and risks associated with each trenchless crossing compared to more traditional, trenched crossing methods. Trenchless, isolated trenched (if water is present at the time of construction), or open-cut (if dry or frozen to the bottom, throughout the entire proposed pipeline corridor, at the time of construction) installation methods recommended for each proposed watercourse crossing are identified in Section 6.0.

Water quality monitoring during watercourse crossing construction will occur at specific watercourse crossings in order to protect aquatic resources during and following construction (Section 6.0), as well as to ensure compliance with applicable water crossing permit conditions.

Clearing within vegetated riparian buffers crossed by the proposed pipeline easement and temporary workspace will occur only if absolutely necessary. The construction right-of-way will be recontoured and approach slopes will be stabilized following crossing installation and will include the installation of sediment controls (*e.g.*, fences, fabric, cross ditches, etc.) until revegetation of the disturbed land is complete. Riparian areas, banks and approaches will be seeded with an approved annual or perennial grass cover crop or native grass mix as soon as feasible after construction. Temporary erosion control measures such as temporary berms, sediment fences or cross ditches will be installed within 24 hours of backfilling banks and approach slopes of watercourse crossings at any location where runoff from the construction right-of-way may flow into a watercourse. The watercourse reclamation strategy for the Project is described in Section 7.1.3.

The EPPs (Volumes 6B, 6C and 6D) provide mitigation plans developed in response to issues identified during Project planning, stakeholder consultation, Aboriginal engagement and regulatory discussions.

Aboriginal Monitors onsite through the construction of commissioning of the of the Project will work with environmental inspectors to provide traditional knowledge to the construction program to ensure protection of the environment; to discuss upcoming traditional and western science elements with the environmental inspector to insure protection and monitoring; and to monitor mitigation success in protecting the environment. Trans Mountain will continue to engage Aboriginal communities through all phases of the Project. Trans Mountain's commitment to retain Aboriginal Monitors is further described in Volume 6A.

Concerns related to aquatic resources were addressed by the proposed mitigation measures discussed. Participants have not recommended any mitigation strategies related to aquatic resources additional to those described in the Section 7.0 to be implemented for the Project.

5.7 Burnaby Terminal

5.7.1 Watercourse Crossings

Only one pipeline watercourse crossing was identified within the Burnaby Terminal. The unnamed tributary to the upper headwaters of Eagle Creek was surveyed in August 2013 and had low potential for fish. A 10.5 ha pond is located along the southwest corner of the existing Burnaby Terminal boundary. The pond is completely drained periodically and does not support fish. Water drains southwest into a penstock which has a 90% grade and appears to be regulated by a pump valve. Downstream from the penstock is an anthropogenic channel approximately 50 m in length which was predominately dry at the time of the assessment. All flow in the channel was reduced to anoxic residual pools of water with abundant orange-brown algae and a DO of 0.95 mg/L. Downstream from the channelized section, there is a 1000 mm concrete culvert drain which feeds into a stormwater outfall system. This stormwater system is approximately 60 m in length and conveys flow underneath Arden Avenue and Shellmont Street. The stormwater outfall and the penstock are considered to be barriers to all upstream fish migration. This tributary to Eagle Creek is designated Class 1 for navigation based on the criteria defined for the Project in Section 3.4 and outlined in the *Minor Works and Waters Ministerial Order* of the *NWPA.*

5.8 Burnaby to Westridge Segment

5.8.1 Watercourse Crossings

There is one mapped watercourse crossing within the Burnaby to Westridge Segment (BC-786). This unnamed watercourse was surveyed in the field in November 2013 and had low potential for fish within the proposed pipeline corridor. The watercourse is less than 1.5 m wide and had limited discharge at the time of survey with sections with marginal channel definition. Burrard Inlet is located approximately 750 m downslope and a gradient of 30% was recorded downstream. A stormwater outfall structure with a vertical drop exceeding 2 m in height as well as other infrastructure (*e.g.*, industrial yard, settling ponds and railway tracks) are barriers between the inlet and the proposed pipeline corridor. This stream channel is designated as non-navigable (Class 2) based on the criteria defined for the Project in Section 3.4 and outlined in the *Minor Works and Waters Ministerial Order* of the *NWPA.* There are no previous fish records for this unnamed watercourse and no fish were captured or observed

6.0 RECOMMENDATIONS

6.1 General Recommendations

Recommendations for potential crossing methods considered the results from desktop analysis, field surveys, TEK studies and industry experience. Habitat sensitivity (*i.e.*, high or low), combined with the determination of fish-bearing status and the presence of indicator species or other species of management concern were integral in the development of recommendations for proposed watercourse crossings methods (Section 5.0).

There were 60 potential watercourse crossings that were not accessible during the 2012-2013 field programs. Where available existing literature and data were used to develop interim assessment results and proposed mitigation measures. With available access, these sites will be visited in 2014. Preliminary risk-based classifications and habitat sensitivities were assigned; watercourse crossings with moderate potential for fish were 'defaulted' to a fish-bearing status (Appendix A). The recommendations for these sites and for sites where second season sampling is still to be conducted may be refined following completion of field surveys (Section 6.9 and Appendix F).

6.1.1 Pipeline Crossings Methods

6.1.1.1 Trenchless Methods

Trenchless pipeline crossing methods (*e.g.*, horizontal directional drill) are proposed for 20 fish-bearing crossings within the proposed pipeline corridor; three of these watercourses (BC-181, BC-716 and BC-718) will be crossed as part of an adjacent large river crossing. Habitat at these crossings was identified as having high sensitivity and/or the presence of species of recreational, commercial, ecological, and Aboriginal concern was confirmed.

Trenchless pipeline crossing methods are a preferred method for crossing larger riverine systems as they do not affect the productive capacities of instream or riparian habitats (DFO 2007a). Trenchless pipeline crossing methods can be constructed at any time of year, regardless of the provincial timing window, and currently require notification to DFO/NEB (*e.g.*, under the BC and Yukon OS for High-Pressure Directional Drilling (HDD) [DFO 2007a] or Punch and Bore Crossings [DFO 2007b]) and to the BC OGC (*Water Act*, Section 9 Approvals and Notifications for "Changes In and About a Stream"). These watercourse crossings would also need to be constructed in a manner that adheres to all of the conditions and mitigation measures discussed in Section 7.0. It is recommended that water quality monitoring coincide with trenchless construction at any crossing of fish-bearing habitat, regardless of construction timing.

6.1.1.2 Trenched Methods

If trenchless pipeline crossing methods are not feasible for all remaining proposed pipeline crossings, trenched pipeline crossing methods would be suitable for the construction. Isolated trenched methods are recommended for these crossings if water is present at the time of construction, while open-cut methods are recommended for crossings that are dry or frozen to the bottom (throughout the entire proposed pipeline corridor) at the time of construction.

6.1.2 Fish-Bearing Watercourses or Wetlands

For the 176 fish-bearing sites along the proposed pipeline corridor where fish habitat was determined to be of high sensitivity and/or where species species of recreational, commercial, ecological, and Aboriginal concern occur, it is recommended that isolated trenched pipeline crossing methods occur with fish salvage inside the timing window, where possible. Where isolation may not be possible inside the timing window because of high flow (*i.e.*, freshet), a trenchless option (any time of year) or DFO authorized contingency open-cut inside the timing window may be appropriate (Section 6.1.5). An option for isolated trenched pipeline crossing method described above is to construct outside of the timing window when flow is more suitable for isolation (*e.g.*, late summer, fall or winter). This would require a timing variance and approval from DFO. A water quality monitoring program would be completed at all trenched pipeline crossings with high sensitivity values.

Sensitivity was rated low (*i.e.*, reach is nonfish-bearing within proposed pipeline corridor and/or nil potential for indicator species) at 52 fish-bearing crossings. At those crossings, trenched pipeline crossing methods could occur at any time (*i.e.*, regardless of the instream timing window), presuming the successful implementation of appropriate mitigation and reclamation measures during construction (Section 7.0). At those nonfish-bearing crossings identified with fish-bearing reaches or watercourses within the ZOI, a water quality program would also be implemented similar to that for higher value fish-bearing programs described above to monitor any downstream turbidity issues within the immediate ZOI of the proposed crossing (*i.e.*, RSA).

For crossings of fish-bearing wetlands or for fish-bearing watercourses where wetland characteristics were identified, additional mitigation measures specific to wetlands may be required. Refer to the Wetlands Evaluation Technical Report of Volume 5C for additional mitigation at these sites.

Under the BC and Yukon Operational Statement (OS) for Dry Open-cut Crossing (DFO 2007c) the NEB/DFO will be notified in advance for all dry/frozen fish-bearing watercourse crossings. Fish-bearing crossings that do not meet all the conditions and mitigation measures in the BC and Yukon OS for Dry Open-cut Crossing (DFO 2007c) (*e.g.*, flowing, stream location involving known fish spawning habitat, clearing of riparian vegetation) will require case-specific review by NEB/DFO.

If required, Trans Mountain will make an application for the appropriate provincial permits for crossings of defined watercourses, including wetlands (*e.g.,* under the *Water Act* (Section 9 Approvals and Notifications for “Changes In and About a Stream”, where a “stream” under the *Water Act* is defined as "includes a natural watercourse or source of water supply, whether usually containing water or not, and a lake, river, creek, spring, ravine, swamp and gulch") (*Water Act* 1993).

6.1.3 Nonfish-Bearing Watercourses or Wetlands

Trenched pipeline methods can be constructed at any time of year (*i.e.*, regardless of instream timing window) at all nonfish-bearing habitat (which includes 154 NCD and 202 NVC) crossed by the proposed pipeline corridor (Appendix C - Nonfish-bearing Atlas). These recommendations consider the absence of fish, a lack of suitable habitat potential determined during desktop analyses and field programs, and distance from known fish habitat (*e.g.*, extent of ZOI) at each proposed crossing location. At these locations, isolated trenched construction can occur when water is present while an open-cut method can occur where the channel is dry or frozen to bottom throughout the entire proposed pipeline corridor at the time of construction.

Trans Mountain will make an application for the appropriate BC OGC permits as required for routine pipeline crossing methods of defined nonfish-bearing watercourses and wetlands prior to construction. There are no anticipated regulatory requirements associated with notification or application to NEB/DFO (*Fisheries Act*) for these nonfish-bearing watercourses, presuming the successful implementation of appropriate mitigation and reclamation measures during construction (Section 7.0).

A total of 23 wetlands were confirmed to provide no fish habitat potential along the proposed pipeline corridor. Crossing method recommendations and related mitigation measures for these wetland crossings and all others are provided in the Wetland Evaluation Technical Report of Volume 5C.

6.1.4 Beaver Dam Removal

Where trenched pipeline crossing methods are recommended, 18 proposed watercourse crossings were influenced by recent beaver activity (*e.g.*, beaver dams/impoundments). It is anticipated that the beaver dam removal may be required for approximately 13 fish-bearing drainages and 5 nonfish-bearing drainages to reduce the water levels during construction and facilitate the successful use of isolation techniques. Trans Mountain may determine that removal of beaver dams is necessary at other crossings where trenched construction would be implemented. Beaver dam removal in BC typically involves a case-specific review and approval from DFO (*Fisheries Act*) and the BC OGC (*Water Act*) and a permit from BC MFLNRO (*Wildlife Act*). All beaver dam removal should be conducted in a manner that adheres with all of the conditions and mitigation measures discussed in Section 7.0.

6.1.5 Contingency Pipeline Crossings of Large Rivers

If trenchless methods at the large river crossings (*i.e.*, S1 and S2) are found to be unfeasible or unsuccessful, isolated trenched or open-cut pipeline crossing method may be considered as a contingency method (Table 6.1).

Isolated trenched and open-cut construction at any of these sites would require a case-specific review by NEB/DFO. In case either of these methods need to be implemented, a site-specific reclamation plan may need to be developed for each crossing to ensure their productive capacity is maintained at each watercourse. Alternatively, discussions with NEB/DFO should be conducted to confirm whether approved plans for compensation/offset of habitat loss will be required prior to trenched construction as mitigation alone may not ensure there is 'no net loss' of productive fish habitat at these crossings.

6.1.6 Recommended Temporary Vehicle and Equipment Crossing Methods

Construction within the proposed pipeline corridor will also require temporary watercourse crossings for vehicles and equipment. Wherever possible and regardless of fish presence or habitat sensitivity at the Project's watercourse crossings, all vehicles and equipment will utilize existing bridges, culverts and/or roads. If there are no existing roads at or near the proposed crossing stream, fording by vehicles and equipment will be kept to a minimum on an as required basis. Notification and/or an Approval are required by the BC OGC for all proposed temporary vehicle and equipment crossings of defined watercourses and wetlands (includes upgrades to existing crossing structures).

A clear-span bridge with supporting structures located outside the ordinary high watermark is a common construction approach at fish-bearing watercourse crossings. Application of appropriate mitigation measures and adherence to conditions as set out in DFO's BC and Yukon OS (DFO 2007d) will ensure no net loss of productive capacity and would only require a notification to NEB/DFO. A case-specific review by NEB/DFO may be necessary where conditions of the OS cannot be met (*e.g.*, involves the alteration of channel banks or clearing of riparian vegetation). It is recommended that clear-span bridges be used as the primary vehicle crossing method for fish-bearing habitat within the proposed pipeline corridor. Other temporary vehicle crossing methods (*e.g*., culverts, swamp mats) could be used at low sensitivity fish-bearing watercourses and wetlands but would be subject to a case-specific review by NEB/DFO and BC OGC.

During frozen conditions and where there is sufficient ice/snow at the time of construction, vehicles and equipment could cross watercourses using snowfills and ice bridges if no existing crossing structures occur. These crossing methods will require notification to NEB/DFO under DFO's BC and Yukon OS for Ice Bridges and Snow Fills (DFO 2007e). Trans Mountain will make application for the appropriate BC OGC permits as required.

Open or closed bottom culvert crossing may be considered at lower sensitivity fish-bearing watercourse crossings, and flow will be isolated where necessary during construction. The installation of a culvert at any defined fish-bearing watercourse will require case-specific review by NEB/DFO. It is expected that at some proposed crossings, the removal of beaver dams and the draining of beaver impoundments may also be necessary prior to the installation of temporary vehicle and equipment crossing structures. Recommendations related to beaver dam removal are provided in Section 6.1.4 above. Appropriate mitigation for culvert installation and beaver dam removal is provided in Section 7.0.

Logfill or other approved alternative crossing structures (*e.g.*, swamp mat) could also be used as a temporary vehicle and equipment crossing method at nonfish-bearing watercourses or wetlands. This method should only be used at crossings where the watercourse or wetland is dry or frozen to the bottom or where there is sufficient ice-cover to support the crossing and the crossing material must be removed before spring break-up. Additional mitigation for this crossing method is provided in Section 7.0. DFO/NEB would require a case-specific review for use of this crossing type. A one-time ford in flowing waters, or seasonally dry streambed ford may be used for short term construction access where conditions of DFO's BC and Yukon OS for Temporary Ford Stream Crossing are met (*e.g*., does not involve alteration of the stream channel, avoidance of known fish spawning sites) (DFO 2007f). As such, a notification to DFO would be required under the OS; appropriate mitigation for use of vehicle fords is also provided in Section 7.0.

6.1.7 Recommended Pipeline and Vehicle Crossing Methods for Non-Classified Drainages and Isolated Ponds

There are no anticipated regulatory requirements to NEB/DFO/BC OGC concerning pipeline crossing methods, vehicle, or equipment crossing methods across nonfish-bearing NCDs.

The appropriate use of snowfills and ice bridges, logfills, culverts, swamp mats, fords and clear-span bridges may be possible at nonfish-bearing NCDs, depending on the time of construction (spread timing) and anticipated flow conditions. Trans Mountain should select the appropriate crossing structure based on the site characteristics and conditions at time of construction.

Anthropogenic ponds created for water storage (*e.g.*, irrigation, livestock watering, golf courses and aesthetics) are not always connected by surface waters to any fish-bearing waters at any time of year, and, therefore, are not considered a stream as defined by the *Forests and Range Practices Act (FRPA 2004)*. These structures have no inflow and outflow, and little to no effect on fish or fish habitat (DFO 2007g). Crossings of these types of isolated ponds can proceed without DFO/NEB review and would only require a notification (*e.g.*, under the BC and Yukon OS for Isolated Ponds [DFO 2007g]) where conditions of the OS can be met.

6.2 Hargreaves to Darfield Segment

6.2.1 Summary of Recommended Pipeline Crossing Methods

Trans Mountain has proposed a trenchless method (*i.e.*, HDD) for most of the large watercourse crossings. Current and geotechnical assessments have shown that trenchless crossing of the Fraser River (BC-10) is unfeasible. A trenched crossing method (*i.e.*, isolation, open-cut) will be used for the remaining watercourses based on the recommendations in this report. Beaver dam removal and/or additional mitigation to protect wetland habitat may be required at some crossings. A summary of the recommended pipeline crossing methods for the Hargreaves to Darfield Segment is presented in Table 6.1.

TABLE 6.1

SUMMARY OF POTENTIAL PIPELINE CROSSING METHODS ALONG THE HARGREAVES TO DARFIELD SEGMENT

Pipeline Construction Method	Sensitivity (Habitat)	Number Proposed	Key Crossings
Fish-Bearing			
Trenchless (*e.g.*, HDD) with water quality monitoring	High	8	North Thompson River (3 HDDs; includes BC-181), Blue River, Finn Creek, Raft River, Clearwater River, and Mann Creek
Isolation with fish salvage and water quality monitoring inside or outside the timing window, or open-cut with water quality monitoring if isolation is not feasible.	High	60	Stage 2 crossings require environmental and engineering considerations and include[1]: Fraser River, Marathon Creek, Terry Fox Creek, Swift Creek, Canoe River, Camp Creek, Albreda River, Clemina Creek, Dora Creek, Dominion Creek, Moonbeam Creek, Serpentine Creek, Chappell Creek, Miledge Creek, Thunder River, Goose Creek, Froth Creek, Tumtum Creek Mad River, Lemieux Creek, Eakin Creek, Darlington Creek, and Lindquist Creek
Isolation with fish salvage and/or water quality monitoring if water present; open-cut (DFO OS) if dry or frozen to bottom; water quality monitoring may be recommended under flowing conditions, and where site has moderate to high potential for indicator species in the LSA	Low	34	Stage 2 crossings require environmental and engineering considerations and include[1]: Whitewater Creek Other key crossings include: Robina Creek, Switch Creek, Sager Creek, Crossing Creek, School Creek
Wetlands	High/Low	9	Goose Creek (BC-180) and an Unnamed Drainage (BC-73) may require a Stage 2 engineering review
Potential beaver dam removal	High/Low	8	Includes: BC-65, BC-82, BC-89, BC-180, BC-185, BC-215, BC-249, BC-317
Nonfish-Bearing			
Isolation if water present; open-cut (DFO OS) if dry or frozen to bottom	Low	172	Foam Creek, Ivy Creek, Noblequartz Creek,
Wetlands	Low	14	

TABLE 6.1 Cont'd

Pipeline Construction Method	Sensitivity (Habitat)	Number Proposed	Key Crossings
Potential beaver dam removal	Low	3	Includes: BC-46, BC-77, BC-235
NCDs	Low	62	
NVCs	Low	62	

Note: 1 Refer to Project Design and Execution - Engineering of Volume 4A for explanation and criteria of Stage 2 review sites.

2 Sites that are wetlands and have potential for beaver dam removal are also included in the totals of each pipeline crossing method.

6.2.2 Summary of Recommended Vehicle Crossing Methods

Recommended vehicle and equipment crossing methods were made for each watercourse crossing based on habitat sensitivity. These are summarized for the Hargreaves to Darfield Segment in Table 6.2.

TABLE 6.2

SUMMARY OF POTENTIAL VEHICLE AND EQUIPMENT CROSSING METHODS FOR THE HARGREAVES TO DARFIELD SEGMENT

Vehicle Crossing Method	Sensitivity (Habitat)	Number Proposed
Fish-Bearing		
Access both banks	--	7
Clear-span bridge	High / Low	83
Other approved crossing methods (*e.g.*, ramp and culvert, swamp mat, snow/icefill, logfill, ford)	Low	12
Nonfish-Bearing		
Clear-span bridge	Low	11
Other approved crossing methods (*e.g.*, ramp and culvert, swamp mat, snow/icefill, logfill, ford)	Low	161

Note: 1 Sites that are classed as NVC are not included in the crossing methods totals.

6.3 Black Pines to Hope Segment

6.3.1 Summary of Recommended Pipeline Crossing Methods

A summary of the recommended pipeline crossing methods for the Black Pines to Hope Segment is presented in Table 6.3.

TABLE 6.3

SUMMARY OF POTENTIAL PIPELINE CROSSING METHODS ALONG THE BLACK PINES TO HOPE SEGMENT

Pipeline Construction Method	Sensitivity (Habitat)	Number Proposed	Key Crossings
Fish-Bearing			
Trenchless (*e.g.*, HDD) with water quality monitoring	High	7	Thompson River, Nicola River, Coldwater River (4 HDDs), Coquihalla River (BC-654)
Isolation with fish salvage and water quality monitoring inside or outside the timing window, or open-cut with water quality monitoring if isolation is not feasible.	High	24	Stage 2 crossings requiring environmental and engineering considerations include[1]: Anderson Creek, Moore Creek, Clapperton Creek, Juliet Creek, Ladner Creek, Dewdney Creek, Coquihalla River (4 crossings), and Dewdney Creek

TABLE 6.3 Cont'd

Pipeline Construction Method	Sensitivity (Habitat)	Number Proposed	Key Crossings
Isolation with fish salvage and/or water quality monitoring if water present; open-cut (DFO OS) if dry or frozen to bottom; water quality monitoring may be recommended under flowing conditions, and where site has moderate to high potential for indicator species in the LSA	Low	10	Skuagam Creek and Salem Creek,
Wetlands	High/Low	2	Includes: BC-414, BC-433
Potential beaver dam removal	High/Low	3	Includes: BC-433, BC-504, BC-559
Nonfish-Bearing			
Isolation if water present; open-cut (DFO OS) if dry or frozen to bottom	Low	151	Boston Bar Creek, unnamed tributaries to Boston Bar Creek upstream from barrier
Wetlands	Low	6	Includes: BC-430, BC-438, BC-439, BC-445, BC-448, BC-455
Potential beaver dam removal	Low	2	Includes: BC-426, BC-438
NCDs	Low	73	
NVCs	Low	112	

Note: 1 Refer to Project Design and Execution - Engineering of Volume 4A for explanation and criteria of Stage 2 review sites.

2 Sites that are wetlands and have potential for beaver dam removal are also included in the totals of each pipeline crossing method.

6.3.2 Summary of Recommended Vehicle Crossing Methods

A summary of the recommended vehicle and equipment crossing methods for the Black Pines to Hope Segment is presented in Table 6.4.

TABLE 6.4

SUMMARY OF POTENTIAL VEHICLE AND EQUIPMENT CROSSING METHODS

Vehicle Crossing Method	Sensitivity (Habitat)	Number Proposed
Fish-Bearing		
Access both banks	--	5
Clear-span bridge	High / Low	34
Other approved crossing methods (*e.g.*, ramp and culvert, swamp mat, snow/icefill, logfill, ford)	Low	2
Nonfish-Bearing		
Clear-span bridge	Low	18
Other approved crossing methods (*e.g.*, ramp and culvert, swamp mat, snow/icefill, logfill, ford)	Low	133

Note: 1 Sites that are classed as NVC are not included in the crossing methods totals.

6.4 Black Pines Power Line

The Black Pines Power Line will cross the North Thompson River and six nonfish-bearing drainages (all six are NVC).

Construction of power lines should avoid clearing and encroachment of riparian areas and ensure that poles are not installed within close proximity of watercourse crossings (*i.e.*, placed well outside the high water mark, and ideally outside of the riparian reserve zone [BC MOF 1995]). Mitigation measures discussed in Section 7.0 for pipeline and facilities construction and operation should incorporate measures to protect fish habitat and riparian areas during right-of-way clearing, installation of temporary vehicle crossings for line construction. DFO's BC and Yukon OS for Overhead Line Construction should be followed; notification is required where conditions of the OS can be met (*e.g.*, the electrical transmission line is not greater than 60 kV and right-of-way is not greater than 10 m) (DFO 2007h). Where conditions of the OS cannot be met approval from NEB/DFO will be required.

Temporary vehicle and equipment crossings of all nonfish-bearing drainages may be crossed using existing crossing structures, clear-span bridge or other approved crossing methods (*e.g.*, culvert, swamp mat, snow/icefill, logfill, ford). The North Thompson River should be accessed from both sides (*i.e.*, Highway 5 and Westsyde Road) and crossed using existing bridges (*i.e.*, Halston Avenue).

6.5 Kingsvale Power Line

The Kingsvale Power Line will cross a total of 2 fish-bearing watercourse crossings (Howarth Creek and Kanevale Creek) and 24 nonfish-bearing crossings (includes four watercourses). Refer to Section 6.4 above for recommendations associated with overhead line crossings of watercourses and waterbodies.

Howarth Creek and Kanevale Creek should be crossed using a clear-span bridge; all remaining 24 nonfish-bearing drainages may be crossed using a clear-span bridge or other approved crossing methods (*e.g.*, culvert, swamp mat, snow/icefill, logfill, ford).

6.6 Hope to Burnaby Segment

6.6.1 Summary of Recommended Pipeline Crossing Methods

A summary of the recommended pipeline crossing methods for the Hope to Burnaby Segment is presented in Table 6.5.

TABLE 6.5

SUMMARY OF POTENTIAL PIPELINE CROSSING METHODS ALONG THE HOPE TO BURNABY SEGMENT

Pipeline Construction Method	Sensitivity (Habitat)	Number Proposed	Key Crossings
Fish-Bearing			
Trenchless (*e.g.*, HDD) with water quality monitoring	High	5	Chilliwack/Vedder River and side channels (including BC-716, BC-717, and BC-718), Sumas River, Fraser River
Isolation with fish salvage and water quality monitoring inside or outside the timing window, or open-cut with water quality monitoring if isolation is not feasible.	High	48	Stage 2 crossings requiring environmental and engineering considerations include[1]: Silverhope Creek, Chawuthen Creek, Hunter Creek, Lorenzetta Creek, Whaleach Creek, Chilliwack Creek, Sumas Lake Canal, Clayburn Creek, McLennan Creek, Nathan Creek Salmon River, Como Creek, and Stoney Creek. Crossings with potential for *SARA*-listed species include: Semmihault Creek, Chilliwack Creek, Salmon River and Stoney Creek
Isolation with fish salvage and/or water quality monitoring if water present; open-cut (DFO OS) if dry or frozen to bottom; water quality monitoring may be recommended under flowing conditions, and where site has moderate to high potential for indicator species in the LSA	Low	15	
Wetlands	High/Low	2	Includes: BC-738 and BC-752
Potential beaver dam removal	High/Low	5	Includes: BC-658, BC-666, BC-693, BC-716, BC-781
Nonfish-Bearing			
Isolation if water present; open-cut (DFO OS) if dry or frozen to bottom	Low	30	
Wetlands	Low	2	Includes: BC-738, BC-752
Potential beaver dam removal	Low	1	BC-752
NCDs	Low	11	
NVCs	Low	11	

Note: 1 Refer to Project Design and Execution - Engineering of Volume 4A for explanation and criteria of Stage 2 review sites.

2 Sites that are wetlands and have potential for beaver dam removal are also included in the totals of each pipeline crossing method.

6.6.2 Summary of Recommended Vehicle Crossing Methods

A summary of the recommended vehicle and equipment crossing methods for the Hope to Burnaby Segment is presented in Table 6.6.

TABLE 6.6

SUMMARY OF POTENTIAL VEHICLE AND EQUIPMENT CROSSING METHODS FOR THE HOPE TO BURNABY SEGMENT

Vehicle Crossing Method	Sensitivity (Habitat)	Number Proposed
Fish-Bearing		
Access both banks	--	4
Clear-span bridge	High/Low	57
Other approved crossing methods (*e.g.*, ramp and culvert, swamp mat, snow/icefill, logfill, ford)	Low	7
Nonfish-Bearing		
Clear-span bridge	Low	6
Other approved crossing methods (*e.g.*, ramp and culvert, swamp mat, snow/icefill, logfill, ford)	Low	24

Note: 1 Sites that are classed as NVC are not included in the crossing methods totals.

6.7 Burnaby Terminal

The upper headwater tributary to Eagle Creek along the southwest corner of the Burnaby Terminal was assessed to be nonfish-bearing. Proposed expansion of the Burnaby Terminal is not likely to negatively affect fish and fish habitat at this location.

The upper headwater tributary to Eagle Creek may be crossed using a ramp and culvert or other approved crossing methods (*e.g.*, clear-span, swamp mat, snow/icefill, logfill, and ford).

6.8 Burnaby to Westridge Segment

The unnamed tributary to Burrard Inlet was assessed to be nonfish bearing. The recommended pipeline crossing method is a trenched isolation if water is present and a trenched open-cut if dry or frozen to bottom. This watercourse may be crossed using a ramp and culvert or other approved crossing methods (*e.g.*, clear-span, swamp mat, snow/icefill, logfill, and ford).

6.9 Traditional Ecological Knowledge

A comprehensive review of the recommended mitigation measures provided in Section 7.0 and of all the issues raised by participating Aboriginal communities was conducted with each community during the field surveys and during follow-up results review (Section 3.2.10). Concerns related to aquatic resources were addressed by the proposed mitigation measures discussed. Participants have not recommended any mitigation strategies related to aquatic resources additional to those described in Section 7.0 to be implemented for the Project.

6.10 Supplemental Studies

The 2012/2013 field programs focused on the assessment of potential fish habitat traversed by the proposed pipeline corridor, the Burnaby Terminal and power lines, where private and Crown land access was permitted. In some cases, access to proposed watercourse crossings via private land or Indian Reserves was not permitted within the LSA. In other locations, the timing of alterations to the proposed pipeline corridor alignment precluded multiple seasons of sampling where required. A total of 47 potential crossings were not assessed during the 2012/2013 field program, and 18 watercourse crossings require additional sampling to confirm fish habitat potential and use. These watercourse crossings are identified in Appendix F as sites that require supplemental studies (to occur after November 8, 2013).

As mentioned previously, some large fish-bearing channels with known fish species information were included in the results; however, a field investigation is still necessary to collect site-specific information at these proposed crossing locations. Other watercourses will still require one to two seasons of sampling to confirm fish presence or absence and establish a final sensitivity classification. Preliminary classifications, sensitivity rankings, and classification justifications were completed for these watercourses where possible and are indicated in Appendix A. This was accomplished using map inferences, historical fish information at or adjacent to proposed watercourse crossings, gradient calculations, catchment basin size, and potential for connectivity downstream. Some sites were also visited in the field downslope from the proposed crossing locations to confirm connectivity and presence or absence of a defined channel. These comments are included in Appendix F.

Preliminary classifications, sensitivity rankings, and classification justifications were completed for these watercourses where possible and are indicated in Appendix F. This was accomplished using map inferences, historical fish information at or adjacent to proposed watercourse crossings, gradient calculations, catchment basin size, and potential for connectivity downstream. Some sites were also visited in the field downslope from the proposed crossing locations to confirm connectivity and presence or absence of a defined channel. These comments are included in Appendix F. Note that watercourse crossings in Appendix F were not generally included in the final results, except where historical information was sufficient. The final classification and sensitivity status is still to be determined (TBD) and will be updated in 2014 during supplemental data collection.

Additional surveys may also be required to assess any future route refinements or unmapped watercourse crossings identified during detailed survey of the final route. Watercourse assessments may also be required for access roads, power lines or ancillary facilities located outside the proposed pipeline corridor including construction camps, storage areas, contractor yards, and borrow pits. The potential pathway of effects of pipelines, access roads and power lines construction and operations to the aquatic environment are well known. Mitigation strategies presented in the Project's Environmental Protection Plans (EPPs) can be applied to these watercourse crossings.

It is also acknowledged that a plan for compensation/offset of any potential habitat loss may be required if it is determined that Project-related activities will result in serious harm to fishes or their habitat. As such, specific pre-construction field programs to determine potential opportunities may be required prior to construction to avoid any temporal loss of habitat productivity.

A re-examination of the Project's federal notification and authorisation requirements, as related to construction activities with the potential to affect fish and fish habitat, will also be needed. It is expected that an MOU between the NEB and DFO will be released prior to the end of 2013. Once this MOU (and relevant review process tools) is interpreted with the Project's activities and context, appropriate notification and authorization requirements (*i.e.,* an update from what is currently provided in earlier sub-sections of Section 6.0) will be identified.

Additional information gathered during ongoing engagement with potentially affected Aboriginal communities will be incorporated into Project planning, including the Project's EPPs and the Environmental Alignment Sheets, as appropriate.

7.0 MITIGATION AND RECLAMATION

This section discusses Project-related interactions and effects, mitigation and recommended reclamation measures specific to pipeline construction and operations. For the purpose of the BC Fisheries Technical Report, discussions concerning mitigation and reclamation also pertain to construction and operation of terminals, temporary access roads and power lines.

7.1 Pipeline and Facilities Construction and Operations

7.1.1 Pathway of Effects

The potential pathway of effects from pipeline construction and operations to the aquatic environment are well known. There are a number of pre-mitigation pipeline construction and operation activities that have potential to directly affect the productive capacity of instream and riparian fish habitat at and near the proposed crossings (Section 3.1). Depending on the sensitivity of the habitat as determined by species distribution and habitat quality (sensitive watercourses) (Section 4.0 and 5.0); there may be greater potential for direct and indirect effects to fish and fish habitat. Best Management Practices (Section 7.1.2) and Recommended General Mitigation Measures (Section 7.1.3) will be required to reduce or eliminate effects to aquatic resources before and during construction.

7.1.2 Best Management Practices

Specific endpoint measurements for the Project may include direct mortality or injury to fish from Project activities, or instream and riparian habitat loss or alteration at watercourses crossed by the proposed pipeline corridor (Section 3.1.3). Mitigation developed for the Project incorporates best mangament practices and is designed to reduce the potential for residual effects from the Project, as well as to maintain the current natural productive capacity of fish habitats. Mitigation recommended below incorporates standard measures provided in provincial and federal guidelines (*e.g.*, DFO OSs and BC MWLAP guidance documents).

Eliminating or reducing the potential effects to fish and fish habitat from Project-related activities (Table 7.1) involves the incorporation of site-specific, regional, provincial and/or federal mitigation measures and guidelines. However, the passing of Bill C-38 in June 2012 resulted in changes to various federal legislation (*e.g.*, *the Fisheries Act,* the *Canadian Environmental Assessment Act*, *Species at Risk Act*, and *National Energy Board Act*) and ongoing changes to relevant regulations and policies. Specific to the *Fisheries Act*, legislative changes resulted in DFO's *Habitat Management Program* changing to the *Fisheries Protection Program*, and a revised focus of DFO with a shift from a habitat based approach to one encompassing habitat and fish of Aboriginal, commercial and recreational value. Refer to Section 1.5.1.1 of this report for more information.

The following recommended mitigation for the reduction of potential effects is based on the current understanding of the *Fisheries Act* and applicable policies and acts that are currently being administered. It is important to note that, as additional changes to the existing policies and regulations are implemented, the regulatory requirements for the proposed pipeline corridor under the federal *Fisheries Act* and other applicable acts may further evolve. As a result of these regulatory changes, revisions to some of the recommendations in this report may be needed.

It is recommended that Trans Mountain adheres to the guidance prescribed in DFO's current *Fisheries Protection Policy Statement* (DFO 2013f) and to DFO's guiding principal of "no net loss" as outlined in the *Policy for the Management of Fish Habitat* (DFO 1986). As outlined below by means of a hierarchy of preferences, these policies provide direction to apply measures required to achieve an overall net gain and "no net loss" of habitat productivity:

- maintain, without disruption, the natural productive capacity of the habitats affected by avoiding any loss or alteration through redesign or realignment selection;
- mitigate potential damages using biologically and technically feasible techniques (*e.g.*, crossing methods appropriate to the specific watercourse) and plans (*e.g.*, erosion

and sediment control plan) and contingency plans (*e.g*., spill response, response to an inadvertent release of drilling fluid); and

- consider options for compensation/offset of habitat losses where fish habitat has been ranked as sensitive and it is not possible to maintain the existing productive capacity through mitigation and restoration.

In coordination with the current *Fisheries Protection Policy Statement* (DFO 2013c), Trans Mountain should employ standard mitigation (EPP) and site-specific measures and best management practices to protect fish and fish habitat through the following:

- comply with all regulatory, permit and approval conditions including habitat protection provisions of the *Fisheries Act*;
- prevent the potential for adverse environmental effects and/or release of deleterious materials to the environment;
- employ environmentally and economically responsible construction practices at all times, using applicable industry-accepted practices and procedures;
- select appropriate crossing techniques for the environmental sensitivity of the watercourse;
- construction of watercourse crossings during low flow periods and adherence to instream timing windows, where practicable;
- use of suitable isolation methods (dam and pump or flume to achieve a clean-water bypass) if water is present;
- complete fish salvages in all fish-bearing watercourses where flow is present;
- conduct water quality monitoring for crossings of sensitive habitat with potential for management concern;
- use horizontal directional drilling, where feasible, for larger watercourses and more sensitive crossings;
- maintain the natural terrain integrity, including natural hydrologic regimes and slope stability;
- protect and maintain the ecosystem function of riparian areas;
- restore all crossings to ensure that the productive capacity of the habitat is maintained; and
- apply detailed mitigation measures for all fish habitat which are designed to reduce or eliminate anticipated Project-related effects to fish and fish habitat.

7.1.3 Recommended General Mitigation Measures

Detailed mitigation measures for all watercourse crossings are designed to reduce or eliminate anticipated Project-related effects to fish and fish habitat. The recommendations and mitigation measures for the proposed crossings along the proposed pipeline corridor included in this report were developed in accordance with construction standards outlined in the guide for Pipeline Associated Watercourse Crossings, 3rd Addition (CAPP *et al.* 2005), DFO Regional Operational Statements for BC and the Yukon (DFO, 2010b) and other guiding and planning documents referenced below. The guide for Pipeline Associated Watercourse Crossings includes an endorsement from DFO that indicates it is a compilation of modern planning considerations, 'best management practices' for pipeline and vehicle crossing construction techniques and current environmental protection methods that are used to meet regulatory

requirements across Canada and to reduce fish and fish habitat effects associated with pipeline-related watercourse crossing activities.

Guidelines and planning tools for current mitigation, restoration and best management practices for watercourse crossings in BC may include the following:

- Pipeline Associated Watercourse Crossings, 3rd Edition (CAPP 2005);
- Planning Horizontal Directional Drilling for Pipeline Construction (CAPP 2004);
- DFO Regional Operational Statements for BC and the Yukon (DFO 2007a-h);
- Standards and Best Practices for In-stream Works (BC MWLAP 2004);
- Environmental Protection and Management Guide (BC OGC 2013);
- Oil and Gas Water Use in British Columbia (BC OGC 2011);
- Fish-Stream Crossing Guidebook (BC MFLNRO *et al.* 2012);
- A Users Guide to Working In and Around Water - Understanding the Regulation under British Columbia's *Water Act* (BC MOE 2005);
- Fish Habitat Rehabilitation Procedures (BC MELP *et al.* 1997);
- Freshwater Intake End-of-Pipe Fish Screen Guideline (DFO 1995);
- Canadian Council of Ministers of the Environment “Canadian Water Quality Guidelines for the Protection of Aquatic Life (CCME 2002);
- Guidelines for the Use of Explosives in or near Canadian Fisheries Waters (Wright and Hopky 1998);
- Land Development Guidelines for the Protection of Aquatic Habitat (Chilibeck *et al.* 1993);
- Riparian Area Regulation (BC MOE 2007);
- Riparian Management Area Guidebook (BC MFLNRO 1995); and
- Riparian Areas and Re-vegetation (DFO 2013e).

DFO Regional OSs for BC and the Yukon contain numerous mitigation measures that should be followed whether or not all conditions in the OS are met and are included in the following subsections. In addition, the following mitigation measures should help ensure that the aquatic capacity of each watercourse crossing is not compromised during instream activities. Note that additional site-specific mitigation measures may be necessary pending review from various provincial and federal agencies. The confirmation of construction methods at each crossing and additional site-specific mitigation may also be required for select watercourse crossings pending construction timing, instream timing windows and construction methods. These measures will be identified in the EPPs for the Project prior to construction.

The EPPs are separate documents (Pipeline EPP of Volume 6B, Facilities EPP of Volume 6C) and have been developed in accordance with industry and provincial regulatory guidelines for all disciplines, as well as in accordance with Trans Mountain’s standards. The Project-specific EPPs will be adhered to during the construction phase of the Project and will be a resource for planning and construction personnel. The EPPs will provide general mitigation measures and management plans to ensure the protection of the aquatic environment which includes fish and fish habitat. Implementation of the EPP will be included as a condition of the Project’s permits and approvals.

Table 7.1 outlines the various Project activities associated with pipeline construction and operations which can have an effect on fish and fish habitat (pre-mitigation). The potential effects on fish and fish habitat indicators associated with the construction and operations of the pipeline listed in Section 3.2 were identified based on the results of the literature review, desktop analysis, field surveys, industry experience, and TEK studies as well as consultation with regulatory authorities and stakeholders. Corresponding mitigation related to the potential activities are also in Table 7.1. Through the implementation of these measures, it is expected that the Project will meet the objectives of relevant federal and provincial requirements. The mitigation measures presented in Table 7.1 are presented with respect to the crossings' potential effect on unique spatial boundaries identified for the Project (*i.e.,* the FSA and LSA). Because some of the potential effects are possible in multiple spatial boundaries, duplicate mitigation recommendations result in Table 7.1.

TABLE 7.1

PATHWAY OF EFFECTS FOR PIPELINE CONSTRUCTION AND OPERATION

Potential Effect	Pipeline Segment	Spatial Boundary[1]	Key Recommendations/Mitigation Measures [Section Where Mitigation Located in the Pipeline EPP of Volume 6B][2]
1.0 Riparian and instream habitat for valuable sport, commercial and subsistence fisheries			
1.1 Potential loss or alteration of instream and/or riparian habitat from pipeline construction	Hargreaves to Darfield; Black Pines to Hope; Hope to Burnaby; Burnaby to Westridge	LSA	***General Construction Activities*** • The Environmental Inspector(s) will ensure the implementation of the Pipeline EPP during all phases of pipeline construction (*i.e.*, flagging/staking, clearing, topsoil/root zone material salvage, grading, clean-up and revegetation, sedimentation control, water withdrawal and watercourse/wetland crossings) [Section 6.0 of the EPP]. • Ensure that mitigation measures concerning fish, wildlife or plant species at risk are communicated to employees, contractor and subcontractors and are enforced by the Environmental Inspector(s) [Section 7.0 of the EPP]. • Review all mitigation and regulatory requirements during the pre-job or tailgate meetings involving the appropriate personnel (i.e., the Contractor, the Environmental Inspector, water quality monitoring crews and/or subcontractors) to ensure that all applicable mitigation are understood and can be implemented [Section 8.7.1 of the EPP]. • Correspondence from appropriate regulatory authorities (*e.g.*, DFO) may result in additional conditions and measures regarding the proposed works that will be incorporated into the mitigation program. **Permits and Approvals** • Notify the Fisheries and Oceans Canada (DFO) Impact Assessment Biologists a minimum of 14 days, prior to the commencement of water crossing construction, in accordance with the applicable Operational Statements (DFO 2007a, 2007b, 2007c and 2007d). Refer to the Letters of Advice or Authorization, if applicable, to determine the advance notice required by DFO [Section 4.0 of the EPP]. • Notify the NEB prior to the anticipated construction schedule a minimum of 14 working days prior to construction (see Appendix D of the Pipeline EPP of Volume 6B). Contact will be maintained until Project completion [Section 4.0 of the EPP]. • Notify appropriate authorities and licensees, if required by Section 8 requirements, prior to the commencement of water crossing construction and prior to withdrawing water for hydrostatic testing [Section 4.0 of the EPP]. • Determine if approvals from the appropriate irrigation district authorities are necessary prior to construction of any canal or ditch crossing under their jurisdiction (see Appendix D of the Pipeline EPP of Volume 6B). Also obtain approval from the landowner prior to crossing privately-owned irrigation/drainage ditches [Section 8.7.1 of the EPP]. • Work with regulatory authorities to determine the necessary approvals, licences and permits needed for a particular activity or construction site prior to the commencement of the applicable activity or construction at that site (see Appendix D of the Pipeline EPP of Volume 6B). Conditions of applicable permits (including NEB Act approval, Historical Resources Act (Alberta) clearance approval, Heritage Conservation Act (BC) clearance approval, Alberta Water Act approval and BC Water Act notifications, BC OGC, DFO, AESRD lands permits, BC Ministry of Environment (MOE), BC Ministry of Forests, Lands and Natural Resource Operations (MFLNRO), BC Ministry of Forest (MOF) lands permits, road crossing agreements, rail crossing agreements, burning permits and irrigation canal crossing agreements) will be met. Inconsistencies between conditions of different permits will be rectified prior to construction [Section 6.0 of the EPP].

TABLE 7.1 Cont'd

Potential Effect	Pipeline Segment	Spatial Boundary[1]	Key Recommendations/Mitigation Measures [Section Where Mitigation Located in the Pipeline EPP of Volume 6B][2]
1.1 Potential loss or alteration of instream and/or riparian habitat from pipeline construction (cont'd)	Hargreaves to Darfield; Black Pines to Hope; Hope to Burnaby; Burnaby to Westridge	LSA	• Follow applicable DFO Operational Statements outlining conditions and measures to avoid serious harm to fish or any permanent alteration to, or destruction of, fish habitat when working in or near a watercourse/wetland/lake that has been identified as providing fish habitat [Section 8.7.1 of the EPP]. • Notify recreational boaters of the hazards associated with instream construction in accordance with NEB guidelines or approval conditions for navigable waters. Place warning signs (*e.g.*, Warning – Pipeline Construction Ahead) up and downstream of all the navigable crossings. The signs are to be legible at a distance recommended by the conditions of necessary permit approval(s) granted by the NEB, if applicable. [Section 4.0 of the EPP] • Maintain signage and other warning systems required by the NEB in place until navigational hazards are removed [Section 8.7.1 of the EPP]. • For all activities in the vicinity of a watercourse/wetland/lake, adhere to the best practices and measures as follows [Section 8.7.1 of the EPP]: – A Users' Guide for Working In and Around Water (BC MOE 2005). – Standards and Best Practices for Instream Works (BC Ministry of Water, Land and Air Protection 2004a). • If required, complete a Section 8 application for the diversion of water and submit to Front Counter BC a minimum of 45 days prior to the start of construction or testing. Complete a Section 9 application for work in an about a stream and submit to Front Counter BC a minimum of 45 days prior to the start of construction. Based on current processing times (approximately 90 days), the 45 day minimum submission date may be extended based on the project details and areas of work. These requirements will be clearly outlined in approvals and permits [Section 8.7.1 of the EPP]. • Notify the appropriate regulatory authority a minimum of 10 days prior to the use of a ford, installation of a clear-span bridge, construction of an ice bridge or snow fill vehicle crossing, or maintenance of a culvert or bridge in accordance with applicable provincial and federal requirements [Section 9.0 of the EPP]. **Clearing** • Adhere to clearing guidelines for protection of streams and wetlands provided in the Forest Practices Code, Riparian Management Area Guidebook in BC (BC MFLNRO 1995), where riparian management zones (widths) are identified based on stream or wetland class See Appendix I of the Pipeline EPP of Volume 6B for dimensions of these riparian zones for watercourses crossed by the pipeline in BC [Section 8.1 of the EPP]. • Adhere to mitigation measures provided in Section 8.0 regarding maintaining buffers, pre-clearing, clearing and grubbing within the vicinity of watercourses/wetlands/lakes [Section 8.7.1 of the EPP]. • Post signs, stakes, flagging and/or post or rope (including name, number and RK) a minimum of 100 m from each watercourse/wetland/lake or at the top of the approach slope (whichever is greater) following clearing to alert the Contractor of the upcoming watercourse/wetland/lake [Section 6.0 of the EPP]. • Maintain low vegetation or vegetated ground mat within the riparian buffer zone of watercourses, to the extent practical, by clearing only trees and walking-down low vegetation so low-lying vegetation remains intact. Limit grubbing of cleared/mowed trees/shrubs only to the trench line and work side area needed for the vehicle crossing to protect riparian areas [Section 8.1 of the EPP]. • Leave vegetative ground mat and root structure intact at watercourses, wetland or lake riparian buffers when pre-clearing is necessary. Clearing/grading within the vegetated buffer is subject to approval of the Environmental Inspector(s) after considering: 1) slope gradient before grading and after slope has been graded out; 2) potential for sedimentation (*i.e.*, soil texture of materials to be graded); 3) water crossing construction method and schedule; and 4) potential for re-establishment of cleared/grubbed riparian vegetation. Each crossing requires pre-planning with the Environmental Inspector(s) prior to work occurring [Section 8.1 of the EPP]. • Fell trees away from watercourses and away from limits of the construction right-of-way to reduce damage to streambanks, beds and adjacent trees. Hand clear the area, if necessary, to reduce disturbance. Any trees, debris and soil inadvertently deposited within the ordinary high watermark will be promptly removed in a manner that avoids or reduces disturbance of the bed and banks. Trees will not be stood or hauled across watercourses [Section 8.1 of the EPP]. • Clearly flag/stake the drill path and avoid clearing of riparian vegetation within the vegetated buffers at watercourses to be crossed using a trenchless method (*e.g.*, horizontal directional drill [HDD], bore) except, if necessary, along the travel lane [Section 8.1 of the EPP].

TABLE 7.1 Cont'd

Potential Effect	Pipeline Segment	Spatial Boundary[1]	Key Recommendations/Mitigation Measures [Section Where Mitigation Located in the Pipeline EPP of Volume 6B][2]
1.1 Potential loss or alteration of instream and/or riparian habitat from pipeline construction (cont'd)	Hargreaves to Darfield; Black Pines to Hope; Hope to Burnaby; Burnaby to Westridge	LSA	• Reduce vegetation removal and particularly riparian vegetation removal for bridges to only that which is necessary for safety and operational needs [Section 8.7.1 of the EPP]. • Refer to environmental resource-specific mitigation tables for riparian vegetation salvage provided in Appendices I and K of Pipeline EPP of Volume 6B [Section 8.2 of the EPP]. • Retain salvageable timber in the vicinity of water crossings for use in the construction of the watercourse vehicle crossings or reclamation works, if warranted [Section 8.1 of the EPP]. **Grading** • Follow the measures outlined for soil handling and grading in the vicinity of watercourses/wetlands/lakes in Section 8.0 of the Pipeline EPP of Volume 6B [Section 8.7.1 of the EPP].Reduce grading along the construction right-of-way and associated facilities, especially within watercourse/wetland/lake vegetated buffers and on hay land and tame pasture lands with a competent vegetation mat/sod layer [Section 8.2 of the EPP]. • Install erosion control measures, where warranted, prior to commencing grading in the vicinity of water crossings [Section 8.2 of the EPP]. • Grade away from watercourses/wetlands/lakes to reduce the risk of introduction of soil and organic debris. Do not place windrowed or fill material in watercourses/wetlands/lakes during grading. Keep wetland soils separate from upland soils [Section 8.2 of the EPP]. • Install temporary berms on approach slopes to watercourses and erect sediment fence(s) near the base of approach slopes to watercourse(s) following grading (see Drawings [Cross Ditches and Diversion Berms] and [Sediment Fence] provided in Appendix R of Pipeline EPP of Volume 6B) where indicated on the Environmental Alignment Sheets. Inspect the temporary sediment control structures on a daily basis and repair, if warranted, before the end of each working day [Section 8.2 of the EPP]. **Erosion and Sediment Control** • Install erosion and sediment control measures to the satisfaction of the Environmental Inspector(s). Implement structures and materials (*e.g.*, cross ditches and berms) as outlined in the Soil Erosion and Sediment Control Contingency Plan (see Appendix B in the Pipeline EPP of Volume 6B) to ensure that sediment, in surface water draining from the construction right-of-way does not adversely affect the surrounding terrain or watercourses/wetlands/lakes (see Drawings [Cross Ditches and Diversion Berms] and [Sediment Fence] and [Erosion Control Matting/Blanket] provided in Appendix R of the Pipeline EPP of Volume 6B). In particular, control erosion on the banks of watercourses, valley slopes, unstable slopes and grade cuts disturbed by construction activities along the construction right-of-way [Section 7.0 of the EPP]. • Install and maintain appropriate erosion and sediment control measures to prevent sediments from disturbed areas from being transported into watercourses/wetland/lakes (see Drawings [Erosion Control – Rollback in Riparian Areas] and [Mounding in Riparian Areas] provided in Appendix R of the Pipeline EPP of Volume 6B) [Section 7.0 of the EPP]. • Install sack trench breakers back from the edge of watercourses where the banks consist of organic material to prevent sloughing of backfill into the channel (see Drawing [Trench Breaker – Watercourse/Wetland] in Appendix R of the Pipeline EPP of Volume 6B) [Section 8.4 of the EPP]. • Install a temporary sediment barrier (*e.g.*, sediment fences), where warranted, to eliminate the flow of sediment from spoil piles and disturbed areas into nearby watercourses/wetlands/lakes (see Drawing [Sediment Fence] in Appendix R of Pipeline EPP of Volume 6B) [Section 8.7.1 of the EPP]. • Collect and filter sediment resulting from the washing of gravel and other streambed materials [Section 8.7.1 of the EPP]. • Install temporary erosion and sediment control structures, where warranted. Install sediment fences in select areas around the perimeter of an ancillary facility site to restrict sediment laden runoff from flowing into a watercourse/wetland/lake, if warranted [Section 12.0 of the EPP]. • Inspect temporary sediment control structures (*e.g.*, sediment fences, subsoil berms) installed on approach slopes, on a daily basis throughout crossing construction. Repair the structures, if warranted, before the end of the working day [Section 8.7.1 of the EPP]. • Install permanent erosion control measures, as outlined in the Reclamation Management Plan (see Appendix C of the Pipeline EPP of Volume 6B) unless otherwise approved by Trans Mountain to adjust for site conditions and suitability [Section 8.6.3 of the EPP].

TABLE 7.1 Cont'd

Potential Effect	Pipeline Segment	Spatial Boundary[1]	Key Recommendations/Mitigation Measures [Section Where Mitigation Located in the Pipeline EPP of Volume 6B][2]
1.1 Potential loss or alteration of instream and/or riparian habitat from pipeline construction (cont'd)	Hargreaves to Darfield; Black Pines to Hope; Hope to Burnaby; Burnaby to Westridge	LSA	**Equipment Fueling and Servicing** • Implement appropriate precautions to prevent deleterious substances (*e.g.*, gasoline, sediment, oil, cement or concrete residue, etc.) from entering watercourses/wetlands/lakes. Cleaning, fuelling and servicing of equipment are to be conducted in an area, or in a manner, where spills or wash water will not contaminate surface water or groundwater resources. An appropriate emergency spill kit is to be available at all times [Section 7.0 of the EPP]. • Ensure the following separation distances are maintained between a watercourse/wetland/lake when planning and constructing the pipeline, unless otherwise approved [Section 7.0 of the EPP]: – fuel or hazardous material storage site - 300 m; – burning site - 100 m; and – oil change and refuelling area - 100 m. • Bulk hazardous materials will be stored in temporary construction yards or other designated areas except for quantities required for the daily construction activities. Wastes will be stored in temporary construction yards or other designated areas and removed during final clean-up. Fuel, oil or hazardous materials required to be stored on-site will be stored within secondary containment that is to be located greater than 300 m from a wetland, watercourse or lake [Section 7.0 of the EPP]. • Retain salvageable timber in the vicinity of water crossings for use in the construction of the watercourse vehicle crossings or reclamation works, if warranted [Section 8.1 of the EPP]. **Grading** • Follow the measures outlined for soil handling and grading in the vicinity of watercourses/wetlands/lakes in Section 8.0 of the Pipeline EPP of Volume 6B [Section 8.7.1 of the EPP].Reduce grading along the construction right-of-way and associated facilities, especially within watercourse/wetland/lake vegetated buffers and on hay land and tame pasture lands with a competent vegetation mat/sod layer [Section 8.2 of the EPP]. • Install erosion control measures, where warranted, prior to commencing grading in the vicinity of water crossings [Section 8.2 of the EPP]. • Grade away from watercourses/wetlands/lakes to reduce the risk of introduction of soil and organic debris. Do not place windrowed or fill material in watercourses/wetlands/lakes during grading. Keep wetland soils separate from upland soils [Section 8.2 of the EPP]. • Install temporary berms on approach slopes to watercourses and erect sediment fence(s) near the base of approach slopes to watercourse(s) following grading (see Drawings [Cross Ditches and Diversion Berms] and [Sediment Fence] provided in Appendix R of Pipeline EPP of Volume 6B) where indicated on the Environmental Alignment Sheets. Inspect the temporary sediment control structures on a daily basis and repair, if warranted, before the end of each working day [Section 8.2 of the EPP]. **Erosion and Sediment Control** • Install erosion and sediment control measures to the satisfaction of the Environmental Inspector(s). Implement structures and materials (*e.g.*, cross ditches and berms) as outlined in the Soil Erosion and Sediment Control Contingency Plan (see Appendix B in the Pipeline EPP of Volume 6B) to ensure that sediment, in surface water draining from the construction right-of-way does not adversely affect the surrounding terrain or watercourses/wetlands/lakes (see Drawings [Cross Ditches and Diversion Berms] and [Sediment Fence] and [Erosion Control Matting/Blanket] provided in Appendix R of the Pipeline EPP of Volume 6B). In particular, control erosion on the banks of watercourses, valley slopes, unstable slopes and grade cuts disturbed by construction activities along the construction right-of-way [Section 7.0 of the EPP]. • Install and maintain appropriate erosion and sediment control measures to prevent sediments from disturbed areas from being transported into watercourses/wetland/lakes (see Drawings [Erosion Control – Rollback in Riparian Areas] and [Mounding in Riparian Areas] provided in Appendix R of the Pipeline EPP of Volume 6B) [Section 7.0 of the EPP]. • Install sack trench breakers back from the edge of watercourses where the banks consist of organic material to prevent sloughing of backfill into the channel (see Drawing [Trench Breaker – Watercourse/Wetland] in Appendix R of the Pipeline EPP of Volume 6B) [Section 8.4 of the EPP].

TABLE 7.1 Cont'd

Potential Effect	Pipeline Segment	Spatial Boundary[1]	Key Recommendations/Mitigation Measures [Section Where Mitigation Located in the Pipeline EPP of Volume 6B][2]
1.1 Potential loss or alteration of instream and/or riparian habitat from pipeline construction (cont'd)	Hargreaves to Darfield; Black Pines to Hope; Hope to Burnaby; Burnaby to Westridge	LSA	• Install a temporary sediment barrier (*e.g.*, sediment fences), where warranted, to eliminate the flow of sediment from spoil piles and disturbed areas into nearby watercourses/wetlands/lakes (see Drawing [Sediment Fence] in Appendix R of Pipeline EPP of Volume 6B) [Section 8.7.1 of the EPP]. • Collect and filter sediment resulting from the washing of gravel and other streambed materials [Section 8.7.1 of the EPP]. • Install temporary erosion and sediment control structures, where warranted. Install sediment fences in select areas around the perimeter of an ancillary facility site to restrict sediment laden runoff from flowing into a watercourse/wetland/lake, if warranted [Section 12.0 of the EPP]. • Inspect temporary sediment control structures (*e.g.*, sediment fences, subsoil berms) installed on approach slopes, on a daily basis throughout crossing construction. Repair the structures, if warranted, before the end of the working day [Section 8.7.1 of the EPP]. • Install permanent erosion control measures, as outlined in the Reclamation Management Plan (see Appendix C of the Pipeline EPP of Volume 6B) unless otherwise approved by Trans Mountain to adjust for site conditions and suitability [Section 8.6.3 of the EPP]. **Equipment Fueling and Servicing** • Implement appropriate precautions to prevent deleterious substances (*e.g.*, gasoline, sediment, oil, cement or concrete residue, etc.) from entering watercourses/wetlands/lakes. Cleaning, fuelling and servicing of equipment are to be conducted in an area, or in a manner, where spills or wash water will not contaminate surface water or groundwater resources. An appropriate emergency spill kit is to be available at all times [Section 7.0 of the EPP]. • Ensure the following separation distances are maintained between a watercourse/wetland/lake when planning and constructing the pipeline, unless otherwise approved [Section 7.0 of the EPP]: – fuel or hazardous material storage site - 300 m; – burning site - 100 m; and – oil change and refuelling area - 100 m. • Bulk hazardous materials will be stored in temporary construction yards or other designated areas except for quantities required for the daily construction activities. Wastes will be stored in temporary construction yards or other designated areas and removed during final clean-up. Fuel, oil or hazardous materials required to be stored on-site will be stored within secondary containment that is to be located greater than 300 m from a wetland, watercourse or lake [Section 7.0 of the EPP]. • Ensure that during construction no fuel, lubricating fluids, hydraulic fluids, methanol, antifreeze, herbicides, biocides, or other chemicals are dumped on the ground or into watercourses/wetlands/lakes. In the event of a spill, implement the Spill Contingency Plan (see Appendix B of the Pipeline EPP of Volume 6B) [Section 7.0 of the EPP]. • Wash all equipment transferred between sub-basins to ensure that aquatic pests are not transferred [Section 8.7.1 of the EPP]. • Review and adhere to the general mitigation measures provided in Section 7.0 of Pipeline EPP of Volume 6B related to equipment washing, inspection of hydraulic, fuel and lubrication systems of equipment, equipment servicing and refuelling as well as fuel storage in proximity to watercourses during water crossing construction [Section 8.7.1 of the EPP]. • Weld, coat and weigh the pipe prior to commencement of instream construction to the extent feasible. These tasks may be conducted in conjunction with instream construction at crossings of large watercourses [Section 8.7.1 of the EPP]. • Assemble pipeline in upland areas and utilize "push-pull" or "float" technique to place pipe in trench whenever water and other site conditions allow. • Ensure all equipment, including hoses, are in good working condition and no leaks are observed [Section 8.7.1 of the EPP] • Ensure that equipment arrives on site in a clean condition. Equipment should also be cleaned after construction to ensure it does not transfer soil, debris, invasive plants or aquatic pests (*e.g.*, Myxobolus cerebralis - the parasite that causes whirling disease in fish) to other locations [Section 7.0 of the EPP]. • Conduct refuelling a minimum of 100 m (BC Ministry of Water ,Land, Air Protection 2002) from any watercourse/wetlands/lake unless otherwise approved by the appropriate regulatory authority [Section 7.0 of the EPP]. • Do not store fuel, oil or hazardous material within 300 m of a watercourse/wetland/lake [Section 7.0 of the EPP].

TABLE 7.1 Cont'd

Potential Effect	Pipeline Segment	Spatial Boundary[1]	Key Recommendations/Mitigation Measures [Section Where Mitigation Located in the Pipeline EPP of Volume 6B][2]
1.1 Potential loss or alteration of instream and/or riparian habitat from pipeline construction (cont'd)	Hargreaves to Darfield; Black Pines to Hope; Hope to Burnaby; Burnaby to Westridge	LSA	**Spill Response** • Report spills immediately to the Environmental Inspector(s) who will, if warranted, notify Environmental Compliance Manager for reporting to the appropriate regulatory authorities in accordance with the Spill Contingency Plan (see Appendix B of Pipeline EPP of Volume 6B) [Section 7.0 of the EPP]. • Maintain all appropriate spill equipment at all work sites. Assess the risk of resource-specific spills to determine the appropriate type and quantity of spill response equipment and materials to be stored on-site and a suitable location for storage (see Emergency Preparedness and Response Plan in Volume 4B) [Section 7.0 of the EPP]. • Ensure that bulk fuel trucks, service vehicles and pick-up trucks equipped with box-mounted fuel tanks carry spill prevention, containment and clean-up materials that are suitable for the volume of fuels or oils carried. Carry spill response supplies on bulk fuel and service vehicles that are suitable for use on land and water (*i.e.*, sorbent pads, sorbent boom and rope) [Section 7.0 of the EPP]. ***General Watercourse Crossing Mitigation Measures*** • Adhere to water crossing requirements provided in environment resource-specific mitigation tables for aquatic resources provided in Appendix I of the Pipeline EPP of Volume 6B [Section 7.0 of the EPP]. • Ensure completion of the on-site checklist for pipeline and vehicle crossings for each watercourse and wetland prior to, during and following construction (attached to the EPP). These checklists will be filled out by the Environmental Inspector(s). Retain these checklists as a permanent record of pipeline watercourse and wetland crossing installation [Section 8.7.1 of the EPP]. • Complete the water crossing planning sheets (see example provided at the end of Section 8 of Pipeline EPP of Volume 6B) prior to the commencement of any water crossing activities [Section 8.7.1 of the EPP].Ensure all necessary equipment, personnel and materials are on-site and ready for installation prior to commencing instream work. Complete all work as quickly as practical to limit the duration of disturbance [Section 8.7.1 of the EPP]. • Review and adhere to applicable instream timing constraints (least-risk window) and all resource-specific measures outlined in the mitigation tables for aquatic resources provided in Appendix I of the Pipeline EPP of Volume 6B [Section 8.7.1 of the EPP]. • Limit instream construction to the shortest duration practical given the characteristics of the watercourse and the construction season [Section 8.7.1 of the EPP]. • Install the access and pipeline at each watercourse using the technique as identified in environmental resource-specific mitigation table for aquatic resources in Appendix I of the Pipeline EPP of Volume 6B and as shown on the Environmental Alignment Sheets. Ensure that the technique is implemented as per the reports/notifications/applications provided to applicable regulatory authorities [Section 8.7.1 of the EPP]. • Install pipeline and vehicle/equipment crossings at fish-bearing watercourse crossings during window of least risk for proposed crossings, unless otherwise specified in Appendix I of the Pipeline EPP of Volume 6B [Section 8.7.3 of the EPP]. **Permits and Approvals** • Notify downstream water users, where warranted, 30 days prior to the commencement of instream crossing construction in accordance with measures identified in Section 4.0 of the Pipeline EPP of Volume 6B [Section 8.7.1 of the EPP]. • Notify and/or determine if applicable authorization, advice or approval is necessary from DFO and Transport Canada for water crossings, as warranted [Section 8.7.1 of the EPP]. • If required complete a Section 8 application for the diversion of water and submit to Front Counter BC a minimum of 45 days prior to the start of construction or testing. Complete a Section 9 application for work in an about a stream and submit to Front Counter BC a minimum of 45 days prior to the start of construction. Based on current processing times (approximately 90 days), the 45 day minimum submission date may be extended based on the project details and areas of work. These requirements will be clearly outlined in approvals and permits [Section 8.7.1 of the EPP]. • Notify the Environmental Inspector(s) 24 hours (minimum) prior to commencement of water crossing construction (including activities within the riparian buffer) [Section 8.7.1 of the EPP]. • Confirm with the Environmental Inspector(s) that all notifications and approvals and/or letters of advice are in place prior to installing a temporary vehicle crossing or commencing instream construction at each water/canal crossing. Review crossing notification/approval conditions. Retain copies of approvals on-site during crossing construction [Section 8.7.1 of the EPP].

TABLE 7.1 Cont'd

Potential Effect	Pipeline Segment	Spatial Boundary[1]	Key Recommendations/Mitigation Measures [Section Where Mitigation Located in the Pipeline EPP of Volume 6B][2]
1.1 Potential loss or alteration of instream and/or riparian habitat from pipeline construction (cont'd)	Hargreaves to Darfield; Black Pines to Hope; Hope to Burnaby; Burnaby to Westridge	LSA	• Provide to the Environmental Inspector(s) 72 hours prior to the commencement of water crossing construction site-specific, detailed water crossing construction plans including isolation structure, pumps (sizes and quantity), discharge locations, by pass location, spoil containment areas, grey water management, trenching equipment and a plan describing the excavation procedure [Section 8.7.1 of the EPP]. **Water Quality Monitoring** • Develop a water quality monitoring plan with input from a QAES/QEP to monitor TSS concentrations during the installation and repair of open-cut crossings. TSS concentration is to remain within the guidelines provided in CCME (1999) throughout the installation and repair of open-cut crossings [Section 8.7.3 of the EPP].Develop a water quality monitoring plan with input from a QAES/QEP to monitor TSS concentrations during the installation and removal of isolation crossings. TSS concentration levels will be monitored using the guidelines provided in CCME (1999) throughout the installation and removal of isolation crossings. In some cases, such as where fisheries concerns are low and flow volumes are minimal at the time of construction, the water quality monitoring plan may only require visual monitoring [Section 8.7.3 of the EPP].Develop water quality monitoring plans, where required, to monitor for suspended sediment during HDD, and select isolated trenched crossings of watercourses with high sensitivity fish habitat, or open-cut crossing construction activities where flow is present. If monitoring reveals that sediment values are approaching threshold values, the water quality monitors will notify the Lead Environmental Inspector and Environmental Inspector(s) who, with the Construction Manager and Contractor, will develop corrective actions [Section 8.7.1 of the EPP]. • Ensure a Water Quality Resource Specialist is on-site prior to commencement of crossing for the watercourses/wetlands/lakes identified in the environmental resource-specific mitigation tables for aquatic resources provided in Appendix I of the Pipeline EPP of Volume 6B and as per permit/approval conditions [Section 8.7.1 of the EPP]. • Assign the Environmental Inspector(s) or Qualified Aquatic Environmental Specialist (QAES) or Qualified Environmental Professional (QEP) with expertise in the containment of inadvertent release of drilling mud and clean up to HDDs under a watercourse (see Drilling Mud Release Contingency Plan in Appendix B of the Pipeline EPP of Volume 6B) [Section 8.7.1 of the EPP]. **Isolated Open Cut Crossings** • Notify the Lead Environmental Inspector and the Environmental Inspector(s) 72 hours prior to construction of any watercourse crossing, installation of isolation dams or diversions to ensure fish salvage operations are conducted, where warranted [Section 8.7.3 of the EPP]. • Isolated BC pipeline crossings are not included under the Pacific Region DFO's Operational Statement for Isolated or Dry Open-cut Crossings (DFO 2007c) [Section 8.7.3 of the EPP]. • Ensure that generators and pumps used for the construction of isolated watercourse crossings and/or trench dewatering have secondary containment that can hold a capacity of 125% (minimum) of the fuel tank when stationed, operated or refuelled within 100 m of a watercourse [Section 8.7.3 of the EPP]. • Ensure backup pumps are in place should a primary pump fail [Section 8.7.3 of the EPP]. • Ensure maintenance of downstream flow conditions (*i.e.*, quantity and quality) at all times when constructing an isolated crossing. If a pump-around method is used to maintain downstream flow, back-up pumping capacity must be onsite and ready to take over pumping immediately if operating pumps fail. Pumps are to be continuously monitored to ensure flow is maintained at all times until the dam materials are removed and normal flow is restored to the channel [Section 8.7.3 of the EPP]. • Ensure that isolation bypass water maintains downstream flow and does not cause erosion or introduce sediment into the channel. Methods and options for preventing erosion include: flow dissipaters; protection of the substrate with geotextile; releasing water onto vegetation; and strategically placing erosion control mats immediately adjacent to the watercourse [Section 8.7.3 of the EPP]. • Store spoil material removed from the trenched crossing above the ordinary high water level. Stabilize this material, if warranted, to reduce the potential for runoff events to transport spoil material into the watercourse [Section 8.7.1 of the EPP]. **Open Cut Crossings** • Conduct typical open cut of seasonally dry or frozen to the bottom watercourses in BC in accordance with the Pacific Region Operational Statement for Dry Open-cut Stream Crossings (DFO 2008b) [Section 8.7.3 of the EPP].

TABLE 7.1 Cont'd

Potential Effect	Pipeline Segment	Spatial Boundary[1]	Key Recommendations/Mitigation Measures [Section Where Mitigation Located in the Pipeline EPP of Volume 6B][2]
1.1 Potential loss or alteration of instream and/or riparian habitat from pipeline construction (cont'd)	Hargreaves to Darfield; Black Pines to Hope; Hope to Burnaby; Burnaby to Westridge	LSA	• Ensure that trenching does not encroach upon the riparian buffer area at watercourse and wetland crossings. Allow adequate space for the excavation of a bellhole to complete the tie-in following watercourse/wetland crossing construction without disturbance of the riparian buffer [Section 8.3 of the EPP]. • Dewater the trench, if warranted, when laying pipe in areas with high water tables. Place pumps on a tray or within an excavated sump lined with polyethylene sheeting above the ordinary high water level of the watercourse/wetland/lake. Pump water onto stable and well-vegetated areas, tarpaulins or sheeting at least 50 m from the nearest watercourse/wetland/lake in a manner that does not cause erosion or any unfiltered or silted water to re-enter a watercourse. Also, dewater the trench if existing or anticipated (based on precipitation forecasts) water levels or flow rates in the trench could overwhelm existing trench water control measures (*e.g.*, berms, take-offs) allowing sediment-laden water to affect watercourses/wetlands/lakes. If warranted, install soft plugs or maintain hard plugs in the trench [Section 8.3 of the EPP].Where conditions or measures for typical open-cut of seasonally dry or frozen to the bottom watercourses will not be in accordance with the Pacific Region Operational Statement for Dry Open-cut Stream Crossings (DFO 2008c) (*i.e.*, flowing water is expected to coincide with trenched construction), site-specific mitigation and/or reclamation plans will be developed. Discussions with DFO will be conducted to identify preferred timing for instream work in fish-bearing watercourses and wetlands and to confirm whether a fish habitat compensation/offset plan will be required [Section 8.7.1 of the EPP]. • Site specific mitigation/reclamation and/or compensation plans may be required at highly sensitive watercourses where trenched crossings are proposed as the primary or contingency methods. The need for compensation will be reviewed with regulatory authorities, at a later date [Section 8.7.1 of the EPP]. **Trenchless Crossings** • Construct trenchless crossings in accordance with the conditions of the DFO's Operational Statement for Directional Drilling (BC) (2007a) [Section 8.7.3 of the EPP]. • Conduct investigations prior to the commencement of drilling activities to assess groundwater conditions and risks (*e.g.*, water supply wells located within the LSA) in highly vulnerable aquifers. Modify the drill path of the horizontal directional drill, if feasible, to reduce the potential effects on groundwater quality and, if warranted, monitor water supply wells in the immediate area before, during and after the horizontal directional drill. Have plans in place for the supply of alternate water in the event that water quality in the wells is affected [Section 8.7.3 of the EPP]. • Follow notes on Drawings [Watercourse Crossing – Horizontal Directional Drill] and [Watercourse Crossing – Bore or Punch Method (Grasslands)] and [Watercourse Crossing – Bore or Punch Method (Forested)] provided in Appendix R of the Pipeline EPP of Volume 6B, for HDD and bore techniques, respectively [Section 8.7.3 of the EPP]. • Ensure that any permits/approvals/detailed Reclamation Management Plans that are necessary are in place in the event that a trenchless crossing fails and an alternate method is necessary [Section 8.7.3 of the EPP]. • Plan for and use the procedures for a HDD or other trenchless crossing in accordance with those provided in the Horizontal Directional Drilling/Trenchless Planning and Procedures Management Plan (see Appendix C of the Pipeline EPP of Volume 6B) [Section 8.7.3 of the EPP]. • Excavate the entry and expected exit sites to provide for the containment of drilling mud and cuttings during a HDD. Ensure the excavations are located far enough from the watercourse and in containment berms or tanks that are large enough to contain the anticipated maximum volume of drilling mud above the high watermark of the watercourse [Section 8.7.3 of the EPP]. • Ensure that water from dewatering entry and exit sites with a high sediment load is not discharged or allowed to flow into any watercourse/wetland/lake. Remove the sediment (*e.g.*, filter or discharge into a vegetated area) before water is allowed to enter any watercourse/wetland/lake [Section 8.7.3 of the EPP]. • Locate bell holes and entry and exit sites back from the high watermark and far enough from the wetland to provide containment of sediments and other deleterious substances above the high watermark. Vegetation removal for the bellholes and entry and exit sites is only to occur within the approved construction right-of-way and workspace [Section 8.7.4 of the EPP]. • Follow the drilling mud frac-out monitoring and other measures provided in the Horizontal Directional Drilling/Trenchless Planning and Procedures Management Plan (see Appendix C of the Pipeline EPP of Volume 6B) during an HDD [Section 8.7.3 and 8.7.4 of the EPP].

TABLE 7.1 Cont'd

Potential Effect	Pipeline Segment	Spatial Boundary[1]	Key Recommendations/Mitigation Measures [Section Where Mitigation Located in the Pipeline EPP of Volume 6B][2]
1.1 Potential loss or alteration of instream and/or riparian habitat from pipeline construction (cont'd)	Hargreaves to Darfield; Black Pines to Hope; Hope to Burnaby; Burnaby to Westridge	LSA	**Vehicle Crossings** • Inspect all water conveyance installations (*e.g.*, ditches and culverts) and ensure they are functioning appropriately. Take appropriate action prior to and during the spring freshet to clear culverts blocked by ice or debris [Section 7.0 of the EPP]. • Ensure that upgraded or new construction vehicle crossing structures are appropriate for the watercourse approaches, channel width and configuration, anticipated streamflows during the period of use, planned vehicle loads, and overall period/duration of use [Section 8.7.2 of the EPP] • Install temporary bridges at locations identified in the environmental resource-specific mitigation tables for Aquatic resources provided in Appendix I of the Pipeline EPP of Volume 6B. Ensure bridges are clean prior to installation and dispose of soil at an appropriate location (see Drawing [Vehicle Crossing – Ramp and Culvert] provided in Appendix R of the Pipeline EPP of Volume 6B) [Section 8.7.2 of the EPP]. • Install, use and remove bridges in accordance with the measures identified in the DFO Operational Statement for Clear-Span Bridges (DFO 2007d, 2008f) and Operational Statement for Bridge Maintenance (DFO 2007i). Leave bridges to permanent facility sites in place [Section 8.7.2 of the EPP]. • Schedule the installation of bridge abutments on multi-span bridges, if warranted, to occur within the instream work window where feasible or unless otherwise permitted by the appropriate regulatory authority [Section 8.7.1 of the EPP]. • Review vehicle crossing installation notification requirements identified in Section 4.0 of the Pipeline EPP of Volume 6B and ensure notifications have been completed [Section 8.7.1 of the EPP]. • Stabilize and revegetate areas disturbed during installation and removal of a bridge; install erosion control measures, where warranted, to control surface erosion until vegetation is established [Section 8.7.2 of the EPP]. • Conduct fords during the installation of a vehicle crossing in accordance with the DFO Operational Statement for Temporary Ford Stream Crossing (DFO 2007f) [Section 8.7.2 of the EPP]. • Ensure the use of a ford is a one-time crossing (over and back) or limit ford to a seasonally dry streambed [Section 8.7.2 of the EPP]. • Adhere to the instream works reduced risk-timing window when fording in watercourses where water is present [Section 8.7.2 of the EPP]. • Confine the use of fords to watercourses or segments of watercourses with low, stable banks and a stable substrate composed of materials such as gravel or bedrock. Trans Mountain will not grade the banks to create a ford [Section 8.7.2 of the EPP]. • Confine fording to periods of low flow when water depth will not impede passage of equipment [Section 8.7.2 of the EPP]. • Install matting, where warranted, to protect the bed and banks of a watercourse to be forded [Section 8.7.2 of the EPP]. • Install clean snowfills during frozen conditions at locations identified in the environmental resource-specific mitigation tables for aquatic resources provided in Appendix I of the Pipeline EPP of Volume 6B, and at all minor and intermittent watercourses (see Environmental Alignment Sheets of the Pipeline EPP of Volume 6B) [Section 8.7.2 of the EPP]. • Install ice bridges at locations identified in the aquatic resources tables during frozen conditions (see Appendix I of the Pipeline EPP of Volume 6B) [Section 8.7.2 of the EPP]. • Design, construct and abandon ice bridge and snow fill vehicle crossings at watercourses/wetlands/lakes in accordance with the applicable DFO Operational Statement for Ice Bridges and Snow Fills (2007e) [Section 8.7.2 of the EPP]. • Construct ice bridges and snow fills from clean snow, ice and local water; do not use soil, gravel, rock, slash, logs or other woody debris. Lift bulldozer blades when salvaging snow from adjacent upland areas to avoid the incorporation of grasses and other vegetation debris in the fill material [Section 8.7.2 of the EPP]. • Seed disturbed areas on the banks and approaches as soon as practical with an approved grass cover crop species or native grass seed mix and implement sediment control measures to stabilize watercourse banks and prevent sedimentation of the watercourse, respectively. Follow measures provided in the Reclamation Management Plan (see Appendix C of the Pipeline EPP of Volume 6B) [Section 8.7.2 of the EPP]. • Align, if feasible, new access roads or extensions to existing access a minimum of 100 m from watercourses/wetlands/lakes, and a minimum of 30 m back from the edge of terraces, ridges or other elevated landforms, if feasible [Section 9.0 of the EPP].

TABLE 7.1 Cont'd

Potential Effect	Pipeline Segment	Spatial Boundary[1]	Key Recommendations/Mitigation Measures [Section Where Mitigation Located in the Pipeline EPP of Volume 6B][2]
1.1 Potential loss or alteration of instream and/or riparian habitat from pipeline construction (cont'd)	Hargreaves to Darfield; Black Pines to Hope; Hope to Burnaby; Burnaby to Westridge	LSA	• Adhere to the conditions listed in the Forest Road Engineering Guidebook in BC (BC MOF 2002) [Section 9.0 of the EPP]. • Install culverts, where warranted, to prevent accumulation of runoff water and allow surface water drainage to cross built-up access roads [Section 9.0 of the EPP]. • Use closed bottom structures (*i.e.*, culverts) to provide temporary vehicle access at nonfish-bearing watercourses, or on fish-bearing watercourses within a defined nonfish-bearing reach. Ensure compliance with all respective provincial guidelines (*e.g.*, BC MOE, OGC) when installing closed bottom structures [Section 8.7.2 of the EPP]. • Use open bottom structures (*i.e.*, culverts) on both fish-bearing and non-fish-bearing watercourses. Ensure compliance with all respective provincial guidelines (*e.g.*, BC MOE, OGC) when installing open bottom structures [Section 8.7.2 of the EPP]. • Place armouring at both inflow and outflow ends of culverts, if warranted, to prevent erosion [Section 9.0 of the EPP]. • Ensure that culverts of proper size, number and alignment are in place to handle peak runoff events for the period/duration the culverts will be in place and to reduce water movement along ditches and road surface [Section 9.0 of the EPP]. • Reduce alteration of natural drainage patterns by aligning culverts with the drainage and at angles other than right angles to the road [Section 9.0 of the EPP]. • Provide adequate spillways for culverts in unstable areas or where road-fill materials are unprotected [Section 9.0 of the EPP]. • Provide sediment catch basins at the entrance to major culverts as deemed necessary by the appropriate regulatory authorities [Section 9.0 of the EPP]. • Install downspouts, where warranted, to transport water down the slope into prepared ditches where the outflow ends of culverts are located near the top of fill slopes [Section 9.0 of the EPP]. • Do not obtain rock to be used in the construction of aprons (to be installed or repaired at culvert inlets or outlets) from the normal high water level of a watercourse/wetland/lake. Place rocks at a slope similar to the culvert and channel in a manner that will not interfere with fish passage or constrict the channel width. [Section 9.0 of the EPP]. • Flag culvert ends. Periodically monitor culverts for blockages of flow and erosion at the ends. Conduct remedial measures, where warranted, to maintain cross drainage [Section 9.0 of the EPP]. • Do not apply dust control chemicals to roads during windy conditions or within 300 m of a watercourse/wetland/lake or sensitive agricultural crops (*e.g.*, berries and nursery). Dust control chemicals are to be approved by the Lead Environmental Inspector in advance of application[Section 9.0 of the EPP]. • Ensure ditches do not drain directly into a watercourse, unless limited by topography and approved by the appropriate regulatory authority. Install ditch blocks where required [Section 9.0 of the EPP]. • Do not use de-icer or salt for access road maintenance. Prevent sand used for maintenance purposes from entering watercourses by restricting sand application to access roads within 10 m of watercourses/wetlands/lakes [Section 9.0 of the EPP]. • Maintain all side cuts in roads in a stabilized and revegetated condition to the extent feasible. Apply geotechnical or bioengineering techniques, where warranted, to control chronic slumping problems that have the potential to contribute sediment to nearby watercourses [Section 9.0 of the EPP]. • Schedule culvert maintenance to commence within the least-risk window (see Appendix I of the Pipeline EPP of Volume 6B) unless otherwise approved by the appropriate regulatory authority [Section 9.0 of the EPP]. • Consider the use of culvert screening, PVC piping, fencing or other beaver deterrents at culvert locations that are prone to damming by beaver [Section 9.0 of the EPP]. • Construct or install temporary vehicle access across watercourses and adjacent to wetlands and lakes in a manner that follows provincial and federal guidelines [Section 8.7.2 of the EPP]. • Install and remove temporary vehicle crossings in a manner that protects the banks of watercourses from erosion and maintains flows [Section 8.7.2 of the EPP].Use existing vehicle crossings at watercourses crossed by access roads identified in Section 9.0 and within the aquatic resources tables (see Appendix I of the Pipeline EPP of Volume 6B) [Section 8.7.2 of the EPP] • Install crossing structures as identified in the aquatics resource-specific tables (see Appendix I of the Pipeline EPP of Volume 6B) [Section 8.7.2 of the EPP].

TABLE 7.1 Cont'd

Potential Effect	Pipeline Segment	Spatial Boundary[1]	Key Recommendations/Mitigation Measures [Section Where Mitigation Located in the Pipeline EPP of Volume 6B][2]
1.1 Potential loss or alteration of instream and/or riparian habitat from pipeline construction (cont'd)	Hargreaves to Darfield; Black Pines to Hope; Hope to Burnaby; Burnaby to Westridge	LSA	• Consider alternate methods of vehicle crossings on a site-specific basis. The decision making process will include the Contractor, the Construction Manager, the Environmental Inspector(s) and the MOC process. Criteria to be considered when making a crossing structure decision will include protection of the riparian vegetation and fisheries values associated with the crossing location as well as applicable legislation [Section 8.7.2 of the EPP]. • Use only clean ice/snow for construction of an ice/snowfill or ice bridge. Approaches to the bridge should be constructed with compacted snow, ice or matting of sufficient thickness to protect the stream channel and banks. Soils are not to be used for ice bridge approaches [Section 8.7.2 of the EPP]. • Ensure streamflow, if present, is maintained under the vehicle crossing. Remove or breach snow or ice bridge to ensure they do not impede flow. Ensure that removal of access does not disturb the bed or banks of the watercourse crossing [Section 8.7.2 of the EPP]. • The use of log fills is only permitted in non-fish-bearing watercourses. Their use must be in compliance with all respective provincial guidelines (*e.g.*, BC MOE, OGC) when installing log fills [Section 8.7.2 of the EPP]. • Remove vehicle crossing structures from all watercourses following the season of construction unless otherwise approved by the appropriate regulatory authority. Remove all crossing structures on segments constructed during the winter prior to spring breakup. Remove snow or ice bridges, if used, cutting in a v-notch by physical means rather than blasting [Section 8.6.1 of the EPP]. • Temporary vehicle crossings may be left in place through spring breakup if this meets regulatory approval, or is otherwise approved by provincial and federal authorities and if the vehicle crossing has been designed to withstand high flows during spring break up. Otherwise remove the vehicle crossing prior to spring breakup and reinstall for use during final clean-up [Section 8.6.1 of the EPP]. • Use clear span bridges if ice thickness is insufficient to support an ice bridge. Clear span bridges should be installed perpendicular to the watercourse and should be designed to meet provincial requirements related to flood frequency levels unless recommended otherwise by a hydrotechnical engineer. Remove clear span bridges prior to spring break-up [Section 8.7.2 of the EPP]. **Pressure Testing/Water Withdrawal** • Follow the mitigation measures related to water withdrawal provided in Water Withdrawal and Discharge Procedures Management Plan (see Appendix C of the Pipeline EPP of Volume 6B) during hydrostatic testing [Section 8.5 of the EPP]. • Notify the Construction Manager, Lead Activity Inspector, the Lead Environmental Inspector and Environmental Inspector(s) a minimum of 12 hours prior to commencing water withdrawal and test water discharge activities [Section 8.5 of the EPP]. • Determine which applicable regulatory authority approvals are necessary for water withdrawal and discharge to allow for hydrostatic testing of the pipeline and to ensure conditions of approvals are satisfied during water withdrawal for hydrostatic testing [Section 8.5 of the EPP]. • Ensure that any approvals, licenses and permits that are necessary are in place prior to commencing applicable hydrostatic testing activities [Section 8.5 of the EPP]. • Determine if Water Act approvals are necessary under Sections 8 and 9, where warranted, from the BC OGC for the short-term use of water and changes in and about a stream or wetland [Section 8.5 of the EPP]. • Determine if a Basin Section 8 Approval from BC Oil and Gas Commission is necessary under the Water Act for water withdrawals of up to 45 m3/day, to a maximum of 5,000 m3/year, as specified to a drainage basin or basins identified by the OGC for pressure testing. Adhere to all conditions of the Basin Section 8 approval [Section 8.5 of the EPP]. • Trans Mountain must authorize the Contractor's preferred water withdrawal sources for testing purposes (*i.e.*, must have sufficient quantity and quality of water) [Section 8.5 of the EPP]. • Follow all conditions of federal/provincial/permits/approvals, if applicable, during hydrostatic testing [Section 8.5 of the EPP]. • Ensure that test water withdrawn from one drainage basin will not enter surface waters in another drainage basin [Section 8.5 of the EPP]. • Confirm that approvals/notifications are in place for the intended test water sources and that adequate streamflow/volume is present for the testing program [Section 8.5 of the EPP].

TABLE 7.1 Cont'd

Potential Effect	Pipeline Segment	Spatial Boundary[1]	Key Recommendations/Mitigation Measures [Section Where Mitigation Located in the Pipeline EPP of Volume 6B][2]
1.1 Potential loss or alteration of instream and/or riparian habitat from pipeline construction (cont'd)	Hargreaves to Darfield; Black Pines to Hope; Hope to Burnaby; Burnaby to Westridge	LSA	• Ensure that test water withdrawn from one drainage basin is not allowed to enter natural • waters of another drainage basin. Further restrictions will be implemented where whirling disease is present. Ensure that pigs and other testing equipment are properly loaded in the pipe to allow the test water to be discharged at the intended location [Section 8.5 of the EPP]. • Do not exceed the provincial or federal water quality limits (CCME 1999) of wash or other water discharged from a borrow site directly into a watercourse/wetland/lake that supports fish or provides fish habitat [Section 11.0 of the EPP]. • Discharge locations will be preferentially selected to dewater onto stable terrain areas rather than directly into a watercourse/wetland/lake where the water will be filtered through vegetation and soils prior to returning to a watercourse/wetland/lake. Locations for dewatering will be into bar ditches, if feasible, or onto non-arable lands. Sediment reduction methods will be implemented on the bed, banks and approaches to the water source or discharge site, if warranted, to protect downstream fish, fish habitat and water users from increased sedimentation or reduced water quality. Discharge locations will be monitored to ensure that no erosion, flooding or icing occurs [Section 11.0 of the EPP]. • Discharge water from a settling pond, retention pond or other storm water site onto the borrow site if feasible. Avoid discharging this water into a watercourse/wetland/lake without the approval of the Environmental Inspector(s) and acquisition of applicable approvals [Section 11.0 of the EPP]. **Clean-Up and Reclamation** • Ensure any disturbance of the construction right-of-way on the approach to any watercourse or wetland crossed by the construction right-of-way and associated activities are reduced, stabilized and reclaimed [Section 7.0 of the EPP].Ensure disturbance of the right-of-way within the functional riparian area of any watercourse/wetland/lake encountered by the proposed construction right-of-way is reduced [Section 8.7.1 of the EPP]. • Re-establish streambanks and approaches immediately following construction of water crossings as outlined in the Reclamation Management Plan (see Appendix C of the Pipeline EPP of Volume 6B) [Section 8.6.1 of the EPP]. • Install temporary sediment fences, where warranted, to control sedimentation prior to final clean-up and the establishment of permanent erosion and sediment control measures (see Drawing [Sediment Fence] in Appendix R of the Pipeline EPP of Volume 6B). • Revegetate as soon as feasible to reduce or avoid soil erosion and establish long-term cover. Seed immediately following topsoil/root zone material replacement [Section 8.6.3 of the EPP]. • Reclaim all disturbances within one growing season. If feasible, seed and plant seedlings in early spring to take advantage of the spring precipitation [Section 8.6.3 of the EPP]. • Recontour the construction right-of-way and stabilize approach slopes at watercourse crossings. Where reclamation of the pre-construction grade is not feasible due to risk of failure of fill on slopes or maintenance of an access trail, recontour to grades as directed by the Geotechnical Engineer [Section 8.6.3 of the EPP]. • Seed riparian areas with an approved annual or perennial grass cover crop or native grass mix as soon as feasible after construction. See additional measures outlined in the Reclamation Management Plan (see Appendix C of the Pipeline EPP of Volume 6B). Install temporary erosion control measures such as temporary berms, sediment fences, moundsor cross ditches within 24 hours of backfilling banks and approach slopes of water crossings at any location where runoff from the construction right-of-way may flow into a watercourse. Commence clean-up immediately following backfill and erosion control operations. Transplant dormant shrubs, or install dormant willow stakes or commercially grown rooted stock plants (plugs), where warranted, during reclamation of streambanks where riparian vegetation was present prior to construction. See additional measures outlined in the Reclamation Management Plan (see Appendix C of the Pipeline EPP of Volume 6B) and aquatic resources (see Appendix J of the Pipeline EPP of Volume 6B) [Section 8.6.3 of the EPP]. • Rollback slash and small diameter, salvageable timber on steep slopes and approach slopes to watercourses. Do not bury rollback when walking down with bulldozer. Leave gaps in rollback at all obvious wildlife trails [Section 8.6.3 of the EPP]. • Refer to environmental resource-specific mitigation tables for erodible soils and aquatic habitat features provided in Appendices F and I of the Pipeline EPP of Volume 6B, respectively [Section 8.6.3 of the EPP].

TABLE 7.1 Cont'd

Potential Effect	Pipeline Segment	Spatial Boundary[1]	Key Recommendations/Mitigation Measures [Section Where Mitigation Located in the Pipeline EPP of Volume 6B][2]
1.2 Potential loss or alteration of instream and/or riparian habitat from pipeline construction	Hargreaves to Darfield; Black Pines to Hope; Hope to Burnaby; Burnaby to Westridge	FSA	• Clean equipment following water crossing construction and bank reclamation work to ensure the equipment does not transfer soil, debris, invasive plants or aquatic pests (*e.g.*, Myxobolus cerebralis – the parasite that causes whirling disease in fish) to other watercourses [Section 8.7.3 of the EPP]. • Install temporary fencing, if warranted, to allow the revegetation treatments to become established and avoid damage to the banks and riparian area by wildlife/livestock [Section 8.7.3 of the EPP]. • Return the bed and banks of each proposed crossing as close as possible to their preconstruction contours. Crossings are not to be realigned or straightened in any way nor have their hydraulic characteristics changed [Section 8.7.3 of the EPP] • Follow site-specific reclamation or compensation plans at select watercourse crossings, if deemed necessary, following confirmation of construction method and timing [Section 8.7.3 of the EPP]. ***General Construction Activities*** • Abide by the conditions of the BC MoE Standard and Best Practices for Instream Work/Beaver Dam Removal, including 45 day's notification (and approval from DFO), as per Section 40 of the BC Water Regulation . Where approval for removal of a beaver dam has been granted, remove/breach the dam slowly by physical means in order to avoid the rapid release of water, erosion of the bed and banks of the watercourse, downstream flooding and sedimentation as well as wash out of downstream beaver dams. The preservation of water quality baseline parameters (*e.g.*, turbidity, dissolved oxygen) will be maintained downstream of locations where beaver dams have been breached [Section 8.0 of the EPP]. **Clearing** • Post signs, stake, flag and/or posts and rope to clearly identify the identified riparian buffer area on both sides of watercourse, wetland and lake crossings [Section 6.0 of the EPP].Prohibit the use of herbicides within 30 m of a watercourse/wetland/lake unless otherwise approved by the Environmental Inspector(s) [Section 7.0 of the EPP]. • Clear vegetation located within the watercourse/wetland/lake vegetation buffer area crossed by the pipeline right-of-way and TWS only if absolutely necessary [Section 8.1 of the EPP]. • Mark acquired additional TWS prior to the initiation of instream work. Ensure additional TWS does not encroach within vegetated riparian buffers. • Prohibit clearing of extra TWS within the riparian buffer, only the trench and TWS areas will be cleared. Ensure staging areas for watercourse/wetland crossing construction, grade/borrow areas for wetland ramps and spoil storage areas are located a minimum of 10 m from the banks of watercourse/wetland/lake boundaries. This distance may be reduced by the Lead Environmental Inspector and the Environmental Inspector(s) where appropriate controls are in place and where no riparian area is present (*e.g.*, cultivated or disturbed lands that abut the watercourse banks or boundaries of the wetland) [Section 8.1 of the EPP]. • Adhere to the measures related to the maintenance of a vegetative mat within the riparian buffer zone on both sides of watercourse or wetland crossings [Section 8.7.1 of the EPP]. • Adhere to mitigation measures provided in Section 8.0 regarding maintaining buffers, pre-clearing, clearing and grubbing within the vicinity of watercourses/wetlands/lakes [Section 8.7.1 of the EPP]. • Maintain a minimum setback of 100 m from watercourses/wetlands/lakes, and a minimum setback of 30 m back from the edge of terraces, ridges or other elevated landforms [Section 12.0 of the EPP]. • Salvage flagged or fenced live shrubs from the banks of watercourses if requested by the Environmental Inspector(s) or noted on the Environmental Alignment Sheets. Store salvaged dormant shrubs on the side of the construction right-of-way in a manner such that they do not dry out before replanting during final clean-up [Section 8.1 of the EPP].

TABLE 7.1 Cont'd

Potential Effect	Pipeline Segment	Spatial Boundary[1]	Key Recommendations/Mitigation Measures [Section Where Mitigation Located in the Pipeline EPP of Volume 6B][2]
1.2 Potential loss or alteration of instream and/or riparian habitat from pipeline construction (cont'd)	Hargreaves to Darfield; Black Pines to Hope; Hope to Burnaby; Burnaby to Westridge	FSA	• Salvage dormant willow shrubs from the banks of all watercourses (where present) to be disturbed and identified as requiring shrub salvage (outlined in the environmental resource-specific mitigation tables for aquatic or vegetation resources provided in Appendices I and J). Store at the side of the construction right-of-way and use salvaged topsoil/root zone material to cover and protect roots from drying out. Other species such as dogwood, rose and wolf willow may also be used. If salvage of willows from the bank is likely to result in limited success (salvage during non-dormant periods), transplant dormant willows obtained from the adjacent areas during clean-up or use container plant stock from nurseries. Determine if permission from the appropriate regulatory authority is necessary prior to salvaging shrubs from off the construction right-of-way [Section 8.7.1 of the EPP]. • Remove accumulated debris in a controlled and incremental manner to reduce the risk of flow surges, erosion and/or sedimentation of downstream areas. Remove or otherwise stabilize removed debris to prevent the debris from re-entering the watercourse/wetland/lake [Section 9.0 of the EPP]. • Salvage all available topsoil (min. 10 cm and a max. 40 cm) and root zone material (min. • 15-20 cm or 50% organic material and 50% mineral soil) using the Environmental Alignment Sheets as a guide. Where soils are not readily distinguishable by colour, the Environmental Inspector(s) will provide direction based on an evaluation of soil texture and structure as well as the recommended depths noted on the Environmental Alignment Sheets. Overstrip topsoils to a total depth indicated on the Environmental Alignment Sheets at select locations with saline or sodic lower subsoils, or sands and gravels at depth which occurs on native grassland, irrigated lands and/or areas of high wind erosion (see Environmental Alignment Sheets). [Section 8.2 of the EPP]. • Increase the topsoil/root zone material salvage width, if warranted, at locations where bedrock, boulders or sandy textured soils may be encountered at trench depth, in order to minimize the risk of topsoil/root zone material/subsoil mixing or, where the trench may be prone to sloughing or the trench walls may be sloped in order to prevent topsoils from sloughing into the trench. Salvage root zone material from a blade width (minimum) centred over the trench from all locations where grubbing was limited to the area over the trench [Section 8.2 of the EPP]. **Grading** • Post signs, stakes, flagging and/or post and rope (including name, number and RK) a minimum of 100 m from each watercourse/wetland/lake or at the top of the approach slope (whichever is greater) following clearing to alert the Contractor of the upcoming watercourse/wetland/lake. [Section 8.2 of the EPP]. **Equipment Fueling and Servicing** • Do not wash equipment or machinery in watercourses/wetlands/lakes. Control wastewater from construction activities, such as equipment washing or cement mixing, to avoid discharge directly into any body of water [Section 7.0 of the EPP]. • Do not perform concrete coating activities near a watercourse/wetland/lake unless suitable isolation from surface drainage and water sources is ensured [Section 8.7.1 of the EPP]. • Ensure all equipment, including hoses, are in good working condition and no leaks are observed [Section 8.7.1 of the EPP] • Use non-toxic, biodegradable hydraulic fluids in all equipment that will work instream if/when flowing water will be encountered during construction or in wetland and/or lakes if requested by the Environmental Inspector(s) [Section 8.7.1 of the EPP]. **Spill Response** • Employ the following measures to limit the risk of fuel spills in water. Where equipment refuelling is necessary within 100 m of a watercourse/wetland/lake, ensure that [Section 7.0 of the EPP]: – all containers, hoses, nozzles are free of leaks; – all fuel nozzles are equipped with automatic shut-offs; – operators are stationed at both ends of the hose during fuelling unless the ends are visible and readily accessible by one operator; and – fuel remaining in the hose is returned to the storage facility. ***General Watercourse Crossing Mitigation Measures*** • Prevent construction materials and debris from entering watercourses [Section 8.7.1 of the EPP]. • Determine the presence of any aquatic or riparian plants and pests prior to the commencement of construction activities within the riparian buffer. Notify the Contractor of any special measures to be implemented to prevent the transfer of these organisms from one watercourse to another [Section 8.7.1 of the EPP].

TABLE 7.1 Cont'd

Potential Effect	Pipeline Segment	Spatial Boundary[1]	Key Recommendations/Mitigation Measures [Section Where Mitigation Located in the Pipeline EPP of Volume 6B][2]
1.2 Potential loss or alteration of instream and/or riparian habitat from pipeline construction (cont'd)	Hargreaves to Darfield; Black Pines to Hope; Hope to Burnaby; Burnaby to Westridge	FSA	• Postpone instream water crossing construction if excessive flows or flood conditions are present or anticipated. Ensure that all spoil piles are moved above the anticipated flood line. Resume activities when water levels have subsided or equipment/techniques suitable for conditions are deployed [Section 8.7.1 of the EPP]. • Ensure that selected sites for temporary construction camps and staging areas are located outside of riparian buffers [Section 9.0 of the EPP]. • Use a trenchless crossing technique at irrigation canals and ensure canal integrity is maintained. Follow all conditions noted on applicable crossing permits.[Section 8.7.3 of the EPP]. **Permits and Approvals** • Determine if approvals/permits are necessary, in the event that beaver dams or lodges will be disturbed, prior to activities that may cause disturbance [Section 8.7.1 of the EPP]. • Contact the appropriate regulatory authority if a beaver dam removal is required [Section 8.7.1 of the EPP]. **Water Quality Monitoring** • Monitor to assess the immediate effects of crossing construction, where warranted. Also monitor sediment release (*i.e.*, turbidity and total suspended solids) throughout the crossing construction period, when warranted in accordance with the monitoring measures provided in the Water Crossing Construction Monitoring Plan (see Appendix C of the Pipeline EPP of Volume 6B) [Section 8.7.3 of the EPP].Where approval for removal of a beaver dam has been granted, remove/breach the dam slowly by physical means in order to avoid the rapid release of water, erosion of the bed and banks of the watercourse, downstream flooding and sedimentation as well as wash out of downstream beaver dams. The preservation of water quality baseline parameters (*e.g.*, turbidity, dissolved oxygen) will be maintained downstream of locations where beaver dams have been breached.[Section 8.1 of the EPP].Breach the beaver dam slowly to avoid the rapid release of water that could cause erosion of the bed and banks as well as subsequent sedimentation of downstream waters [Section 8.7.1 of the EPP]. **Isolated Open Cut Crossings** • Implement applicable measures from the Fish Species of Concern Contingency Plan (see Appendix B of the Pipeline EPP of Volume 6B) should fish species of concern be discovered during construction [Section 8.7.3 of the EPP]. • Follow the measures noted on Drawings [Watercourse Crossing – Dam and Pump Method] and [Watercourse Crossing – High Volume Pump Method] and [Watercourse Crossing – Flume Method] provided in Appendix R of the Pipeline EPP of Volume 6B for dam and pump, high volume pump and flume methods [Section 8.7.3 of the EPP]. • Dewater the segment of the watercourse between the dams, if feasible and safe to do so. Pump any sediment-laden water out between the dams to well-vegetated lands, away from the watercourse or to settling ponds [Section 8.7.3 of the EPP]. • Ensure that water from flumes, dam and pumps, diversion or other methods does not cause erosion or introduce sediment into the channel. If warranted, place rock rip rap, tarpaulins, plywood sheeting or other materials to control erosion at the outlet of pump hoses and flumes. Supplement the erosion control materials, if warranted, to control any erosion [Section 8.7.3 of the EPP]. • Salvage the upper 0.5 m (minimum) of clean, granular material, if present, and stockpile separately from the remainder of the trench spoil. Backfill the top of the trench with a minimum of 0.5m of clean, granular material where granular material was encountered in the trench. Where there is not sufficient clean, granular material or where salvage of the granular material is not practical to complete backfilling, non-native granular material can be used to cap the trench. All imported granular non-native material used for capping should be clean, washed granular material. This material must be obtained from offsite and not obtained from below the ordinary high water level of any watercourse [Section 8.7.3 of the EPP]. • Remove any accumulations of sediment within the isolation areas that resulted from crossing construction. Spread all sediment and unused trench spoil removed from the watercourse at a location above the high water mark where the materials will not directly re-enter the watercourse [Section 8.7.3 of the EPP]. • Ensure the Environmental Inspector(s) are present during dam removal/modification activities and prepare a monitoring report of the activities [Section 9.0 of the EPP].

TABLE 7.1 Cont'd

Potential Effect	Pipeline Segment	Spatial Boundary[1]	Key Recommendations/Mitigation Measures [Section Where Mitigation Located in the Pipeline EPP of Volume 6B][2]
1.2 Potential loss or alteration of instream and/or riparian habitat from pipeline construction (cont'd)	Hargreaves to Darfield; Black Pines to Hope; Hope to Burnaby; Burnaby to Westridge	FSA	**Open Cut Crossings** • Conduct typical open cut of seasonally dry or frozen to the bottom watercourses in BC in accordance with the Pacific Region Operational Statement for Dry Open-cut Stream Crossings (DFO 2008b) [Section 8.7.3 of the EPP]. • Ensure streamflow, if present, is maintained at all times when trenching through a watercourse. Retain hard plugs at each bank until just prior to pipe installation. Install temporary soft plugs, where necessary, to control water flow and trench sloughing. Ensure the trench is dewatered onto stable vegetated land and not directly into a watercourse. Conduct work from both banks utilizing two backhoes, if necessary, to expedite the crossing (see Drawing [Watercourse Crossing – Open Cut Method For Flowing Watercourses] in Appendix R of Pipeline EPP of Volume 6B) [Section 8.7.3 of the EPP]. • Develop site-specific mitigation and/or reclamation plans where conditions or measures for a typical open cut water crossing (seasonally dry or frozen to the bottom), will not be in accordance with the Pacific Region Operational Statement for Dry Open-cut Stream Crossings (DFO 2008b) (*i.e.*, flowing water is expected to coincide with trenched construction). Discussions with DFO will be conducted to identify preferred timing for instream work and to confirm whether a fish habitat compensation/offset plan will be required [Section 8.7.3 of the EPP]. **Trenchless Crossings** • Cease trenchless crossing work immediately and refer to the Drilling Mud Release Contingency Plan (see Appendix B of the Pipeline EPP of Volume 6B) in the event that an inadvertent release of drilling mud has occurred and the material is or may enter the watercourse or affect other sensitive environmental or land use features [Section 8.7.3 of the EPP]. • Monitor to assess the immediate effects of crossing construction, if warranted. Also monitor sediment release (*i.e.*, turbidity and total suspended solids) throughout the crossing construction period, if required [Section 8.7.3 of the EPP]. **Vehicle Crossings** • Monitor temporary vehicle crossings to ensure that erosion control measures are adequate and streamflow is not disrupted [Section 8.7.1 of the EPP]. • Ensure streamflow, if present, is maintained under the vehicle crossing. Remove or breach snow or ice bridge to ensure they do not impede flow. Ensure that removal of access does not disturb the bed or banks of the watercourse crossing [Section 8.7.2 of the EPP]. • Locate vehicle crossings at straight and stable reaches of watercourses [Section 8.7.2 of the EPP]. • Ensure temporary vehicle crossing structures do not disrupt fish passage at fish-bearing watercourses [Section 8.7.2 of the EPP]. • Install the entire bridge including bridge abutments, footings and armouring above the high watermark of the watercourse unless otherwise approved by the appropriate regulatory authorities. Ensure bridge installation does not alter the stream bed or banks or require infilling of the channel [Section 8.7.2 of the EPP]. • Create approaches to the water crossing perpendicular to the channel of the watercourse [Section 8.7.2 of the EPP]. • Ensure stormwater from the bridge deck, side slopes and bridge approaches is directed away from the watercourse onto a well vegetated area [Section 8.7.2 of the EPP]. • Implement erosion control measures as soon as a disturbance of the vegetation mat occurs [Section 8.7.2 of the EPP] • Remove bridge immediately after use. If bridge is to remain in place through spring break-up to access final clean-up, it must be designed for spring floods and ice jams. Remove support structures and approach fills. Re-establish and stabilize banks [Section 8.7.2 of the EPP]. • Remove bar ditch ramps and reclaim temporary access to stable conditions [Section 8.7.2 of the EPP]. • Confine fording to periods of low flow when water depth will not impede passage of equipment [Section 8.7.2 of the EPP]. • Install matting, where warranted, to protect the bed and banks of a watercourse to be forded [Section 8.7.2 of the EPP]. • Create a v-notch in the centre of the ice bridge or snow/ice fill prior to spring break up in order to allow the crossing to melt from the centre and prevent blocking fish passage, channel erosion and flooding. Where feasible, remove compacted snow from the crossing rather than creating a v-notch [Section 8.7.2 of the EPP].

TABLE 7.1 Cont'd

Potential Effect	Pipeline Segment	Spatial Boundary[1]	Key Recommendations/Mitigation Measures [Section Where Mitigation Located in the Pipeline EPP of Volume 6B][2]
1.2 Potential loss or alteration of instream and/or riparian habitat from pipeline construction (cont'd)	Hargreaves to Darfield; Black Pines to Hope; Hope to Burnaby; Burnaby to Westridge	FSA	• Remove or breach snow or ice bridge to ensure streamflow is maintained under the vehicle crossing. Ensure that removal of access does not disturb the bed or banks of the crossing. Ensure that equipment used during construction of the vehicle crossings is used in a manner that reduces disturbance of the bed and banks, and limits the risk of disrupting streamflow under the ice [Section 8.7.2 of the EPP]. **Blasting Near Watercourses** • Follow appropriate procedures provided in Guidelines for the Use of Explosives in or near Canadian Fisheries Waters (Wright and Hopky 1998) if blasting is necessary. Blasting within 300 m of a watercourse/wetland/lake will be reduced or avoided to the extent feasible (see Watercourse Crossing Management Plan provided in Appendix C of the Pipeline EPP of Volume 6B)[Section 8.3 of the EPP]. **Pressure Testing/Water Withdrawal** • Employ sediment reduction methods (*e.g.*, sediment mat, sediment fence, sand bag, coffer dam, etc.), where warranted, to protect downstream fish, fish habitat and water users from increased sedimentation or reduced water quality where excavation of a sump in the substrate of the water source is necessary [Section 8.5 of the EPP]. • Ensure pump intakes are placed in a manner that reduces or avoids disturbance to the streambed and are screened in accordance with the DFO screening requirements, to prevent the entrapment of fish or wildlife (Freshwater Intake End-of-Pipe Fish Screen Guideline [DFO 1995]) [Section 8.5 of the EPP]. • Utilize screen pump intakes with a maximum mesh size of 2.54 mm and with a maximum approach velocity of 0.038 m/s, where fish habitat is present [Section 8.5 of the EPP]. • Withdraw a maximum of 10% of the instantaneous stream flow at any given time if water extraction is necessary for the construction of a temporary crossing. Pump intakes are to not disturb the streambed. Pumps are to be screened with a maximum mesh size of 2.54 mm and should have a maximum screen approach velocity of less than 0.038 m/s where fish habitat is present [Section 8.7.2 of the EPP]. • Maintain screens clear of debris [Section 8.5 of the EPP]. • The withdrawal rate and volume will not exceed 10% of the flow rate of the watercourse or of the volume of the body of water unless otherwise approved by the appropriate authority when withdrawing water. Avoid or reduce disturbance of the streambed when installing pump intakes [Section 8.5 of the EPP]. • Terminate or reduce the rate of water withdrawal if the approved minimum flow or depth of water in the source watercourse or lake is approached or reached during a water withdrawal, unless otherwise approved by the appropriate regulatory authority. Resume or increase the rate of water withdrawal only when flows or water levels exceed approved minimum values [Section 8.5 of the EPP]. • Implement additional mitigation in consultation with the appropriate regulatory authority in the event that water volumes exceed the allowable volumes and continued water withdrawal is allowed [Section 8.5 of the EPP]. • Dewater onto approved areas where water will be filtered through vegetation and soils before returning to a watercourse/wetland/lake. Provide scour protection (*e.g.*, use of rock aprons, plastic sheeting, plywood, straw bales etc.) or an energy diffuser (*e.g.*, cone with baffles, frog's foot) at the discharge site as directed by Trans Mountain. The rate of discharge will be reduced if these measures are ineffective [Section 8.5 of the EPP]. **Clean-Up and Reclamation** • Follow site-specific reclamation or compensation plans at select watercourse crossings, if deemed necessary, following confirmation of construction method and timing [Section 8.7.3 of the EPP].

TABLE 7.1 Cont'd

Potential Effect	Pipeline Segment	Spatial Boundary[1]	Key Recommendations/Mitigation Measures [Section Where Mitigation Located in the Pipeline EPP of Volume 6B][2]
1.2 Potential loss or alteration of instream and/or riparian habitat from pipeline construction (cont'd)	Hargreaves to Darfield; Black Pines to Hope; Hope to Burnaby; Burnaby to Westridge	FSA	• Return the bed and banks of each crossing as close as feasible to their pre-construction contours (slope and height). Crossings should not be realigned or straightened in any way nor have their hydraulic characteristics changed. Take appropriate measures to reduce the risk of sloughing of the streambanks following construction. The Environmental Inspector(s) will determine on-site whether restoration measures in addition to those identified in the environmental resource-specific mitigation tables for aquatic resources outlined in Appendix I of the Pipeline EPP of Volume 6B are required to stabilize the banks (*e.g.*, soil wraps, brush layers, willow plantings and matting) and promote the restoration of the pre-construction conditions [Section 8.7.3 of the EPP].Return the bed and banks of each crossing as close as feasible to their pre-construction contours (slope and height). Crossings should not be realigned or straightened in any way nor have their hydraulic characteristics changed. Take appropriate measures to reduce the risk of sloughing of the streambanks following construction. The Environmental Inspector(s) will determine on-site whether restoration measures in addition to those identified in the environmental resource-specific mitigation tables for aquatic resources outlined in Appendix I of the Pipeline EPP of Volume 6B are required to stabilize the banks (*e.g.*, soil wraps, brush layers, willow plantings and matting) and promote the restoration of the pre-construction conditions [Section 8.7.3 of the EPP]. • Install coir or other biodegradable erosion control fabric approved by the Environmental Inspector(s) on disturbed portions of the banks [Section 8.6.3 of the EPP]. • Maintain sediment fences or equivalent sediment control structure in place at the base of approach slopes until revegetation of the construction right-of-way is complete [Section 8.7.3 or the EPP]. • Install riprap bank armouring (see Drawing [Streambank Protection – Cobble or Riprap Armouring] in Appendix R of the Pipeline EPP of Volume 6B) along unstable banks with high erosion potential locations as outlined in the environmental resource-specific mitigation tables for aquatic resources provided in Appendix I of the Pipeline EPP of Volume 6B [Section 8.7.3 of the EPP]. • Install vegetated soil wraps or cribwalls (see Drawings [Streambank Protection – Cribwalls] and [Streambank Protection – Grass Roll] provided in Appendix R of the Pipeline EPP of Volume 6B) along unstable banks with high erosion potential to reduce the risk of erosion and to enhance fish habitat at locations as outlined in the environmental resource-specific mitigation tables for aquatic resources provided in Appendix I of the Pipeline EPP of Volume 6B [Section 8.7.3 of the EPP].
2.0 Fish mortality and Injury			
2.1 Potential for injury or mortality of fish during pipeline construction	Hargreaves to Darfield; Black Pines to Hope; Hope to Burnaby; Burnaby to Westridge	LSA	***General Construction Activities*** **Permits and Approvals** • Ensure that any approvals, licenses and permits that may be necessary are in place prior to commencing applicable construction activities [Section 6.0 of the EPP]. • Notify the DFO area Biologist (see Appendix D of the Pipeline EPP of Volume 6B) if instream blasting at water crossings to determine if approval is necessary [Section 4.0 of the EPP].Notify the Fisheries and Oceans Canada (DFO) Impact Assessment Biologists a minimum of 14 days, prior to the commencement of water crossing construction, in accordance with the applicable Operational Statements (DFO 2007a, 2007b, 2007c,and 2007d). Refer to the Letters of Advice or Authorization, if applicable, to determine the advance notice required by DFO [Section 4.0 of the EPP] • Work with regulatory authorities to determine the necessary approvals, licences and permits needed for a particular activity or construction site prior to the commencement of the applicable activity or construction at that site (see Appendix D of the Pipeline EPP of Volume 6B). Conditions of applicable permits (including NEB Act approval, clearance approval, Heritage Conservation Act clearance approval, and BC Water Act notifications, BC OGC, DFO, BC Ministry of Environment (MOE), BC Ministry of Forests, Lands and Natural Resource Operations (MFLNRO), BC Ministry of Forest (MOF) lands permits, road crossing agreements, rail crossing agreements, burning permits and irrigation canal crossing agreements) will be met. Inconsistencies between conditions of different permits will be rectified prior to construction [Section 6.0 of the EPP]. • Follow applicable DFO Operational Statements outlining conditions and measures to avoid serious harm to fish or any permanent alteration to, or destruction of, fish habitat when working in or near a watercourse/wetland/lake that has been identified as providing fish habitat [Section 8.7.1 of the EPP]. ***General Watercourse Crossing Mitigation Measures*** • Adhere to water crossing requirements provided in environment resource-specific mitigation tables for aquatic resources provided in Appendix I of Pipeline EPP of Volume 6B [Section 7.0 of the EPP].

TABLE 7.1 Cont'd

Potential Effect	Pipeline Segment	Spatial Boundary[1]	Key Recommendations/Mitigation Measures [Section Where Mitigation Located in the Pipeline EPP of Volume 6B][2]
2.1 Potential for injury or mortality of fish during pipeline construction (cont'd)	Hargreaves to Darfield; Black Pines to Hope; Hope to Burnaby; Burnaby to Westridge	LSA	• Install pipeline and vehicle/equipment crossings at fish-bearing watercourse crossings during window of least risk for proposed crossings , unless otherwise specified in Appendix I of Pipeline EPP of Volume 6B [Section 8.7.3 of the EPP]. • Determine the presence of any aquatic or riparian plants and pests prior to the commencement of construction activities within the riparian buffer. Notify the Contractor of any special measures to be implemented to prevent the transfer of these organisms from one watercourse to another [Section 8.7.1 of the EPP]. • Postpone instream water crossing construction if excessive flows or flood conditions are present or anticipated. Ensure that all spoil piles are moved above the anticipated flood line. Resume activities when water levels have subsided or equipment/techniques suitable for conditions are deployed [Section 8.7.1 of the EPP]. • Limit instream construction to the shortest duration practical given the characteristics of the watercourse and the construction season [Section 8.7.1 of the EPP]. • Review and adhere to applicable instream timing constraints (least-risk window) and all resource-specific measures outlined in the mitigation tables for aquatic resources provided in Appendix I of the Pipeline EPP of Volume 6B [Section 8.7.1 of the EPP]. **Isolated Open Cut Crossings** • Schedule water crossing construction activities to allow for fish salvage to occur prior to dewatering [Section 8.7.3 of the EPP]. • Notify the Lead Environmental Inspector and the Environmental Inspector(s) 72 hours prior to construction of any watercourse crossing, installation of isolation dams or diversions to ensure fish salvage operations are conducted, where warranted [Section 8.7.3 of the EPP]. • Assign a QAES/QEP to salvage fish with an electrofisher from the isolated area prior to and during dewatering and trenching at isolated water crossings in accordance with the fish Collection Permit (see Appendix D of the Pipeline EPP of Volume 6B) if this permit is determined to be necessary. Release all captured fish to areas downstream of the crossing that provide suitable habitat [Section 8.7.3 of the EPP]. • Confirm with the Environmental Inspector that a QAES or QEP with a Fish Salvage License will be on-site to conduct the fish salvage before and during dewatering between the isolation dams [Section 8.7.3 of the EPP]. • Complete fish rescue on all isolated watercourse crossings with flowing water and as identified in Aquatic Resources (Appendix I of the Pipeline EPP of Volume 6B) prior to the start of pipeline installation in a watercourse [Section 8.7.3 of the EPP]. • Salvage fish in fish-bearing wetlands prior to dewatering the isolated section of the wetland [Section 8.7.4 of the EPP]. • Release captured fish to areas downstream of the crossing that provide suitable habitat [Section 8.7.3 of the EPP]. **Trenchless Crossings** • Ensure that water from dewatering entry and exit sites with a high sediment load is not discharged or allowed to flow into any watercourse/wetland/lake. Remove the sediment (*e.g.*, filter or discharge into a vegetated area) before water is allowed to enter any watercourse/wetland/lake [Section 8.7.3 of the EPP]. • Cease trenchless crossing work immediately and refer to the Drilling Mud Release Contingency Plan (see Appendix B of the Pipeline EPP of Volume 6B) in the event that an inadvertent release of drilling mud has occurred and the material is or may enter the watercourse or affect other sensitive environmental or land use features [Section 8.7.3 of the EPP]. • Follow the drilling mud frac-out monitoring and other measures outlined in the Drilling Mud Release Contingency Plan (see Appendix B of the Pipeline EPP of Volume 6B) during horizontal directional drilling [Section 8.7.3 of the EPP]. • Monitor to assess the immediate effects of crossing construction, where warranted. Also monitor sediment release (*i.e.*, turbidity and total suspended solids) throughout the crossing construction period, when warranted in accordance with the monitoring measures provided in the Water Crossing Construction Monitoring Plan. (See Appendix C of the Pipeline EPP of Volume 6B) [Section 8.7.3 of the EPP]. • Locate bell holes and entry and exit sites back from the high watermark and far enough from the wetland to provide containment of sediments and other deleterious substances above the high watermark. Vegetation removal for the bellholes and entry and exit sites is only to occur within the approved construction right-of-way and workspace [Section 8.7.4 of the EPP].

TABLE 7.1 Cont'd

Potential Effect	Pipeline Segment	Spatial Boundary[1]	Key Recommendations/Mitigation Measures [Section Where Mitigation Located in the Pipeline EPP of Volume 6B][2]
2.1 Potential for injury or mortality of fish during pipeline construction (cont'd)	Hargreaves to Darfield; Black Pines to Hope; Hope to Burnaby; Burnaby to Westridge	LSA	• Follow the drilling mud frac-out monitoring and other measures provided in the Horizontal Directional Drilling/Trenchless Planning and Procedures Management Plan (see Appendix C of the Pipeline EPP of Volume 6B) during an HDD [Section 8.7.4 of the EPP]. **Vehicle Crossings** • Adhere to the instream works reduced risk-timing window when fording in watercourses where water is present [Section 8.7.2 of the EPP]. • Create a v-notch in the centre of the ice bridge or snow/ice fill prior to spring break up in order to allow the crossing to melt from the centre and prevent blocking fish passage, channel erosion and flooding. Where feasible, remove compacted snow from the crossing rather than creating a v-notch [Section 8.7.2 of the EPP]. • Ensure temporary vehicle crossing structures do not disrupt fish passage at fish-bearing watercourses and do not interfere with or impede flow or navigation at any location [Section 8.7.2 of the EPP].Use closed bottom structures (*i.e.*, culverts) to provide temporary vehicle access at non-fish-bearing watercourses, or on fish-bearing watercourses within a defined non-fish-bearing reach. Ensure compliance with all respective provincial guidelines (*e.g.*, BC MOE, OGC) when installing closed bottom structures [Section 8.7.2 of the EPP]. • Use open bottom structures (*i.e.*, culverts) on both fish-bearing and non-fish-bearing watercourses. Ensure compliance with all respective provincial guidelines (*e.g.*, BC MOE, OGC) when installing open bottom structures [Section 8.7.2 of the EPP]. • Do not obtain rock to be used in the construction of aprons (to be installed or repaired at culvert inlets or outlets) from the normal high water level of a watercourse/wetland/lake. Place rocks at a slope similar to the culvert and channel in a manner that will not interfere with fish passage or constrict the channel width [Section 9.0 of the EPP]. • Schedule culvert maintenance to commence within the least-risk window (see Appendix I of the Pipeline EPP of Volume 6B) unless otherwise approved by the appropriate regulatory authority [Section 9.0 of the EPP]. **Pressure Testing/Water Withdrawal** • Ensure that test water withdrawn from one drainage basin will not enter surface waters in another drainage basin [Section 8.5 of the EPP]. • Determine which applicable regulatory authority approvals are necessary for water withdrawal and discharge to allow for hydrostatic testing of the pipeline and to ensure conditions of approvals are satisfied during water withdrawal for hydrostatic testing [Section 8.5 of the EPP]. • Ensure that any approvals, licenses and permits that may be necessary are in place prior to commencing applicable hydrostatic testing activities [Section 8.5 of the EPP]. • Discharge locations will be preferentially selected to dewater onto stable terrain areas rather than directly into a watercourse/wetland/lake where the water will be filtered through vegetation and soils prior to returning to a watercourse/wetland/lake. Locations for dewatering will be into bar ditches, if feasible, or onto non-arable lands. Sediment reduction methods will be implemented on the bed, banks and approaches to the water source or discharge site, if warranted, to protect downstream fish, fish habitat and water users from increased sedimentation or reduced water quality. Discharge locations will be monitored to ensure that no erosion, flooding or icing occurs [Section 11.0 of the EPP]. **Clean-Up and Reclamation** • Clean equipment following water crossing construction and bank reclamation work to ensure the equipment does not transfer soil, debris, invasive plants or aquatic pests (*e.g.*, Myxobolus cerebralis – the parasite that causes whirling disease in fish) to other watercourses [Section 8.7.3 of the EPP]. • Follow site-specific reclamation or compensation plans at select watercourse crossings, if deemed necessary, following confirmation of construction method and timing [Section 8.7.3 of the EPP].
2.2 Potential for injury or mortality of fish during pipeline construction	Hargreaves to Darfield; Black Pines to Hope; Hope to Burnaby; Burnaby to Westridge	FSA	***General Construction Activities*** **Permits and Approvals** • Prohibit recreational fishing by Project personnel on or in the vicinity of the construction right-of-way. The use of the construction right-of-way to access fishing sites is prohibited [Section 7.0 of the EPP].

TABLE 7.1 Cont'd

Potential Effect	Pipeline Segment	Spatial Boundary[1]	Key Recommendations/Mitigation Measures [Section Where Mitigation Located in the Pipeline EPP of Volume 6B][2]
2.2 Potential for injury or mortality of fish during pipeline construction (cont'd)	Hargreaves to Darfield; Black Pines to Hope; Hope to Burnaby; Burnaby to Westridge	FSA	• Abide by the conditions of the BC MoE Standard and Best Practices for Instream Work/Beaver Dam Removal, including 45 day's notification, as per Section 40 of the BC Water Regulation. Where approval for removal of a beaver dam has been granted, remove/breach the dam slowly by physical means in order to avoid the rapid release of water, erosion of the bed and banks of the watercourse, downstream flooding and sedimentation as well as wash out of downstream beaver dams. The preservation of water quality baseline parameters (*e.g.*, turbidity, dissolved oxygen) will be maintained downstream of locations where beaver dams have been breached [Section 8.0 of the EPP]. • Where approval for removal of a beaver dam has been granted, remove/breach the dam slowly by physical means in order to avoid the rapid release of water, erosion of the bed and banks of the watercourse, downstream flooding and sedimentation as well as wash out of downstream beaver dams [Section 7.0 of the EPP]. • Follow applicable DFO Operational Statements outlining conditions and measures to avoid serious harm to fish or any permanent alteration to, or destruction of, fish habitat when working in or near a watercourse/wetland/lake that has been identified as providing fish habitat [Section 8.7.1 of the EPP]. **Clearing** • Prohibit the use of herbicides within 30 m of a waterbody unless otherwise approved by the Environmental Inspector(s) [Section 7.0 of the EPP]. **Grading** • Install erosion control measures, where warranted, prior to commencing grading in the vicinity of water crossings [Section 8.2 of the EPP]. • Grade away from watercourses/wetlands/lakes to reduce the risk of introduction of soil and organic debris. Do not place windrowed or fill material in watercourses/wetlands/lakes during grading. [Section 8.2 of the EPP]. **Erosion and Sediment Control** • Install a temporary sediment barrier (*e.g.*, sediment fences), where warranted, to eliminate the flow of sediment from spoil piles and disturbed areas into nearby watercourses/wetlands/lakes (see Drawing [Sediment Fence] in Appendix R of Pipeline EPP of Volume 6B) [Section 8.7.1 of the EPP]. • Collect and filter sediment resulting from the washing of gravel and other streambed materials [Section 8.7.1 of the EPP]. • Inspect temporary sediment control structures (*e.g.*, sediment fences, subsoil berms) installed on approach slopes, on a daily basis throughout crossing construction. Repair the structures, if warranted, before the end of the working day [Section 8.7.1 of the EPP]. • Install permanent erosion control measures, as outlined in the Reclamation Management Plan (see Appendix C of the Pipeline EPP of Volume 6B) unless otherwise approved by Trans Mountain to adjust for site conditions and suitability [Section 8.6.3 of the EPP]. **Equipment Fueling and Servicing** • Ensure all equipment, including hoses, are in good working condition and no leaks are observed [Section 8.7.1 of the EPP] • Wash all equipment transferred between sub-basins to ensure that aquatic pests are not transferred [Section 8.7.1 of the EPP]. • Do not wash equipment or machinery in watercourses/wetlands/lakes. Control wastewater from construction activities, such as equipment washing or cement mixing, to avoid discharge directly into any body of water [Section 7.0 of the EPP]. • Use non-toxic, biodegradable hydraulic fluids in all equipment that will work instream if/when flowing water will be encountered during construction or in wetland and/or lakes if requested by the Environmental Inspector(s) [Section 8.7.1 of the EPP].Do not perform concrete coating activities near a watercourse/wetland/lake unless suitable isolation from surface drainage and water sources is ensured [Section 8.7.1 of the EPP]. **Spill Response** • Employ the following measures to limit the risk of fuel spills in water. Where equipment refuelling is necessary within 100 m of a watercourse/wetland/lake, ensure that [Section 7.0 of the EPP]: – all containers, hoses, nozzles are free of leaks; – all fuel nozzles are equipped with automatic shut-offs; – operators are stationed at both ends of the hose during fuelling unless the ends are visible and readily accessible by one operator; and – fuel remaining in the hose is returned to the storage facility.

TABLE 7.1 Cont'd

Potential Effect	Pipeline Segment	Spatial Boundary[1]	Key Recommendations/Mitigation Measures [Section Where Mitigation Located in the Pipeline EPP of Volume 6B][2]
2.2 Potential for injury or mortality of fish during pipeline construction (cont'd)	Hargreaves to Darfield; Black Pines to Hope; Hope to Burnaby; Burnaby to Westridge	FSA	• Ensure that during construction no fuel, lubricating fluids, hydraulic fluids, methanol, antifreeze, herbicides, biocides, or other chemicals are dumped on the ground or into watercourses/wetlands/lakes. In the event of a spill, implement the Spill Contingency Plan (see Appendix B of the Pipeline EPP of Volume 6B) [Section 7.0 of the EPP]. • Report spills immediately to the Environmental Inspector(s) who will, if warranted, notify Environmental Compliance Manager for reporting to the appropriate regulatory authorities in accordance with the Spill Contingency Plan (see Appendix B of Pipeline EPP of Volume 6B) [Section 7.0 of the EPP]. ***General Watercourse Crossing Mitigation Measures*** • Where approval for removal of a beaver dam has been granted, remove/breach the dam slowly by physical means in order to avoid the rapid release of water, erosion of the bed and banks of the watercourse, downstream flooding and sedimentation as well as wash out of downstream beaver dams [Section 7.0 of the EPP]. • Breach the beaver dam slowly to avoid the rapid release of water that could cause erosion of the bed and banks and subsequent siltation of downstream waters [Section 8.7.1 of the EPP]. **Water Quality Monitoring** • Monitor to assess the immediate effects of crossing construction, if warranted. Also monitor sediment release *(i.e.*, turbidity and total suspended solids) throughout the crossing construction period, if required [Section 8.7.1 of the EPP]. • Ensure a Water Quality Resource Specialist is on-site prior to commencement of crossing for the watercourses/wetlands/lakes identified in the environmental resource-specific mitigation tables for aquatic resources provided in Appendix I of the Pipeline EPP of Volume 6B and as per permit/approval conditions [Section 8.7.1 of the EPP]. **Isolated Open Cut Crossings** • Assign a QAES/QEP to salvage fish with an electrofisher from the isolated area prior to and during dewatering and trenching at isolated water crossings in accordance with the fish Collection Permit (see Appendix D of the Pipeline EPP of Volume 6B) if this permit is determined to be necessary. Release all captured fish to areas downstream of the crossing that provide suitable habitat [Section 8.7.3 of the EPP]. • Ensure fish are rescued from any temporarily or permanently abandoned reach of channel that is free of debris [Section 8.7.3 of the EPP]. • Clean fish salvage equipment (*e.g.*, waders, boots, nets) of soil, and disinfect with 100 mg/L chlorine bleach before using in any watercourse to prevent the spread of pathogens (*e.g.*, whirling disease) and/or invasive plant species. Ensure that washed off soil is disposed of at a location that will prevent the reintroduction of these untreated materials into a watercourse [Section 8.7.3 of the EPP]. • Ensure all water intakes are screened in accordance with the DFO's Freshwater End-of-Pipe Fish Screen Guideline (DFO 1995). Ensure the screens are free of debris during pumping [Section 8.7.3 of the EPP]. • Ensure that pump intakes avoid or reduce disturbance of the streambed and are screened with a maximum mesh size of 2.54 mm and sized to limit the approach velocity to not exceed 0.038 m/s. To accomplish this, where pumps larger than 15 cm diameter are used, place the intakes in a mesh cage (2.54 mm) to reduce the approach velocity that fish are exposed to and prevent them from being impinged on the intake. Refer to DFO's Freshwater Intake End-of-Pipe Fish Screen Guideline (DFO 1995) for additional information [Section 8.7.3 of the EPP]. • Implement applicable measures from the Fish Species of Concern Contingency Plan (see Appendix B of the Pipeline EPP of Volume 6B) should fish species of concern be discovered during construction [Section 8.7.3 of the EPP]. • Follow the measures noted on Drawings [Watercourse Crossing – Dam and Pump Method] and [Watercourse Crossing – High Volume Pump Method] and [Watercourse Crossing – Flume Method] provided in Appendix R of the Pipeline EPP of Volume 6B for dam and pump, high volume pump and flume methods [Section 8.7.3 of the EPP]. • Dewater the segment of the watercourse between the dams, if feasible and safe to do so. Pump any sediment-laden water out between the dams to well-vegetated lands, away from the watercourse or to settling ponds [Section 8.7.3 of the EPP]. • Ensure that water from flumes, dam and pumps, diversion or other methods does not cause erosion or introduce sediment into the channel. If warranted, place rock rip rap, tarpaulins, plywood sheeting or other materials to control erosion at the outlet of pump hoses and flumes. Supplement the erosion control materials, if warranted, to control any erosion [Section 8.7.3 of the EPP].

TABLE 7.1 Cont'd

Potential Effect	Pipeline Segment	Spatial Boundary[1]	Key Recommendations/Mitigation Measures [Section Where Mitigation Located in the Pipeline EPP of Volume 6B][2]
2.2 Potential for injury or mortality of fish during pipeline construction (cont'd)	Hargreaves to Darfield; Black Pines to Hope; Hope to Burnaby; Burnaby to Westridge	FSA	• Ensure maintenance of downstream flow conditions (*i.e.*, quantity and quality) at all times • when constructing an isolated crossing. If a pump-around method is used to maintain downstream flow, back-up pumping capacity must be onsite and ready to take over pumping immediately if operating pumps fail. Pumps are to be continuously monitored to ensure flow is maintained at all times until the dam materials are removed and normal flow is restored to the channel [Section 8.7.3 of the EPP]. • Ensure that isolation bypass water maintains downstream flow and does not cause erosion or introduce sediment into the channel. Methods and options for preventing erosion include: flow dissipaters; protection of the substrate with geotextile; releasing water onto vegetation; and strategically placing erosion control mats immediately adjacent to the watercourse [Section 8.7.3 of the EPP]. **Open Cut Crossings** • Ensure streamflow, if present, is maintained at all times when trenching through a watercourse. Retain hard plugs at each bank until just prior to pipe installation. Install temporary soft plugs, where necessary, to control water flow and trench sloughing. Ensure the trench is dewatered onto stable vegetated land and not directly into a watercourse. Conduct work from both banks utilizing two backhoes, if necessary, to expedite the crossing (see Drawing [Watercourse Crossing – Open Cut Method for Flowing Watercourses] in Appendix R of Pipeline EPP of Volume 6B) [Section 8.7.3 of the EPP]. **Trenchless Crossings** • Monitor to assess the immediate effects of crossing construction, if warranted. Also monitor sediment release (*i.e.*, turbidity and total suspended solids) throughout the crossing construction period, if required [Section 8.7.3 of the EPP]. **Blasting near Watercourses** • Follow appropriate procedures provided in Guidelines for the Use of Explosives in or near Canadian Fisheries Waters (Wright and Hopkey 1998) if blasting is necessary. Blasting within 300 m of a watercourse/wetland/lake will be reduced or avoided to the extent feasible (see Watercourse Crossing Management Plan provided in Appendix C of the Pipeline EPP of Volume 6B)[Section 8.3 of the EPP]. **Pressure Testing/Water Withdrawal** • Employ sediment reduction methods (*e.g.*, sediment mat, sediment fence, sand bag, coffer dam, etc.), where warranted, to protect downstream fish, fish habitat and water users from increased sedimentation or reduced water quality where excavation of a sump in the substrate of the water source is necessary [Section 8.5 of the EPP]. • Ensure pump intakes are placed in a manner that reduces or avoids disturbance to the streambed and are screened in accordance with the DFO screening requirements, to prevent the entrapment of fish or wildlife (Freshwater Intake End-of-Pipe Fish Screen Guideline [DFO 1995]) [Section 8.5 of the EPP]. • Utilize screen pump intakes with a maximum mesh size of 2.54 mm and with a maximum approach velocity of 0.038 m/s, where fish habitat is present [Section 8.5 of the EPP]. • Do not exceed the provincial or federal water quality limits (CCME 1999) of wash or other water discharged from a borrow site directly into a watercourse/wetland/lake that supports fish or provides fish habitat [Section 11.0 of the EPP].

7.1.4 Watercourse Reclamation Strategy

The primary objective of watercourse reclamation is to stabilize the channel and re-establish both the morphology and integrity of each watercourse to a similar condition that existed prior to construction. At select watercourses, additional reclamation measures (habitat improvements beyond its preconstruction condition) may be required. These would be addressed in a separate plan for compensation/offset of any permanent habitat losses, if deemed necessary.

Reclamation measures presented in Table 7.2 (*i.e.*, Types A to G) have been designed to accommodate the range of different watercourses found along the proposed pipeline corridor. Standard reclamation measures that must be applied to all watercourses are also identified. Appendix A presents all watercourses crossed by the proposed pipeline corridor, along with a list of construction measures designed to protect the integrity of the stream channel, and restore aquatic habitat at each crossing location.

Site-specific watercourse reclamation details will be developed for the larger high sensitivity watercourse crossings. These watercourses are of particular interest to regulatory authorities, given the complexity and sensitivity of these areas and/or the possibility of serious harm to fishes or their habitat.

TABLE 7.2

WATERCOURSE RECLAMATION MEASURES

Reclamation Method	Reclamation Measures	Application Criteria
Standard Procedures for all Watercourses	*Prior to Instream Work* • Identify any instream site-specific features at the crossing proposed and record their location (*e.g.*, root wad, large woody debris, and large boulders). Salvage these for use later. *During Instream Work* • Salvage upper coarse-textured substrate material from the channel and banks, and stockpile separately from lower substrate. *At the Completion of Instream Work* • Return the watercourse (or wetland) bed and banks to their preconstruction configuration and alignment. • Cap disturbed area of the channel and banks with salvaged substrate; extend replacement of cobbles and boulders to the ordinary high water level (OHWL) if adequate material is available. • Replace any site-specific features that are important for fishes or other aquatic organisms (*i.e.*, as initially salvaged or as part of Compensation directed by Trans Mountain's Environmental Inspector). • Install the appropriate temporary erosion and sediment control measures, where warranted (*e.g.*, sediment fence, erosion control blanket, coir logs, etc.). • Seed with an appropriate grass mix and/or cover crop species as directed in the Reclamation Management Plan for the Project.	Standard procedures that apply to all watercourses listed in Appendix A – Watercourse Crossing Summary Table.
Type A	• Re-contour bed and banks/approach slopes to preconstruction profiles and grades.	For shallow or poorly defined channels, including non-classified drainages with low or gently sloping banks (*e.g.*, intermittent, or seasonal watercourses with low flow or standing water, including small ponds).
Type B	• Salvage dormant riparian vegetation along the trench line (and vehicle crossing locations, where grading is required), keeping roots intact (*i.e.*, with a sufficient soil root-ball). Store salvaged dormant plants and plant material away from construction activities for replacement or installation during reclamation. Replace salvaged dormant riparian plants and plant material (stakes and brush) during reclamation (Appendix D, Drawing 1). • Install rooted stock shrubs/trees and/or dormant tree/shrub stakes/brush in disturbed riparian areas to stabilize soils, reduce sedimentation and accelerate vegetation recovery (Appendix D, Drawing 1).	For shallow or poorly defined channels, with low or gently sloping banks and where riparian vegetation and bank material can be salvaged for use in channel reconstruction (*e.g.,* intermittent, or seasonal watercourses with low flow or standing water, including small ponds).
Type C	• Re-contour banks using salvaged bank material and install erosion control blanket and/or coir logs as required (Appendix D, Drawing 2). • Install rooted stock plant shrubs/trees and/or dormant shrub stakes/brush in disturbed riparian areas to stabilize soils, reduce sedimentation and accelerate woody vegetation recovery (Appendix D, Drawing 1). • Coir soil wrap(s) with dormant brush/stake layering may be used for added bank integrity and to create overhanging vegetation (Appendix D, Drawing 3)	For watercourses with low to moderate flow, with vertical or steeply sloping banks up to 0.3 m high, and where the channel and base of the banks can be re-contoured using cobble or boulder substrate. Install erosion control blanket and/or coir logs above the OHWL or riparian vegetation that will not be wetted by stream flows for prolonged periods.

TABLE 7.2 Cont'd

Reclamation Method	Reclamation Measures	Application Criteria
Type D	• Re-contour banks using salvaged bank material, and install erosion control blanket and/or coir logs as required (Appendix D, Drawing 2). • If required, install riprap base below OHWL, keyed in to bed and underlain with filter cloth or gravel layer. • Install coir soil wrap(s) above the OHWL (Appendix D, Drawing 3), or • Log crib structure made from natural logs may be used at the base of the bank (below the OHWL) if appropriate (may be a single log in height, typically a minimum of two logs are used) (Appendix D, Drawing 4). • Install rooted stock shrubs/trees and/or dormant shrub/tree stakes in disturbed riparian areas to stabilize soils, reduce sedimentation and accelerate woody vegetation recovery (Appendix D, Drawing 1).	For watercourses with low to moderate flow, with vertical or steeply sloping banks between 0.3 and 1.5 m high, and where the channel and base of the banks can be re-contoured using cobble or boulder substrate. Where multiple tiers of grass rolls are required and will not be wetted by stream flows for prolonged periods. Also for use where brush/stake layering between grass rolls and coir soil wrap(s) is required to provided overhanging vegetation.
Type E	• Recreate banks using log crib structures made of natural logs (may be a single log in height, typically a minimum of two logs are used) (Appendix D, Drawing 4) or install riprap keyed in to bed and underlain with filter cloth or gravel layer if required. • Supplement with salvaged bank material as required. • Install rooted stock shrubs/trees and/or dormant shrub/tree stakes in disturbed riparian areas to stabilize soils, reduce sedimentation and accelerate woody vegetation recovery (Appendix D, Drawing 1).	Use of log crib structures is appropriate for watercourses with low flow that have a vertical or undercut bank up to 1 m high and where erosion from flow along the base of the bank needs to be mitigated. These watercourses are typically adjacent flood margins with flat or low gradient. This method is also suitable for channels with lower bank heights, adjacent culverts or constrained flows. Cover for fishes is provided by the transplanted shrubs/trees or shrub staking. Log crib structures are not recommended in steeper cobble/boulder systems subject to high velocity seasonal flows found in interior BC.
Type F	• Recreate banks using log crib structures made of natural logs (typically a minimum of two logs is used) (Appendix D, Drawing 4) or install riprap keyed in to bed and underlain with filter cloth or gravel layer. • Supplement with salvaged bank material as required. • Install coir soil wrap(s) with dormant brush/stake layering above log crib or riprap (Appendix D, Drawing 3). • Install rooted stock shrubs/trees and/or dormant shrub/tree stakes in disturbed riparian areas to stabilize soils, reduce sedimentation and accelerate woody vegetation recovery (Appendix D, Drawing 1).	For watercourses with moderate to high flow that have a vertical or undercut bank >1 m high and where erosion from flow along the base of the bank needs to be mitigated. Used where steeper flood margins extend from the top of the bank. This method is also suitable for channels with lower bank heights, adjacent culverts or constrained flows. Cover for fishes are provided by the brush/stake layering between the coir soil wraps, rooted shrubs/trees and/or shrub/tree staking.
Type G	• Re-contour bed and banks using native cobble and boulder armouring to the OHWL. • Supplement with locally obtained riprap if required to stabilize banks. • Install rooted stock shrubs/trees and/or dormant shrub/tree stakes in disturbed riparian areas to stabilize soils, reduce sedimentation and accelerate woody vegetation recovery (Appendix D, Drawing 1).	For larger watercourses subject to high seasonal flows, or watercourses with a steep (> 5%) gradient and bed/banks comprised of large cobble or boulder substrate. Usually in watercourses that experience high flow conditions.

7.1.5 Post-Construction Monitoring

Post-construction monitoring will be required to monitor the habitat stability of watercourse crossings and re-vegetation of riparian areas following reclamation. Specific post-construction monitoring programs (*e.g.*, compliance monitoring to ensure specifications with the EPP were followed) may also be a regulatory requirement for watercourse crossings authorized under the *Fisheries Act*. Additional monitoring may also be obligatory, should an unanticipated environmental effect occur post-construction or additional pipeline maintenance and integrity work is required.

Other post-construction monitoring (*e.g.*, conformance monitoring) plans typically include site inspections, assessments of riparian vegetation survival rates, assessments of instream habitat stability, and to ensure the effectiveness of works implemented for compensation offset of any habitat loss are functioning as intended.

8.0 SUMMARY

Fish and fish habitat investigations were carried out to satisfy application and regulatory requirements in support of an environmental and socio-economic assessment for the Trans Mountain Expansion Project. The approximately 674.4 km proposed pipeline corridor (BC portion) will pass through 13 watersheds and 3 management unit boundaries. The BC portion comprises four pipeline segments (Hargreaves to Darfield, Black Pines to Hope, Hope to Burnaby and Burnaby to Westridge) and two power lines (Black Pines Power Line and Kingsvale Power Line).

The fish and fish habitat effects assessment considered potential effects to fish and fish habitat within defined FSA, LSA, and RSA boundaries. Fish habitat was rated for spawning, rearing, overwintering and migration and habitat was rated as high or low sensitivity. Key indicator species for the BC portion of the FSA include coho salmon, Chinook salmon, bull trout, rainbow trout and cutthroat trout. Fish and fish habitat assessments also considered potential for species at risk along the proposed pipeline corridor, including *SARA*-listed white sturgeon (Upper Fraser River Population), green sturgeon, salish sucker, nooksack dace; provincially Red-listed white sturgeon (Middle and Lower Fraser River Population); Blue-listed mountain sucker, bull trout, eulachon, and chiselmouth, and COSEWIC ranked Interior Fraser coho salmon and Cultus Lake sockeye salmon.

Results for the technical data report included mapping of all potential watercourse crossings along the proposed pipeline corridor, a historical literature review of fish species presence and distribution within the FSA and RSA (BC portions), and site-specific field surveys to document current fish and fish habitat information (baseline conditions) and crossing recommendations for each watercourse crossing (LSA). Overall fish and fish habitat potential (*e.g.*, spawning, rearing, overwintering, and migration) was rated for each watercourse crossing and a fish sensitivity (high or low) was derived based on potential species presence (recreational, commercial, ecological or Aboriginal importance) and habitat potential. Fish and fish habitat assessments also considered local TEK/ATK knowledge within the LSA and RSA. Field surveys were also used to screen which waterways were navigable, potentially navigable and minor or non-navigable waters.

All results of the fish and fish habitat assessments are summarized within the technical data report, the Watercourse Crossing Summary Table (Appendix A), fish-bearing atlas (Appendix B), nonfish-bearing atlas (Appendix C) and fish sensitivity maps (Appendix D). The totals below are calculated from the final results of the 2012 and 2013 field programs, and the literature review.

- Field investigations were carried out through spring, summer and fall at 776 potential watercourses.
- There are currently 393 defined watercourse crossings included in the BC portion of the FSA including 202 fish-bearing channels and 191 nonfish-bearing channels. A total of 8 supplemental sites were included in the fish-bearing total as they have adequate historical information.
- Of the 202 fishbearing watercourses, 174 have fish-bearing reaches within the proposed corridor; additionally there are 12 fish-bearing wetlands within the proposed corridor.
- Of the 186 (fish-bearing watercourse reaches and wetlands) within the proporsed corridor, 154 were assessed as having a high sensitivity and 32 were considered to have a low sensitivity.
- A total of 154 NCDs, 35 NCD-Ws and 202 NVCs, were identified along the proposed pipeline corridor.
- Trenchless crossings methods (*e.g.*, HDDs) are proposed for 20 high sensitivity crossings; isolation with fish salvage and water quality monitoring is recommended for the remaining 134 high sensitivity crossings, inside or outside the timing window, where practical, and depending on the watercourse size and discharge (refer to the Watercourse Crossing Summary Table [Appendix A] for all watercourses requiring a Stage 2 review and Volume 4A – Project Design and Execution – Engineering for “Watercourse Crossing Method Selection” and Potential HDD Watercourse Crossings). Potential for watercourse isolation, inside or outside the provincial instream construction

timing windows, may not be feasible depending on the regional hydrological cycle; an open-cut inside the provincial instream timing window may be required for some watercourses.

- Low sensitivity watercourses within the proposed corridors (191) have low potential for direct mortality or injury to fish within the LSA, or do not have potential (*i.e.,* nonfish-bearing) to affect fish species of recreational, ecological, commercial or Aboriginal concern.

- Isolation with precautionary fish salvage is recommended for low sensitivity fish-bearing watercourses, except where fish presence was excluded (*e.g.*, gradient or two seasons of sampling).

- General best management practices will ensure water quality is maintained where the ZOI includes a larger fish-bearing watercourse (*e.g.*, Fraser River), and water quality monitoring may still be important at low sensitivity watercourses where indicator species were captured or observed directly downstream within the LSA.

- Isolation if water is present is generally recommended for all nonfish-bearing watercourses otherwise open-cut (DFO OS) if dry or frozen to bottom.

- Clear-span bridges are generally recommended for all fish-bearing watercourses; other approved temporary vehicle crossings methods may be used where the watercourse is dry or frozen to the bottom or where fish habitat potential, at or adjacent to the proposed pipeline corridor, has been documented as low.

- Ramp and culvert, swamp mats, logfill, snow/icefill or other approved methods are recommended for all nonfish-bearing habitat, although clear-span bridges are generally recommended for flowing watercourses greater than 2.5 m wide.

- 60 watercourse crossings still require supplemental studies (Appendix F) (*i.e.*, one to two seasons of sampling) to confirm fish presence or absence and/or site-specific biophysical data collection, although 8 of these watercourse crossings were considered in the final results for fish-bearing drainages, based on inferred fish presence and known habitat potential.

- All sites requiring supplemental data collection were assigned a preliminary classification status based on desktop review, field investigations adjacent (upstream or downstream) to the proposed pipeline corridor and estimates of gradient and connectivity (Appendix F).

The pathway of effects for pipeline construction and operation are described in Table 7.1. The Project-specific EPPs, general mitigation guidelines, best management practices and DFO Regional OSs for BC should be adopted by Trans Mountain, wherever possible, to reduce residual effects of pipeline construction and operations. The EPPs watercourse mitigation measures are provided in a separate document (Pipeline EPP of Volume 6B and Facilities EPP of Volume 6C) and general watercourse reclamation details are provided in Table 7.2 and Appendix E. Additional mitigation and site-specific reclamations measures may be necessary pending review from various provincial and federal agencies, and compensatory options may be considered where fish habitat has been ranked as sensitive and it is not possible to maintain the existing productive capacity through mitigation and reclamation. Supplemental studies may also be required for alternative route revisions, temporary access roads, ancillary facilities or development of habitat compensation/offset plans prior to construction. Post-construction monitoring programs will allow monitoring of bank stability and re-vegetation at watercourse crossings as well as long-term monitoring for potential compensation projects.

9.0 REFERENCES

9.1 Literature Cited

Applied Aquatic Research Ltd. 2005. TMX - Anchor Loop Project: Fish and Fish Habitat Investigations, Alberta, Jasper National Park, Mount Robson Provincial Park and British Columbia.

Agriculture and Agri-Food Canada. (2009). Pacific Sockeye Salmon. Website: http://www.ats-sea.agr.gc.ca/sea-mer/4810-eng.htm. Accessed: March 2013.e

Alaska Department of Fish and Game. 2013. Steelhead/Rainbow Trout (*Oncorhynchus mykiss*) species profile. Website: http://www.adfg.alaska.gov/index.cfm?adfg=steelhead.main. Accessed: January 2013.

Alberta Environment. 2000a. Code of Practice for Pipelines and Telecommunication Lines Crossing a Water Body. Includes Amendments to February 2007. 26 pp. Government of Alberta.

Alberta Environment. 2000b. Code of Practice for Watercourse Crossings. Includes Amendments to February 2007. 26 pp. Government of Alberta.

Allen, M.A. and T.J. Hassler. 1986. Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (Pacific Southwest): Chinook Salmon. Biological Report:82 (11.49).

Amec Earth & Environmental. 2010. Merritt Area Transmission Project, Environmental Overview Assessment, Appendix 1, Section 6: Heritage Resources. Prepared for BC Hydro. Burnaby, BC.

Anderson, P.G. 1998. Sediment generation from forestry operations and associated effects on aquatic ecosystems. Pages 491-508 in Brewin, M.K., and D.M.A. Monita editors, Forest-Fish Conference Proceedings: land management practices affecting aquatic ecosystems. Natural Resources Canada, Canadian Forest Service. Northern Forestry Centre, Edmonton, AB, Inf. Rep. NOR-X-356.

Anderson, P.G., B.R. Taylor, and G.C. Balch. 1996. Quantifying the effects of sediment release on fish and their habitats. Vancouver, British Columbia and Winnipeg, Manitoba, Fisheries and Oceans Canada, Eastern BC Habitat Unit and Alberta Area Habitat Management Division. Canadian Manuscript Report of Fisheries and Aquatic Sciences No 2346.

Arc Environmental Ltd. 2005. Scientific Fish Collection Permit SU05-13903 - Boston Bar Creek. Prepared for BC Ministry of Environment.

Archaeo Research Limited. 2002. An Aboriginal Impact Assessment of the Cariboo Gold Project. Prepared for International Wayside Gold Mines Ltd. Victoria, BC.

Baxter, J.S. and J.D, McPhail. 1996. A review of Bull Trout (*Salvelinus confluentus*) life-history and habitat use in relation to compensation and improvement opportunities. Fisheries Management Report, 104.

Beaudry, P.G. 1998. Suspended sediment regimes of three experimental watersheds in the Takla area of north-central British Columbia. Pages 231-240 in Brewin, M.K., and D.M.A. Monita editors, Forest-Fish Conference Proceedings: land management practices affecting aquatic ecosystems. Natural Resources Canada, Canadian Forest Service. Northern Forestry Centre, Edmonton, AB, Inf. Rep. NOR-X-356.

Berman, C. 1998. Summary of temperature preference ranges and effects for life states of seven species of salmon and trout (Appendix A). US EPA Region 10.

Bjornn, T.C. and D.W. Reiser. 1991. Habitat requirements of salmonids in streams. Pages 83-138 *in* Meehan, W.R. Influences of Forest and Rangeland Management on Salmonid Fishes and their Habitats. American Fisheries Society Special Publication. 622 pp.

Birtwell, I.K. 1999. The effects of sediment on fish and their habitat. Fisheries and Oceans Canada.

BC Conservation Data Centre. 2013. Species Summary: *Acrocheilus alutaceus, Cottus* sp., *Notropis hudsonius, Rhinichthys cataractae*, *Thaleichthys pacificus.* BC Ministry of Environment. Victoria, BC. Website: http://a100.gov.bc.ca/pub/eswp. Accessed: March 2013.

BC Conservation Data Centre. 2012. Fish-stream Crossing Guidebook. Website: http://a100.gov.bc.ca/pub/eswp/search.do. Accessed: January 2012.

BC Ministry of Environment. 2011. Species and Ecosystems at Risk in B.C. Website: http://www.env.gov.bc.ca/atrisk/ . Accessed: January 2013.

BC Ministry of Environment. 2009a. Conservation Framework, Conservation Priorities for Species and Ecosystems. Website: http://www.env.gov.bc.ca/conservationframework/. Accessed: January 2013.

BC Ministry of Environment. 2009b. Manual of British Columbia Hydrometric Standards, Version 1.0. Website: http://www.ilmb.gov.bc.ca/risc/pubs/aquatic/hydrometric/man_BC_hydrometric_stand_V1.0.pdf. Accessed: January 2013.

BC Ministry of Environment, Ecosystems Branch. 2008a. Reconnaissance (1:20 000) Fish and Fish Habitat Inventory Fish Collection Form (and individual Fish Data Form) Field Guide. Resources Inventory Standards Committee.

BC Ministry of Environment, Ecosystems Branch. 2008b. Reconnaissance (1:20 000) Fish and Fish Habitat Inventory: Site Card Field Guide. Resources Inventory Standards Committee.

BC Ministry of Environment. 2007. Thompson Region Timing Windows. Website: http://www.env.gov.bc.ca/wsd/regions/thr/wateract/work_windows_jan17_2007.pdf. Accessed: May 2013.

BC Ministry of Environment. 2006. Lower Mainland Region Timing Windows. Website: http://www.env.gov.bc.ca/wsd/regions/sry/wateract/work_windows_sry.pdf. Accessed: May 2013.

BC Ministry of Environment. 2004. Omineca Region Timing Windows. Website: http://www.env.gov.bc.ca/wsd/regions/omr/wateract/omineca_water_act_terms_conditions.pdf. Accessed: May 2013.

BC Ministry of Environment. n.d. BC Species and Ecosystems Explorer. Website: http://a100.gov.bc.ca/pub/eswp/search.do. Accessed: January 2013.

BC Ministry of Environment, Lands and Parks. 1997. Fish Collection Methods and Standards, Version 4.0. Prepared for the Resource Inventory Committee. Website: http://www.ilmb.gov.bc.ca/risc/pubs/aquatic/fishcol/index.htm. Accessed: December 2012.

BC Ministry of Environment, Lands and Parks. 1995. Wildlife in British Columbia at Risk: Nooksack Dace. Victoria, BC. Website: http://www.env.gov.bc.ca/wld/documents/nooksack.pdf. Accessed: July 2013.

BC Ministry of Environment, Lands and Parks. 1993. Wildlife in British Columbia at Risk: Salish Sucker. Victoria, BC. Website: http://www.env.gov.bc.ca/wld/documents/salishsucker.pdf. Accessed: July 2013.

BC Fisheries - Information Services Branch. 2001. Reconnaissance (1:20 000) Fish and Fish Habitat Inventory Standards and Procedures. Prepared for the Resources Inventory Committee. Website: http://www.ilmb.gov.bc.ca/risc/pubs/aquatic/recon/assets/recce2c.pdf. Accessed: January 2013.

BC Fisheries – Information Services Branch. 2000. Reconnaissance (1:20 000) Fish and Fish Habitat Inventory: Quality Assurance Procedures. Prepared for the Resources Inventory Committee. Website: http://www.ilmb.gov.bc.ca/risc/pubs/aquatic/quality/assets/quality.pdf. Accessed: January 2013.

BC Ministry of Fisheries. 1999. Overview Fish and Fish Habitat Inventory Methodology, Version 1.0. Prepared for the Resources Inventory Committee. Website: http://www.ilmb.gov.bc.ca/risc/pubs/aquatic/overview/assets/overview.pdf. Accessed: January 2013.

BC Ministry of Fisheries. 1997. BC Fish Facts: Mountain Sucker. Victoria, BC. Website: http://www.shuswapwatershed.ca/teacherguide/D-Reports/mountainsucker.pdf. Accessed: July 2013.

BC Ministry of Forests, Lands and Natural Resources Operations, B.C. Ministry of Environment, and Fisheries and Oceans Canada. 2012. Fish-stream crossing guidebook. Rev. ed. For. Prac. Invest. Br. Victoria, BC. 71 pp. Website: http://www.pac.dfo-mpo.gc.ca/habitat/docs/fish_stream_crossing_guidebook_2012.pdf. Accessed: January 2013.

BC Ministry of Forests. 2002. Forest Road Engineering Guidebook. Forest Practices Code. June 2002.

BC Ministry of Forests. 1998a. Fish-Stream Identification Guidebook, Version 2.1. Website: http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/fish/FishStream.pdf. Accessed: January 2013.

BC Ministry of Forests 1998b. Biogeoclimatic Zones of British Columbia. Website: http://www.for.gov.bc.ca/hfd/library/documents/treebook/biogeo/biogeo.htm. Accessed: January 2013.

BC Ministry of Forests. 1996. FPC Channel Assessment Procedure Field Guidebook. Website: http://www.geog.ubc.ca/~beaton/images/Ch_Assess_Guide_field.pdf. Accessed: June 2013.

BC Ministry of Forests. 1995. “FPC Riparian Management Area Guidebook”. Website: http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/riparian/rip-toc.htm. Accessed: June 2013.

BC Ministry of Water, Land and Air Protection. Ecosystems Standards and Planning Biodiversity Branch. 2004. Standards and Best Practices for Instream Works. Website: http://www.env.gov.bc.ca/wld/documents/bmp/iswstdsbpsmarch2004.pdf. Accessed: April 2013.

BC Oil and Gas Commission. 2013. “Environmental Protection and Management Guide”. Version 1.6. Website: http://www.bcogc.ca/document.aspx?documentID=927&type=.pdf. Accessed: June 2013.

BC Oil and Gas Commission. 2011. “Oil and Gas Water Use in British Columbia”. Victoria, BC.

Brodeur, R. D. 1990. A Synthesis of the Food Habits and Feeding Ecology of Salmonids in Marine Waters of the North Pacific. (INPFC Doc.) FRI-UW-9016. Fish. Res. Inst., University of Washington, Seattle. 38 pp. Website: http://www.ecy.wa.gov/programs/tcp/SciencePanel2009/mtgInfo/mtg_120611/TechIssuePaper_Salmon_06-01-12_Draft.pdf. Accessed: October 2013.

Burrows, J., T. Euchner and N. Baccante. 2001. “Bull Trout Movement Patterns: Halfway River and Peace River Progress” in *Bull Trout II Conference Proceedings*. M.K. Brewin, A.J. Paul and M. Monita. (Eds.). Canmore, AB. 153-157 pp.

Canadian Council of Ministers of the Environment. 2002. Canadian Water Quality Guidelines for the Protection of Aquatic Life. Total Particulate Matter in: Canadian Environmental Quality Guidelines, 1999, updated 2002. Canadian Council of Ministers of the Environment, Winnipeg, MB.

Canadian Council of Ministers of the Environment. 1999. Canadian Water Quality Guidelines for the Protection of Aquatic Life: Summary Table. Website: http://st-ts.ccme.ca/. Inclusive of Releases until [December 2007]. Accessed September 2013.

Carlson, K (Ed.). 2001. A Stó:lō Coast Salish Historical Atlas. Published by Douglas & McIntyre. Vancouver, BC. 102-120 pp.

City of Burnaby. 2013. Eagle Creek Streamkeepers Society Annual Salmon Release. Website: http://www.burnaby.ca/Things-To-Do/Calendar-of-Events/Eagle-Creek-Streamkeepers-Society-Annual-Salmon-Release_s_p3987.html?EventMode=View&EventOccurrence=0. Accessed: July 2013.

COSEWIC. 2012. Candidate wildlife species. Committee on the Status of Endangered Wildlife in Canada. Website: http://www.cosewic.gc.ca/eng/sct3/index_e.cfm#3. Accessed: January 2013.

COSEWIC. 2011. COSEWIC assessment and status report on the Eulachon, Nass/Skeena Rivers population, Central Pacific Coast population and the Fraser River population *Thaleichthys pacificus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa, ON. xv + 88 pp. (www.sararegistry.gc.ca/status/status_e.cfm).

COSEWIC. 2010a. COSEWIC assessment and update status report on the Mountain Sucker *Catostomus platyrhynchus* (Saskatchewan – Nelson River populations, Milk River populations and Pacific populations) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa, ON. xvii + 54 pp. (www.sararegistry.gc.ca/status/status_e.cfm).

COSEWIC. 2010b. COSEWIC assessment and status report on the Coastrange Sculpin *Cottus aleuticus*, (Cultus Population) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa, ON. xi + 28 pp. (www.sararegistry.gc.ca/status/status_e.cfm).

COSEWIC. 2007. COSEWIC assessment and update status report on the Nooksack dace *Rhinichthys cataractae* ssp. In Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa, ON. vii + 27 pp. (www.sararegistry.gc.ca/status/status_e.cfm).

COSEWIC. 2003a. COSEWIC assessment and update status report on the white sturgeon Acipenser transmontanus in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa, ON. vii + 51 pp. (www.sararegistry.gc.ca/status/status_e.cfm)

COSEWIC. 2003b COSEWIC assessment and status report on the sockeye salmon *Onchorynchus nerka*, (Cultus Population) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa, ON. xi + 57 pp. (www.sararegistry.gc.ca/status/status_e.cfm).

COSEWIC. n.d. Canadian Species at Risk. Website: http://www.cosewic.gc.ca/eng/sct5/index_e.cfm. Accessed: April 2013.

Cunjak, R.A. 1996. Winter habitat of selected stream fishes and potential impacts from land-use activity. Canadian Journal of Fisheries and Aquatic Sciences 53 (S1):267-282.

Desrochers, B. 1997. Fisheries Information and Summary System (FISS): Data Compilation and Mapping Procedures. Prepared for BC Ministry of Environment, Lands and Parks Resources Inventory Branch. Draft 3. Enviro-Links. West Vancouver, BC.

Environment Canada. 1981. Hydrometric Field Manual-Measurement of Stream Flow.

Fedorenko, A.Y., P.E.I. Fee and A.L. Kahl. 1983. Trapping and coded wire tagging of wild juvenile Chinook Salmon in the Upper Fraser River. Canadian Manuscript Report of Fisheries and Aquatic Sciences, 1733.

First Nations Environmental Contaminants Program. n.d. Skeetchestn Environmental Food Contaminants Project. Website: http://www.skeetchestn.ca/download/document/Contaminants.pdf. Accessed: March 2013.

Fisheries and Oceans Canada. 2013a. Practitioners Guide to the Risk Management Framework for DFO Habitat Management Staff. Website: http://www.dfo-mpo.gc.ca/habitat/role/141/1415/14155/risk-risque/page03-eng.asp. Accessed: September 2013.

Fisheries and Oceans Canada. 2013b. Region 2—Lower mainland. Website: http://www.pac.dfo-mpo.gc.ca/fm-gp/rec/fresh-douce/region2-eng.htm. Accessed: January 2013.

Fisheries and Oceans Canada. 2013c. Fisheries Protection Policy Statement. October, 2013

Fisheries and Oceans Canada. 2013d. Fraser River Eulachon Egg/larval Abundance Surveys. Website: http://www.pac.dfo-mpo.gc.ca/science/species-especes/pelagic-pelagique/herring-hareng/herspawn/pages/river1-eng.htm. Accessed: July 2013.

Fisheries and Oceans Canada. 2013e. Riparian Areas and Revegetation. Website: http://www.pac.dfo-mpo.gc.ca/habitat/reveg/index-eng.htm. Accessed: June 2013.

Fisheries and Oceans Canada. 2012. Chehalis hatchery-background. Website: http://www.pac.dfo-mpo.gc.ca/sep-pmvs/projects-projets/chehalis/bg-rb-eng.htm. Accessed: December 2012.

Fisheries and Oceans Canada. 2011a. Information document to assist development of a Fraser Chinook management plan.

Fisheries and Oceans Canada. 2011b. Strategic fisheries overview for the Middle Fraser Habitat Management Area. Department of Fisheries and Oceans, Fraser River Action Plan.

Fisheries and Oceans Canada. 2010a. Pacific Region's Habitat Definitions. Website: http://www.pac.dfo-mpo.gc.ca/habitat/Glossary-glossaire-eng.htm. Accessed: April 2013.

Fisheries and Oceans Canada. 2010b. Assessment of Cultus Lake Sockeye Salmon in British Columbia in 2009 and Evaluation of Recent Recovery Activities. DFO Can. Sci. Advis. Sec. Rep. 2010/056

Fisheries and Oceans Canada. 2008. Interior Fraser Coho conservation strategy. Website: http://www.pac.dfo-mpo.gc.ca/fm-gp/species-especes/salmon-saumon/InteriorFraserCohoCS/background1.4-eng.htm. Accessed: January 2013.

Fisheries and Oceans Canada. 2007a. Directional Drilling. Fisheries and Oceans Canada Pacific Region Operational Statement. Website: http://www.pac.dfo-mpo.gc.ca/habitat/os-eo/pdfs/directional_drilling_e.pdf. Accessed: April 2013.

Fisheries and Oceans Canada. 2007b. Punch and Bore Crossings. Fisheries and Oceans Canada Pacific Region Operational Statement. Website: http://www.pac.dfo-mpo.gc.ca/habitat/os-eo/pdfs/punch_bore_e.pdf. Accessed: April 2013.

Fisheries and Oceans Canada. 2007c. Dry Open-cut Stream Crossings. Fisheries and Oceans Canada Pacific Region Operational Statement. Website: http://www.pac.dfo-mpo.gc.ca/habitat/os-eo/pdfs/dry_opencut_e.pdf. Accessed: April 2013.

Fisheries and Oceans Canada. 2007d. Clearspan Bridges. Fisheries and Oceans Canada Pacific Region Operational Statement. Website: http://www.pac.dfo-mpo.gc.ca/habitat/os-eo/pdfs/clear_span_bridge_e.pdf. Accessed: April 2013.

Fisheries and Oceans Canada. 2007e. Ice Bridges and Snow Fills. Fisheries and Oceans Canada Pacific Region Operational Statement. Website: http://www.pac.dfo-mpo.gc.ca/habitat/os-eo/pdfs/ice_bridges_e.pdf. Accessed: April 2013.

Fisheries and Oceans Canada. 2007f. Temporary Ford Stream Crossing. Fisheries and Oceans Canada Pacific Region Operational Statement. Website: http://www.pac.dfo-mpo.gc.ca/habitat/os-eo/pdfs/temp_ford_e.pdf. Accessed: April 2013.

Fisheries and Oceans Canada. 2007g. Isolated Ponds. Fisheries and Oceans Canada Pacific Region Operational Statement. Website: http://www.pac.dfo-mpo.gc.ca/habitat/os-eo/ponds-etangs-eng.htm. Accessed: April 2013.

Fisheries and Oceans Canada. 2007h. Overhead Line Construction. Fisheries and Oceans Canada Pacific Region Operational Statement. Website: http://www.pac.dfo-mpo.gc.ca/habitat/os-eo/pdfs/overhead_line_e.pdf. Accessed: April 2013.

Fisheries and Oceans Canada. 2007i. Bridge Maintenance. Fisheries and Oceans Canada Pacific Region Operational Statement. Website: http://www.pac.dfo-mpo.gc.ca/habitat/os-eo/pdfs/bridge_maintenance_e.pdf. Accessed: November 2013.

Fisheries and Oceans Canada. 1999. Fraser River Chinook Salmon. DFO Science Stock Status Report, D6-11. Website: http://www.dfo-mpo.gc.ca/csas/Csas/status/1999/D6-11e.pdf. Accessed: January 2013.

Fisheries and Oceans Canada. 1998a. Salmon Watershed Planning Profiles for the South Thompson-Shuswap Management Area, Fraser River Action Plan, Vancouver BC. 302 pp.

Fisheries and Oceans Canada. 1998b. Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters. Canadian Technical Report of Fisheries and Aquatic Sciences 2107. Cat. No. Fs 98-6/2107E.

Fisheries and Oceans Canada. 1995. Freshwater Intake End-of-Pipe Fish Screen Guideline. Communications Directorate, DFO. Ottawa, ON. Cat. No, Fs 23-270 / 1995E.

Fisheries and Oceans Canada. 1986. Policy for the Management of Fish Habitat. Department of Fisheries and Oceans, Fish Habitat Management Branch, Ottawa, ON. Cat. No. Fs 23-98/1986E. 28 pp.

Ford, B.S., P.S. Higgins, A.F. Lewis, K.L. Cooper, T.A. Watson, C.M. Gee, G.L. Ennis and R.L. Sweeting. 1995. Literature reviews of the life history, habitat requirements and mitigation/compensations strategies for thirteen sportfish species in the Peace, Liard, and Columbia River drainages of British Columbia. Canadian Manuscript Report of Fisheries and Aquatic Sciences (2321): xxiv. 342 pp.

Freshwater Fisheries Society of British Columbia. 2013. Clearwater Trout Hatchery. Website: http://www.gofishbc.com/about-us/what-we-do/fish-hatcheries/clearwater-hatchery.aspx. Accessed: September 2013.

Gibson, J.R., Haedrich, R.L, and C.M. Wernerheim, 2005. Loss of fish habitat as a result of inappropriately constructed stream crossings. Fisheries 30:10-17.

Golder Associates. 2008. British Columbia Interior to Lower Mainland Transmission Line: Section 6.17 First Nations Interests. Prepared for the British Columbia Transmission Corporation. Vancouver, BC.

Government of Canada. 2009. Minor Works and Waters (*Navigable Waters Protection Act*) Order. Canadian Gazette. Vol. 143, No 19.

Government of Canada. n.d. Species at Risk Public Registry. Website: http://www.sararegistry.gc.ca/species/default_e.cfm. Accessed: April 2013.

Government of Canada. Water Survey of Canada. n.d. Hydrometric Data. Website: http://www.ec.gc.ca/rhc-wsc/. Accessed: August 2013.

Groot, C., Marcolis, L. (1991). Pacific salmon: Life histories. Website: http://books.google.ca/books?hl=en&lr=&id=l_S0xCME0CYC&oi=fnd&pg=PR7&dq=sockeye+salmon+distribution+british+columbia&ots=_vABzH8qi1&sig=NHq-xZft8imeOof-bxA-d458W4c#v=onepage&q=sockeye%20distribution%20british%20columbia&f=false. Accessed: March 19, 2013.

Haas, G. 2001. The mediated associations and preferences of native bull trout and rainbow trout with respect to maximum water temperature, its measurement standards, and habitat. In Brewin, M.K., A.J. Paul and M. Monita. 2001, Bull trout II conference proceedings, p 53-56. Trout Unlimited Canada, Calgary, AB.

Hanson, D.L. and T. Cochnauer. 1992. White sturgeon management framework plan. Pacific States Marine Fisheries Commission. Portland, OR.

Harper, D.J., Quigley, J.T. (2000). No net loss of fish habitat: an audit of forest road crossings of fish-bearing streams in British Columbia, 1996-1999. Canadian Technical Report of Fisheries and Aquatic Sciences, 2319.

Harding, T., L. Jaremovic, and G. Kosakoski. 1994. Strategic review of fisheries resources North Thompson habitat management area. Final Draft. Fraser River Action Plan, Dept. of Fisheries and Oceans, Vancouver, BC. 127 pp. + appendices.

Hatfield, T., S. McAdam, and T. C. Nelson. 2004*. Impacts to abundance and distribution of Fraser River white sturgeon.* A summary of existing information and presentation of impact hypotheses: Report prepared for the Fraser River Sturgeon Conservation Society and the Fraser River White Sturgeon Working Group.

Henderson, M.A., Graham, C.C. (1998). History and status of Pacific salmon in British Columbia. Northern Pacific Anadromous Fish Commission, 1:13-22.

Inglis, S. 1995. Wildlife in British Columbia at Risk: Nooksack Dace. B.C. Minist. of Environment, Lands and Parks. Website: http://www.env.gov.bc.ca/wld/documents/nooksack.pdf. Accessed: March 2013.

Irvine, J.R., C.K. Parken, D.G. Chen, J. Candy, T. Ming, J. Supernault, W. Shaw and R.E. Bailey. 2001. 2001 assessment of stock status for coho salmon from the interior Fraser River. Canadian Science Advisory Secretariat Research Document, 2001/083.

Irvine, J.R., K. Wilson, B. Rosenberger, and R. Cook. 1999. Stock Assessment of the Thompson River / Upper Fraser River Coho Salmon. Fisheries and Oceans Canada. Canadian Stock Assessment Secretariat. Research Doc 99/28. Ottawa, ON. 66 pp.

Johannes, M.R., L.H. Nikl, R.J. Hoogendoorn and R.E. Scott. 2011. Fraser River sockeye habitat use in the Lower Fraser and Strait of Georgia. Golder Associated Ltd. Cohen Commission Technical Report, 12.

Johns, T. and T. Ernst. 2007. Culvert crossings as potential barriers to fish movement in the Kakwa River watershed, Alberta. Data Report, D-2007-001 Alberta Conservation Association, Peace River, AB. Website: http://www.ab-conservation.com/go/default/custom/uploads/ reportseries2/Clvrt-Cr-Pot-Bar-F-Move-Kakwa-R-wtrshd,AB.pdf. Accessed: April 2013.

Johnston, N.T. and P.A. Slaney. 1996. Fish Habitat Assessment Procedures. Watershed Restoration Technical Circular No. 8. Ministry of Environment, Lands and Parks and Ministry of Forests. Watershed Restoration Program. Vancouver, BC.

Katzie Development Corporation. 2011. Nooaitch Indian Band Land Use Plan. Prepared for the Nooaitch Band Council/ Prepared by N. Murphy, and D. Biddiscombe. Pitt Meaows, BC.

Katzie First Nation. 2002. Treaty Negotiations. Website: http://www.katzie.ca/treaty_negotiations.htm. Accessed: January 2013.

Knapp, W.D., M.D. Nassichuk, J.J. Turner and I.K. Birtwell. 1982. The Thompson River Basin: Pacific salmon resources and Environmental Issues. Canadian Manuscript Report of Fisheries and Aquatic Sciences 1668. March 1982.

Komori, V. 1997. Wild, threatened, endangered and lost streams of the Lower Fraser Valley, Summary Report. Lower Fraser Valley Stream Review. Vol. 3.

Kwantlen First Nation. 2013. History. Website: www.kwantlenfn.ca/history.htm. Accessed: January 2013.

Kwikwetlem First Nation. 2007. Kwikwetlem First Nation Traditional Use Study Report, Phase 1: Relating to the Portions of Kwikwetlem Asserted traditional territory Affected by the Ministry of Transportation's Gateway Program. Coquitlam, BC.

Labelle, M. 2009. Status of pacific salmon resources in southern British Columbia and the Fraser River Basin. Pacific Fisheries Resource Conservation Council.

Langer, O.E. 2010. Juvenile sockeye use of the Lower Fraser River and its estuary. A note for submission to the Cohen Commission.

Laufle, J.C., G.B. Pauley and M.F. Shepard. 1986. Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (Pacific Northwest): Coho Salmon. Biological Report, 82 (11.48).

LGL Ltd. Environmental Research Associates. 2007. Development of an annual salmonid productivity assessment program for the Nicola River watershed. M. Mathews, B. Bocking, G. Glova, N. Todd and T. Sampson. Prepared for the Pacific Salmon Foundation. Website: http://www.thinksalmon.com/reports/FSWP_07_D2_NTA_FINAL_REPORT.pdf. Accessed: January 2013.

LGL Ltd. Environmental Research Associates. 2001. Coldwater River watershed recovery plan. T. Nelson, R. Bocking and M. Gaboury. Prepared for the Pacific Salmon Endowment Fund. Website: http://www.psf.ca/files/ColdwaterRiverWatershedSalmonRecoveryPlan.pdf. Accessed: January 2013.

Lheidli T'enneh. n.d.. Fisheries. Website: http://www.lheidli.ca/Lands_And_Natural_Resources/fisheries.php. Accessed: April 2013.

Lill, A.F. 2002. Greater Georgia basin steelhead recovery action plan. Prepared for the Pacific Salmon Foundation in conjunction with the Ministry of Water, Land and Air Protection.

Marshall, T. 1996. Stream crossings on the Weldwood FMA, 1995 stream crossing inventory report. Prepared for Weldwood of Canada, Hinton Division, Hinton, AB.

McPhail. J.D. 2007. The freshwater fishes of British Columbia. The University of Alberta Press, Ring House 2. Edmonton, AB.

McPhail, J.D. and R. Carveth. 1994. Field Key to the Freshwater Fishes of British Columbia. Resources Inventory Committee, Vancouver, B.C. Website: www.ilmb.gov.bc.ca/risc/pubs/aquatic/freshfish/assets/fresh.pdf. Accessed; June 2013.

McPhail, J.D. and C.C. Lindsey. 1970. Freshwater Fishes of Northwestern Canada and Alaska. Queen's Printer for Canada. Ottawa, ON.

Millar, J., M. Child and N. Page. 1997. Nicola River Watershed: Fisheries Resource Issues and the Involvement of DFO, MELP and First Nations. Department of Fisheries and Oceans, Fraser River Action Plan.

Moyle, P.B. and J.J. Cech. 2004. Fishes: An Introduction to Ichthyology – 5th ed. Prentice Hall. Upper Saddle River, NJ.

Murray, C.B. 1980. Some effects of temperature on zygote and alevin survival, rate of development and size at hatching and emergence of Pacific Salmon and Rainbow Trout. University of British Columbia, Vancouver, BC.

National Energy Board. 2013a. Memorandum of Understanding between Transport Canada and the National Energy Board for Pipelines and Power Lines Subject to the *National Energy Board Act* and *Canada Oil and Gas Operations Act*. National Energy Board. Website: http://www.neb-one.gc.ca/clf-nsi/rpblctn/ctsndrgltn/mmrndmndrstndng/trnsprtcnd2013_07_03-eng.html. Accessed: July 2013.

National Energy Board. 2013b. NEB Filing Manual. Inclusive of Release 2013-03 (August 2013). Calgary AB. Website: http://www.neb-one.gc.ca/clf-nsi/rpblctn/ctsndrgltn/flngmnl/flngmnl-eng.html. April 2013.

Natural Resources Canada. 2012. Annual Mean Total Precipitation. Website: http://atlas.nrcan.gc.ca/site/english/maps/environment/climate/precipitation. Accessed: January 2013.

Neary, K. 2011. Cultural Heritage Sites Literature Review. Prepared for the Kwantlen Territory Knowledge Project. Vancouver, BC.

Nelson, T.C., W.J. Gazey, D. Robichaud, K.K. English and T. Mochizuki. 2013. Status of White Sturgeon in the Lower Fraser River – Report on the Findings of the Lower Fraser River White Sturgeon Monitoring and Assessment Program 2012. Fraser River Surgeon Conservation Society. Vancouver, BC.

Newcombe, C.P. and D.D. MacDonald. 1991. Effects of suspended sediments on aquatic ecosystems. North American Journal of Fisheries Management, 11 (1):72-82.

Pacific Salmon Commission. 2013. In Season Fraser River Escapement Reports. Website: http://www.psc.org/info_inseasonfraserescapement.htm. Accessed: June 2013.

Pacific Trails Pipelines Limited Partnership. 2007. Application for Environmental Assessment Certificate for the KLS Pipeline Looping Project: Volume 2 Baseline Studies Socio-economic Technical Report. Vancouver, BC.

Park, D., Sullivan, M., Bayne, E., Scrimgeour, G. (2008). Landscape-level stream fragmentation caused by hanging culverts along roads in Alberta's boreal forest. Canadian Journal of Forest Research, 38 (3): 566-575.

Perrin, C.J., A. Heaton and M.A. Laynes. 2000. White Sturgeon (*Acipenser transmontanus*) spawning habitat in the Lower Fraser River, 1999. Report prepared by Limnotek Research and Development Inc. for BC Fisheries.

Post, J. R. and F.D. Johnston. 2009. Status of the Bull Trout (*Salvelinus confluentus*) in Alberta, Wildlife Status Report No. 39, Alberta Sustainable Resource Development Fish and Wildlife Division and Alberta Conservation Association. Edmonton, AB.

Russell, L.R., C.C. Graham, A.G. Sewid and D.M. Archibald. 1980. Distribution of Juvenile Chinook, Coho and Sockeye Salmon in Shuswap Lake - 1978-1979; Biophysical inventory of littoral areas of Shuswap Lake, 1978. Fish. Mar. Serv. Man. Rep. 1479: 54 pp.

Salmo Consulting Inc., Diversified Environmental Services, GAIA Consultants Inc., Forem Technologies Ltd., and Axys Environmental Consulting Ltd. 2003. Volume 2: Cumulative Effects Indicators, Thresholds, and Case Studies. Calgary, AB. Prepared for British Columbia Oil and Gas Commission and Muskwa-Kechika Advisory Board. 83 pp.

Sandercock, F. K. 1991. Life history of Coho salmon (*Oncorhynchus kisutch*). Pp. 397-445 in Pacific Salmon Life Histories. C. Groot and L. Margolis (Eds.). UBC Press. Servizi and Martens. Vancouver, BC.

Sary, Z. 1999. Fish and Fish Habitat Inventory of the Blue River, Whitewater Creek (east side) Pedie Creek, Foam Creek, and Shannon Creek Watersheds. Report prepared by ARC Environmental Ltd., Kamloops, BC. Prepared for Weyerhaeuser Canada Ltd. 61 pp.

Sawyer, M.D., and D.W. Mayhood. 1998. Cumulative effects analysis of land-use in the Carbondale River catchment: implications for fish management. Pages 429-444 in M.K. Brewin and D.M.A. Monita (editors). Proceedings of the Forest-Fish Conference: land management practices affecting aquatic ecosystems. Natural Resources Canada, Canadian Forest Service, Northern Forestry Centre, Edmonton, Alberta. Information Report NOR-X-356.

Scrimgeour, G., P. Hvenegaard, J. Tchir, S. Kendall and A. Wildeman. 2003. Stream fish management: cumulative effects of watershed disturbances on stream fish communities in the Kakwa and Simonette River Basins. Alberta Conservation Association and the Alberta Research Council for the Northern Watershed Project Stakeholder Committee. Northern Watershed Project, Edmonton, AB. Website: http://www.ab-conservation.com/go/default/custom/uploads/reportseries2/NWP%20REPORT%203.pdf Accessed: April 2013.

Scott, W.B. and E.J. Crossman. 1998. Freshwater Fishes of Canada. Galt House Publications Ltd. Oakville, ON, Canada. 966 pp.

Scott, W.B. and E.J. Crossman. 1973. Freshwater fishes of Canada. Bulletin 184, Fisheries Research Board of Canada Bulletin. 966 pp.

Simpson, K., D. Dobson, R. Semple, S. Lehmann, S. Baillie and I. Matthews. 2001. Status in 2000 of coho stock adjacent to the Strait of Georgia. Canadian Science Advisory Secretarial Research Document, 2001/144.

Skeetchestn Indian Band. n.d. Creation Story. Website: http://www.skeetchestn.ca/creation_story. Accessed: March 2013.

Sloat, M.R., R.G. White, B.B. Shepard and S. Carson. 2001. Factors limiting the contemporary distribution of westslope cutthroat trout in the Madison River basin, Montana. Page 66 in Shepard, B. (editor). Practical approaches for conserving native inland fishes of the west. Montana Chapter, American Fisheries Society, MT.

Simon Fraser University. 1998. Thompson River Steelhead: A Resource in Crises? Speaking for the Salmon Workshop Highlights, October 13-14, Spences Bridge, BC. Website: http://www.sfu.ca/grow/science/resources/1273783937.pdf. Accessed: September 2013.

Squamish First Nation. 2001. *Xay Temixw* Land Use Plan: For the Forests and Wilderness of the Squamish Nation Asserted traditional territory. Website: http://www.squamish.net/files/PDF/XayFirstDraft.pdf. Accessed: April 2013.

Sts'ailes Band. 2010. Sts'ailes Development Corporation: Sts'ailes Fisheries. Website: http://www.stsailesdevcorp.com/natural-resources/stsailes-fisheries. Accessed: April 2013.

Taseko Mines Limited. 2009. Prosperity Gold-Copper Project: Environmental Impact Statement, Vol. 8, First Nations. Prepared for Taseko Mines Limited. Vancouver, BC.

Tomkins, E. 2010. Filling up the land with Pilalt: Countering the BC Referrals Process and Reclaiming Stó:lō Ways of Being on the Land. Masters Thesis. University of Victoria. Website: http://web.uvic.ca/igov/uploads/pdf/ErinTomkins-Final%20Governance%20Project.pdf. Accessed: April 2013.

Triton Environmental Consultants Limited. 2013. Baseline Index Monitoring of White Sturgeon Spawning Activities in the Fraser River Herrling Side Channel. Prepared for the Ministry of Forest, Lands and Natural Resource Operations – South Coast. Kamloops, BC.

Triton Environmental Consultants Limited. 2012a. Field Crews Technical Orientation Inventory Standards and Procedures.

Triton Environmental Consultants Limited. 2012b. Kinder Morgan Trans-Mountain Expansion Project QA/QC Standards, Revision 1.

Triton Environmental Consultants Limited. 2011. Fraser River Sturgeon Sampling and Monitoring Program. Prepared for Emergency Management BC. Kamloops, BC.

Van Dischoeck, P. 2001. Wild Steelhead Conservation Planning in the Lower Mainland Region: Chilliwack River Adult Steelhead Sampling Program, Snorkel Counts and Radio Telemetry Survey, Spring 2000. Aquatic Resources, Ltd. Report no. 337-4. Prepared for the Ministry of Water, Air and Land Protection, Fish and Wildlife Science and Allocaton, Surrey, BC. 34 pp. + appendices.

Van Dishoeck, P., T. Slaney and J. Korman. 1998. Wild steelhead conservation planning in the Lower Mainland Region: Chilliwack/Vedder River. BC Ministry of Environment, Lands, and Park, Fish and Wildlife Management.

Vienoot, G., T. Northcote, M. Rosenau and R.D. Evans. 1999. Concentrations of strontium in the pectoral fin rays of the white sturgeon (*Acipenser transmontanus*) by laser ablation sampling-inductively coupled plasma-mass spectrometry as an indicator of marine migrations. Canadian Journal of Fisheries and Aquatic Sciences, 56:1981-1990.

West Vancouver Streamkeepers Society. 2012. Salmon Surveys. Website: http://www.westvancouverstreamkeepers.ca/dox/13-03-05_SS2012.pdf. Accessed: July 2013.

Whelen, M. A. and Associates Ltd. 1998. Reconnaissance (1:20 000) Fish and Fish Habitat Inventory of Upper Coquihalla River Watershed WSC: 100-115400. Prepared for International Forest Products Ltd. (Interfor).

Wright, D.G. and G.E. Hopky. 1998. Guidelines for the use of explosives in or near Canadian fisheries waters. Website: http://www.dfo-mpo.gc.ca/habitat/role/141/1415/14155/explosives-explosifs/pdf/explos-eng.pdf. Accessed: October 2013.

9.2 GIS Data and Mapping References

This subsection includes references cited on the figures accompanying this report.

Natural Resources Canada, Centre for Topographic Information. 2013. CanMatrix (Georeferenced) Digital Topographic Maps of Canada 50k (digital file). Sherbrooke, QC. Available: http://geogratis.cgdi.gc.ca/geogratis/en/download/scanned.html. Acquired July 2012. Last Update Check: July 2012.

Natural Resources Canada. 2012. CanVec -Transportation - 1020009 Railway (digital file). Sherbrooke, QC. Available: http://geogratis.cgdi.gc.ca/geogratis/en/download/topographic.html. Acquired: June 2012. Last Update Check: November 2012.

APPENDIX A

WATERCOURSE CROSSING SUMMARY TABLE

APPENDIX A

WATERCOURSE CROSSING SUMMARY TABLE

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen				
BC-1	489.7	Unnamed Drainage	--	NVC	11	349212	5875616	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Forested slope with no channelization, or evidence of fluvial processes.	A
BC-2	489.8	Unnamed Drainage	Seasonal	NCD	11	349136	5875559	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	No channelization and no water present; probable seepage area.	A
BC-3*	490.5	Baer Creek	Perennial	TBD (S2)	11	348532	5875184	TBD (BT, RB)	High	TBD	TBD	TBD	TBD	July 15 - August 15	TBD	Summer/Winter	Isolation with fish salvage and water quality monitoring (1)	Isolation with fish salvage and water quality monitoring during low flow (3)	Clear-Span Bridge	Snow/Icefill or other regulatory approved crossing method	Navigable	TBD	TBD
BC-4*	491.3	Unnamed Drainage	TBD	TBD (S6 or NCD)	11	347884	5874721	TBD (None)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Summer/Winter	TBD	TBD	TBD	TBD	TBD	TBD	TBD
BC-5* (2)	491.6	Marathon Creek	Perennial	TBD (S2)	11	347674	5874591	TBD (RB)	High	TBD	TBD	TBD	TBD	July 15 - April 15	TBD	Summer/Winter	Isolation with fish salvage and water quality monitoring during low flow (3)	Open-cut with water quality monitoring inside timing window (4)	Clear-Span Bridge	Snow/Icefill or other regulatory approved crossing method	Navigable	TBD	TBD
BC-6*	494.7	Unnamed Channel	TBD	TBD (S6)	11	345313	5872737	TBD (None)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Summer/Winter	TBD	TBD	TBD	TBD	TBD	TBD	TBD
BC-7*	495.8	Unnamed Channel	TBD	TBD (S4 or S6)	11	344677	5872114	TBD (None)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Summer/Winter	TBD	TBD	TBD	TBD	TBD	TBD	TBD
BC-8* (2)	495.8	Terry Fox Creek	Perennial	TBD (S2)	11	344631	5872047	TBD (BT, RB)	High	TBD	TBD	TBD	TBD	July 15 - August 15	TBD	Summer/Winter	Isolation with fish salvage and water quality monitoring during low flow (3)	Open-cut with water quality monitoring inside timing window (4)	Clear-Span Bridge	Snow/Icefill or other regulatory approved crossing method	Navigable	TBD	TBD
BC-9*	496.7	Unnamed Channel	TBD	TBD (S4 or S6)	11	343875	5871716	TBD (None)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Summer/Winter	TBD	TBD	TBD	TBD	TBD	TBD	Comply with Federal and Provincial Regulations
BC-10 (2)	499.7	Fraser River	Perennial	S1B	11	343735	5871698	RB (BB,BT,CCG,CH,LKC, LNC,LSU,LW,MW,NSC,PCC,PW,RB,RSC, WSG)	High	67.22	73.00 / 64.00	1.00	No	July 15 - August 15 (Contact DFO)	July 15 - August 15 (Contact DFO)	Summer/Winter	Open-cut with water quality monitoring inside timing window* (1) (x2)	Open-cut with water quality monitoring during low flow*(3)	Access both banks	Access both banks	Navigable	High velocity and extensive riffles limit rearing, spawning and overwintering potential; Juvenile RB captured along channel edges in low velocity areas; no movement barriers and river provides migratory corridor for CH spawners; historical presence of WSG may extend upstream from ZOI.	Comply with Federal and Provincial Regulations
BC-11	497.8	Unnamed Drainage	--	NVC	11	342788	5871625	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	No sign of water or fluvial processes.	A
BC-12*	500.5	Unnamed Channel	TBD	TBD (S6)	11	344410	5871658	TBD (None)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Summer/Winter	TBD	TBD	TBD	TBD	TBD	TBD	TBD
BC-13*	500.8	Unnamed Channel	TBD	TBD (S6)	11	344144	5871467	TBD (None)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Summer/Winter	TBD	TBD	TBD	TBD	TBD	TBD	TBD
BC-14*	501.3	Unnamed Channel	TBD	TBD (S6)	11	343910	5871097	TBD (None)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Summer/Winter	TBD	TBD	TBD	TBD	TBD	TBD	TBD
BC-15*	501.8	Unnamed Channel	TBD	TBD (S6)	11	343523	5870805	TBD (None)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Summer/Winter	TBD	TBD	TBD	TBD	TBD	TBD	TBD
BC-16*	502.5	Unnamed Channel	TBD	TBD (S6)	11	342797	5870607	TBD (None)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Summer/Winter	TBD	TBD	TBD	TBD	TBD	TBD	TBD

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-17	503.5	Unnamed Channel	Seasonal	S6	11	341833	5870715	None (None)	Low	0.02 (05/06/13)	1.25 / 1.08	0.21	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Impassable falls and reach gradient of 35%.	D
BC-18	504.7	Unnamed Channel	Seasonal	S6	11	340784	5871238	None (None)	Low	0.09 (28/07/12)	2.0 / 1.38	0.35	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Entire reach exceeds 33% gradient; discontinuous channel downslope.	D
BC-19	505.8	Unnamed Drainage	--	NVC	11	339901	5870729	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	No sign of water or fluvial processes.	A
BC-20	506.1	Unnamed Channel	Seasonal	S6	11	339806	5870423	None (None)	Low	0.06 (05/06/13)	2.40 / 1.56	0.17	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Reach gradient of >20%.	C or D
BC-21	507.1	Unnamed Channel	Seasonal	S6	11	339537	5869680	None (None)	Low	0.03 (28/07/12)	3.10 / 2.02	0.25	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Poor downstream connectivity, sub-surface flow; >20% gradient.	C
BC-22	510.1	Unnamed Drainage (Wetland)	Seasonal	NCD-W	11	340846	5867152	None (None)	Low	--	--	--	Yes	None	Open	Summer/Winter	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	No connectivity downslope from Hwy 5. / Refer to Wetland Evaluation Technical Report of Volume 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C
BC-23	510.6	Unnamed Drainage	--	NVC	11	341139	5866651	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	No sign of water or fluvial processes.	A
BC-24	511.1	Unnamed Drainage	--	NVC	11	341416	5866279	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	No sign of water or fluvial processes.	A
BC-25	512.2	Unnamed Drainage	--	NVC	11	342084	5865395	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	No sign of water or fluvial processes.	A
BC-26	514.3	Hogan Creek	Perennial	S6	11	343410	5863750	None (None)	Low	0.38 (27/07/12)	2.50 / 2.10	0.47	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Clear-span Bridge	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Impassable 35% culvert grade at Hwy 5; multiple steep bed drops (0.9-1.1 m); poor connectivity.	C or D
BC-27	515.5	Teepee Creek	Perennial	S3	11	344137	5862768	BT, CCG (BT, CCG)	High	0.65 (27/07/12)	5.00 / 4.00	0.57	No	June 15 - August 15	June 15 - August 15	Summer/Winter	Isolation with fish salvage and water quality monitoring [1]	Isolation with fish salvage and water quality monitoring during low flow [3]	Clear-Span Bridge	Clear-Span Bridge	Class 3 Non-Navigable	Moderate rearing potential at peak flow conditions; good overall cover and in-stream complexity; unembedded coarse substrates; perennial flow with occasional deep pools.	G
BC-28	517.8	Crooked Creek	Perennial	S3	11	345436	5861010	RB,BT (BT, RB)	High	0.08 (26/09/13)	6.40 / 3.87	0.43	No	July 15 - August 15	July 15 - August 15	Summer/Winter	Isolation with fish salvage and water quality monitoring [1]	Isolation with fish salvage and water quality monitoring during low flow [3]	Clear-Span Bridge	Clear-Span Bridge	Class 3 Non-Navigable	Overall moderate to high habitat values for salmonids (low gradient, good connectivity to Swift Creek).	D or F
BC-29	521.4	Unnamed Drainage	--	NVC	11	346135	5857736	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	No sign of water or fluvial processes.	A
BC-30	521.6	Unnamed Drainage	--	NVC	11	346146	5857518	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	No sign of water or fluvial processes.	A
BC-31	521.7	Unnamed Drainage	--	NVC	11	346149	5857401	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	No sign of water or fluvial processes.	A

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-32 [2]	522.5	Swift Creek	Perennial	S1B	11	345952	5856592	BT, CH (CH, BT, RB, CCG)	High	8.57 (30/07/12)	44.00/ 23.50	1.12	No	July 15 - August 15 (Contact DFO)	July 15 - August 15 (Contact DFO)	Summer/Winter	Isolation with fish salvage and water quality monitoring during low flow [3]	Open-cut with water quality monitoring inside timing window [4]	Clear-Span Bridge or access both banks	Clear-Span Bridge or access both banks	Navigable	High value spawning and nursery habitat for salmonids; known spawning channel for Upper Fraser Spring 52 Chinook; 1 adult CH spawner observed immediately downstream from proposed ROW; juvenile BT captured within ZOI; excellent course substrate for salmonid spawning; excellent channel complexity (abundant LWD, deep pools and OHV); excellent overwintering for juvenile and resident adult fishes (alternating pools (0.5-1.5 m) between riffle sequences).	Comply with Federal and Provincial Regulations
BC-33	523.7	Cranberry Creek	Intermittent	S6	11	345820	5855438	None (None)	Low	--	1.00 / 0.85	0.23	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Marginal channel definition; sub-surface flow; insufficient flow to support fish. / Refer to Wetland Evaluation Technical Report of Volume 5C.	B
BC-34	524.8	Unnamed Drainage	--	NVC	11	345791	5854345	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	No sign of water or fluvial processes.	A
BC-35	525.7	Cranberry Creek	--	NVC	11	346265	5853610	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	No sign of water or fluvial processes.	A
BC-36 [2]	531.3	Canoe River	Perennial	S1B	11	347688	5848656	BT, CCG (BT, LSU, RB, CCG, MW, PW, KO)	High	--	39.00 / 34.00	0.99	No	July 15 - August 15	July 15 - August 15	Summer/Winter	Isolation with fish salvage and water quality monitoring during low flow [3]	Open-cut with water quality monitoring inside timing window [4]	Clear-Span Bridge or access both banks	Clear-Span Bridge or access both banks	Navigable	Cover includes undercut banks, OV and LWD; good off-channel rearing area located 350 m downstream; large perennial channel; moderate rearing and wintering (extensive fast riffle habitat and lack of pool/run formation); good mixture of course substrate; high percentages of large cobble and boulder; the Canoe River provides migratory, rearing and spawning habitat for Kinbasket Lake KO.	Comply with Federal and Provincial Regulations
BC-37	532.8	Unnamed Drainage (Wetland)	Seasonal	NCD-W	11	347896	5847182	None (None)	Low	--	--	--	Yes	None	Open	Summer/Winter	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Open low-lying fen/bog with standing water and seepage areas; no connectivity to fish habitat / Refer to Wetland Evaluation Technical Report of Volume 5C.	Refer to Wetland Evaluation Technical Report of Vol. 5C

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-38 [2]	534.5	Camp Creek	Perennial	S2	11	347310	5845675	RB, BT, CCG (BT, RB, CAS, CCG, KO, LKC)	High	5.37 (16/08/12)	18.00 / 15.17	0.95	No	July 15 - August 15	July 15 - August 15	Summer/Winter	Isolation with fish salvage and water quality monitoring during low flow [3]	Open-cut with water quality monitoring inside timing window [4]	Clear-span Bridge	Clear-span Bridge	Navigable	High value rearing and migratory habitat for salmonids (excellent riparian habitat (abundant OV, LWD, SWD, boulders and undercut banks; large perennial channel) ; known to support KO; moderate overwintering potential(predominately riffle); high percentage of boulder and large cobble.	G
BC-39	537.7	Unnamed Channel	Intermittent	S6	11	347452	5842636	None (None)	Low	0.004 (31/07/12)	0.90 / 0.60	0.45	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Reach gradient of 27%; dry ~ 100m downslope; no connectivity to Camp Creek.	B or C
BC-40	539.5	Unnamed Drainage	--	NVC	11	348068	5841003	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	No sign of water or fluvial processes.	A
BC-41	539.9	Unnamed Drainage	--	NVC	11	348300	5840705	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	No sign of water or fluvial processes.	A
BC-42	540.2	Unnamed Drainage	--	NVC	11	348553	5840411	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	No sign of water or fluvial processes.	A
BC-43	540.6	Unnamed Channel	Seasonal	S3	11	348769	5840156	RB, CCG (None)	High	0.05 (31/07/12)	2.60 / 1.75	0.48	No	July 15 - April 15	July 15 - April 15	Summer/Winter	Isolation with fish salvage and water quality monitoring if flowing[1]	Open-cut (DFO OS) if dry or frozen to bottom	Clear-span Bridge	Clear-Span Bridge or other regulatory approved crossing method	Class 2 Non-Navigable	Small confined watercourse with moderate habitat potential for salmonids; channel provides good spawning and nursery habitat below Hwy 5; good cover and in stream complexity with abundant juvenile and YOY RB captured and observed. upstream from Hwy 5 the gradient increases (12%) and habitat potential was limited by channel size, perched culverts and occasional bed drops; wintering potential was low given small channel size and low discharge; 1 adult RB was captured near proposed ROW and fish salvage is recommended; maintenance of downstream water quality and quantity is also important given the abundance of juvenile salmonids observed near confluence with Camp Creek	G
BC-44	541.5	Unnamed Channel	Seasonal	S6	11	349300	5839478	None (None)	Low	0.06 (01/08/12)	1.90 / 1.40	0.45	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Shallow depths; 33-40% reach gradient.	D
BC-45	541.9	Unnamed Channel	Seasonal	S6	11	349581	5839108	None (None)	Low	0.07 (01/08/12)	2.60 / 1.85	0.58	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Shallow depths; multiple cascade/bed drops; poor connectivity; dry in 2006.	D

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-46	542.8	Unnamed Channel	Seasonal	S6	11	350354	5838633	None (None)	Low	0.04 (03/08/12)	1.80 / 1.35	0.43	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Shallow depths; multiple barriers to fish (beaver dam at Hwy culvert, 25% cascade at confluence, cascades/bed drops throughout). Potential beaver dam removal.	D
BC-47	543.2	Unnamed Channel	Seasonal	S6	11	350644	5838436	None (None)	Low	0.12 (03/08/12)	3.60 / 2.90	0.49	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Clear-span Bridge or Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Multiple barriers (bed drops [0.8-1.1 m], perched culvert (0.8 m), 14-23% gradients).	C or D
BC-48	543.7	Unnamed Channel	Seasonal	S6	11	350904	5838066	None (None)	Low	0.05 (03/08/12)	1.00 / 0.86	0.45	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Reach gradients exceed 25%; 50% gradient recorded downstream.	B or C
BC-49	544.0	Unnamed Drainage	--	NVC	11	351012	5837780	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	No sign of water or fluvial processes.	A
BC-50	544.7	Unnamed Channel	Seasonal	S6	11	351303	5837161	None (None)	Low	0.04 (07/06/13)	1.24 / 1.05	0.75	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Shallow gradient; sections of undefined channel; dry channel in September 2013.	D
BC-51	544.8	Unnamed Channel	Perennial	S3	11	351314	5837040	RB (RB)	High	0.18 (06/06/13)	2.70 / 1.52	0.35	Yes	July 15 - April 15	July 15 - April 15	Summer/Winter	Isolation with fish salvage and water quality monitoring [1]	Open-cut (DFO OS) if dry or frozen to bottom	Existing or Clear-Span Bridge	Existing or Clear-Span Bridge	Class 2 Non-Navigable	Good instream complexity; cover from OHV, deep pools and undercut banks; suitable spawning substrates; frequent pools; perennial flow; perched culvert and falls downstream may be seasonal barriers; approaches to existing TMPL ROW are flat and well maintained.	C
BC-52 [2]	545.9	Camp Creek	Perennial	S2	11	351655	5836144	BT, RB (BT, RB, CAS, CCG, KO, LKC)	High	2.99 (18/08/12)	17.00 / 13.25	1.04	No	July 15 - August 15	July 15 - August 15	Summer/Winter	Isolation with fish salvage and water quality monitoring during low flow [3]	Open-cut with water quality monitoring inside timing window [4]	Existing or Clear-Span Bridge	Existing or Clear-Span Bridge	Navigable	Excellent channel complexity with abundant cover; large perennial channel; abundant juvenile BT captured and observed within the ZOI; 5 adult BT observed holding/staging in large pool approximately 100 m downstream; presence of deep pools; pockets of small and large gravel exist throughout, but some sections of high percentage of fines; off-channel areas adjacent to proposed crossing often flood and should be considered FSZs /Refer to Wetland Evaluation Technical Report of Volume 5C.	G
BC-53	546.1	Unnamed Channel	Intermittent	S6	11	351532	5835985	None (None)	Low	0.01 (17/08/12)	1.50 / 1.20	0.43	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Dry channel downslope in August 2012, 25% gradients upslope /Refer to Wetland Evaluation Technical Report of Volume 5C.	B or C
BC-54	546.2	Unnamed Drainage	Seasonal	NCD	11	351527	5835852	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Intermittent sections of water, no continuous defined channel; 40% gradient upslope from the PPC.	A

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-55	546.9	Unnamed Channel	Seasonal	S3	11	352046	5835359	BT, RB (None)	High	0.05 (17/08/12)	2.90 / 2.05	0.42	No	July 15 - August 15	Open	Summer/Winter	Isolation with fish salvage and water quality monitoring if flowing	Open-cut (DFO OS) if dry or frozen to bottom	Existing or Clear-Span Bridge	Existing or Clear-Span Bridge	Class 2 Non-Navigable	Moderate rearing potential for juvenile BT and RB (moderate amount of IV, OHV and LWD); juvenile salmonids observed both upstream and downstream from proposed crossing location; high percentage of fines; small channel size and low discharge; small 300 mm culvert located at existing TMPL ROW; connectivity to Camp creek DS.	C or D
BC-56 [2]	547.6	Camp Creek	Perennial	S2	11	352601	5834985	BT, RB, CCG (BT, RB, CAS, CCG, KO, LKC)	High	2.55 (17/08/12)	18.00 / 12.67	1.16	No	July 15 - August 15	July 15 - August 15	Summer/Winter	Isolation with fish salvage and water quality monitoring during low flow [3]	Open-cut with water quality monitoring inside timing window [4]	Clear-Span Bridge	Clear-Span Bridge	Potentially Navigable	Occasional deep wintering pools observed downstream of proposed crossing location; good in stream habitat complexity and shading; cover includes OHV and LWD; high percentage of boulders and large cobble; pockets of small and large gravel throughout; juvenile and YOY BT captured at proposed ROW with potential for RB within ZOI.	G
BC-57	548.5	Unnamed Drainage	--	NVC	11	352999	5834255	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	No sign of water or fluvial processes.	A
BC-58	549.2	Unnamed Channel	Seasonal	S6	11	353438	5833684	None (None)	Low	0.03 (02/08/12)	0.90 / 0.73	0.40	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Downstream sections of subsurface flows; 20% reach gradient downstream; poor connectivity through large shallow wetland area downstream.	C or D
BC-59	549.6	Unnamed Channel	Seasonal	S6	11	353665	5833274	None (None)	Low	0.01 (04/08/12)	0.90 / 0.49	0.20	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Reach gradient 30-38%; sections of subsurface flow; discontinuous channel downslope.	B
BC-60	549.8	Unnamed Channel	Seasonal	S6	11	353763	5833140	None (None)	Low	0.01 (04/08/12)	0.60 / 0.47	0.35	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Small channel size; sub-surface flow; discontinuous channel downslope.	B
BC-61	549.9	Unnamed Channel	Seasonal	S6	11	353819	5833038	None (None)	Low	0.01 (18/08/12)	1.40 / 1.08	0.45	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Small shallow channel; 32% reach gradient; discontinuous channel.	B or C
BC-62	550.2	Unnamed Drainage	Seasonal	NCD	11	353992	5832820	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Sections of overland flow; 40% reach gradient downslope.	A
BC-63	550.7	Unnamed Channel	Perennial	S5	11	354260	5832456	None (None)	Low	0.11 (04/08/12)	5.60 / 3.12	0.75	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge	Class 3 Non-Navigable	16% reach gradient; frequent bed drops; poor connectivity to the Albreda River (shallow alluvial fan and overland flow downstream).	D
BC-64	551.5	Unnamed Channel	Perennial	S5	11	354898	5831912	None (None)	Low	0.13 (02/08/12)	8.00 / 4.50	1.02	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge or other regulatory approved crossing method	Class 3 Non-Navigable	Abundant cover; poor connectivity to the Albreda River; frequent bed drops downstream; large shallow alluvial fan with marginal channel definition may prevent fish passage.	D or G

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-65[2]	552.1	Albreda River	Perennial	S2	11	355477	5831724	CO (BT, CC, CO, RB, WF)	High	1.12 (03/08/12)	7.00 / 6.00	0.25	No	July 22-August 15	July 22-August 15	Summer/Winter	Isolation with fish salvage and water quality monitoring during low flow [3]	Open-cut with water quality monitoring inside timing window [4]	Clear-Span Bridge	Clear-Span Bridge	Navigable	Over 70 juvenile CO captured and observed in 2006 and 2012; good channel complexity and riparian cover, OHV, woody debris, deep pools, undercut banks; high percentage of fines; deep pools, perennial flow; Potential beaver dam removal.	G
BC-66	552.9	Robina Creek	Perennial	S5/S2	11	356181	5831285	BT (BT)	Low	0.36 (18/08/12)	10.00 / 5.13	0.83	Yes	July 22 - August 15	July 22 - August 15	Summer/Winter	Isolation with water quality monitoring [1]	Isolation with water quality monitoring during low flow [3]	Clear-Span Bridge	Clear-Span Bridge or other regulatory approved crossing method	Potentially Navigable	Reach gradient 24-34%; steep sections up and downstream of PPC; BT captured 250 m downstream of the PPC.	G
BC-67	554.0	Unnamed Drainage (Wetland)	Seasonal	NCD-W (FB)	11	356828	5830505	CO, BT (CO, BT)	Low	--	--	--	No	July 15 - August 15	Open	Summer/Winter	Isolation with fish salvage and water quality monitoring if flowing	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert or Swamp Mats	Snow/Icefill or other regulatory approved crossing method	Refer to Wetland Evaluation Technical Report of Vol. 5C	Connectivity to Albreda River; CO rearing habitat in ponded areas near confluence / Refer to ESA Wetland Evaluation Technical Report of Volume 5C.	Refer to Wetland Evaluation Technical Report of Vol. 5C
BC-68	554.9	Unnamed Channel	Seasonal	S6	11	357516	5829839	None (None)	Low	0.01 (18/08/12)	1.30 / 0.90	0.25	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Small marginally defined channel; 22% reach gradient upstream; 2 m perched culvert and dry channel downstream.	B or C
BC-69	555.0	Unnamed Channel	Intermittent	S6/S4	11	357530	5829795	CO (None)	Low	0.01 (19/08/12)	1.40 / 1.10	0.25	Yes	July 15 - August 15	Open	Summer/Winter	Isolation with water quality monitoring if flowing	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Downstream perched culvert barrier; shallow depth and sub-surface sections; 18-22% reach gradients; rearing quality improves downslope.	F or G
BC-70	555.1	Unnamed Channel	Seasonal	S4	11	357750	5829709	CO (None)	Low	0.001 (20/08/12)	1.70 / 1.21	0.55	Yes	July 15 - August 15	Open	Summer/Winter	Isolation with fish salvage and water quality monitoring if flowing	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge or other regulatory approved crossing method	Class 2 Non-Navigable	Shallow depths, low discharge, sub-surface sections; 12.5-30% gradients; rearing quality improves downstream where gradient is less but still low discharge and a lack of pool formation; high percentage of fines; juvenile CO captured in main stem 50 m downstream and in a downstream tributary (BC 56.3), approximately 125 m from proposed crossing.	C
BC-71	555.5	Unnamed Channel	Seasonal	S4	11	357795	5829322	CO (CO)	High	0.07 (19/08/12)	1.80 / 1.33	0.33	No	July 15 - August 15	Open	Summer/Winter	Isolation with fish salvage and water quality monitoring if flowing	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge or other regulatory approved crossing method	Class 2 Non-Navigable	Good channel complexity with small pools, OHV and woody debris, perennial connectivity with Albreda River; abundant juvenile fish observed within the ZOI; rearing potential decreases upstream (increased gradient; smaller channel size; subsurface barriers);substrate predominately fines; small channel size; low discharge; however, 1-2 year age classes were observed.	C or D

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-72	556.2	Unnamed Channel	Perennial	S5/S3	11	358076	5828714	CO (None)	Low	0.21 (19/08/12)	5.00 / 4.77	0.65	Yes	July 15 - August 15	July 15 - August 15	Summer/Winter	Isolation with water quality monitoring if flowing (1)	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge or other regulatory approved crossing method	Class 3 Non-Navigable	Multiple barriers downstream form PPC (70 m wooden causeway [confined velocity barrier]; 2 hanging culverts at Hwy 5); lack of pool formation; good mixture of unembedded gravel and cobble; juvenile CO captured 225m downstream of Hwy 5.	G
BC-73 (2)	556.5	Unnamed Drainage (Wetland)	Perennial	NCD-W (FB)	11	358112	5828394	CO (CO, RB, LDC)	High	--	--	--	No	July 22 - August 15	Open	Summer/Winter	Isolation with fish salvage and water quality monitoring during low flow (3)	Open-cut with water quality monitoring inside timing window (4); install sediment barriers at culvert inlet	Access both banks	Swamp Mats or other regulatory approved crossing method	Refer to Wetland Evaluation Technical Report of Vol. 5C	Good off-channel rearing and overwintering habitat for CO with direct connectivity to the Albreda River. Refer to Wetland Evaluation Technical Report of Volume 5C.	Refer to Wetland Evaluation Technical Report of Vol. 5C
BC-74	556.8	Unnamed Channel	Perennial	S4	11	358159	5828111	None (CO, RB)	Low	0.03 (26/08/12)	1.70 / 1.42	0.45	No	July 22 - August 15	July 22 - August 15	Summer/Winter	Isolation with fish salvage and water quality monitoring(1)	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge or other regulatory approved crossing method	Class 2 Non-Navigable	18% gradients downstream; shallow depths; low discharge; gradient at ROW and limited gravel substrate throughout no fish captured or observed within PPC; however 100 m DS, channel flows into BC-73 wetland where juvenile CO were captured and observed in 2012, and where CO and RB were captured in 2006.	G
BC-75	557.5	Unnamed Drainage	--	NVC	11	358181	5827378	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	No sign of water or fluvial processes.	A
BC-76 (2)	559.0	Clemina Creek	Perennial	S2	11	357793	5826095	MW, BT, CCG (BT)	High	4.59 (20/08/12)	23.00 / 17.17	1.50	No	June 1 - August 15	June 1 - August 15	Summer/Winter	Isolation with fish salvage and water quality monitoring during low flow(3)	Open-cut with water quality monitoring inside timing window(4)	Existing or Clear-Span Bridge	Existing or Clear-Span Bridge	Navigable	perennial channel with connectivity to Albreda River 550m downstream; some fast riffle sections with high percentage of larger course substrate but pockets of suitable gravel/cobble exists throughout; BT and MW captured in margins behind boulders and LWD; side channel with good off-channel rearing habitat present approx. 200 m downstream /Refer to Wetland Evaluation Technical Report of Volume 5C	G
BC-77	559.3	Unnamed Channel	Seasonal	S6	11	357702	5825761	None (None)	Low	--	2.00 / 1.65	0.21	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Small unconfined drainage; discontinuous channel; sections of subsurface flow; blocked culvert at the proposed crossing; multiple beaver dams downslope /Refer to Wetland Evaluation Technical Report of Volume 5C. Potential beaver dam removal.	B

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-78 [2]	559.4	Dora Creek	Perennial	S2	11	357642	5825687	BT (BT, CO)	High	1.83 (21/08/12)	11.00 / 7.37	0.53	No	July 15 - August 15	July 15 - August 15	Summer/Winter	Isolation with fish salvage and water quality monitoring during low flow[3]	Open-cut with water quality monitoring inside timing window[4]	Existing or Clear-Span Bridge	Existing or Clear-Span Bridge	Potentially Navigable	Abundant gravel/small cobble substrates; good riparian habitat, OHV, boulders and woody debris; juvenile and YOY BT captured near PPC; previous records of CO; low overall fish habitat potential 150 m downstream; highly braided; shallow channel; overland flows /Refer to Wetland Evaluation Technical Report of Volume 5C	G
BC-79	559.6	Unnamed Channel	Seasonal	S6	11	357552	5825499	None (None)	Low	0.02 (21/08/12)	2.00 / 1.38	0.15	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Small watercourse; low discharge; no definitive migration barriers.	B or C
BC-80	560.3	Unnamed Channel	Seasonal	S4	11	357441	5824897	CO, BT (CO, BT)	High	0.01 (22/08/12)	1.50 / 1.18	0.44	No	July 15 - August 15	Open	Summer/Winter	Isolation with fish salvage and water quality monitoring if flowing	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge or other regulatory approved crossing method	Clear-Span Bridge or other regulatory approved crossing method	Class 1 Non-Navigable	Good in stream complexity, abundant cover; OHV, small pools and woody debris; juvenile CO captured 2006 and 2012; juvenile BT captured in 2006; small channel size; low discharge; high percentage of fines; close proximity to the Albreda River but limited during periods of low flow /Refer to Wetland Evaluation Technical Report of Volume 5C	B or C
BC-81	560.9	Unnamed Channel	Seasonal	S6	11	357273	5824142	None (None)	Low	0.001 (22/08/12)	2.00 / 1.27	0.50	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Small drainage; 25% reach gradients; subsurface sections; overland flows 100 m downslope with no defined channel and poor connectivity to the Albreda River.	B
BC-82 [2]	561.2	Albreda River	Perennial	S1B	11	357039	5824060	CO, CCG (BT, CC, CO, RB, WF)	High	6.76 (22-08-12)	30.00 / 21.88	0.40	No	July 22 - August 15	July 22 - August 15	Summer/Winter	Isolation with fish salvage and water quality monitoring during low flow[3]	Open-cut with water quality monitoring inside timing window [4]	Clear-Span Bridge	Clear-Span Bridge	Navigable	Mixture of course substrates for spawning; cover from deep pools, OHV, woody debris and off channel habitat; deep runs and pools between riffle sections; low lying areas to east and west of channel could cause fish entrapment following high water levels. Potential beaver dam removal.	G
BC-83	562.1	Unnamed Channel	Seasonal	S6	11	356662	5823293	None (None)	Low	-	1.25 / 1.09	0.40	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Small drainage; dry channel over two seasons; may no longer drain from ponded area upstream; no connectivity to Albreda River.	B

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-84	563.5	Unnamed Channel	Seasonal	S4	11	356601	5821872	CO, BT (CO, BT)	High	0.03 (23/08/12)	1.60 / 1.43	0.55	No	July 15 - August 15	Open	Summer/Winter	Isolation with fish salvage and water quality monitoring if flowing	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge or other regulatory approved crossing method	Clear-Span Bridge or other regulatory approved crossing method	Class 2 Non-Navigable	Good riparian habitat and cover; OV, woody debris, small pools; juvenile BT and CO captured within ZOI; connectivity to the Albreda River but 2 culverts and an old log fill downstream may interfere with fish migration at low flows; high percentage of fines and organic material; small channel size and low discharge.	C
BC-85 [2]	563.6	Albreda River	Perennial	S2	11	356695	5821810	CO, BT (BT, CC, CO, RB, WF)	High	6.76 (23/08/12)	24.00 / 19.00	0.77	No	July 22 - August 15	July 22 - August 15	Summer/Winter	Isolation with fish salvage and water quality monitoring during low flow [3]	Open-cut with water quality monitoring inside timing window [4]	Clear-Span Bridge	Clear-Span Bridge	Navigable	Fast riffle habitat with larger course substrate material; good riparian and in stream habitat; boulders, woody debris and OV; a small side channel at right bank provides good off-channel rearing habitat; abundant juvenile CO captured and observed 2006 and 2012, BT captured 2012; main stem habitat predominately fast riffles with limited pools.	Comply with Federal and Provincial Regulations
BC-86	563.6	Unnamed Drainage (Wetland)	Seasonal	NCD-W	11	356832	5821582	None (None)	Low	-	-	-	Yes	None	Open	Summer/Winter	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Ponded habitat connected by marginally defined channel; no connectivity to the Albreda River observed downslope of Hwy 5; poor dissolved oxygen (2.09-5.47 mg/L).	Refer to Wetland Evaluation Technical Report of Vol. 5C
BC-87	565.0	Unnamed Drainage	--	NVC	11	357166	5820487	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	No sign of water or fluvial processes.	A
BC-88	565.2	Unnamed Channel	Seasonal	S6	11	357204	5820311	None (None)	Low	--	1.70 / 1.45	0.18	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Marginal channel definition; poor substrate for spawning; 14% reach gradient within ZOI; low connectivity to the Albreda River; dry channel in 2012.	B
BC-89	565.3	Unnamed Channel	Seasonal	S6/NCD-W (FB)	11	357226	5820187	BT, CO (CO)	Low	--	1.40 / 1.17	0.33	Yes	July 15 - August 15	Open	Summer/Winter	Isolation with water quality monitoring if flowing	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Dry channel with seasonal connectivity to fish bearing wetland 150 m downstream; rearing potential within wetland area. Potential beaver dam removal.	TBD; Refer to Wetland Evaluation Technical Report of Vol. 5C, for additional reclamation
BC-90	565.9	Unnamed Channel	Perennial	S3	11	357070	5819606	CO (None)	High	0.04 (24/08/12)	4.00 / 3.09	0.58	No	July 15 - August 15	July 15 - August 15	Summer/Winter	Isolation with fish salvage and water quality monitoring [1]	Open-cut (DFO OS) if dry or frozen to bottom	Existing or Clear-Span Bridge or Ramp and Culvert for smaller channels	Snow/Icefill or other regulatory approved method	Class 3 Non-Navigable	Good channel complexity and in stream cover; small pools, OHV, undercut banks and woody debris; juvenile CO captured downstream; high percentage of fines, but pockets of gravel exist throughout; channel braids downstream and 3 culverts downstream may limit upstream fish migration during low flows.	G

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-90a	566.1	Unnamed Drainage	Seasonal	NCD	11	357031	5819490	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Small shallow drainage with intermittent flow and less than 100 m of continuous scour; no fish habitat potential or connectivity to fish habitat.	A
BC-91	566.5	Unnamed Channel	Seasonal	S4	11	356896	5818998	CO, CH (CO, CH)	Low	0.01 (24/08/12)	1.70 / 1.12	0.22	Yes	July 15 - August 15	Open	Summer/Winter	Isolation with fish salvage if flowing	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge or other regulatory approved crossing method	Clear-Span Bridge or other regulatory approved crossing method	Class 1 Non-Navigable	Abundant cover; channel lacks connectivity to Dominion Creek; channel dissipates 100 m downstream; overland flows through a seasonal wetland area (BC-92); wetland connects to Dominion Creek through culvert underneath Hwy 5 only during unseasonably high flow periods; as such, juvenile CO inhabiting BC-91 are presently stranded; dry conditions and lack of channelization restricts fish passage downstream; may be connectivity to BC-92 during unseasonably high flows.	C
BC-92	566.8	Unnamed Drainage (Wetland)	Seasonal	NCD-W (FB)	11	356755	5818756	None (None)	Low	--	--	--	Yes	July 15 - August 15	Open	Summer/Winter	Isolation with fish salvage if water present	Open-cut (DFO OS) if dry or frozen to bottom	Swamp Mats or other regulatory approved crossing method	Swamp Mats, Snow/Icefill or other regulatory approved crossing method	Refer to Wetland Evaluation Technical Report of Vol. 5C	Seasonal wetland area with low habitat value; 1 CO was captured stranded in upstream tributary BC-91 / Refer to Wetland Evaluation Technical Report of Volume 5C.	Refer to Wetland Evaluation Technical Report of Vol. 5C
BC-93 [2]	567.6	Dominion Creek	Perennial	S2	11	356818	5818088	BT (BT, CO, MW)	High	3.21 (08/06/13)	20.00 / 14.17	0.39	No	June 1 - August 15	June 1 - August 15	Summer/Winter	Isolation with fish salvage and water quality monitoring during low flow[3]	Open-cut with water quality monitoring inside timing window[4]	Clear-Span Bridge	Clear-Span Bridge	Potentially Navigable	Abundant cover from boulders, LWD, deep pools and OHV; limited by high velocities; extensive riffle sections with a high percentage of boulders and large cobbles; entire reach is accessible for mature salmonids, but water velocities may act as a barrier to juveniles during high flows; deep pools within the LSA.	G
BC-94 [2]	571.9	Moonbeam Creek	Perennial	S2	11	355364	5814336	BT (BT)	High	3.58 (09/06/13)	18.00 / 14.25	0.45	No	June 1 - August 15	June 1 - August 15	Summer/Winter	Isolation with fish salvage and water quality monitoring during low flow[3]	Open-cut with water quality monitoring inside timing window[4]	Clear-Span Bridge	Clear-Span Bridge	Navigable	Abundance of cover and velocity breaks; pockets of gravel and small cobble throughout; abundance of deep pools; migration potential could be limited by a historic 1.5 m high fish weir downstream of the PPC, planned to be removed in fall 2013.	G
BC-95	572.8	Unnamed Channel	Seasonal	S6	11	355212	5813519	None (None)	Low	--	2.55 / 1.52	0.12	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Gradient barriers of 30% to 60% throughout ZOI; limited by low discharge and temporal flow.	B
BC-96	573.0	Unnamed Drainage	Ephemeral	NCD	11	355100	5813342	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Short discontinuous section of scour; steep side slope (55%); approaches have low stability; no fish habitat potential.	B

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-97	573.2	Unnamed Channel	Seasonal	S6	11	354960	5813106	None (None)	Low	--	1.42 / 1.09	0.10	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Areas of sub-surface flow, large sections of dry channel, and gradient barrier (50%) downstream from the PPC; channel pattern altered by FSR and culvert.	B
BC-98	573.4	Unnamed Channel	Seasonal	S6	11	354860	5813032	None (None)	Low	--	2.60 / 1.30	0.19	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Habitat limited by insufficient depth, reach gradients of 30-44%, sections of sub-surface flow, and a perched culvert under FSR.	B
BC-99	573.5	Unnamed Channel	Seasonal	S5	11	354800	5812944	None (None)	Low	0.11 (10/06/13)	7.55 / 4.68	0.41	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge or other regulatory approved crossing method	Class 3 Non-Navigable	Suitable cover and pool habitat throughout reach; adequate bankful depths and velocity breaks; falls, cascade morphology, multiple perched culvert barriers inhibit fish up-migration.	D
BC-100	574.4	Unnamed Drainage	Intermittent	NCD	11	354429	5812179	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Small drainage; sub-surface flow with short sections of scour downstream from PPC; no fish habitat potential and no connectivity to the North Thompson River.	A
BC-100a	574.6	Unnamed Channel	Seasonal	S5	11	354341	5811962	None (None)	Low	0.02 (20/07/13)	5.80 / 3.70	0.80	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge or other regulatory approved crossing method	Class 3 Non-Navigable	Shallow channel with gradient of 40% throughout ZOI; perched culvert under railway tracks; no connectivity to North Thompson River; no fish captured or observed.	C
BC-101	574.8	Unnamed Channel	Seasonal	S5	11	354310	5811794	None (None)	Low	--	6.75 / 3.20	0.46	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Clear-span Bridge or Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 3 Non-Navigable	Shallow, poorly defined channel; sections of sub-surface flow downstream; >40% gradient within PPC; limited connectivity through damaged culvert at 50 m downstream; no fish captured or observed; no connectivity to North Thompson River; steep unstable approaches.	C
BC-101a	575.0	Unnamed Channel	Seasonal	S6	11	354156	5811606	None (None)	Low	--	1.23 / 1.02	0.41	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Dry sections with poorly defined channel; >38% gradient throughout ZOI; 2 m vertical drop at 100 m downstream and insufficient flow are barriers.	B
BC-102	575.4	Unnamed Drainage	Ephemeral	NCD	11	354120	5811279	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Some scour and evidence of overland flow; no defined bed or banks; no fish habitat potential or connectivity to fish habitat.	B
BC-102a	575.6	Unnamed Drainage	Seasonal	NCD	11	354092	5811009	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	No continuous defined channel; short sections of scour; average reach gradient is 62%; no fish habitat potential or connectivity to fish habitat.	B

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-102b	575.7	Unnamed Channel	Seasonal	S6	11	354118	5810940	None (None)	Low	--	2.15 / 2.15	0.25	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Average reach gradient 68% and 3 m hanging culvert are barriers to migration; insufficient discharge; angular substrate.	B or C
BC-103	575.9	Unnamed Drainage	Seasonal	NCD	11	354096	5810723	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	No continuous defined channel; gradient >55% within PPC; no connectivity to fish habitat.	B
BC-104	576.3	Unnamed Channel	Perennial	S2	11	353935	5810380	BT, CCG (BT, CCG)	Low	0.24 (20/07/13)	9.74 / 6.83	0.80	Yes	June 1 - August 15	June 1 - August 15	Summer/Winter	Isolation with fish salvage and water quality monitoring[1]	Isolation with fish salvage and water quality monitoring during low flow [3]	Clear-Span Bridge	Clear-Span Bridge or other regulatory approved crossing method	Potentially Navigable	Pockets of unembedded gravel; numerous deep residual pools; abundance of LWD, OHV, boulders, undercut banks; gradient and steep cascades limit rearing in PPC; gradient >30% upstream from PPC and >3 m falls downstream from PPC.	G
BC-105	576.7	Unnamed Drainage	Seasonal	NCD	11	353772	5810083	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Steep drainage; overland flow and short sections of scour; no continuous defined channel; no potential for fish or connectivity to fish habitat.	A
BC-106	577.1	Unnamed Channel	Seasonal	S6	11	353690	5809709	None (None)	Low	--	2.29 / 1.52	0.69	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Insufficient depth; alluvial fan within PCC; flow dissipates overland 25 m downslope; no connectivity to fish habitat.	B
BC-107	577.7	Switch Creek	Perennial	S3	11	353597	5809129	BT, CH (None)	Low	0.50 (05/06/13)	7.00 / 3.14	0.56	Yes	July 15 - August 15	Open	Summer/Winter	Isolation with fish salvage and water quality monitoring	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge or other regulatory approved crossing method	Class 3 Non-Navigable	High gradient; adequate cover but high velocities; waterfall and step-pool morphology; unsuitable residual pool depths; pockets of suitable gravel.	D or F
BC-108	578.3	Unnamed Channel	Seasonal	S6	11	353532	5808565	None (None)	Low	--	2.12 / 1.54	0.69	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Steep gradient throughout reach (32%); insufficient depth and flow.	B
BC-109	579.2	Unnamed Channel	Seasonal	S6	11	353222	5807738	None (None)	Low	0.003 (07/06/13)	1.19 / 1.17	0.40	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Sections of subsurface flow 100 m downstream from the PCC; gradient barrier of 40% and multiple falls (0.5 m high) throughout reach.	B
BC-109a*	580.3	Unnamed Channel	TBD	TBD (S6)	11	352625	5807073	TBD (None)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Summer/Winter	TBD	TBD	TBD	TBD	TBD	TBD	TBD
BC-110 [2]	580.4	Serpentine Creek	Perennial	S2	11	352570	5807008	BT (CCG, BT, MW, CH)	High	1.33 (25/09/13)	17.30 / 12.05	0.43	No	August 7 - August 15	August 7 - August 15	Summer/Winter	Isolation with fish salvage and water quality monitoring during low flow [3]	Open-cut with water quality monitoring inside timing window [4]	Clear-Span Bridge	Clear-Span Bridge	Potentially Navigable	Deep pools, boulder and OHV cover; no barriers, low gradient; few suitable gravel patches.	G

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-111 (2)	581.2	North Thompson River	Perennial	S1A	11	352062	5806372	None (BL, BSU, CCG, CH, CO, CRH, CSU, LDC, LKC, BT, LNC, LSU, MSU, MW, NSC, PCC, RB, RSC, RW, SK)	High	200 (30/07/13)	110.00 / 94.17	2.07	No	July 22 - August 15	July 22 - August 15	Summer/Winter	Trenchless with water quality monitoring	Open-cut with water quality monitoring inside timing window (4)	Access both banks	Access both banks	Navigable	Historical presence of BT, RB, CO, CH, PK, SK; adequate riparian and instream cover; LWD, OHV, deep channel; pockets of suitable spawning gravels; large deep channel; perennial flow; essential corridor for migrating salmon, no barriers, perennial flow.	Comply with Federal and Provincial Regulations
BC-112 (2)	582.0	Chappell Creek	Perennial	S2	11	351527	5805704	BT (BT, CCG)	High	1.03 (15/08/12)	26.00 / 14.10	1.58	No	June 1 - August 15	June 1 - August 15	Summer/Winter	Isolation with fish salvage and water quality monitoring (1)	Isolation with fish salvage and water quality monitoring during low flow(3)	Existing or Clear-Span Bridge	Existing or Clear-Span Bridge	Navigable	Good mixture of coarse substrate; abundant boulders and pools; may be limited by 2 perched culverts under Hwy 5 upstream from PPC; deep pools located throughout; cover provided by deep pools, boulders and OHV; high spring flows, armouring likely required.	G
BC-113	582.8	Unnamed Channel	Seasonal	S6/S3	11	351212	5805012	CO (None)	Low	0.01 (21/07/13)	7.00 / 2.95	0.11	Yes	July 15 - August 15	Open	Summer/Winter	Isolation with water quality monitoring if flowing	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert or other regulatory approved crossing method	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Average reach gradient exceeds 25%; small channel size with overland flow downstream; CO captured near confluence with North Thompson River; poor substrate but good riparian and in-stream habitat; low velocities; some deep pools near confluence with North Thompson.	D or F
BC-114	582.8	Unnamed Drainage	Seasonal	NCD	11	351176	5804987	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Overland flow with pockets of standing water; drainage converges with BC95 (NCD) downslope; no downslope connectivity to fish habitat.	A
BC-115	582.9	Unnamed Drainage	Seasonal	NCD	11	351181	5804876	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	No continuous defined channel; overland flow with pockets of standing water; some saturated ground along existing ROW; no connectivity to fish habitat.	A
BC-116	583.0	Unnamed Channel	Seasonal	S6	11	351148	5804844	None (None)	Low	--	0.58 / 0.58	0.20	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Low discharge; 50-80% gradient; low connectivity given abundant subsurface sections.	B
BC-117	583.0	Unnamed Channel	Seasonal	S6	11	351134	5804785	None (None)	Low	--	1.85 / 1.85	0.08	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Low discharge; 30-70% gradient; low connectivity (abundant subsurface sections).	B
BC-118	583.1	Unnamed Drainage	Seasonal	NCD	11	351178	5804718	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Dry drainage; steep gradient; short sections of scour upslope; no defined channel downslope; no connectivity to fish habitat.	A
BC-119	583.2	Unnamed Channel	Seasonal	S6	11	351199	5804578	None (None)	Low	--	2.64 / 1.56	0.90	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Small channel size; intermittent flow; 20-30% gradient; watercourse dry approximately 70 m downslope; no connectivity to the North Thompson River.	B

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-120	583.6	Amy Creek	Seasonal	S6	11	351269	5804204	None (None)	Low	--	2.67 / 1.94	0.28	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Shallow braided channel; limited pool depth; a small inclined culvert 60 m downstream may create a velocity barrier to upstream fish migration.	B or C
BC-121	583.9	Unnamed Channel	Seasonal	S6	11	351281	5803928	None (None)	Low	--	0.29 / 0.29	0.07	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Small incised channel; average reach gradient 22%; multiple subsurface sections; steep cascade (90% gradient) downslope; channel converges with Amy Creek (BC98) also with low fish habitat potential.	B
BC-122	585.0	Unnamed Drainage	Seasonal	NCD	11	351371	5802806	None (None)	Low	--	--	--	-	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Overland flows; discontinuous bed and banks; 35% gradient downslope; no connectivity to fish habitat.	B
BC-123	585.1	Unnamed Drainage	Seasonal	NCD	11	351365	5802783	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Steep drainage; overland flow; discontinuous bed and banks; no connectivity to fish habitat.	A
BC-124	585.2	Unnamed Channel	Seasonal	S6	11	351399	5802586	None (None)	Low	--	0.70 / 0.70	0.53	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Small incised channel; average reach gradient >35%; a vertical cliff immediately downslope (gradient >100%); abundant sub-surface sections; poor connectivity.	C
BC-125	585.6	Unnamed Channel	Seasonal	S6	11	351396	5802284	None (None)	Low	--	0.40 / 0.40	0.35	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Small incised channel; 60 % gradient downslope; steep contours upslope.	B or C
BC-126	585.7	Unnamed Drainage	Seasonal	NCD	11	351365	5802153	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Steep seasonal drainage; overland flow and standing water; no connectivity to fish habitat.	A
BC-127	585.9	Unnamed Channel	Seasonal	S6	11	351271	5801947	None (None)	Low	--	2.60 / 1.87	--	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Small watercourse; marginally defined channel; 30% gradient upslope.	A or B
BC-128	586.0	Unnamed Channel	Seasonal	S6	11	351252	5801886	None (None)	Low	--	2.40 / 1.68	--	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Small drainage parallels access road and joins BC101 further south; gradient barrier downstream likely to limit fish passage; no connectivity to fish habitat.	B or C
BC-129	586.2	Unnamed Channel	Seasonal	S6	11	351293	5801620	None (None)	Low	--	2.40 / 1.22	--	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Small channel; an almost vertical slope (>100%) DS.	B or C
BC-130	586.7	Unnamed Drainage	Seasonal	NCD	11	351440	5801167	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Discontinuous channel; >30% gradients; predominately overland flow with sections of scour; no connectivity to fish habitat.	A
BC-131	586.9	Unnamed Drainage	--	NVC	11	351488	5800937	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Open swale with no sign of water or fluvial processes; drainage may have flown historically.	A

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-132	587.2	Unnamed Channel	Perennial	S6/NC D-W (FB)	11	351545	5800685	CH, CO (None)	Low	0.02 (28/09/13)	1.34 / 1.28	0.06	No	July 15 - August 15	Open	Summer/Winter	Isolation with water quality monitoring if flowing	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert or other regulatory approved crossing method	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	CO and CH captured in wetland 50 m downstream from PPC, none in captured in small channel; shallow depths and flow regime limit fish habitat potential; wetland provides rearing habitat (abundant cover and pools).	B; Refer to Wetland Evaluation Technical Report of Vol. 5C, for additional reclamation
BC-134	587.5	Unnamed Drainage	--	NVC	11	351530	5800352	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	No sign of water or fluvial processes.	A
BC-135	588.0	Unnamed Drainage	--	NVC	11	351471	5799923	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	No sign of water or fluvial processes.	A
BC-136	588.1	Unnamed Drainage	--	NVC	11	351455	5799754	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	No sign of water or fluvial processes.	A
BC-137	588.2	Unnamed Channel	Seasonal	S6	11	351427	5799653	None (None)	Low	--	2.40 / 1.90	0.50	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Small shallow watercourse; minimal in-stream cover; potential gradient and velocity barrier at Hwy 5 culvert.	C
BC-138	588.4	Unnamed Channel	Seasonal	S6	11	351426	5799529	None (None)	Low	--	1.44 / 1.44	--	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Small steep channel; reach gradient exceeded 30%; a 1.05 m perched culvert present downstream.	C
BC-139	588.6	Unnamed Channel	Seasonal	S6	11	351353	5799310	None (None)	Low	--	1.30 / 1.17	0.50	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Small shallow channel; steep gradients downstream.	C or D
BC-140	589.3	Unnamed Channel	Seasonal	S6	11	351340	5798573	None (None)	Low	0.07 (14/08/12)	1.53 / 1.41	0.52	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Small shallow channel; channel briefly flows into ditch along Hwy 5; low in stream complexity; shallow pool depths prevalent; abundant steep cascade sections; reach gradient of >30% from PPC to 220 m downstream preclude fish from PPC.	C or D
BC-141	589.5	Unnamed Drainage	Seasonal	NCD	11	351340	5798450	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Low-lying wet area; no defined channel; approx. 80% gradient downslope; no connectivity to fish habitat.	A
BC-142	589.6	Unnamed Drainage	Seasonal	NCD	11	351303	5798338	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Poorly defined channel at ROW; no defined channel upslope; seepage from hillside with insufficient depth and flow to support fish downstream; reach gradient exceeds 25%.	B
BC-143	589.7	Unnamed Channel	Seasonal	S6	11	351295	5798177	None (None)	Low	--	0.75	0.01	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Small shallow channel; poor flow; reach gradient of approximately 55%.	B
BC-144	590.0	Unnamed Channel	Seasonal	S6	11	351205	5797880	None (None)	Low	--	0.86	0.10	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Small shallow channel; 30% gradient barrier downstream; average reach gradient of approximately 25%.	C
BC-145	590.1	Unnamed Drainage	Seasonal	NCD	11	351199	5797851	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Dry drainage; no continuous defined channel; approximately 80% gradient downslope; no connectivity to fish habitat.	A

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-146	590.3	Unnamed Channel	Seasonal	S6	11	351127	5797662	None (None)	Low	--	1.85	--	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Shallow channel; steep cascade sections downstream	C
BC-147	590.5	Unnamed Channel	Seasonal	S6	11	351067	5797373	None (None)	Low	--	1.00 / 0.55	0.15	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Sections of subsurface flow; reach gradient of approximately 35-45%.	B
BC-148	590.7	Unnamed Channel	Seasonal	S6	11	351088	5797239	None (None)	Low	--	0.30 / 0.25	0.06	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	45% reach gradient; 2 m vertical falls immediately downstream.	B
BC-149	591.0	Unnamed Channel	Seasonal	S6	11	351114	5796959	None (None)	Low	0.098 (09/08/12)	1.70 / 0.98	0.29	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Approximately 27-50% reach gradient; large vertical falls downstream.	C or D
BC-150	591.2	Unnamed Drainage	--	NVC	11	351099	5796736	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Upland site on crest of hill; no sign of water or fluvial processes.	A
BC-151 [2]	592.9	Miledge Creek	Perennial	S1B	11	350781	5795173	BT (BT, CO)	High	--	30.00 /22.60	1.18	No	August 7 - August 15	August 7 - August 15	Summer/Winter	Isolation with fish salvage and water quality monitoring during low flow [3]	Open-cut with water quality monitoring inside timing window [4]	Clear-Span Bridge	Clear-Span Bridge	Navigable	Perennial channel with extensive riffles; known spawning and rearing channel for CO; BT captured in 2013; extensive riffles; high proportion of large cobble/boulders; boulders, LWD, OHV; may be limited during high flows; close proximity to N. Thompson; good depth and flow.	G
BC-152	594.0	Unnamed Channel	Seasonal	S6	11	350555	5794183	None (None)	Low	--	0.70 / 0.63	0.13	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Low flow; 43-55% gradient.	B
BC-153	596.4	Unnamed Channel	Perennial	S6/S3	11	349950	5791920	BT (None)	Low	--	2.30 / 1.90	0.49	Yes	June 1 - August 15	June 1 - August 15	Summer/Winter	Isolation with water quality monitoring [1]	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge or Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	BT captured 80 m downstream from PPC in Hwy 5 plunge-pool; gradient barriers of 27% and 1.3 m falls immediately downstream from PPC prevent fish migration through the PPC; moderate rearing and spawning habitat downstream from barriers (good quality gravel/cobble substrate, several pools); small channel size, shallow depths could limit overwintering fish.	C or D
BC-154	596.5	Unnamed Drainage	--	NVC	11	349926	5791802	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Topographic depression with no visible scour.	A
BC-155	597.1	Unnamed Channel	Seasonal	S6	11	349581	5791277	None (None)	Low	--	2.00 / 1.22	0.23	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Small shallow watercourse; reach gradient exceeds 25%; gradient barrier of 37% and 1 m falls downstream.	C

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-156	598.4	Unnamed Channel	Seasonal	S6/S4	11	349084	5790149	BT (None)	Low	0.04 (11/06/13)	1.50 / 1.18	0.34	Yes	June 1 - August 15	June 1 - August 15	Summer/Winter	Isolation with water quality monitoring if flowing[1]	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Small seasonal watercourse; poor channel definition; sections of overland flow; reach gradient of approximately 45% upstream from Hwy 5; juvenile BT captured 200 m downstream from PPC; stream enters a North Thompson side channel; numerous YOY fish observed at confluence.	B or C
BC-157	598.5	Unnamed Drainage	Seasonal	NCD	11	349070	5790006	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Small undefined seepage drainage; no continuous channel definition; steep gradient downslope; no connectivity to fish habitat.	A
BC-158	598.5	Unnamed Channel	Seasonal	S6	11	349056	5789987	None (None)	Low	--	1.10 / 0.90	0.12	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Small seasonal watercourse; lack of flow; reach gradient 45-62%.	B
BC-159	598.6	Unnamed Drainage	Seasonal	NCD	11	349053	5789953	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Drainage with short sections of scour and overland flow; discontinuous channel definition; steep gradient upslope and downslope; no connectivity to fish habitat.	A
BC-160	598.7	Unnamed Channel	Seasonal	S6	11	349019	5789853	None (None)	Low	--	1.00	--	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Small seasonal watercourse; low discharge; reach gradient exceeds 25%; gradients of 30% present downstream.	B
BC-161	599.2	Unnamed Channel	Seasonal	S6	11	348858	5789373	None (None)	Low	--	0.50	--	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Small poorly defined channel; reach gradient exceeds 25%.	B
BC-162	599.3	Unnamed Drainage	Seasonal	NCD	11	348807	5789231	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Sections of subsurface and overland flow; no continuous defined channel; steep gradient; no connectivity to fish habitat.	A
BC-163	599.3	Unnamed Channel	Seasonal	S6	11	348804	5789214	None (None)	Low	--	1.20 / 0.82	0.08	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Low flow; 55% gradient.	B
BC-164	599.4	Unnamed Drainage	Seasonal	NCD	11	348787	5789170	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	No continuous defined channel; overland flow with minimal scour; no connectivity to fish habitat.	A
BC-165	599.5	Unnamed Drainage	--	NVC	11	348743	5789049	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	No depression or evidence of scour; crossing located on high ground at crest of hill.	A
BC-166	600.0	Unnamed Drainage	Seasonal	NCD	11	348571	5788567	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	No continuous defined channel; sections of overland flow; saturated areas and pockets of standing water; no connectivity to fish habitat.	A

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-167	600.1	Unnamed Channel	Seasonal	S6	11	348547	5788522	None (None)	Low	--	0.3 / 0.3	0.10	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Low discharge; a crushed culvert acts as a barrier to fish movement with only a 4 cm opening allowing water through.	B
BC-168 [2]	600.2	Thunder River	Perennial	S1B	11	348418	5788455	BT (BT, CO, MW, CCG)	High	2.36 (10/10/12)	26.00/21.67	1.63	No	June 1 - August 15	June 1 - August 15	Summer/Winter	Isolation with fish salvage and water quality monitoring during low flow [3]	Open-cut with water quality monitoring inside timing window [4]	Clear-Span Bridge	Clear-Span Bridge	Navigable	Cover from boulders and LWD; high velocities; slower water velocities in the fall; spawning limited by high proportions of large cobble/boulder); presence of boulders and velocity breaks for migrating fish; occasional deep pools; two adult bull trout observed October 2012, holding 1 km downstream at confluence with the North Thompson River. Identified as a spawning and rearing tributary for North Thompson CO.	G
BC-169	602.5	Unnamed Drainage	--	NVC	11	347689	5786357	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	No sign of water or fluvial processes; steep gradient upslope and downslope.	A
BC-170	603.3	Unnamed Channel	Seasonal	S6	11	347283	5785592	None (None)	Low	--	2.20 / 1.41	0.26	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Shallow watercourse; 1.0 m vertical falls upstream and downstream; average reach gradient 22-26%; cascade section of 45% DS.	C
BC-171	603.9	Unnamed Drainage	Seasonal	NCD	11	347048	5785088	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Small seasonal drainage; no defined channel upslope or downslope; no connectivity to fish habitat.	A
BC-172	604.5	Unnamed Channel	Seasonal	S6	11	346817	5784473	None (None)	Low	--	1.00 / 0.67	0.10	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	45% gradient; flow over moss covered rock suggests dry channel by late summer/fall.	B
BC-173 [2]	605.2	Whitewater Creek	Perennial	S5/S2	11	346603	5783869	RB (BT, CRH, RB)	Low	0.75 (29/09/13)	12.00 / 9.00	0.78	Yes	August 7 - August 15	August 7 - August 15	Summer/Winter	Isolation with water quality monitoring during low flow [3]	Open-cut with water quality monitoring inside timing window [4]	Clear-Span Bridge	Clear-Span Bridge	Potentially Navigable	Steep stream with high velocity flows; few deep pools, steep gradient; absence of smaller cobble sand gravels; North Thompson River within ZOI; RB captured 100 m downstream from PPC.	Comply with Federal and Provincial Regulations
BC-174	606.6	Unnamed Channel	Perennial	S5/S3	11	345601	5782847	BT, CCG (None)	Low	0.09 (29/09/13)	4.60 / 4.00	0.45	Yes	June 1 - August 15	June 1 - August 15	Summer/Winter	Isolation with water quality monitoring if flowing[1]	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge or other regulatory approved crossing method	Class 3 Non-Navigable	Shallow channel; boulder/cobble substrate; cascade-pool morphology; 25-37% reach gradient from PPC to 200 m downstream; multiple falls (3.0 m) upstream and downstream; BT and CCG captured downstream from CN culvert (200 m downstream) where gradient is shallower.	D

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-175	607.6	Unnamed Channel	Perennial	S3	11	345072	5782064	BT, CCG, RB (None)	High	0.05 (29/09/13)	2.40 / 1.93	0.40	Yes	July 22 - August 15	July 22 - August 15	Summer/Winter	Isolation with fish salvage and water quality monitoring [1]	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge or other regulatory approved crossing method	Class 2 Non-Navigable	Deep pools, good cover; high percentage of large cobbles and boulders; fish captured >30 m downstream; no barriers; 32-47% gradient and large cascades and falls upstream and downstream from PCC.	D
BC-176	609.4	Cook Creek	Perennial	S2	11	344404	5780401	CO (CO, CH, BT, RB, MW, CC)	High	0.68 (31/07/12)	10.50 / 8.50	0.30	No	August 7 - August 15	August 7 - August 15	Summer/Winter	Isolation with fish salvage and water quality monitoring [1]	Isolation with fish salvage and water quality monitoring during low flow[3]	Existing or Clear-span Bridge	Existing or Clear-span Bridge	Potentially Navigable	Known spawning and rearing area for North Thompson CO; good channel complexity, functional riffle-pool habitat, deep pools and OHV present; juvenile CO captured within ZOI; sections of small/large gravel but high percentage of fines in downstream sections; ; no barriers to fish observed.	G
BC-177	611.6	Cedar Creek	Perennial	S2	11	343591	5778305	CO, CH, BT, CCG (BT,CRH,CO,MW,RB)	High	0.08 (30/07/12)	6.80 / 6.08	0.49	No	June 1 - August 15	June 1 - August 15	Summer/Winter	Isolation with fish salvage and water quality monitoring[1]	Isolation with fish salvage and water quality monitoring during low flow[3]	Clear-Span Bridge	Clear-Span Bridge	Potentially Navigable	Excellent riparian habitat; abundant ISV, OHV and woody debris; perennial channel with good flow; juvenile CO, CH and BT captured in ZOI; good mixture of course substrate; sections with high percentages of fines or boulders; predominately riffle with limited pool habitat, North Thompson River is located within ZOI.	G
BC-178 [2]	613.8	Blue River	Perennial	S1B	11	342426	5776508	CO, CH, CCG (BT,CAS,CCG,CH,CO ,MW,RB,LNC,RSC)	High	6.43 (20/08/12)	51.80 / 29.83	0.75	No	August 7 - August 15	August 7 - August 15	Summer/Winter	Trenchless with water quality monitoring	Isolation during low flow [3] or open-cut inside timing window [4]; fish salvage and water quality monitoring	Clear-Span Bridge	Clear-Span Bridge	Navigable	Excellent riparian habitat; abundant OHV, undercut banks and woody debris along margins; pool depth and boulders in stream; juvenile CO and CH captured within ZOI; good mixture of clean unembedded course substrate; Blue River is a known spawning and rearing channel for Thompson River CO and Summer 52 Chinook; high overwintering potential (pool depths of 0.5 to 1.2 m).	Comply with Federal and Provincial Regulations
BC-179	614.4	Unnamed Drainage	--	NVC	11	342217	5776011	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Swale on either side of road; no evidence of historical or recent flow; no connectivity to Eleanor Lake.	A
BC-180 [2]	616.9	Goose Creek	Perennial	NCD-W (FB)	11	341776	5773608	CO (CO,MW,RB,BT)	High	--	--	--	No	July 22 - August 15	Open	Summer/Winter	Isolation with fish salvage and water quality monitoring during low flow [3]	Open-cut with water quality monitoring inside timing window [4]	Existing or Clear-Span Bridge	Swamp Mats or other regulatory approved crossing method	Refer to Wetland Evaluation Technical Report of Vol. 5C	Perennial wetland channel with rearing and wintering potential for juvenile salmonids / Refer to Wetland Evaluation Technical Report of Volume 5C. Potential beaver dam removal.	Refer to Wetland Evaluation Technical Report of Vol. 5C

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-181 [2]	619.8	Unnamed Channel	Seasonal	S2	11	341263	5770812	CO, CSU (None)	High	--	16.00 / 13.33	0.95	Yes	July 15 - August 15	July 15 - August 15	Summer/Winter	Trenchless as part of North Thompson River trenchless (BC-182)	Isolation during low flow with fish salvage and water quality monitoring [3]	Clear-Span Bridge	Swamp Mats or other regulatory approved crossing method	Potentially Navigable	Channel was flooded in June 2013; abundance of in stream vegetation and deep pools; channel dries up by late summer/early fall; low DO within PPC in summer; 100% fines and organics substrates; lack of flow in fall; direct connectivity to North Thompson River.	D
BC-182 [2]	619.9	North Thompson River	Perennial	S1A	11	341238	5770664	MW (BL, BSU, CCG, CH, CO, CRH, CSU, LDC, LKC, BT, LNC, LSU, MSU, MW, NSC, PCC, RB, RSC, RW, SK)	High	146.05 (30/07/13)	150.00 / 107.50	1.49	No	July 22 - August 15	July 22 - August 15	Summer/Winter	Trenchless with water quality monitoring	Open-cut with water quality monitoring inside timing window[4]	Access both banks	Access both banks	Navigable	Historical presence of BT, RB, CO, CH, PK, SK; adequate riparian and instream cover; deep pools; limited suitable spawning substrate; large deep channel; perennial flow; essential corridor for migrating salmon; no barriers; perennial flow.	Comply with Federal and Provincial Regulations
BC-183	621.4	Unnamed Drainage	--	NVC	11	340623	5769454	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Hummocky forested area with no sign of scour, seepage, or flow.	A
BC-184	622.5	Unnamed Drainage	Seasonal	NCD	11	340708	5768481	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	stagnant pockets of water; no defined channel upslope or downslope; no connectivity to the North Thompson River.	A
BC-185	622.9	Unnamed Drainage (Wetland)	Seasonal	NCD-W (FB)	11	340507	5768062	CO (None)	Low	--	--	--	Yes	July 15 - August 15	Open	Summer/Winter	Isolation with fish salvage and water quality monitoring if flowing	Open-cut (DFO OS) if dry or frozen to bottom	Existing or Ramp and Culvert	Swamp Mats or other regulatory approved crossing method	Refer to Wetland Evaluation Technical Report of Vol. 5C	Low fish habitat potential with PPC; juvenile CO caught downstream from existing TMPL ROW in seasonally flooded area near confluence with North Thompson River; crushed culvert limits fish migration /Refer to Wetland Evaluation Technical Report of Volume 5C. Potential beaver dam removal.	Refer to Wetland Evaluation Technical Report of Vol. 5C
BC-186	623.7	Unnamed Channel	Seasonal	S3	11	340105	5767347	CO (None)	High	0.01 (21/08/12)	3.10 / 2.17	0.83	Yes	July 15 - August 15	Open	Summer/Winter	Isolation with fish salvage and water quality monitoring if flowing	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge or Ramp and Culvert	Clear-Span Bridge or other regulatory approved crossing method	Class 2 Non-Navigable	Good riparian cover; small channel size, lack of flow; perched culverts downstream both with 0.8 m plunge; lack of flow; North Thompson River within ZOI; 10 juvenile CO stranded in isolated pool below perched culvert and 1 CO juvenile captured upstream; 100 % fines; seasonal flow and shallow depths.	B

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-187	623.9	Unnamed Channel	Seasonal	S3	11	340049	5767195	CO (None)	Low	0.02 (18/06/13)	5.80 / 2.18	0.32	Yes	July 15 - August 15	Open	Summer/Winter	Isolation with fish salvage if flowing	Open-cut (DFO OS) if dry or frozen to bottom	Swamp Mats or other regulatory approved crossing method	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	High gradient (22%) and sub-surface sections upstream from existing TMPL ROW; no potential for fish within PPC; CO caught 100 m downstream from PPC; no fish captured upstream from high gradient section over two seasons of sampling; seasonal low flows; sufficient cover downstream from OHV and SWD; direct connectivity with North Thompson River downstream of high gradient sub-surface sections.	B
BC-188	624.0	Unnamed Channel	Seasonal	S6	11	339985	5767079	None (None)	Low	--	1.25 / 1.06	0.23	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Poor flow; 30% gradient; channel goes subsurface immediately downstream; poor connectivity to the North Thompson River.	B
BC-189 (2)	626.6	Froth Creek	Perennial	S2	11	339573	5764702	BT, CH (BT, RB)	High	0.61 (21/08/12)	10.00 / 9.50	0.60	No	August 7 - August 15	August 7 - August 15	Summer/Winter	Isolation with fish salvage and water quality monitoring (1)	Isolation with fish salvage and water quality monitoring during low flow(3)	Existing or Clear-Span Bridge	Existing or Clear-Span Bridge	Potentially Navigable	Large perennial channel; extensive riffle habitat; boulders, LWD, OV and small pools throughout; pockets of gravel throughout, areas of high percentages of boulder and large cobble; North Thompson River less than 100m downstream; no barriers observed.	G
BC-190	631.1	Unnamed Drainage (Wetland)	Seasonal	NCD-W	11	341463	5761354	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Vegetated wetland with seepage; hydrophilic vegetation; no fish habitat potential and no connectivity to fish habitat.	Refer to Wetland Evaluation Technical Report of Vol. 5C
BC-191	631.4	Unnamed Drainage	Seasonal	NCD	11	341462	5761013	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Dry drainage; evidence of historical water presence but no channelization or continuous scour; no connectivity to fish habitat.	A
BC-192	632.1	Unnamed Channel	Seasonal	S6	11	341422	5760248	None (None)	Low	0.041 (10/07/13)	3.13 / 2.19	0.30	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Clear-span Bridge or Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Small channel with shallow depth; high percentage of fines in substrate; good riparian cover; >2.5 km from North Thompson River with steep gradient (>25%) between North Thompson and PPC.	C
BC-193	633.9	Foam Creek	Perennial	S5	11	341287	5758573	None (RB, AO, BT, WF)	Low	--	20.00 / 10.75	0.85	Yes	August 7 – August 15	Open	Summer/Winter	Isolation	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge	Potentially Navigable	Reach gradient > 26%; occasional deep pools; high percentage of boulders and cobbles; historical presence of RB, AO, BT and WF in downstream sections Foam Creek but fish presence within ZOI precluded by gradient and cascades.	G

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-194	636.4	Unnamed Channel	Seasonal	S6	11	340118	5756635	None (None)	Low	0.001 (10/06/13)	1.40 / 1.00	0.29	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Sections of steep gradient (>30%), subsurface flow, and sections of overland flow with marginal channelization; little to no fish habitat potential	B
BC-195	636.5	Unnamed Channel	Seasonal	S6	11	340136	5756533	None (None)	Low	0.01 (11/06/13)	1.69 / 1.17	0.33	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Sections of subsurface flow downstream from the PPC and steep gradients (> 25%) throughout the reach; gradient barrier of over 50% at 300 m downstream from the PPC.	B
BC-196	636.8	Unnamed Channel	Seasonal	S6	11	340090	5756218	None (None)	Low	0.002 (10/06/13)	1.80 / 1.00	0.30	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Sections of subsurface flow; classified as NCD downstream; gradient barrier of 30%, and a lack of channelization beyond 200 m downstream; seasonal flow pattern; little to no fish habitat potential.	B
BC-197	637.0	Unnamed Channel	Seasonal	S6	11	340107	5756051	None (None)	Low	--	1.14 / 0.78	0.23	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Average gradient >30%; numerous upstream waterfalls; shallow bankful depths throughout reach, potential seasonal sub-surface flow; little to no fish habitat potential.	B
BC-198	637.0	Unnamed Channel	Seasonal	S6	11	340103	5756003	None (None)	Low	0.02 (09/06/13)	1.62 / 1.38	0.46	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Shallow stream with average reach gradient >25%; channel becomes NCD downslope from PPC.	B
BC-199	637.5	Unnamed Drainage	Seasonal	NCD	11	340031	5755471	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Water limited to low-lying wet area along existing TMPL ROW.	B
BC-200	638.0	Unnamed Channel	Seasonal	S6	11	339778	5755039	None (None)	Low	--	2.36 / 1.46	0.45	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Dry channel; some suitable substrate for spawning.	B or C
BC-201 [2]	638.8	Finn Creek	Perennial	S2	11	340053	5754392	RB, BT (CH, CO, SK, RB, BT, MW,CCG, CAS)	High	1.46 (23/08/12)	31.00 / 18.70	0.90	No	July 22 - August 15	July 22 - August 15	Summer/Winter	Isolation with fish salvage and water quality monitoring during low flow [3]	Open-cut with water quality monitoring inside timing window [4]	Clear-span Bridge	Clear-span Bridge	Potentially Navigable	Abundant boulders, OHV, small pools and woody debris; numerous resident RB and BT captured and observed throughout ZOI; patches of gravel observed throughout but some areas with large percentages of boulder and cobble; Finn Creek is a known spawning channel for Thompson River CO, CH and SK; overwintering potential with sufficient flow and numerous pools.	Comply with Federal and Provincial Regulations
BC-202	639.1	Unnamed Drainage	Seasonal	NCD-W	11	340232	5754152	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Short sections of scour upslope (<100 m); no connectivity to Finn Creek downslope.	B
BC-203	639.6	Unnamed Drainage	Seasonal	NCD	11	340462	5753690	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Short sections of scour (<100 m); overland flow; no connectivity to fish habitat.	A

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-204	640.4	Unnamed Drainage	Seasonal	NCD	11	340784	5752968	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Short sections of scour (<100m); sections of ponded water and intermittent overland flow; no connectivity to fish habitat.	A
BC-205	640.7	Unnamed Drainage	Seasonal	NCD	11	340784	5752631	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Seasonal overland flow; pockets of standing water; no connectivity to fish habitat.	A
BC-206	641.5	Unnamed Drainage	Seasonal	NCD	11	340992	5751845	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Overland flow; intermittent pockets of standing water; no connectivity to fish habitat.	A
BC-207	641.9	Unnamed Drainage	Seasonal	NCD	11	341117	5751450	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Short sections of scour but no alluvium present; subsurface flow with no connectivity to fish habitat.	A
BC-208	642.0	Unnamed Drainage	Seasonal	NCD	11	341166	5751376	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Short section of scour; overland and subsurface flow upslope and downslope; no connectivity to fish habitat.	A
BC-209	642.1	Unnamed Channel	Seasonal	S6	11	341180	5751292	None (None)	Low	0.07 (28/08/12)	1.35 / 1.34	2.55	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Small channel; no connectivity downstream.	B
BC-210	642.3	Unnamed Channel	Perennial	S3	11	341183	5751131	RB (None)	Low	0.07 (28/08/12)	2.35 / 1.65	0.19	No	July 22 - October 31	July 22 - October 31	Summer/Winter	Isolation with fish salvage and water quality monitoring [1]	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge or other regulatory approved crossing method	Class 2 Non-Navigable	Cover from undercut banks and LWD; limited by small channel size and lack of pool depth; no fish captured or observed upstream from Hwy 5 near the proposed ROW but juvenile RB captured below Hwy 5 culvert; clean unembedded gravel substrates near confluence, but predominately larger substrate material within PPC; migration limited by gradient upstream (13.5-17%).	G
BC-211	642.4	Unnamed Drainage	Seasonal	S6	11	341204	5751013	None (None)	Low	0.04 (30/08/12)	0.77 / 0.73	0.13	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Small channel that converges with BC-212 along PPC to the south; multiple steep sections (22%) throughout.	A
BC-212	642.5	Unnamed Channel	Seasonal	S6	11	341236	5750892	None (None)	Low	0.04 (30/08/12)	2.23 / 1.54	0.17	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Small shallow watercourse; multiple sections of steep gradient downstream.	B
BC-213	642.6	Unnamed Drainage (Wetland)	Perennial	S4/NCD-W	11	341264	5750801	CO (None)	Low	0.01 (30/08/12)	0.60 / 0.49	0.09	No	July 15 - August 15	Open	Summer/Winter	Isolation with fish salvage and water quality monitoring if flowing	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Swamp Mats or other regulatory approved crossing method	Class 1 Non-Navigable	Small watercourse draining into wetland area 140 m downstream from centre of PPC; juvenile CO captured in the wetland.	Refer to Wetland Evaluation Technical Report of Vol. 5C
BC-214	642.8	Unnamed Drainage (Wetland)	Perennial	NCD-W (FB)	11	341257	5750646	CO (None)	High	--	--	--	No	July 15 - August 15	Open	Summer/Winter	Isolation with fish salvage and water quality monitoring	Open-cut (DFO OS) if dry or frozen to bottom	Existing or Clear-Span Bridge or Ramp and Culvert	Swamp Mats or other regulatory approved crossing method	Refer to Wetland Evaluation Technical Report of Vol. 5C	Abundant juvenile salmonids observed downstream from the PPC / Refer to Wetland Evaluation Technical Report of Volume 5C.	Refer to Wetland Evaluation Technical Report of Vol. 5C

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-215	643.8	Unnamed Drainage (Wetland)	Perennial	NCD-W (FB)	11	341263	5749662	CO, CAS (None)	Low	--	--	--	Yes	July 15 - August 15	Open	Summer/Winter	Isolation with fish salvage and water quality monitoring if flowing	Open-cut (DFO OS) if dry or frozen to bottom	Existing or Clear-Span Bridge or Ramp and Culvert	Swamp Mats or other regulatory approved crossing method	Refer to Wetland Evaluation Technical Report of Vol. 5C	Moderate rearing habitat for juvenile salmonids; beaver dam restricts fish migration / Refer to Wetland Evaluation Technical Report of Volume 5C. Potential beaver dam removal.	Refer to Wetland Evaluation Technical Report of Vol. 5C
BC-216	644.6	Unnamed Drainage	--	NVC	11	341597	5748812	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Topographic depression; no evidence of flow.	A
BC-217	645.3	Unnamed Channel	Perennial	S4	11	341701	5748207	CO, MW (None)	High	0.01 (30/08/12)	1.40 / 1.33	0.17	No	July 15 - August 15	July 15 - August 15	Summer/Winter	Isolation with fish salvage and water quality monitoring if flowing (1)	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge or other regulatory approved crossing method	Clear-Span Bridge or other regulatory approved crossing method	Class 2 Non-Navigable	Cover from OHV and SWD; rearing limited by low discharge, steep gradient (18%) and low channel complexity; limited gravel substrates; lack of deep pools for overwintering fish; perched culvert below Hwy 5 during low flows.	C or D
BC-217a	645.5	Unnamed Channel	Seasonal	S3	11	341756	5747957	CO (None)	Low	--	1.60 / 1.50	0.06	Yes	July 15 - August 15	Open	Summer/Winter	Isolation with fish salvage and water quality monitoring if flowing	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge or Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Abundant cover; woody debris and OHV; small channel; low discharge; CO captured in 2012; 17-25% gradient.	B
BC-218	646.0	Unnamed Channel	Seasonal	S6/S4	11	341893	5747537	CO (None)	Low	--	0.60 / 0.58	0.11	Yes	July 15 - August 15	Open	Summer/Winter	Isolation with water quality monitoring if flowing	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Small incised watercourse; vertical slope <50 m downstream from PPC and gradient exceeds 25% from Hwy 5 to PPC; minimal flow; CO captured near confluence with North Thompson River and in ditch-line upstream from Hwy 5 but no potential for fish through the PPC.	B
BC-219	646.1	Unnamed Drainage	Seasonal	NCD	11	341943	5747386	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Short sections of scour <100 m; pockets of standing water and overland flow; no connectivity to fish habitat.	A
BC-220	646.3	Unnamed Channel	Seasonal	S6	11	341973	5747212	None (None)	Low	--	0.70 / 0.65	0.10	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Reach gradient approximately 35%; narrow incised channel; minimal flow and insufficient depth to support fish.	B
BC-221	646.5	Unnamed Drainage	--	NVC	11	341980	5747066	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Topographic depression; no evidence of water or fluvial processes.	A
BC-222	647.1	Unnamed Drainage (Wetland)	Perennial	NCD-W (FB)	11	342053	5746475	CO (None)	Low	--	--	--	Yes	July 15 - August 15	Open	Summer/Winter	Isolation with fish salvage and water quality monitoring if flowing	Open-cut (DFO OS) if dry or frozen to bottom	Existing or Clear-Span Bridge or Ramp and Culvert	Swamp Mats or other regulatory approved crossing method	Refer to Wetland Evaluation Technical Report of Vol. 5C	No fish were captured or observed upstream from Hwy 5, CO captured and observed at outfall downstream; perched culvert restricts fish migration / Refer to Wetland Evaluation Technical Report of Volume 5C.	Refer to Wetland Evaluation Technical Report of Vol. 5C
BC-223	647.8	Unnamed Drainage	--	NVC	11	342196	5745829	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Topographic depression; no evidence of flow or scour.	A

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-224	648.0	Sundt Creek	Perennial	S2	11	342242	5745592	RB (CO, MW)	High	0.01 (12/09/12)	22.20 / 8.83	0.30	No	August 7 - August 15	August 7 - August 15	Summer/Winter	Isolation with fish salvage and water quality monitoring (1)	Isolation with fish salvage and water quality monitoring during low flow(3)	Clear-Span Bridge	Clear-Span Bridge	Potentially Navigable	Good cover; boulder, OHV and woody debris; juvenile RB captured within PCC; pockets of clean gravel/small cobble; limited sections with coarser substrates; low discharge; shallow residual pool depths (0.2 -0.4 m)); North Thompson River <200 m downstream; no barriers.	G
BC-225	648.5	Unnamed Drainage (Wetland)	Seasonal	NCD-W	11	342385	5745076	None (None)	Low	--	--	--	Yes	None	Open	Summer/Winter	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Areas of standing water and overland flow; no connectivity to fish habitat.	Refer to Wetland Evaluation Technical Report of Vol. 5C
BC-226	648.7	Unnamed Drainage	Seasonal	NCD	11	342435	5744895	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Sections of standing water and overland flow; no connectivity to fish habitat /Refer to Wetland Evaluation Technical Report of Volume 5C	A
BC-227 (2)	648.9	Tumtum Creek	Perennial	S2	11	342516	5744707	CO, CC (CH,CO,RB)	High	0.02 (12/09/12)	16.40 / 10.46	0.38	No	July 22 - August 15	July 22 - August 15	Summer/Winter	Isolation with fish salvage and water quality monitoring (1)	Isolation with fish salvage and water quality monitoring during low flow(3)	Clear-Span Bridge	Clear-Span Bridge	Potentially Navigable	Excellent channel complexity, good cover; deep pools, undercut banks, OV and woody debris; abundant juvenile CO captured and observed within ZOI; potential for RB, CH and BT; good discharge; abundant pools; good mixture of course unembedded substrate; large channel; good discharge; North Thompson River approx. 520 m DS.	G
BC-228	649.2	Unnamed Channel	Seasonal	S6/S3	11	342612	5744426	RB, RSC (None)	Low	0.06 (13/09/12)	2.40 / 1.69	0.20	Yes	July 22 - October 31	Open	Summer/Winter	Isolation with water quality monitoring if flowing	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Clear-Span Bridge or other regulatory approved crossing method	Class 2 Non-Navigable	Small braided channel with steep gradient upstream from Hwy 5; poor channel complexity; drains into small wetland area on upstream side of Hwy 5; RB and RSC captured in ponded area 350 m downstream from PPC on west side of Hwy 5; good cover; OHV, SWD, LWD; shallow depths; few pockets of spawning gravels, low flows); ponded area likely dry/frozen to bottom in winter; approximately 25% gradient upstream of PPC; low connectivity through wetland at 200 m downstream of PPC; culvert under Hwy 5 is a potential barrier.	B

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-229	649.6	Unnamed Drainage (Wetland)	Seasonal	NCD-W	11	342505	5744042	None (None)	Low	--	--	--	Yes	None	Open	Summer/Winter	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Low-lying wetland; no discernible flow or defined channels within PPC; no connectivity to the North Thompson River or to seasonal rearing habitat on west side of Hwy 5.	Refer to Wetland Evaluation Technical Report of Vol. 5C
BC-230	649.7	Unnamed Channel	Perennial	S4	11	342506	5743985	CO (None)	Low	0.04 (13/09/12)	1.18 / 1.07	0.23	No	July 15 - August 15	Open	Summer/Winter	Isolation with fish salvage and water quality monitoring if flowing	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge or other regulatory approved crossing method	Clear-Span Bridge or other regulatory approved crossing method	Class 1 Non-Navigable	Moderate cover; OHV; woody debris; small channel size and low discharge; juvenile CO captured in channel downstream of wetland on west side of Hwy 5; high percentage of fines throughout.	C
BC-231	650.1	Unnamed Drainage	--	NVC	11	342356	5743582	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Topographic depression; no evidence of scour or fluvial processes; 24% reach gradient.	A
BC-232	650.4	Unnamed Drainage	--	NVC	11	342225	5743339	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	45% reach gradient upstream; no evidence of water or fluvial processes.	A
BC-233	650.7	Unnamed Drainage	--	NVC	11	342002	5743090	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	No sign of water or fluvial processes; 45-55% gradient upstream.	A
BC-234	650.8	Unnamed Drainage	--	NVC	11	341980	5743045	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	No sign of water or fluvial processes; 45-55% reach gradient upstream.	A
BC-235	651.1	Unnamed Drainage (Wetland)	Seasonal	NCD-W	11	341696	5742983	None (None)	Low	--	--	--	Yes	None	Open	Summer/Winter	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Wetland complex with no surface connectivity to North Thompson River (NVC observed 80 m downslope); NW and SE portions of wetland connected by Hwy 5 culvert; low DO; this site will be included in the HDD crossing over the North Thompson River / Refer to Wetland Evaluation Technical Report of Volume 5C. Potential beaver dam removal.	Refer to Wetland Evaluation Technical Report of Vol. 5C
BC-236 [2]	651.6	North Thompson River	Perennial	S1A	11	341289	5742820	None (BL, BSU, CCG, CH, CO, CRH, CSU, LDC, LKC, BT, LNC, LSU, MSU, MW, NSC, PCC, RB, RSC, RW, SK)	High	239.16 (25/07/13)	175.00 / 163.33	1.03	No	July 22 - August 15	July 22 - August 15	Summer/Winter	Trenchless with water quality monitoring	Open-cut with water quality monitoring inside timing window[4]	Access both banks	Access both banks	Navigable	Historical presence of BT, RB, CO, CH, PK, SK; deep pools and OHV; limited by high discharge with few velocity breaks; high percentage of fines; large deep channel; perennial flow; essential corridor for migrating salmon; no barriers; perennial flow.	Comply with Federal and Provincial Regulations
BC-237	652.4	Unnamed Drainage (Wetland)	Seasonal	NCD-W	11	340693	5742221	None (None)	Low	--	--	--	Yes	None	Open	Summer/Winter	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Large saturated area (~300 m wide); no discernible flow, lack of depth, no suitable substrate; no connectivity to fish habitat / Refer to Wetland Evaluation Technical Report of Volume 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-238	652.7	Unnamed Channel	Perennial	S3	11	340567	5742008	RB, BT (None)	High	0.02 (20/09/12)	3.37 / 3.02	0.51	No	July 22 - August 15	July 22 - August 15	Summer/Winter	Isolation with fish salvage and water quality monitoring [1]	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge	Class 3 Non-Navigable	Good channel complexity, cover; OV, woody debris; undercut banks); juvenile RB and BT captured within ZOI; unembedded course substrates; low discharge; shallow residual pool depths; extensive channel braiding 200 m downstream /Refer to Wetland Evaluation Technical Report of Volume 5C	D or G
BC-239	653.3	Unnamed Channel	Perennial	S3	11	340329	5741436	SA (None)	High	0.04 (20/09/12)	2.14 / 1.65	0.75	No	July 15 - August 15	July 15 - August 15	Summer/Winter	Isolation with fish salvage and water quality monitoring[1]	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge	Class 2 Non-Navigable	Good channel complexity, OHV, woody debris; undercut banks, abundant juvenile salmonids observed (likely CO); suitable gravel throughout; some sections of high percentage of fines; low discharge; shallow residual pool depths; close proximity to the North Thompson River DS.	D or G
BC-240	653.9	Unnamed Channel	Perennial	S3	11	339883	5741247	CO, BT (None)	High	--	3.30 / 2.45	0.34	No	July 15 - August 15	July 15 - August 15	Summer/Winter	Isolation with fish salvage and water quality monitoring[1]	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge	Class 2 Non-Navigable	Cover provided by; OHV and woody debris; juvenile CO and BT captured within the ZOI; unembedded course substrates; limited pools; close proximity to N. Thompson River but shallow braided channel DS.	E or G
BC-241	654.4	Unnamed Channel	Seasonal	S6	11	339657	5740792	None (None)	Low	0.05 (20/09/12)	2.46 / 1.47	16.50	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Small shallow channel; limited instream complexity; negligible discharge; overland flow approximately 200 m downstream.	B
BC-242	656.1	Avola Creek	Perennial	S3	11	339728	5739127	CO, BT, RB (CO, RB)	High	0.06 (18/09/12)	5.10 / 2.89	0.49	No	July 22 - August 15	July 22 - August 15	Summer/Winter	Isolation with fish salvage and water quality monitoring [1]	Isolation with fish salvage and water quality monitoring during low flow[3]	Clear-Span Bridge	Clear-Span Bridge	Class 2 Non-Navigable	Low gradient, low velocity, abundant cover, small pools, OHV, undercut banks and woody debris; juvenile CO and BT captured within ZOI; reports of adult CO spawners travelling upstream by landowner; clean unembedded gravels and cobbles throughout; residual pool depths of 0.2 to 0.5 m; Hwy 5 and CN culverts may obstruct fish passage at low flows /Refer to Wetland Evaluation Technical Report of Volume 5C	E or G
BC-243	657.2	Unnamed Drainage	Seasonal	NCD	11	339628	5738034	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Sections of overland flow; short sections of scour downslope from Hwy 5 culvert; no connectivity to fish habitat.	A

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-244	659.1	Unnamed Channel	Seasonal	S3	11	339010	5736294	CO, BT (None)	High	--	3.50 / 2.86	0.59	No	July 15 - August 15	July 15 - August 15	Summer/Winter	Isolation with fish salvage and water quality monitoring if flowing(1)	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge or other regulatory approved crossing method	Class 2 Non-Navigable	CO and BT captured within ZOI; limited overall habitat potential upstream of Hwy 5 (26% gradients); increased rearing potential downstream of Hwy 5 (low gradient; good cover; OHV, undercut banks; woody debris; unembedded gravels and cobbles; low discharge and shallow depths may limit overwintering fish.	G
BC-245	659.9	Unnamed Channel	Seasonal	S6	11	338809	5735572	None (None)	Low	--	1.36 / 0.92	0.35	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Entire reach gradient 35-45%; culvert barriers at highway/railway crossings; poor flow; shallow depths; low complexity.	B
BC-246	661.2	Unnamed Drainage (Wetland)	Seasonal	NCD-W	11	338278	5734434	None (None)	Low	--	--	--	Yes	None	Open	Summer/Winter	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Large wetland area (~400 m long); saturated ground; no defined channel at inlet or outlet; culvert present under Hwy 5 / Refer to Wetland Evaluation Technical Report of Volume 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C
BC-247	661.5	Unnamed Drainage (Wetland)	Seasonal	NCD-W	11	338072	5734225	None (None)	Low	--	--	--	Yes	None	Open	Summer/Winter	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Large wetland area; saturated ground; no defined channel at inlet or outlet; culvert present under Hwy 5 / Refer to Wetland Evaluation Technical Report of Volume 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C
BC-248	663.1	Unnamed Channel	Seasonal	S2	11	336890	5733118	RB (None)	High	0.001 (24/09/12)	14.50 / 9.73	1.39	Yes	July 22 - October 31	July 22 - October 31	Summer/Winter	Isolation with fish salvage and water quality monitoring if flowing(1)	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge or other regulatory approved crossing method	Potentially Navigable	Juvenile RB captured and observed in numerous shallow residual pools; seasonal rearing in summer; intermittent channel; low discharge in fall/winter; dewatered sections observed downstream; spring spawning potential, (pockets of suitable gravel throughout but some sections of high percentages of cobble and boulder).	G
BC-249	664.3	Sager Creek	Seasonal	S2	11	336159	5732127	CO (CO)	Low	--	18.00 / 11.74	1.19	Yes	August 7 - August 15	Open	Summer/Winter	Isolation with fish salvage and water quality monitoring if flowing	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge or other regulatory approved crossing method	Potentially Navigable	Dry channel during two sampling seasons; 9 - 12% gradient; lack of cover; lack of suitable substrate; seasonal flows; CO captured downstream in wetland below existing TMPL ROW; Potential beaver dam removal.	C
BC-250	666.1	Unnamed Drainage (Wetland)	Seasonal	NCD-W	11	334817	5730963	None (None)	Low	--	--	--	Yes	None	Open	Summer/Winter	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Large wetland area; no water present; no evidence of flow; no fish habitat potential or connectivity to fish habitat	Refer to Wetland Evaluation Technical Report of Vol. 5C

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-251	666.4	Bearpark Creek	Seasonal	S6/S3	11	334681	5730765	RB (None)	Low	0.01 (09/07/13)	3.14 / 2.50	0.31	Yes	July 22 - October 31	July 22 - October 31	Summer/Winter	Isolation with fish salvage and water quality monitoring[(1)]	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge or other regulatory approved crossing method	Class 2 Non-Navigable	Dry channel within PPC during two seasons of sampling; RB captured 110 m downstream from PPC; seasonal flow; minimal cover; de-watered from PPC to 100 m downstream; high percentage of fines in substrate; Likely frozen to bed in the winter.	G
BC-252	666.6	Unnamed Drainage	Seasonal	NCD	11	334553	5730632	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Sections of standing water and overland flow; no connectivity to fish habitat.	B
BC-253	668.3	Unnamed Drainage	--	NVC	11	333237	5729656	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	25% reach gradient; some ground seepage along existing TMPL ROW.	A
BC-254	668.5	Unnamed Drainage	Seasonal	NCD	11	333086	5729552	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	No continuous upstream channel, some evidence of seasonal overland flows; 70% gradient; some pooled water on existing TMPL ROW.	A
BC-255	668.9	Unnamed Drainage	Seasonal	NCD	11	332782	5729232	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Short sections of scour and overland flow; lack of channelization; 35% gradient.	B
BC-256	669.2	Unnamed Drainage	--	NVC	11	332650	5728986	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	32% reach gradient; no evidence of water or fluvial processes.	A
BC-257	671.9	Unnamed Drainage	Seasonal	NCD	11	330536	5727960	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Dry at time of survey, 20-25% gradient; short sections of scour; no direct connectivity to fish habitat.	A
BC-258	672.0	Ivy Creek	Seasonal	S5	11	330465	5727990	None (None)	Low	0.01 (19/09/12)	10.15 / 6.52	1.05	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge or other regulatory approved crossing method	Potentially Navigable	No fish captured or observed; lack of flow; perched culvert at confluence with the North Thompson River.	G
BC-259	675.1	Hornet Creek	Perennial	S3	11	327591	5727196	RB (None)	High	0.01 (08/07/13)	4.14 / 3.17	0.52	Yes	July 22 - October 31	July 22 - October 31	Summer/Winter	Isolation with fish salvage and water quality monitoring [(1)]	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge	Class 3 Non-Navigable	Juvenile RB captured and observed upstream of Hwy 5 culvert; abundant cover from OHV, undercut banks and pools; good channel complexity; pockets of suitable gravel throughout but some sections with high percentages of cobble and boulder; numerous pools >0.5 m deep; perennial flows; culvert under Hwy 5 could be seasonal barrier.	G
BC-260	676	Cormet Creek	Perennial	S3	11	326657	5727385	RB (None)	High	0.02 (20/09/12)	4.90 / 3.59	0.55	No	July 22 - October 31	July 22 - October 31	Summer/Winter	Isolation with fish salvage and water quality monitoring [(1)]	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge	Class 3 Non-Navigable	Juvenile RB captured and observed within ZOI; good channel complexity; good cover; OHV, undercut banks; woody debris; unembedded small and large gravels with some sections of high percentage of fines; low discharge; residual pool depths 0.4 to 0.65 m.	F or G

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-261	676.7	Unnamed Drainage	--	NVC	11	325970	5727466	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	No sign of scour; no evidence of historical or recent flow.	A
BC-262	678.3	Jake Creek	Seasonal	S6	11	324457	5727935	None (None)	Low	--	2.64 / 2.01	0.44	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Dry ephemeral channel; lack of flow; 16% gradient; anthropogenic channel infilling approximately. 100 m downstream.	C
BC-263	678.5	Unnamed Drainage	--	NVC	11	324297	5728004	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	No evidence of scour; 32% reach gradient; saturated ground at existing TMPL ROW.	A
BC-264	678.8	Unnamed Drainage	Seasonal	NCD	11	323949	5727996	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Dry at time of survey; short sections of scour; no connectivity to fish habitat /Refer to Wetland Evaluation Technical Report of Volume 5C	B
BC-265	678.9	Unnamed Channel	Seasonal	S6	11	323842	5727983	None (None)	Low	0.001 (25/09/12)	1.75 / 1.05	0.34	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Small channel; lack of flow; 60% gradient; no defined channel for 100 m downstream.	B
BC-266	679.0	Unnamed Channel	Seasonal	S6	11	323824	5727944	None (None)	Low	0.002 (25/09/12)	0.60 / 0.51	0.31	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Small channel; lack of flow; 60% gradient; no defined channel for 100 m downstream.	B
BC-267	679.7	Unnamed Drainage	--	NVC	11	323206	5727576	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Site located in pastureland; no evidence of fluvial processes.	A
BC-268	679.8	Unnamed Drainage	--	NVC	11	323143	5727561	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Site located in pastureland; no evidence of fluvial processes.	A
BC-269	679.9	Unnamed Drainage	Seasonal	NCD	11	323006	5727456	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Dry at time of survey; short sections of scour; no connectivity to fish habitat.	A
BC-270	680.9	Unnamed Drainage	Seasonal	NCD	11	322065	5727537	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	25% gradient; short sections of discontinuous scour; no defined channel no connectivity to fish habitat downslope.	B
BC-271	681.4	Unnamed Drainage	Seasonal	NCD	11	321571	5727560	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	30% gradient; dry at time of survey; some evidence of scour and overland flow; no continuous defined channel; no connectivity to fish habitat downslope.	B
BC-272	681.5	Unnamed Drainage	--	NVC	11	321392	5727554	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	No depression or evidence of water or fluvial processes.	A
BC-273	681.9	Unnamed Drainage	--	NVC	11	321065	5727577	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	No evidence of water or fluvial processes. Steep side hill with an old skid trail.	A
BC-274	682.8	Unnamed Drainage	--	NVC	11	320204	5727766	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	20-25% reach gradient; no evidence of scour, historical or recent flow.	A

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-275 [2]	683.4	Mad River	Perennial	S2	11	319734	5728004	CO, RB (CCG, CH, CO, LNC, RB)	High	0.13 (19/09/12)	19.20 / 16.59	3.14	No	August 7 - September 30	August 7 - September 30	Summer/Winter	Isolation with fish salvage and water quality monitoring during low flow[3]	Open-cut with water quality monitoring inside timing window[4]	Clear-Span Bridge	Clear-Span Bridge	Potentially Navigable	Juvenile RB and CO captured within the ZOI; records of CH; moderate in stream cover; boulders; occasional pools; high percentage of larger course substrate; channel lacks deep pools near ROW; confluence with North Thompson River is 150m DS.	G
BC-276	685.2	Unnamed Channel	Seasonal	S5/S3	11	318026	5728275	RB, CCG (None)	Low	0.03 (05/07/13)	6.75 / 4.14	0.91	Yes	July 22 - October 31	July 22 - October 31	Summer/Winter	Isolation with water quality monitoring if flowing[1]	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge or other regulatory approved crossing method	Class 3 Non-Navigable	No fish captured or observed upstream from Hwy 5 culvert (300 m downstream from the PPC); lack of flow; sporadic residual pools; some suitable substrate for spawning; steep channel gradients (18% at existing TMPL ROW, 31% downstream).	G
BC-277	686.4	Cove Creek	Seasonal	S2	11	316856	5727993	RB (None)	High	0.009 (12/08/13)	8.32 / 5.93	0.99	Yes	July 22 - October 31	July 22 - October 31	Summer/Winter	Isolation with fish salvage and water quality monitoring if flowing[1]	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge	Potentially Navigable	Juvenile RB captured and observed in shallow residual pools; seasonal rearing habitat during the spring/summer; low discharge in the fall; dewatered channel sections downstream; pockets of suitable, unembedded gravels throughout; channel likely dry in fall/winter); perched culvert at Hwy 5 may be seasonal barrier.	G
BC-278	687.1	Divide Creek	Seasonal	S6	11	316294	5727799	None (None)	Low	0.03 (20/11/12)	2.42 / 1.78	0.18	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert or other regulatory approved crossing method	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Steep gradient; lack of depth; lack of suitable spawning; limited cover; absence of perennial habitat.	C
BC-279	688.2	Bill Creek	Seasonal	S6	11	315358	5727110	None (CO)	Low	-	1.20 / 1.10	0.20	Yes	July 22 – August 15	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Flows into stagnant pond; no connectivity to North Thompson River; insufficient water depth, small channel size, overland flow.	B
BC-280	688.8	Blackberg Creek	Seasonal	S6	11	315043	5726687	None (None)	Low	--	2.00 / 1.65	0.21	Yes	July 22 – August 15	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Dry intermittent channel; 35-49 % gradients; lack of flow; no channel definition upslope of Hwy 5.	B or C
BC-281	689.9	Unnamed Drainage	--	NVC	11	314402	5725887	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	No evidence of water or fluvial processes; dry gully observed ~ 650 m upslope.	A
BC-282	690.7	Unnamed Channel	Seasonal	S6	11	314010	5725149	None (None)	Low	0.01 (25/09/12)	1.65 / 0.94	0.26	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Small shallow watercourse; low discharge; 65% gradients downstream	B or C
BC-283	690.8	Unnamed Channel	Seasonal	S6	11	313987	5725015	None (None)	Low	--	1.60 / 0.99	0.59	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Small shallow watercourse; low discharge; 65% gradients downstream.	C or D
BC-284	691.0	Unnamed Drainage	--	NVC	11	313894	5724847	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	15-20% reach gradient; no evidence of historical or recent flow.	A

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-285	691.1	Unnamed Drainage	--	NVC	11	313827	5724746	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	No evidence of water of fluvial processes; access road parallels existing TMPL ROW to the East; no culverts under road.	A
BC-286	691.7	Montanna Creek	Seasonal	S6/S3	11	313607	5724219	CO (None)	Low	0.01 (07/07/13)	2.95 / 1.99	0.70	Yes	July 15 - August 15	July 15 - August 15	Summer/Winter	Isolation with water quality monitoring if flowing(1)	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert or Clear-Span Bridge	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	22% gradient; low gradient near confluence, but multiple barriers and seasonally intermittent flows upstream; cover from boulders and OHV; shallow pool depths; multiple barriers including drops, 1 m log falls, culverts and gradient; CO captured below barriers near confluence with North Thompson River.	G
BC-287	691.8	Unnamed Drainage	Seasonal	NCD	11	313562	5724121	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Lack of flow; no continuous defined channel; pooling at inlet and outlet of culvert but flows subsurface downstream.	A
BC-288	691.9	Unnamed Drainage	Seasonal	NCD	11	313520	5724006	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	No evidence of flow upslope; discontinuous channel downslope; no connectivity to fish habitat.	A
BC-289	695.4	Unnamed Channel	Seasonal	S6	11	313175	5720609	None (None)	Low	--	1.84 / 1.24	0.54	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Dry channel sections downstream; banks and stream bed heavily altered by cattle and anthropogenic modifications (water trough); lack of cover, depth and suitable substrate; multiple culverts	B
BC-290	695.6	Unnamed Drainage	Seasonal	NCD	11	313049	5720451	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Existing or Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Overland flow; short sections of scour downslope; no connectivity to fish habitat.	A
BC-291	697.6	Johnston Creek	Seasonal	NCD	11	311423	5719524	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Steep drainage; dry at the time of survey; some evidence of overland flow; short sections of scour; no connectivity to fish habitat.	A
BC-292	697.8	Unnamed Drainage	Seasonal	NCD	11	311264	5719325	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Dry topographical depression; no evidence of scour or alluvial deposits; no connectivity to fish habitat downslope.	A
BC-293	700.6	Unnamed Drainage	Seasonal	NCD	11	308780	5718817	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Dry at time of survey; culvert installed under private road; no evidence of recent flow or continuous defined channel; no connectivity to fish habitat downslope.	A
BC-294	701.3	Unnamed Drainage	Seasonal	NCD	11	308084	5718914	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Steep gully; short sections of scour; no evidence of continuous defined channel; no connectivity to fish habitat downslope.	B

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-295	701.5	Unnamed Drainage	Seasonal	NCD	11	307877	5718922	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	45% gradient; overland flow; short sections of scour; no continuous channel; no connectivity to fish habitat.	B
BC-296	701.9	Peavine Creek	Seasonal	S2	11	307475	5719119	RB (None)	High	0.01 (26/09/12)	8.60 / 6.63	0.72	Yes	July 22 - October 31	July 22 - October 31	Summer/Winter	Isolation with fish salvage and water quality monitoring if flowing(1)	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge or other regulatory approved crossing method	Potentially Navigable	Abundant juvenile and YOY fish captured and observed in residual pools within ZOI; cover from boulders and undercut banks but limited by seasonal flow; moderate spring spawning potential, suitable gravels present for early spawning.	C
BC-297	702.4	Unnamed Drainage	Seasonal	NCD	11	306995	5719018	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Ephemeral overland flow; short intermittent sections of defined scour; no continuous channel definition no connectivity to fish habitat downslope.	B
BC-298	702.6	Unnamed Drainage	--	NVC	11	306804	5718991	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Topographic depression; no evidence of water or fluvial processes.	A
BC-299	702.7	Unnamed Drainage	--	NVC	11	306769	5718990	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	No visible topographic depression; no evidence of water, fluvial processes or culverts.	A
BC-300	704.3	Unnamed Channel	Seasonal	S6	11	305151	5718837	None (None)	Low	--	4.10 / 2.77	0.33	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Ephemeral channel; dry channel; a 1.15 m perched culvert approximately 60 m downslope.	C or D
BC-301	704.5	Unnamed Drainage	--	NVC	11	304996	5718782	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Vegetated swale; no evidence of water or scour.	A
BC-302	707.9	Crossing Creek	Perennial	S5/S3	11	301702	5719600	CO, CH (CO)	Low	0.05 (19/07/13)	4.50 / 3.10	0.62	Yes	August 7 - August 15	August 7 - August 15	Summer/Winter	Isolation with water quality monitoring if flowing(1)	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge or other regulatory approved crossing method	Clear-Span Bridge or other regulatory approved crossing method	Class 3 Non-Navigable	Juvenile CO and CH captured and observed >400 m downstream of PPC; adequate cover from OHV, undercut banks, woody debris; pockets of suitable gravels but high percentage of fines; no residual pools deeper than 0.50 m; gradient barrier upstream from PPC; numerous falls; 1.0 m falls within PPC, 1.3 m falls with shallow plunge pool at 400 m downstream, NFC upstream of 1.3 m falls.	G
BC-303	708.8	Unnamed Drainage	--	NVC	11	300849	5719808	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	No evidence of scour or alluvial deposition; groundwater seepage along private access road downslope.	A
BC-304	710.6	Unnamed Drainage	--	NVC	11	299561	5720964	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	No evidence of water or scour.	A
BC-305	710.9	Noblequartz Creek	Seasonal	S5	11	299393	5721150	None (CO)	Low	--	4.30 / 3.47	1.20	Yes	August 7 - August 15	August 7 - August 15	Summer/Winter	Isolation with water quality monitoring if flowing (1)	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge or other regulatory approved crossing method	Class 3 Non-Navigable	Seasonal watercourse; dry at time of investigation; 9-21% gradient.	C or D

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-306	711.0	Unnamed Drainage	--	NVC	11	299219	5721214	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	No evidence of water or fluvial processes. Steep side hill with an old skid trail.	A
BC-307	712.4	Unnamed Drainage	--	NVC	11	298090	5721892	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	No evidence of water or fluvial processes. Steep side hill with an old skid trail.	A
BC-308	713.3	Unnamed Drainage	--	NVC	11	297317	5722448	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	No evidence of water or fluvial processes; dry vegetated swale.	A
BC-309 [2]	717.7	Raft River	Perennial	S1B	11	294175	5725201	CO, RB (CAS, CH, CO, CSU, BT, L, LNC, MW, RB, SK)	High	--	45.00 / 37.82	0.62	No	July 22 - August 15	July 22 - August 15	Summer/Winter	Trenchless with water quality monitoring	Isolation during low flow [3] or open-cut inside timing window [4]; fish salvage and water quality monitoring	Access both banks	Access both banks	Navigable	RB and CO captured; velocity breaks, abundant OHV and boulders; unembedded gravels; no barriers, low gradient, perennial flow.	Comply with Federal and Provincial Regulations
BC-310	719.8	School Creek	Seasonal	S3	10	707453	5726234	CO (None)	Low	0.01 (08/07/13)	2.90 / 2.35	0.29	Yes	July 15 - August 15	July 15 - August 15	Summer/Winter	Isolation with fish salvage and water quality monitoring if flowing[1]	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge or other regulatory approved crossing method	Class 2 Non-Navigable	Dry channel during first visit (September 2012); juvenile CO captured downstream from perched culvert and PPC in July 2013; low velocity; good riparian cover; OHV; woody debris; lacks suitable substrate; likely dry/frozen to bottom during winter; no permanent barriers within PPC but perched culvert at 260 m downstream is probable barrier.	G
BC-311	721.3	Unnamed Drainage	--	NVC	10	705952	5726139	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Dry swale; no evidence of water or fluvial processes.	A
BC-312 [2]	725.5	Clearwater River	Perennial	S1A	11	702102	5724656	None (CCG, CH, CO, BT, LNC, MW, RB, RSC, SK)	High	71.83 (29/11/12)	116.20 / 105.15	1.71	No	August 7 - August 15	August 7 - August 15	Summer/Winter	Trenchless with water quality monitoring	Open-cut with water quality monitoring inside timing window[4]	Access both banks	Access both banks	Navigable	Good habitat for salmonids including SK, CH and CO; runs with good depth, in stream cover and boulders; sections of suitable gravels but high percentages of boulder/cobble and moderate embeddedness; large channel morphology; sufficient depth; perennial flow; North Thompson River located within ZOI.	Comply with Federal and Provincial Regulations
BC-313	728.8	Gill Creek	Seasonal	NCD-W	10	700796	5722368	None (None)	Low	--	--	--	Yes	None	Open	Summer/Winter	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Small wetland area with standing surface water; no defined channel; poor connectivity to the North Thompson River; heavy disturbance to drainage area downslope; low dissolved oxygen; lack of residual pool habitat.	Refer to Wetland Evaluation Technical Report of Vol. 5C
BC-314	733.4	Unnamed Drainage (Wetland)	Seasonal	NCD-W	10	699054	5718189	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Dry in Sept 2012, stagnant water present in July 2013; potentially an unsuccessful diversion attempt by landowners; no connectivity to fish habitat upslope or downslope.	Refer to Wetland Evaluation Technical Report of Vol. 5C

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-315 [2]	735.0	Mann Creek	Perennial	S2	10	698509	5716833	CO, RB, C, CRH, RSC (BT, CH, CO, CRH, EB, LSU, PK, RB, SK, WF)	High	0.09 (13/09/12)	24.00 / 19.50	0.67	No	July 22 - August 20	July 22 - August 20	Summer/Winter	Trenchless with water quality monitoring	Isolation with fish salvage and water quality monitoring during low flow [3]	Clear-Span Bridge	Clear-Span Bridge	Navigable	Slow deep runs; off-channel habitat located upstream; PCC located approx. 100 m upstream from the North Thompson River; Mann Creek is a known escapement stream for SK, CO and CH; river offers important migratory and staging habitat for adult spawners and juvenile fish; low spawning potential within ZOI /Refer to Wetland Evaluation Technical Report of Volume 5C	G
BC-316*	736.2	Unnamed Channel	TBD	TBD (S3)	10	697301	5716634	TBD (None)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Summer/Winter	TBD	TBD	TBD	TBD	TBD	TBD	TBD
BC-317	737.0	Unnamed Drainage (Wetland)	Seasonal	NCD-W (FB)	10	696530	5716571	CO, CH (CO, CH)	High	--	--	--	Yes	July 15 - August 15	Open	Summer/Winter	Isolation fish salvage and water quality monitoring if flowing	Open-cut (DFO OS) if dry or frozen to bottom	Existing or Clear-Span Bridge	Swamp Mats or other regulatory approved crossing method	Refer to Wetland Evaluation Technical Report of Vol. 5C	Seasonal rearing habitat for CO and CH / Refer to Wetland Evaluation Technical Report of Volume 5C. Potential beaver dam removal.	Refer to Wetland Evaluation Technical Report of Vol. 5C
BC-318	737.3	Unnamed Channel	Seasonal	S6	10	696249	5716513	None (None)	Low	--	2.28 / 1.57	0.97	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Dry channel; marginal channel definition; average reach gradient of 25%.	B
BC-319	737.5	Unnamed Channel	Seasonal	S6	10	696055	5716513	None (None)	Low	--	3.10 / 2.03	0.51	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Intermittent watercourse; sections of dry channel and subsurface flow; average reach gradient of 40%.	B
BC-320	738.6	Unnamed Drainage	--	NVC	10	695017	5716382	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	No evidence of water or defined drainage pattern.	A
BC-321	739.3	Unnamed Drainage	--	NVC	10	694466	5715928	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	No evidence of water or fluvial processes.	A
BC-322	739.7	Unnamed Drainage	Seasonal	NCD	10	694101	5715671	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Overland flow and pockets of standing water; lack of flow; no channel definition; no connectivity to fish habitat.	A
BC-323	740.8	Unnamed Drainage	--	NVC	10	693601	5714744	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	>40% reach gradient; armouring present; no signs of scour or defined drainage pattern.	A
BC-324	741.9	Unnamed Drainage	Seasonal	NCD	10	692892	5713960	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Some discernible groundwater flow; no significant scour or defined channel >100 m; no connectivity to fish habitat.	A
BC-325	742.2	Unnamed Drainage	Seasonal	NCD	10	692939	5713635	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Ground seepage; no evidence of continuous scour or defined channel; no connectivity to fish habitat.	B
BC-326	742.8	Unnamed Drainage	Seasonal	NCD	10	692898	5713039	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Short sections of scour and overland flow; no connectivity to fish habitat.	A

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-327	745.5	Unnamed Drainage	Seasonal	NCD	10	693048	5710449	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Short sections of scour and overland flow; no connectivity to fish habitat /Refer to Wetland Evaluation Technical Report of Volume 5C	B
BC-328	746.2	Unnamed Channel	Perennial	S6	10	693062	5709746	None (None)	Low	--	2.00 / 1.42	0.15	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Small shallow channel; lack of suitable instream cover, depth, and substrate; poor flow conditions winter 2013; 40% gradient approximately 60 m downstream.	B or C
BC-330 (2)	749.3	Lemieux Creek	Perennial	S1B	10	692986	5706768	SK, BT, CC, CO, CH (CH, CO, KO, MW, RB, SK, LNC, NSC)	High	0.10 (06/09/12)	50.00 / 20.23	0.39	No	July 22 - August 15	July 22 - August 15	Summer/Winter	Isolation with fish salvage and water quality monitoring (1)	Isolation with fish salvage and water quality monitoring during low flow(3)	Clear-Span Bridge	Clear-Span Bridge	Potentially Navigable	Abundant juvenile CO and CH captured in 2006; adult SK and BT observed in 2012; known as an important spawning and rearing stream for SK, CH and CO; good stream complexity; abundant cover; deep pools, boulders, OV and woody debris; clean unembedded large gravel and small cobble throughout; lake-fed system; occasional deep pools over 1 m deep.	G
BC-331	751.0	Nehalliston Creek	Perennial	S2	10	692826	5705228	CO, RB (RB)	High	0.09 (06/09/12)	14.10 / 8.10	0.49	No	July 22 - August 15	July 22 - August 15	Summer/Winter	Isolation with fish salvage and water quality monitoring (1)	Isolation with fish salvage and water quality monitoring during low flow(3)	Clear-Span Bridge	Clear-Span Bridge	Potentially Navigable	Juvenile CO and RB captured within ZOI; high channel complexity; good shading and cover; boulders, woody debris; OHV; unembedded coarse substrates; pockets of gravel; but areas of high percentage of large cobble/boulder; no barriers to migration.	G
BC-332 (2)	752.3	Eakin Creek	Perennial	S2	10	692998	5703875	RB, CO, CCG (RB, CO, CCG)	High	--	13.00 / 10.50	1.02	No	July 22 - August 15	July 22 - August 15	Summer/Winter	Isolation with fish salvage and water quality monitoring (1)	Isolation with fish salvage and water quality monitoring during low flow(3)	Existing or Clear-Span Bridge	Existing or Clear-Span Bridge	Potentially Navigable	Historical records of RB and CO; good channel complexity; good shading; abundant velocity breaks; cover from deep pools, boulders, undercut banks and woody debris; pockets of suitable gravels and small cobble throughout but high percentage of larger course substrates; lake fed; perennial flows; large channel and catchment area.	G
BC-333	753.8	Unnamed Drainage	--	NVC	10	693317	5702452	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Forested slope; slight topographic swale; no visible scour or seepage.	A
BC-334*	754.2	Unnamed Channel	TBD	TBD (S6 or NCD)	10	693313	5702091	TBD (None)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Summer/Winter	TBD	TBD	TBD	TBD	TBD	Minor tributary located 330 m upstream from Lemieux Creek; low potential for fish and steep gradient within the LSA. Likely nil/low flows and predicted to be dry during late summer and/or frozen to bottom in winter	TBD

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-335*	755.3	Spokane Creek	Perennial	TBD (S6)	10	693373	5701003	None (None)	TBD	TBD	2.80 / 1.80	0.52	No	none	Open	Summer/Winter	TBD	TBD	TBD	TBD	Class 2 Non-Navigable	Small shallow channel; >1km from overwintering habitat; poor in stream cover; lack of pool depth.	B
BC-336	757.9	Montigny Creek	Perennial	S3	10	694122	5698652	RB (RB)	High	--	4.20 / 4.00	1.08	Yes	July 22 - October 31	July 22 - October 31	Summer/Winter	Isolation with fish salvage and water quality monitoring (1)	Isolation with fish salvage and water quality monitoring during low flow(3)	Clear-Span Bridge	Clear-Span Bridge	Class 3 Non-Navigable	Resident RB have been captured in the channel over multiple years of sampling (2006, 2012); abundant cover; woody debris, boulders, small pools; OHV; pockets of suitable gravels but high percentages of large course substrates; low discharge but resident RB likely survive in small residual pools; perched culvert at Hwy 5.	G
BC-337	760.2	Unnamed Drainage	Seasonal	NCD	10	694666	5696667	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	26% reach gradient; overland flows present downstream with lower gradient, but no channel definition; no connectivity to fish habitat downslope.	A
BC-338	761.1	Thuya Creek	Perennial	S2	10	694978	5695850	RB (RB)	High	0.21 (02/08/12)	8.40 / 7.43	0.52	Yes	July 22 - October 31	July 22 - October 31	Summer/Winter	Isolation with fish salvage and water quality monitoring (1)	Isolation with fish salvage and water quality monitoring during low flow(3)	Existing or Clear-Span Bridge	Existing or Clear-Span Bridge	Potentially Navigable	Juvenile RB captured within channel over multiple years (2006 , 2012); good cover; boulders, pools; OHV; high percentage of large cobble and boulder; annual flows from Thuya Lake, moderate discharge; sufficient pool depth for overwintering fish; perched culvert at Hwy 5.	G
BC-339	762.7	Bryan Creek	Seasonal	NCD	10	695207	5694327	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Dry vegetated drainage; no evidence of scour; culvert under highway shows no sign of recent flow; no connectivity to fish habitat downslope.	A
BC-340	763.0	Unnamed Drainage	--	NVC	10	695287	5694060	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Open vegetated drainage; no culverts observed DS.	A
BC-341	764.2	Unnamed Drainage	--	NVC	10	695833	5692976	None (None)	None	--	--	--	-	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Dry coniferous forest; no sign of water or fluvial processes.	A
BC-342	767.6	Unnamed Channel	Seasonal	S6/S3	10	696522	5689819	CO (None)	Low	--	3.49 / 2.80	0.34	Yes	July 15 - August 15	July 15 - August 15	Summer/Winter	Isolation with fish salvage and water quality monitoring if flowing (1)	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge or Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Juvenile CO captured in an isolated pool approximately 50 m downstream from existing ROW; seasonal nature of the channel, lack of in stream cover; high percentages of bedrock and boulder at ROW; some pockets of suitable gravels/cobbles downstream of Hwy 5; approximately 50% gradient upstream from TMPL; poor winter flow conditions, February 2012).	F or G

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-343 [2]	768.2	Darlington Creek	Perennial	S2	10	696564	5689224	CO, RB (CO)	High	0.84 (01/08/12)	21.80 / 12.30	0.62	No	July 22 - August 15	July 22 - August 15	Summer/Winter	Isolation with fish salvage and water quality monitoring [1]	Isolation with fish salvage and water quality monitoring during low flow[3]	Clear-Span Bridge	Clear-Span Bridge	Potentially Navigable	Juvenile CO and RB captured within the ZOI; abundant velocity breaks; suitable in stream cover; boulders, undercut banks, OHV; woody debris; predominance of large substrates within the ZOI.	G
BC-344 [2]	768.5	Lindquist Creek	Perennial	S2	10	696607	5688926	CO, RB (CO, RB, LSU)	High	1.70 (31/07/12)	14.80/ 10.13	0.28	No	July 22 - August 15	July 22 - August 15	Summer/Winter	Isolation with fish salvage and water quality monitoring [1]	Isolation with fish salvage and water quality monitoring during low flow[3]	Clear-Span Bridge	Clear-Span Bridge	Potentially Navigable	Juvenile CO and RB captured within the ZOI; good in stream complexity; good cover; undercut banks, pools, OHV, woody debris; clean unembedded course substrate; good overwintering habitat for fish.	G
BC-345	811.9	Unnamed Drainage	--	NVC	10	692911	5648560	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	No evidence of fluvial processes; no sign of channelization or depressions.	A
BC-346	812.1	Unnamed Drainage	--	NVC	10	692919	5648267	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Agricultural land with no evidence of fluvial processes; no sign of channelization or depressions.	A
BC-347	812.5	Unnamed Drainage	--	NVC	10	692899	5647930	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Grassy field with no evidence of fluvial processes; no sign of channelization or depressions.	A
BC-348	812.9	Unnamed Drainage	--	NVC	10	692904	5647456	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Agricultural land; no evidence of defined channel or fluvial processes; landowner mentioned an underground natural spring on property; /Refer to Wetland Evaluation Technical Report of Volume 5C	A
BC-349	813.2	Unnamed Drainage	--	NVC	10	692872	5647241	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Agricultural land; no sign of swale or depression.	A
BC-350	813.4	Unnamed Drainage	--	NVC	10	692853	5647037	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Agricultural land; no sign of swale or depression.	A
BC-351	813.7	Unnamed Drainage	--	NVC	10	692857	5646654	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Agricultural land; no sign of swale or depression.	A
BC-352	813.9	Unnamed Drainage	--	NVC	10	692842	5646555	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Agricultural land; no sign of swale or depression; no connectivity to fish habitat.	A
BC-353	814.0	Unnamed Drainage	--	NVC	10	692822	5646438	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Agricultural land; no sign of swale or depression.	A
BC-354	814.2	Unnamed Drainage	--	NVC	10	692815	5646227	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	No topographic depression; crossing located on floodplain adjacent to the North Thompson River.	A
BC-355	814.3	Unnamed Drainage	--	NVC	10	692802	5646058	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Grassy lawn; no sign of scour or seepage.	A
BC-356	814.5	Unnamed Drainage	--	NVC	10	692822	5645909	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Flat pasture; no topographic depression; a fish-bearing side channel of the North Thompson located approximately 50 m east.	A

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-357	815.0	Unnamed Drainage	--	NVC	10	692845	5645438	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	No evidence of scour or fluvial processes; North Thompson River is within 50 m of PPC.	A
BC-358*	815.7	Unnamed Drainage	TBD	TBD (S6 or NCD)	10	692651	564754	TBD (None)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Summer/Winter	TBD	TBD	TBD	TBD	TBD	TBD	TBD
BC-359*	816.3	Unnamed Drainage	TBD	TBD (NCD)	10	692391	5644217	TBD (None)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Summer/Winter	TBD	TBD	TBD	TBD	TBD	TBD	TBD
BC-360*	816.8	Unnamed Drainage	TBD	TBD (NCD)	10	692182	5643688	TBD (None)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Summer/Winter	TBD	TBD	TBD	TBD	TBD	TBD	TBD
BC-361*	817.1	Unnamed Drainage	TBD	TBD (NCD)	10	692136	5643431	TBD (None)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Summer/Winter	TBD	TBD	TBD	TBD	TBD	TBD	TBD
BC-362*	817.2	Unnamed Drainage	TBD	TBD (NCD)	10	692123	5643353	TBD (None)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Summer/Winter	TBD	TBD	TBD	TBD	TBD	TBD	TBD
BC-363*	817.4	Unnamed Drainage	TBD	TBD (NCD)	10	692079	5643110	TBD (None)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Summer/Winter	TBD	TBD	TBD	TBD	TBD	TBD	TBD
BC-364	817.6	Unnamed Drainage	--	NVC	10	692047	5642912	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Flat agricultural land; historical flood plain 65 m downslope; current flood plain 170 m downslope.	A
BC-365	817.8	Unnamed Drainage	--	NVC	10	692034	5642776	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Flat agricultural land; no sign of water or fluvial processes.	A
BC-366	817.9	Unnamed Drainage	--	NVC	10	692033	5642611	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Depression in relatively flat pasture; no sign of water of fluvial processes; side channel of the North Thompson River is 50 m downslope /Refer to Wetland Evaluation Technical Report of Volume 5C	A
BC-367	818.1	Unnamed Drainage	--	NVC	10	691910	5642427	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Upland bench; no sign of water or fluvial processes.	A
BC-368	818.5	Unnamed Drainage	--	NVC	10	691864	5642061	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Upland bench; no sign of water or fluvial processes.	A
BC-369	818.9	Unnamed Drainage	--	NVC	10	691814	5641708	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Upland agricultural field; no sign of water or fluvial processes.	A
BC-370*	819.3	Unnamed Drainage	TBD	TBD (NCD)	10	691806	5641231	TBD (None)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Summer/Winter	TBD	TBD	TBD	TBD	TBD	TBD	TBD
BC-371	820.2	Jamieson Creek	Perennial	S2	10	691547	5640420	CO (BT, CO, RB)	High	0.32 (12/11/13)	25.00 / 15.85	1.14	No	July 22 – September 30	July 22 – September 30	Summer/Winter	Isolation with fish salvage and water quality monitoring [1]	Isolation with fish salvage and water quality monitoring during low flow [3]	Clear-Span Bridge	Clear-Span Bridge	Potentially Navigable	Resident and spawning CO captured in the channel; abundant cover; boulders, frequent pools; pockets of suitable gravels but high percentages of large course substrates; moderate discharge with sufficient overwintering depth.	D
BC-372	823.4	Unnamed Channel	Seasonal	S6	10	689937	5638351	None (None)	Low	0.002 (17/04/13)	1.60 / 1.11	0.32	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Dry intermittent channel; 20-25% gradient; lack of year-round flow; multiple barriers to fish migration	C or D
BC-373	823.7	Unnamed Drainage	--	NVC	10	689726	5638035	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Vegetated swale; no sign of water or fluvial processes.	A

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-374	824.6	Unnamed Channel	Seasonal	S3	10	689237	5637357	None (RB)	Low	0.01 (30/07/13)	2.10 / 1.79	0.27	Yes	July 22 - October 31	Open	Summer/Winter	Isolation with fish salvage and water quality monitoring if flowing[1]	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge or Ramp and Culvert	Clear-Span Bridge or other regulatory approved crossing method	Class 2 Non-Navigable	Small seasonal channel; spawning, rearing, and overwintering limited by lack of depth and cover, high percentage of fines; no downstream connectivity to North Thompson River but connectivity to O'Connor Lake (FB) US.	C
BC-375	824.7	Unnamed Drainage	Seasonal	NCD	10	689155	5637277	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Vegetated drainage; no scour or defined bed and banks; pockets of seepage through PPC; BC-374 (FB) located 100 m downstream, but no connectivity between BC-374 and BC-375 /Refer to Wetland Evaluation Technical Report of Volume 5C	A
BC-376	825.5	Lanes Creek	Perennial	S2	10	688737	5636588	RB (RB)	High	0.10 (31/07/13)	12.20 / 6.30	0.72	Yes	July 22 - September 30	July 22 - September 30	Summer/Winter	Isolation with fish salvage and water quality monitoring [1]	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge or other regulatory approved crossing method	Potentially Navigable	Juvenile RB captured within the ZOI; good instream complexity; abundant cover; boulders, OHV, woody debris; small pockets of gravels; high percentage of cobbles and boulders; many shallow pools; low discharge; low migration potential (fish can migrate downstream from O'Connor Lake (FB, ~5 km US) to PPC but 12 m bedrock chute is barrier to upstream migration).	G
BC-377	825.9	Unnamed Drainage	--	NVC	10	688408	5636462	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Low gradient, grassy area within Douglas-fir forest; no signs of scour or fluvial processes.	A
BC-378	826.7	Unnamed Drainage	--	NVC	10	687862	5635852	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Vegetated swale; no sign of water or fluvial processes.	A
BC-379	827.0	Unnamed Drainage	--	NVC	10	687739	5635625	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Grassland; no visible channel; no sign of water or fluvial processes.	A
BC-380	827.8	Unnamed Drainage	--	NVC	10	687359	5634905	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Dry vegetated gully; no evidence of recent or historical fluvial processes; steep approaches.	A
BC-381	828.3	Dairy Creek	Perennial	S3	10	687063	5634473	RB (RB)	High	0.01 (13/08/13)	3.90 / 2.60	0.47	No	July 22 - September 30	July 22 - September 30	Summer/Winter	Isolation with fish salvage and water quality monitoring [1]	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge or other regulatory approved crossing method	Class 2 Non-Navigable	Four RB captured within ZOI; pockets of gravel; spawning limited by shallow depth and high percentage of cobbles; good channel complexity and cover; undercut banks, boulders, OHV, woody debris; steep approaches throughout ZOI.	D
BC-382	829.0	McQueen Creek	Intermittent	S6	10	686885	5633809	None (None)	Low	0.004 (29/05/13)	2.12 / 1.71	0.27	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Soft ground and pugging evident, severe channel degradation, poor connectivity and poor water quality	D

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-383	831.2	Unnamed Drainage	Seasonal	NCD	10	686962	5631733	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Ford	(None)	Refer to Wetland Evaluation Technical Report of Volume 5C	A
BC-384	831.8	Unnamed Drainage	--	NVC	10	686979	5631269	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Vegetated swale with no evidence of fluvial processes. 6% slope towards Deep Lake.	A
BC-385	832.3	Unnamed Drainage	--	NVC	10	686786	5630746	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Grassy swale within Lac Du Bois Grasslands Park; no sign of fluvial processes.	A
BC-386	832.3	Unnamed Drainage	--	NVC	10	686776	5630708	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Grassy swale; possible historical connectivity to Deep Lake; no sign of recent flow.	B
BC-387	833.2	Unnamed Drainage	--	NVC	10	686477	5629901	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Vegetated swale that connects with dry alkali lake downslope; no signs of recent flow; no sign of scour or defined bed and banks.	B
BC-388	833.6	Unnamed Drainage	--	NVC	10	686331	5629442	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Vegetated swale located 50 m downslope from outlet of an unnamed alkali lake; no signs of recent flow.	B
BC-389	834.1	Unnamed Drainage	--	NVC	10	686193	5629043	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Shallow vegetated slope; no evidence of water or fluvial processes /Refer to Wetland Evaluation Technical Report of Volume 5C	A
BC-390	834.4	Unnamed Drainage	--	NVC	10	686094	5628743	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Wide grassy valley; no evidence of fluvial processes; dry gully begins >150 m downslope from site.	A
BC-391	834.4	Unnamed Drainage	--	NVC	10	686079	5628707	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Wide grassy valley; no evidence of fluvial processes.	A
BC-392	835.0	Unnamed Drainage	--	NVC	10	685885	5628144	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Well-defined dry, vegetated gully; no evidence of water scour or fluvial processes.	A
BC-393	835.1	Unnamed Drainage	--	NVC	10	685834	5628044	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Small vegetated swale; no evidence of scour or fluvial processes; /Refer to Wetland Evaluation Technical Report of Volume 5C.	A
BC-394	835.5	Unnamed Drainage	--	NVC	10	685732	5627701	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Vegetated small swale; no sign of alluvial processes.	A
BC-395	835.9	Unnamed Drainage	--	NVC	10	685608	5627331	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Vegetated swale; no sign of fluvial processes; no sign of scour; no bed or banks.	B
BC-396	836.2	Unnamed Drainage	Ephemeral	NCD	10	685722	5627066	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Vegetated ephemeral swale; no sign of fluvial processes; maybe have ephemeral runoff; no sign of scour; no bed or banks; no fish habitat or connectivity to fish habitat.	B

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-397	836.7	Unnamed Drainage	Ephemeral	NCD	10	685991	5626603	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Dry vegetated gully; no evidence of scour or alluvial material; no connectivity to fish habitat.	B
BC-398	837.0	Unnamed Drainage	Ephemeral	NCD	10	685929	5626322	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Dry vegetated gully; no defined channel; no evidence of scour or alluvial material; no connectivity to fish habitat.	B
BC-399	837.6	Unnamed Drainage	--	NVC	10	685852	5625718	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Dry open grassland.	A
BC-400	837.7	Unnamed Drainage	Ephemeral	NCD	10	685815	5625632	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Dry vegetated gully; sections of light scour; no continuous defined channel; no connectivity to fish habitat.	B
BC-401	838.1	Unnamed Drainage	-	NVC	10	685869	5625268	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Dry open grassland; no evidence of water or fluvial processes.	A
BC-402	838.5	Unnamed Drainage	Ephemeral	NCD	10	685913	5624810	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Dry ephemeral drainage; some evidence of flow; no defined channel; no connectivity to fish habitat.	B
BC-403	838.5	Unnamed Drainage	Ephemeral	NCD	10	685914	5624782	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Dry vegetated gully with no defined channel or recent flow; no fish habitat potential or connectivity to fish habitat.	B
BC-404	838.7	Unnamed Drainage	Ephemeral	NCD	10	685949	5624591	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Dry vegetated gully; no defined channel; no connectivity to fish habitat.	B
BC-405	839.0	Unnamed Drainage	--	NVC	10	685913	5624394	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Dry open grassland; no sign of water or fluvial processes.	A
BC-406	839.6	Unnamed Drainage	Ephemeral	NCD	10	685603	5623923	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Shallow dry vegetated gully; no evidence of a defined channel; no connectivity to fish habitat.	A
BC-407	839.6	Unnamed Drainage	--	NVC	10	685555	5623885	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Dry open grassland; no sign of water or fluvial processes.	A
BC-408	839.9	Unnamed Drainage	--	NVC	10	685353	5623627	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Dry open grassland; no sign of water or fluvial processes.	A
BC-409	841.5	Unnamed Drainage	--	NVC	10	684097	5622735	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Dry open grassland; no sign of water or fluvial processes.	A
BC-410	842.3	Unnamed Drainage	--	NVC	10	683328	5622323	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Dry open grassland; no sign of water or fluvial processes.	A
BC-411	843.0	Unnamed Drainage	Ephemeral	NCD	10	682903	5622073	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Dry vegetated gully; some evidence of scour; no continuous defined channel; no connectivity to fish habitat.	B
BC-412	844.1	Unnamed Drainage	Ephemeral	NCD	10	681893	5621557	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Dry vegetated gully; some evidence of scour; no continuous defined channel; no connectivity to fish habitat.	B

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-413 [2]	846.8	Thompson River	Perennial	S1A	10	681618	5619240	None (CH, CO, PK, SK, RB, BB, BT, MW, ST, LSU, CSU, PCC, RSC, L, KO, NSC, LT, CC, LNC, SU)	High	745.50 (20/08/13)	604.00 / 555.00	2.29	No	July 22 - August 15	July 22 - August 15	Summer/Winter	Trenchless with water quality monitoring	Open-cut with water quality monitoring inside timing window[4]	Access both banks	Access both banks	Navigable	Known presence of indicator and anadromous salmon species (BT, RB, CO, CH, PK, SK); high percentage of fines, no spawning gravels within ZOI; deep channel; limited by low channel complexity and lacks cover; no barriers; essential corridor for spawning salmon.	Comply with Federal and Provincial Regulations
BC-414	847.4	Unnamed Drainage (Wetland)	Seasonal	NCD-W (FB)	10	681765	5618675	NSC, RSC, PCC (None)	Low	--	--	--	Yes	None	Open	Summer/Winter	Isolation with fish salvage if water present	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge or Ramp and Culvert or Swamp Mats	Swamp Mats or other regulatory approved crossing method	Refer to Wetland Evaluation Technical Report of Vol. 5C	Low potential for salmonids but moderate habitat value for coarse fish / Refer to Wetland Evaluation Technical Report of Volume 5C.	Refer to Wetland Evaluation Technical Report of Vol. 5C
BC-415	847.5	Unnamed Drainage	Ephemeral	NCD	10	681794	5618601	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Drainage is situated in a ditch paralleling the railway line; no signs of scour or fluvial processes; ditch may collect storm runoff; no connectivity to fish habitat; no fish habitat potential.	A
BC-416	847.8	Unnamed Drainage	Ephemeral	NCD	10	681930	5618307	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Dry swale through open grassland; some short sections of scour; no continuous defined channel; no connectivity to fish habitat.	A
BC-417	848.2	Unnamed Drainage	Ephemeral	NCD	10	682077	5617936	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Dry vegetated gully; no sign of water or fluvial processes; no connectivity to fish habitat /Refer to Wetland Evaluation Technical Report of Volume 5C	B
BC-418	849.4	Unnamed Drainage	--	NVC	10	682267	5616790	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Dry vegetated gully; no sign of water or fluvial processes /Refer to Wetland Evaluation Technical Report of Volume 5C.	A
BC-419	850.1	Unnamed Drainage	--	NVC	10	682492	5616175	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Dry open grassland; no sign of water or fluvial processes.	A
BC-419a	853.6	Unnamed Drainage	--	NVC	10	683365	5612877	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Dry open grassland; no sign of water or fluvial processes.	A
BC-419b	854.1	Unnamed Drainage	--	NVC	10	683513	5612388	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Dry open grassland; no sign of water or fluvial processes.	A
BC-419c	854.3	Unnamed Drainage	--	NVC	10	683526	5612102	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Dry open grassland; no sign of water or fluvial processes.	A
BC-419d	855.3	Unnamed Drainage	--	NVC	10	683178	5611330	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Grassy sloping swale; alkali lake 480 m to the north; no signs of water or fluvial processes.	A
BC-419e	855.6	Unnamed Drainage	--	NVC	10	682947	5611189	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Dry grassy swale; no signs of water or fluvial processes.	A

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-419f	856.2	Unnamed Drainage	--	NVC	10	682455	5610813	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Dry swale in rolling rangeland; no signs of water or fluvial processes.	A
BC-419g	857.9	Unnamed Drainage	--	NVC	10	681442	5609459	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Dry grassy swale; no signs of water or fluvial processes; Jacko Lake 500 m east of PPC.	A
BC-426	858.4	Peterson Creek	Seasonal	S6	10	681479	5608990	None (None)	Low	--	2.48 / 1.74	0.50	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Dry intermittent channel with low fish habitat potential and multiple beaver dams. Potential beaver dam removal.	B or C
BC-427	860.9	Unnamed Drainage	Seasonal	NCD	10	683346	5607592	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Vegetated swale with wetland 30 m to the SW; gravel road with overflow culvert between PPC centre line and wetland; water may run through culvert and into PPC during flooding/freshet periods; no fish habitat potential /Refer to Wetland Evaluation Technical Report of Volume 5C.	A
BC-428	861.1	Unnamed Drainage	Seasonal	NCD	10	683603	5607613	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Vegetated depression; probable high water table with seasonal seepage in depression; no sign of channelization or alluvium; no connectivity to fish habitat.	A
BC-429	861.9	Unnamed Drainage	Seasonal	NCD	10	683951	5607002	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Low lying, wet, vegetated draw; no defined channel; no connectivity to fish habitat.	B
BC-430	862.4	Unnamed Drainage (Wetland)	Seasonal	NCD-W	10	684165	5606543	None (None)	Low	--	--	--	Yes	None	Open	Summer/Winter	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Small low lying wetland east of the existing TMPL ROW; no defined channel upslope or downslope; no standing water observed; steep approaches / Refer to Wetland Evaluation Technical Report of Volume 5C.	Refer to Wetland Evaluation Technical Report of Vol. 5C
BC-431	864.6	Unnamed Drainage	--	NVC	10	684779	5604390	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Vegetated depression; no sign of water or fluvial processes.	A
BC-432	865.0	Unnamed Drainage	--	NVC	10	684912	5604033	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Low lying vegetated draw; no sign of water or fluvial processes.	A
BC-433 [2]	865.2	Anderson Creek	Perennial	NCD-W (FB)	10	684973	5603816	RB (RB)	High	--	--	--	Yes	July 22 - August 15	July 22 - October 31	Summer/Winter	Isolation with fish salvage and water quality monitoring during low flow [3]	Open-cut with water quality monitoring inside timing window [4]	Clear-Span Bridge or other regulatory approved crossing method	Swamp Mats or other regulatory approved crossing method	Refer to Wetland Evaluation Technical Report of Vol. 5C	Moderate habitat potential for RB; beaver dam may restrict fish migration / Refer to Wetland Evaluation Technical Report of Volume 5C. Potential beaver dam removal.	Refer to Wetland Evaluation Technical Report of Vol. 5C
BC-434	865.4	Unnamed Drainage	Seasonal	NCD	10	685052	5603638	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Low-lying drainage; pockets of standing water and overland flow; no continuous defined channel; heavy cattle upstream; no connectivity to fish habitat.	B

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-435	865.8	Unnamed Channel	Seasonal	S6	10	685190	5603276	None (None)	Low	--	0.66 / 0.57	0.23	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Poor channel definition; 45-55% gradient downstream; dry channel in October 2013	C
BC-436	867.3	Unnamed Drainage	--	NVC	10	685735	5601959	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Low-lying vegetated area; no sign of water or fluvial processes.	A
BC-437	868.5	Unnamed Channel	Seasonal	S6	10	686290	5600861	None (None)	Low	0.003 (13/11/12)	0.95 / 0.70	0.19	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	30% gradient downstream; channel dissipates overland through low-lying wet area approximately 200 m downstream.	D
BC-438	869.9	Unnamed Drainage (Wetland)	Seasonal	NCD-W	10	686707	5599491	None (None)	Low	--	--	--	Yes	None	Open	Summer/Winter	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Connected to lake via 600 mm culvert that is blocked by beaver dam; fish habitat limited by low DO, few deep pools, and 100% fines in substrate; no fish captured or observed; Columbia Spotted Frogs and numerous bird species present / Refer to Wetland Evaluation Technical Report of Volume 5C. Potential beaver dam removal.	Refer to Wetland Evaluation Technical Report of Vol. 5C
BC-439	871.9	Unnamed Drainage (Wetland)	Seasonal	NCD-W	10	687026	5597621	None (None)	Low	--	--	--	Yes	None	Open	Summer/Winter	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Isolated low-lying wetland; no defined channel present; saturated ground; no connectivity to fish habitat / Refer to Wetland Evaluation Technical Report of Volume 5C.	Refer to Wetland Evaluation Technical Report of Vol. 5C
BC-440	872.3	Unnamed Drainage	--	NVC	10	686887	5597168	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Low-lying vegetated depression; no sign of water or fluvial processes.	A
BC-441*	874.2	Droppingwater Creek	Seasonal	TBD (S6)	10	686332	5595390	None (None)	TBD	0.003 (30/10/12)	4.30 / 2.92	0.43	No	none	Open	Summer/Winter	TBD	TBD	TBD	TBD	Class 2 Non-Navigable	Upper headwaters of Droppingwater Creek; shallow channel; lack of flow; shallow residual pool depths; flow recedes during fall/winter; cattle use.	C or D
BC-442	874.4	Droppingwater Creek	Seasonal	NCD	10	686285	5595191	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Small drainage; pooled water on existing TMPL ROW; saturated ground upslope and downslope; no defined channel; no connectivity to fish habitat.	A
BC-443	875.8	Unnamed Drainage	Seasonal	NCD	10	685872	5593803	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Overland flows and short sections of scour with alluvium, predominately organics/large cobble; non-continuous channel downslope; no connectivity to fish habitat.	A
BC-444	875.9	Unnamed Drainage	Seasonal	NCD	10	685866	5593735	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Low lying vegetated drainage; overland flow; pockets of standing water; short sections of scour and alluvium, no defined channel downslope; subsurface flows downslope; no connectivity to fish habitat.	A

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-445	876.4	Unnamed Drainage (Wetland)	Seasonal	NCD-W	10	685724	5593234	None (None)	Low	--	--	--	Yes	None	Open	Summer/Winter	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Isolated wetland; saturated ground; shallow pockets of standing water; no defined channel; no connectivity to fish habitat.	Refer to Wetland Evaluation Technical Report of Vol. 5C
BC-446	877.1	Unnamed Drainage	Seasonal	NCD	10	685490	5592537	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Low-lying draw; saturated ground; pockets of standing water; no continuous defined channel; no connectivity to fish habitat.	B
BC-447	878.5	Unnamed Drainage	Seasonal	NCD	10	685242	5591183	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Low-lying vegetated drainage; overland flow and pockets of standing water; no connectivity to fish habitat.	B
BC-448	879.7	Unnamed Drainage (Wetland)	Seasonal	NCD-W	10	685034	5590031	None (None)	Low	--	--	--	Yes	None	Open	Summer/Winter	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Isolated low-lying wetland; saturated ground; no connectivity to fish habitat / Refer to Wetland Evaluation Technical Report of Volume 5C.	Refer to Wetland Evaluation Technical Report of Vol. 5C
BC-449	880.5	Unnamed Drainage	--	NVC	10	684894	5589157	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Dry vegetated swale, no evidence of recent flow; no sections of scour or alluvium.	A
BC-450	881.6	Unnamed Drainage	--	NVC	10	684715	5588094	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	No sign of water or fluvial processes /Refer to Wetland Evaluation Technical Report of Volume 5C.	A
BC-451	883.5	Unnamed Drainage	--	NVC	10	684431	5586193	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Dry open grassland; no sign of water or fluvial processes.	A
BC-452	884.4	Unnamed Drainage	Ephemeral	NCD	10	684132	5585345	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Low-lying vegetated depression; no sign of water or fluvial processes; no connectivity to fish habitat.	B
BC-453	885.8	Unnamed Drainage	Ephemeral	NCD	10	683660	5584025	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Artificial irrigation drainage with steel lined sections; no continuous channel; drainage dissipates overland downslope; no connectivity to fish habitat.	A
BC-454	886.7	Unnamed Drainage	--	NVC	10	683334	5583267	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Grassy depression; no sign of water or fluvial processes.	A
BC-455	887.2	Unnamed Drainage (Wetland)	Seasonal	NCD-W	10	683136	5582765	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Isolated wetland vegetated with emergent vegetation; standing water and seepage present; no fish habitat or connectivity to fish habitat.	Refer to Wetland Evaluation Technical Report of Vol. 5C
BC-456	887.5	Unnamed Drainage	--	NVC	10	683023	5582442	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Open pasture; no sign of water or fluvial processes.	A
BC-457	888.2	Unnamed Drainage	--	NVC	10	682780	5581806	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Open pasture; no sign of water or fluvial processes.	A
BC-458	888.5	Unnamed Drainage	--	NVC	10	682675	5581523	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Open pasture; no sign of water or fluvial processes.	A

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-459 [2]	892.8	Moore Creek	Perennial	S2	10	681510	5577520	RB (EB, KO, LSU, RB)	High	0.08 (09/11/12)	8.65 / 6.67	0.69	No	July 22 - August 31	July 22 - August 31	Summer/Winter	Isolation with fish salvage and water quality monitoring [1]	Isolation with fish salvage and water quality monitoring during low flow[3]	Existing or Clear-Span Bridge	Existing or Clear-Span Bridge	Potentially Navigable	Moderate habitat for salmonids including RB, EB, and KO; juvenile RB captured within the ZOI; good riparian habitat and channel complexity; good cover; OHV, undercut banks, boulders; woody debris; mixture of coarse substrates with pockets of suitable gravel; some areas of high percentages of fines and cobble/boulder.	G
BC-460	893.5	Cultus Creek	Seasonal	S6	10	681326	5576938	None (None)	Low	--	2.25 / 1.58	0.51	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Small ephemeral drainage; dry channel at time of survey; marginal channel definition downstream.	B
BC-461	894.3	Unnamed Drainage	--	NVC	10	681484	5576062	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Dry vegetated upland area; no sign of water or fluvial processes.	A
BC-462	894.7	Unnamed Drainage	--	NVC	10	681505	5575694	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Open forest with no sign of scour, seepage, or fluvial processes.	A
BC-463	895.9	Unnamed Drainage	--	NVC	10	681625	5574539	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Open forest with no sign of scour, seepage, or fluvial processes.	A
BC-464	896.0	Unnamed Drainage	--	NVC	10	681615	5574388	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	PPC located in a clearing within an open forest; no visible scour or seepage.	A
BC-465	896.6	Unnamed Drainage	--	NVC	10	681409	5573831	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Grassy draw with no visible scour or seepage; steep approaches from the north and south.	A
BC-466	896.8	Disappearing Stream	Ephemeral	NCD	10	681361	5573674	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Low-lying draw; saturated soil; 35% gradient upslope; no connectivity to fish habitat.	B
BC-467	897.6	Unnamed Drainage	--	NVC	10	681081	5572950	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Dry grassland with no visible scour, seepage, or evidence of fluvial processes.	A
BC-468	898.4	Unnamed Drainage	Ephemeral	NCD	10	680804	5572189	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	25-30% gradient; short section of defined channel upslope from the PPC; no defined channel at or downslope from PPC; flows dissipate overland; no connectivity to Moore Creek.	A
BC-469	900.1	Unnamed Drainage	Ephemeral	NCD	10	679484	5571251	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Overland flow; some pockets of standing water along existing TMPL ROW; no connectivity to fish habitat.	A
BC-470	900.3	Rocky Gulch	Seasonal	S6	10	679324	5571089	None (None)	Low	0.01 (30/10/12)	4.0 / 2.80	0.66	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Low discharge in fall/winter; low migration potential attributed to steep gradient downstream; 1.0 m falls downstream	D
BC-471	901.6	Unnamed Drainage	--	NVC	10	678767	5570094	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Open forest with no visible scour or seepage.	A
BC-472	902.2	Unnamed Drainage	--	NVC	10	678255	5569769	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	No sign of water or fluvial processes.	A

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-473	903.3	Klup Creek	Perennial	S5	10	677393	5569142	None (None)	Low	--	4.50 / 3.33	0.27	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge or other regulatory approved crossing method	Snow/Icefill or other regulatory approved crossing method	Class 3 Non-Navigable	Dry ephemeral channel; marginal channel definition; channel definition lost downslope; dry conditions at time of sample; steep gradient section downstream; low connectivity to fish habitat.	C
BC-474	904.3	Unnamed Drainage	Ephemeral	NCD	10	677022	5568186	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Dry vegetated draw; no defined channel; overland flow; pockets of standing water; steep gradients downslope; no connectivity to fish habitat.	B
BC-475	905.6	Unnamed Drainage	Seasonal	NCD	10	676324	5567065	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Vegetated drainage; no defined channel; may support water during spring melt; tributary to fish habitat 3 km downstream.	A
BC-476	906.1	Unnamed Drainage	--	NVC	10	675988	5566747	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Dry grassy slope; no sign of water or fluvial processes.	A
BC-477	908.1	Unnamed Drainage	--	NVC	10	674055	5566599	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Dry grassy depression.	A
BC-478	910.5	Unnamed Drainage	--	NVC	10	671573	5566464	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Dry grassy area.	A
BC-479*	911.9	Zoht Creek	Seasonal	TBD (S6)	10	670287	5566662	None (None)	TBD	0.03 (28/10/12)	3.00 / 2.10	0.26	No	none	Open	Summer/Winter	TBD	TBD	TBD	TBD	Class 2 Non-Navigable	Sections with small pools, OHV, LWD, undercut banks, shallow channel; poorly defined banks, high cattle damage; no suitable gravels; shallow depth; low discharge.	B or C
BC-480	912.8	Unnamed Drainage	Seasonal	NCD	10	669599	5566211	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Short sections of scour; no continuous defined channel upslope or downslope; no connectivity to fish habitat.	A
BC-481	914.9	Unnamed Drainage	--	NVC	10	668628	5564387	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Dry gully; no sign of fluvial processes.	A
BC-482 [2]	915.9	Clapperton Creek	Perennial	S2	10	667892	5563721	RB (CO, ST, CH, and RB)	High	0.06 (27/10/12)	26.00/ 11.83	1.16	Yes	July 22 - August 1	July 22 - October 31	Summer/Winter	Isolation with fish salvage and water quality monitoring [1]	Isolation with fish salvage and water quality monitoring during low flow[3]	Existing or Clear-Span Bridge	Existing or Clear-Span Bridge	Potentially Navigable	Abundant juvenile RB captured and observed within ZOI; abundant velocity breaks, moderate in stream cover; woody debris, boulders; pockets of unembedded gravel sections of high percentage of cobble/boulder; no observed permanent barriers downstream; an identified falls downstream is a reported barrier to fish migration with CH, CO, RB, and ST located below (DFO, Kamloops).	G
BC-483	916.2	Unnamed Drainage	--	NVC	10	667641	5563530	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Dry grassland; no sign of water or fluvial processes; no connectivity to fish habitat.	A
BC-484	916.7	Unnamed Drainage	--	NVC	10	667320	5563147	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Dry grassland; no sign of water or fluvial processes.	A
BC-485*	918.0	Unnamed Channel	TBD	TBD (S6)	10	666631	5562292	TBD (None)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Summer/Winter	TBD	TBD	TBD	TBD	TBD	TBD	TBD

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-486*	918.3	Shuta Creek	Perennial	TBD (S3)	10	666104	5562101	RB (None)	High	TBD	TBD	TBD	TBD	TBD	TBD	Summer/Winter	Isolation with fish salvage and water quality monitoring [(1)]	Isolation with fish salvage and water quality monitoring during low flow[(3)]	Clear-Span Bridge	Clear-Span Bridge	TBD	RB captured upstream from PPC at secondary PPC option.	TBD
BC-487	918.6	Unnamed Channel	Seasonal	S6	10	665881	5561934	None (None)	Low	0.02 (10/04/13)	2.40 / 2.19	0.11	No	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Anthropogenic channel with altered banks and low instream complexity; poor channel definition and a lack of connectivity downstream.	C
BC-488	919.1	Unnamed Drainage	Seasonal	NCD	10	665535	5561578	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Low-lying wet area; no continuous defined channel; short sections of scour; sections of standing water and overland flow; no connectivity to fish habitat.	A
BC-489	919.6	Unnamed Drainage	--	NVC	10	665245	5561221	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Topographic depression through dry grassland area; no sign of water or fluvial processes; agricultural fields downslope.	A
BC-490	920.0	Unnamed Drainage	Ephemeral	NCD	10	665009	5560916	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Vegetated swale; no continuous defined channel; no evidence of scour or alluvial material; 16% gradient; some groundwater seepage upslope from existing TMPL ROW; no connectivity to fish habitat downslope.	B
BC-491	920.0	Unnamed Drainage	--	NVC	10	664976	5560874	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Topographic swale through native grassland; no sign of water or fluvial processes.	A
BC-492	920.2	Unnamed Drainage	--	NVC	10	664893	5560758	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Dry vegetated swale; no sign of water or fluvial processes.	A
BC-493	920.3	Unnamed Channel	Seasonal	S6	10	664768	5560614	None (None)	Low	--	1.50 / 0.98	0.09	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Existing or Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Marginal channel definition; poor discharge; low in stream complexity; subsurface flows 60 m downstream of existing TMPL ROW; several 1 m drops and gradients of 19% throughout ZOI; anticipated flow only during freshet.	B
BC-494	920.9	Unnamed Drainage	--	NVC	10	664423	5560244	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Dry gully; farmland 100 m downslope of existing TMPL ROW; no sign of water or fluvial processes.	A
BC-495	921.0	Unnamed Drainage	Seasonal	NCD	10	664309	5560098	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	No continuous defined channel; Hwy 5 culvert outlet 30m upslope; all flow dissipates overland downslope; no connectivity to fish habitat.	B
BC-496	921.5	Unnamed Drainage	Ephemeral	NCD	10	664001	5559732	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Dry vegetated gully; no sign of scour or alluium; signs of overland flow; no connectivity to fish habitat.	A

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-497	922.1	Unnamed Drainage	Ephemeral	NCD	10	663660	5559278	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Dry ephemeral drainage; 35% gradient downslope from Hwy 5; no sign of water or fluvial processes; no connectivity to fish habitat.	B
BC-498	922.9	Unnamed Drainage	--	NVC	10	663260	5558584	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Dry gully; active farmland 50 m downslope from existing TMPL ROW; no sign of water or fluvial processes.	A
BC-499	923.1	Unnamed Drainage	--	NVC	10	663152	5558362	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Dry gully; active farmland 50 m downslope from existing TMPL ROW; no sign of water or fluvial processes.	A
BC-500	923.4	Unnamed Drainage	--	NVC	10	663042	5558135	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Dry gully; active farmland 50 m downslope from existing TMPL ROW; no sign of water or fluvial processes.	A
BC-501	924.8	Unnamed Drainage	--	NVC	10	662247	5556864	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	No sign of water or fluvial processes.	A
BC-502	925.4	Unnamed Drainage	--	NVC	10	661893	5556514	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	No sign of water or fluvial processes.	A
BC-503	925.9	Unnamed Drainage	--	NVC	10	661620	5556219	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	No sign of water or fluvial processes.	A
BC-504 [2]	928.0	Nicola River	Perennial	S2	10	661603	5553985	CMC, CSU, RSC (BB, BL, BSU, BT, CAS, CCG, CH, CMC, CO, KO, LDC, LNC, LSU, LT, LW, MW, NSC, PK, PL, PCC, RB, RL, RSC, SK, ST, WSU)	High	--	22.00 / 17.33	2.03	No	July 22 - August 1	July 22 - August 1	Summer/Winter	Trenchless with water quality monitoring	Isolation during low flow [3] or open-cut inside timing window [4]; fish salvage and water quality monitoring	Clear-Span Bridge	Clear-Span Bridge	Navigable	CMC captured within ZOI; historical presence of RB, CH, CO, and BT; high water temperatures (22°C in July) limit salmonid rearing but enhance CMC rearing potential; good cover; OHV, deep pools; deep, turbid water and high amount of fines and small gravels limit spawning potential for salmonids but not limiting for CMC; large channel size, deep with perennial flow; no barriers /Refer to Wetland Evaluation Technical Report of Volume 5C. Potential beaver dam removal.	Comply with Federal and Provincial Regulations
BC-505	928.7	Hamilton Creek	Ephemeral	NCD	10	661438	5553262	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Dry ephemeral drainage; no continuous defined channel; historical evidence of scour and alluvial material in headwaters; no surface connectivity to fish habitat.	A
BC-506	929.0	Unnamed Drainage	Ephemeral	NCD	10	661281	5553075	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Dry ephemeral drainage; no continuous defined bed or banks; no evidence of recent fluvial processes; high cattle upstream in area; steep approaches.	B

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-507	929.1	Unnamed Drainage	Ephemeral	NCD	10	661225	5552990	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Dry vegetated swale through grassland; no continuous defined channel; no sign of recent flow; no connectivity to fish habitat.	A
BC-508	929.2	Unnamed Drainage	Ephemeral	NCD	10	661142	5552894	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Dry vegetated swale through grassland; no continuous defined channel; no sign of recent flow; short sections with bed and bank definition 75 m downslope; high cattle upstream; no surface connectivity to fish habitat.	A
BC-509	929.4	Unnamed Drainage	Ephemeral	NCD	10	661011	5552727	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Dry drainage through grassland; short intermittent sections of scour; no evidence of recent flow; no surface connectivity to fish habitat.	B
BC-510	929.8	Unnamed Drainage	Seasonal	NCD	10	660791	5552456	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Dry seasonal drainage; no continuous defined channel; receives seasonal runoff; no connectivity to fish habitat.	A
BC-511	930.0	Unnamed Drainage	--	NVC	10	660640	5552269	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Open grassland; no sign of water or fluvial processes.	A
BC-512*	931.0	Godey Creek	Seasonal	TBD (S3 or S6)	10	660029	5551498	TBD (None)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Summer/Winter	TBD	TBD	TBD	TBD	TBD	TBD	TBD
BC-513*	931.5	Unnamed Channel	TBD	TBD (S6 or NCD)	10	659740	5551131	TBD (None)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Summer/Winter	TBD	TBD	TBD	TBD	(None) or Refer to Wetland Evaluation Technical Report of Vol. 5C	TBD	TBD
BC-514*	931.5	Unnamed Channel	TBD	TBD (S6 or NCD)	10	659697	5551077	TBD (None)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Summer/Winter	TBD	TBD	TBD	TBD	(None) or Refer to Wetland Evaluation Technical Report of Vol. 5C	TBD	TBD
BC-515	931.9	Unnamed Drainage	Seasonal	NCD	10	659504	5550736	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Sporadic pockets of standing water; flows predominately subsurface and overland; no defined channel; no connectivity to fish habitat downstream.	A
BC-516	932.3	Spanish Creek	Ephemeral	NCD	10	659330	5550380	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Shallow gully; no sign of water or fluvial processes; sections of scour in separate depressions joining Spanish Creek near PPC; no connectivity to fish habitat.	A
BC-517	933.0	Unnamed Drainage	--	NVC	10	659063	5549736	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Dry pastureland; no sign of scour or fluvial processes.	A
BC-518	933.4	Unnamed Drainage	--	NVC	10	658916	5549349	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Dry rangeland; no sign of scour or fluvial processes.	A
BC-519	934.3	Unnamed Drainage	--	NVC	10	658234	5548891	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Grassy swale; no sign of fluvial processes; high cattle use area.	A

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-520	934.5	Unnamed Drainage	--	NVC	10	658104	5548687	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Vegetated gully; no sign of fluvial processes; site is within a high cattle use area.	A
BC-521	934.7	Unnamed Drainage	--	NVC	10	658041	5548496	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Open grassland area; no sign of fluvial processes; site is within a high cattle use area.	A
BC-522	935.1	Unnamed Drainage	--	NVC	10	657958	5548171	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Open grassland area at toe of Coquihalla Hwy retaining wall; no sign of fluvial processes; site is within a high cattle use area.	A
BC-523	935.5	Unnamed Drainage	--	NVC	10	657607	5547824	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Flat grassland; no sign of water or fluvial processes.	A
BC-524	935.7	Unnamed Drainage	--	NVC	10	657465	5547711	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Open grassland; no depression; no evidence of scour or recent flow.	A
BC-525	935.8	Unnamed Drainage	--	NVC	10	657444	5547689	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Gently sloping grassland; no sign of water or fluvial processes.	A
BC-526	935.9	Unnamed Drainage	Seasonal	NCD	10	657333	5547588	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Low-lying seepage area; no continuous defined channel; short sections of scour with pockets of standing water, natural swale is connected to BC-527 drainage complex; no surface connectivity to fish habitat /Refer to Wetland Evaluation Technical Report of Volume 5C.	A
BC-527	936.1	Unnamed Drainage	Seasonal	NCD	10	657198	5547447	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Low lying area; few sections of saturated soils; pockets of standing water; no connectivity to fish habitat /Refer to Wetland Evaluation Technical Report of Volume 5C	A
BC-528	937.5	Stirling Creek	Seasonal	S6	10	656488	5546326	None (None)	Low	--	1.10 / 0.96	0.22	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Dry seasonal channel; poor channel definition; surface flow present 200 m upstream from existing TMPL ROW; no flow through PPC.	B
BC-529	938.3	Unnamed Drainage	--	NVC	10	656796	5545557	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Vegetated depression; no scour, seepage, or evidence of fluvial processes.	A
BC-530	938.4	Unnamed Drainage	--	NVC	10	656813	5545490	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Vegetated depression; no scour, seepage, or evidence of fluvial processes.	A
BC-531	941.5	Kwinshatin Creek	Perennial	S3 (C)	10	655302	5543296	RB (None)	High	0.02 (07/08/13)	6.60 / 3.43	0.52	No	July 22 - October 31	July 22 - October 31	Summer/Winter	Isolation with fish salvage and water quality monitoring (1)	Isolation with fish salvage and water quality monitoring during low flow(3)	Clear-Span Bridge	Clear-Span Bridge	Class 3 Non-Navigable	Juvenile RB captured within ZOI; good channel complexity; good in stream cover; deep pools, OHV, LWD, undercut banks; sections of suitable gravels; logjams could limit migration during some flow levels; numerous deep pools; Community Watershed.	D

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-532	941.5	Unnamed Channel	Seasonal	S4 (C)	10	655245	5543246	None (None)	Low	0.009 (24/10/13)	0.60 / 0.48	0.18	Yes	July 22 - October 31	July 22 - October 31	Summer/Winter	Isolation with fish salvage and water quality monitoring if flowing(1)	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge or other regulatory approved crossing method	Swamp Mats or other regulatory approved crossing method	Class 1 Non-Navigable	Very small seasonal channel; rearing, wintering, spawning, and migration limited by small channel size, high percentage of fines in the substrate, and lack of depth; Community Watershed; converges with Kwinshatin Creek (FB) 50 m downstream from PPC	B
BC-533	941.7	Unnamed Channel	Perennial	S3 (C)	10	655084	5543189	None (None)	High	0.05 (24/10/13)	3.50 / 2.65	0.54	No	July 22 - October 31	July 22 - October 31	Summer/Winter	Isolation with fish salvage and water quality monitoring (1)	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge or other regulatory approved crossing method	Class 2 Non-Navigable	Juvenile RB captured 120 m downstream in Kwinshatin Creek; no barriers to migration; good in stream cover; undercut banks, OHV, LWD; sections of suitable gravels; Community Watershed.	D
BC-534	943.0	Skuagam Creek	Seasonal	S4 (C)	10	653987	5542890	None (None)	Low	0.01	2.00 / 1.21	0.20	Yes	July 22 - October 31	July 22 - October 31	Summer/Winter	Isolation with fish salvage and water quality monitoring if flowing (1)	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge or other regulatory approved crossing method	Class 2 Non-Navigable	Low fish habitat potential through PPC; sections of steep gradient and shallow depths; RB captured 1.6 km downstream in Coldwater River; some suitable gravels; OHV and SWD cover; Community Watershed.	C
BC-535	945.7	Unnamed Drainage	--	NVC	10	651725	5541537	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Dry upland site on pastureland; no evidence of fluvial processes.	A
BC-536	946.3	Castillion Creek	--	NVC	10	651260	5541241	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Open grassy field with no evidence of fluvial processes; may be subsurface flow.	A
BC-537	948.0	Unnamed Drainage	Seasonal	NCD	10	650122	5539975	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Dry seasonal drainage; small sections of scour and alluvial material; no continuous channel definition; overland flow through grassland and agricultural fields downslope.	A
BC-538	949.3	Salem Creek	Seasonal	S3	10	649400	5539010	RB (None)	Low	0.12 (14/05/13)	3.10 / 2.64	0.49	Yes	July 22 - October 31	July 22 - October 31	Summer/Winter	Isolation with fish salvage and water quality monitoring if flowing(1)	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Swamp Mats or other regulatory approved crossing method	Class 2 Non-Navigable	Low fish habitat potential through PPC; dry channel during 2012 survey; RB captured 300 m downstream from PPC; perched culverts, seasonal flow, and high water velocities limit fish migration through the PPC.	G
BC-539	949.9	Unnamed Drainage	Seasonal	NCD	10	649245	5538379	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Dry vegetated swale; no sign of recent flow; no crossing structures observed; no connectivity to fish habitat.	A
BC-540	951.5	Unnamed Drainage	--	NVC	10	648584	5536954	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Dry grassy area; no sign of water or fluvial processes.	A
BC-541	952.9	Unnamed Drainage	--	NVC	10	649383	5535891	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	No sign of water or fluvial processes; no crossing structures observed.	A

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-542	953.4	Unnamed Channel	Seasonal	S6	10	649668	5535454	None (None)	Low	0.01 (24/10/12)	3.00 / 2.18	0.18	No	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Shallow channel; low perennial habitat; minimal flow at the time of survey; perched culvert at Coldwater Road 150 m downstream.	C
BC-543	954.2	Unnamed Drainage	Seasonal	NCD	10	649960	5534617	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Sections of standing water and overland flow; no continuous defined channel; no connectivity to fish habitat.	A
BC-544	954.9	Unnamed Drainage	--	NVC	10	649973	5533988	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Topographic depression with no visible scour or channelization.	A
BC-545	955.3	Unnamed Drainage	Seasonal	NCD	10	649965	5533606	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Overland flow from groundwater seepage; no channelization or fish habitat potential.	B
BC-546	955.9	Unnamed Drainage	Seasonal	NCD	10	649858	5533024	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Evidence of historical flow; half pipe culvert installed at existing TMPL ROW; no channelization upstream or downstream from PPC; no fish habitat potential or connectivity to fish habitat.	B
BC-547	957.4	Unnamed Drainage	--	NVC	10	649417	5531667	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Site located in a large field; no sign of scour of fluvial processes..	A
BC-548 [2]	957.9	Coldwater River	Perennial	S1B	10	649365	5531263	CO, CH (BT, CC, CH, CO, BT, L, LDC, LNC, MW, PL, RB, ST, SU)	High	--	30.00 / 24.20	0.95	No	August 7 - August 10	August 7 - August 10	Summer/Winter	Trenchless with water quality monitoring	Isolation with fish salvage and water quality monitoring during low flow[3]	Clear-Span Bridge	Clear-Span Bridge	Navigable	Good side channel habitat with moderate cover with no observed barriers; perennial flow, few and shallow residual pools, lack of suitable spawning gravels; juvenile CO and CH salmon were captured in a side channel during the study.	Comply with Federal and Provincial Regulations
BC-549	958.1	Gillis Creek	Seasonal	S3	10	649333	5531024	CO, RB (RB)	High	0.02 (10/08/13)	5.20 / 3.73	0.41	Yes	July 22 – August 15	July 22 – August 15	Summer/Winter	Isolation with fish salvage and water quality monitoring if flowing[1]	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge or other regulatory approved crossing method	Clear-Span Bridge or other regulatory approved crossing method	Potentially Navigable	Juvenile RB and CO captured upstream from TMPL; deep pools and SWD cover upstream from PPC; intermittent flows in late summer/fall; potential for spring spawners (may be continual flows; pockets of unembedded gravels present); creek is fed by Gillis Lake which has historical RB presence; seasonal connectivity to Coldwater River /Refer to Wetland Evaluation Technical Report of Volume 5C.	C
BC-550	960.0	Unnamed Drainage	Seasonal	NCD	10	648669	5529335	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	No continuous defined channel; less than 100 m of continuous scour; wet area downstream of PPC; Pacific tree frog captured; no fish habitat potential or connectivity to fish habitat.	A

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-551	960.5	Kingsvale Creek	Seasonal	S6	10	648649	5528781	None (None)	Low	0.02 (14/07/13)	3.40 / 2.48	0.34	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Suitable fish habitat throughout PPC; cascades throughout reach are barriers to migration from the Coldwater River.	C or D
BC-552	960.7	Unnamed Drainage	Seasonal	NCD	10	648651	5528638	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Less than 100 m of continuous scour; pooled water upstream and downstream of PPC; no fish habitat potential or connectivity to fish habitat.	A
BC-553	961.7	Unnamed Drainage	Seasonal	NCD	10	648601	5527620	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Dry drainage; less than 100 m of continuous scour; no fish habitat potential or connectivity to fish habitat.	B
BC-554	961.9	Unnamed Channel	Perennial	S5	10	648582	5527400	None (None)	Low	0.03 (13/07/13)	4.30 / 4.22	0.37	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge or other regulatory approved crossing method	Class 3 Non-Navigable	Abundant cover, deep pools and perennial flow; sections of unembedded gravels; PPC is 2.3 km upstream from Coldwater River, series of cascades downstream of PPC are barriers.	D
BC-555	964.4	Unnamed Channel	Seasonal	S6	10	648076	5525040	None (None)	Low	0.01 (13/07/13)	4.00 / 1.53	0.22	No	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Small shallow channel; minimal flow at the time of survey; channel degraded by pugging; frogs observed; ponding upstream and downstream of PPC.	C
BC-556	965.4	Unnamed Channel	Seasonal	S6	10	648290	5524163	None (None)	Low	0.01 (12/07/13)	3.40 / 2.78	0.38	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Suitable fish habitat throughout PPC; series of cascades downstream of PPC are possible barriers from Coldwater River.	C or D
BC-557	965.9	Unnamed Drainage	--	NVC	10	648829	5524071	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Dry open forested area; no sign of water or fluvial processes.	A
BC-558	969.6	Unnamed Channel	Perennial	S5	10	648497	5520660	None (None)	Low	0.19 (28/05/13)	11.4 / 3.51	0.56	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge	Class 3 Non-Navigable	Perched culvert with high velocities at existing TMPL ROW is likely a barrier to migration; numerous pools, good riparian cover, some pockets of unembedded gravels; no fish captured or observed.	D
BC-559 [2]	970.3	Coldwater River	Perennial	S1B	10	648235	5520068	CO, RB (BT, C, CC, CH, CO, L, LDC, LNC, MW, PL, RB, RSC, ST, SU)	High	1.41 (20/10/13)	52.00 / 35.05	1.26	No	July 22 - August 1	July 22 - August 1	Summer/Winter	Trenchless with water quality monitoring	Isolation during low flow [3] or open-cut inside timing window [4]; fish salvage and water quality monitoring	Clear-span Bridge	Clear-span Bridge	Navigable	Excellent year round fish habitat; juvenile CO and RB captured and observed within ZOI; good in-stream cover; OHV, deep pools, boulders; unembedded spawning gravel; known to be important corridor for spawning ST, CH, and CO.	Comply with Federal and Provincial Regulations
BC-560	970.5	Unnamed Channel	Seasonal	S6	10	648132	5519800	None (None)	Low	0.06 (28/05/13)	4.10 / 2.37	0.35	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	33% reach gradient; abundant pools, boulders and OHV; small amounts of gravels, few deep pools	C

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-561	971.2	Unnamed Channel	Seasonal	S6/S4	10	647787	5519290	CO (None)	Low	0.01 (23/05/13)	1.10 / 0.91	0.14	Yes	July 15 - August 15	Open	Summer/Winter	Isolation with water quality monitoring if flowing	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Steep gradients, insufficient water depth, poor spawning substrate within PPC; sub-surface flow at existing TMPL ROW prevents upstream migration from Coldwater River; CO captured downstream from existing TMPL ROW; suitable CO rearing habitat near the confluence with the Coldwater River where gradient is less steep (2-3%) /Refer to Wetland Evaluation Technical Report of Volume 5C.	F or G
BC-562	972.0	Unnamed Channel	Perennial	S3	10	647147	5518682	CO (None)	Low	0.09 (22/05/13)	3.33 / 1.74	0.21	Yes	July 15 - August 15	July 15 - August 15	Summer/Winter	Isolation with fish salvage and water quality monitoring[1]	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge or other regulatory approved crossing method	Class 2 Non-Navigable	Backwatered and flooded across existing TMPL ROW at time of survey; low gradient; LWD and OHV cover; shallow depth and lack of pools; blocked culverts and 1.8 m falls downstream; some suitable spawning substrate, limited by flooding and marginally defined channel; culvert maintenance recommended /Refer to Wetland Evaluation Technical Report of Volume 5C.	E or G
BC-563	972.7	Unnamed Drainage	Seasonal	NCD	10	646994	5518123	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Dry gully; no defined bed or banks; no evidence of fluvial processes at centre of PPC; groundwater seepage begins 20 m downstream from centre of PPC; no fish habitat potential or connectivity to fish habitat.	B
BC-564	973.6	Unnamed Channel	Perennial	S3	10	646480	5517406	RB/ST, ST (None)	High	0.46 (16/05/13)	6.00 / 4.37	0.82	No	July 22 - October 31	July 22 - October 31	Summer/Winter	Isolation with fish salvage and water quality monitoring [1]	Isolation with fish salvage and water quality monitoring during low flow[3]	Clear-Span Bridge	Clear-Span Bridge	Class 3 Non-Navigable	Juvenile RB/ST captured within the ZOI and adult ST observed; deep pools, abundant boulder cover; pockets of suitable spawning gravel; resting pools along the margins, no barriers to passage.	G
BC-565	976.0	Unnamed Drainage	Seasonal	NCD	10	644982	5515741	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	No evidence of scour or alluvial deposits; no fish habitat potential within the PPC; some sub-surface flow upslope and isolated ponded area downslope; ponded area has no inlet or connectivity to Coldwater River.	A
BC-566	976.2	Unnamed Channel	Seasonal	S6	10	644860	5515533	None (None)	Low	0.01 (17/07/13)	1.05 / 1.19	0.26	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Shallow depth; sections of sub-surface flow	B or C

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-567	976.6	Unnamed Channel	Seasonal	S6/S4	10	644703	5515149	CO (None)	Low	0.02 (17/07/13)	1.40 / 1.17	0.16	Yes	July 15 - August 15	Open	Summer/Winter	Isolation with water quality monitoring if flowing	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Juvenile CO observed near confluence; no fish captured or observed near PPC; abundant cover, velocity breaks, high percentage of fines within PPC; 3.5 m falls and perched culvert with 1.3 m drop and no plunge pool downstream of PPC; likely dry/frozen to bottom in winter.	C
BC-568	978.5	Unnamed Channel	Seasonal	S6	10	643959	5513468	None (None)	Low	0.18 (17/07/13)	2.30 / 1.68	0.18	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	No fish captured or observed; sufficient cover, velocity breaks, high percentage of fines within PPC; mud-slide and sub-surface flow at 80 m downstream from PPC; likely dry/frozen to bottom in winter.	C
BC-569	978.9	Unnamed Drainage	--	NVC	10	643867	5513077	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	Dry forested area; no sign of water or fluvial processes.	A
BC-570 [2]	980.0	Coldwater River	Perennial	S1B	10	643453	5512173	CH, CO (BT, C, CC, CH, CO, L, LDC, LNC, MW, PL, RB, RSC, ST, SU)	High	2.43 (18/07/13)	56.00 / 33.67	1.18	No	July 22 - August 1	July 22 - August 1	Summer/Winter	Trenchless with water quality monitoring	Isolation with fish salvage and water quality monitoring during low flow[3]	Clear-Span Bridge	Clear-Span Bridge	Navigable	Abundant juvenile CO and CH captured and observed within ZOI; velocity breaks, good in-stream cover; OHV, undercut banks, boulders; pockets of unembedded spawning gravel, but high percentage of cobble/boulder in PPC; known to be important corridor for spawning ST, CH, and CO.	Comply with Federal and Provincial Regulations
BC-571 [2]	980.8	Juliet Creek	Perennial	S1B	10	643142	5511551	CH, CO (BT, CO, CH, RB)	High	0.17 (09/08/13)	34.50 / 22.53	3.67	No	July 22 - August 15	July 22 - August 15	Summer/Winter	Isolation with fish salvage and water quality monitoring[1]	Isolation with fish salvage and water quality monitoring during low flow[3]	Clear-Span Bridge	Clear-Span Bridge	Navigable	Juvenile CO and CH captured within ZOI; velocity breaks, deep pools, cover provided by rip-rap and bridge footings; numerous pockets of unembedded gravel; perennial flows and frequent pools; no barriers; good connectivity with Coldwater River.	G
BC-572	981.3	Unnamed Drainage	Seasonal	NCD	10	643066	5511108	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Constructed stormwater/snowmelt drainage along Hwy 5; discontinuous; no fish habitat potential; no connectivity to fish habitat.	A
BC-573	981.6	Unnamed Drainage	Seasonal	NCD	10	642951	5510790	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Constructed stormwater/snowmelt drainage along Hwy 5; discontinuous; no fish habitat potential; no connectivity to fish habitat.	A
BC-574	982.2	Unnamed Drainage	Seasonal	NCD	10	642958	5510218	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Dry vegetated drainage; defined channel <100 m long; no habitat potential or connectivity to fish habitat.	A

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-575	984.7	Unnamed Channel	Seasonal	S6	10	642896	5507669	None (None)	Low	0.02 (19/07/13)	1.68 / 1.36	0.19	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Suitable cover and velocity breaks throughout ZOI; lack of suitable residual pools; 0.7 m falls and steep gradients (45%) upstream of the PPC.	D
BC-575a	984.9	Unnamed Channel	Seasonal	S6	10	642932	5507504	None (None)	Low	0.01 (19/07/13)	0.95 / 1.48	0.13	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Shallow intermittent flow; NCD upstream and downstream from PPC; reach gradient >30%; high percentage of fines in substrate; no connectivity to fish bearing watercourse.	B or C
BC-576	985.3	Unnamed Channel	Seasonal	S6	10	642951	5507140	None (None)	Low	0.01 (30-05-13)	3.40 / 1.81	0.16	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Cover from OHV and woody debris, gravel substrates downstream from PPC); deep pools present; bed-drops, falls and 30% gradient, sections of sub-surface flow downstream from the PPC; left and right bank approaches 15% gradient.	C
BC-577	985.8	Unnamed Channel	Seasonal	S6	10	643030	5506576	None (None)	Low	0.04 (30/05/13)	3.80 / 2.85	0.38	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	In-stream cover from OHV, SWD, LWD; sections of suitable-sized unembedded gravel; few deep pools; 2.4 m falls with no plunge pool at 120 m downstream of PPC, seasonal sub-surface sections.	D
BC-578	987.0	Unnamed Drainage	--	NVC	10	643124	5505436	None (None)	None	--	--	--	--	None	Open	Summer/Winter	Open-cut	Open-cut	Ford	Ford	(None)	No evidence of a defined channel within the PPC; low-lying swale upslope from existing TMPL ROW; relic dry channel 60 m downslope.	A
BC-579	987.1	Mine Creek	Perennial	S2	10	643142	5505373	BT, CH, CO, RB (RB)	High	0.03 (19/07/13)	10.70 / 5.32	1.43	No	July 22 - August 15	July 22 - August 15	Summer/Winter	Isolation with fish salvage and water quality monitoring [1]	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge or other regulatory approved crossing method	Potentially Navigable	Juvenile CO, CH, RB, and BT captured within ZOI; anthropogenically altered and de-forested stream banks within Hwy 5 ROW and downstream of Hwy; velocity breaks, good in-stream cover; deep pools, boulders, woody debris; sections of unembedded gravel but high percentage of cobble/boulder in PPC; numerous deep residual pools within ZOI but few within PPC; good connectivity; no barriers.	G
BC-580	987.6	Unnamed Drainage	Seasonal	NCD	10	643154	5504788	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Short channelized sections upstream and downstream but less than 100 m of continuous scour; no fish habitat potential or connectivity to fish habitat.	A
BC-580a	987.9	Unnamed Drainage	Seasonal	NCD	10	643126	5504510	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Short sections of scour; overland flow through PPC; no fish habitat potential or connectivity to fish habitat.	A

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-581	989.4	Unnamed Channel	Ephemeral	S6	10	643351	5503030	None (None)	Low	--	2.60 / 1.72	0.24	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Dry at time of survey; NCD downstream from PPC; no connectivity to the Coldwater River /Refer to Wetland Evaluation Technical Report of Volume 5C	C
BC-582 (2)	990.0	Coldwater River	Perennial	S2	10	643548	5502492	CO (BT, C, CC, CH, CO, L, LDC, LNC, MW, PL, RB, RSC, ST, SU)	High	0.61 (22/11/13)	28.50 / 16.05	0.78	No	July 22 - August 1	July 22 - August 1	Summer/Winter	Trenchless with water quality monitoring	Isolation during low flow (3) or open-cut inside timing window (4); fish salvage and water quality monitoring	Clear-Span Bridge	Clear-Span Bridge	Navigable	Excellent year round fish habitat; juvenile CO captured within ZOI; good channel complexity and in-stream cover; OHV, deep pools, boulders; unembedded spawning gravel; known to be important corridor for spawning ST, CH, and CO.	Comply with Federal and Provincial Regulations
BC-583	992.9	Unnamed Channel	Seasonal	S6	10	643658	5500070	None (None)	Low	0.02 (23/07/13)	2.80 / 1.60	0.25	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Small channel with some cover; lack of deep pools, poor spawning substrate, and low discharge; perched culvert at 300 m downstream is barrier.	C or D
BC-584	994.2	Unnamed Channel	Seasonal	S6	10	642597	5499248	None (None)	Low	0.001 (23/07/13)	1.40 / 1.08	0.23	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Small channel with intermittent flow; lack of deep pools, poor spawning substrate, and low discharge; downstream gradient and perched culvert are barriers to migration.	C or D
BC-585	994.7	Unnamed Channel	Seasonal	S6	10	642119	5499045	None (None)	Low	--	1.10 / 0.79	0.15	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Small channel with intermittent flow; lack of deep pools, poor spawning substrate, and low discharge; gradient, sub-surface flow, perched culvert at 370 m downstream are barriers.	B or C
BC-585a	995.0	Unnamed Channel	Seasonal	S6	10	641879	5498830	None (None)	Low	0.001 (22/07/13)	3.20 / 1.81	0.29	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Small shallow channel; sections of sub-surface flow; large cliff between Coquihalla River and PPC prevents all migration.	B or C
BC-585b	995.3	Unnamed Channel	Seasonal	S6	10	641676	5498676	None (None)	Low	0.01 (22/07/13)	2.70 / 1.84	0.21	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Small shallow channel; sections of sub-surface flow; large cliff between Coquihalla River and PPC prevents all migration.	C or D
BC-586	995.4	Unnamed Channel	Seasonal	S6	10	641588	5498601	None (None)	Low	0.001 (22/07/13)	1.70 / 1.06	0.11	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Small channel, limited in-stream cover and very low discharge; sections of sub-surface flow; perched culvert at 370 m downstream is barrier.	C
BC-587	996.1	Dry Gulch	Seasonal	NCD	10	641169	5498087	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Existing or other regulatory approved crossing method	Ford	(None)	Very steep and high approach slopes; substantial erosion along approaches; no fish habitat potential.	A

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-588	997.3	Fallslake Creek	Perennial	S3	10	640281	5497243	None (RB)	High	0.39 (20/07/13)	6.30 / 4.43	0.68	Yes	August 1 - October 31	August 1 - October 31	Summer/Winter	Isolation with fish salvage and water quality monitoring [1]	Isolation with fish salvage and water quality monitoring during low flow[3]	Clear-Span Bridge	Clear-Span Bridge	Class 3 Non-Navigable	Historical presence of RB; good in-stream complexity and cover; OHV, undercut banks, boulders, deep pools; pockets of unembedded gravel but high percentage of cobble/boulders; numerous deep residual pools; falls downstream from PPC could be a barrier to upstream fish migration; good connectivity to upstream lake (Falls Lake), which has known RB presence.	F
BC-589	998.1	Unnamed Channel	Seasonal	S6	10	639690	5496684	None (None)	Low	0.002 (22/10/13)	1.80 / 1.29	0.23	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Ramp and Culvert or other regulatory approved crossing method	Class 2 Non-Navigable	Small channel with average reach gradient of >30%; shallow depths and no residual pools; high percentage of boulders; little to no fish habitat potential.	C
BC-589a	998.9	Unnamed Channel	Seasonal	S6	10	639130	5496113	None (None)	Low	--	1.50 / 1.12	0.27	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Ramp and Culvert or other regulatory approved crossing method	Class 1 Non-Navigable	Small channel with average reach gradient of >30%; shallow depths and no residual pools; high percentage of fines and organics in substrate; little to no fish habitat potential.	C
BC-590	999.0	Unnamed Channel	Seasonal	S5	10	639065	5496050	None (None)	Low	--	6.50 / 4.36	0.82	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge or other regulatory approved crossing method	Clear-Span Bridge or other regulatory approved crossing method	Class 3 Non-Navigable	High elevation channel with average reach gradient of >30%; shallow depths and few deep pools; high bedrock and boulder content; little fish habitat potential.	C
BC-590a	1001.8	Unnamed Channel	Seasonal	S6	10	635775	5495166	None (None)	Low	0.004 (23/10/13)	1.30 / 1.00	0.31	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Ramp and Culvert or other regulatory approved crossing method	Class 1 Non-Navigable	High elevation channel with average reach gradient of >30%; minimal discharge; 1.3 m falls immediately downstream from PPC; little fish habitat potential.	C
BC-591	1003.1	Boston Bar Creek	Perennial	S5	10	635516	5495168	None (DV/BT, RB and SST)	Low	0.07 (23/10/13)	8.00 / 5.80	0.82	Yes	August 1 - August 31	Open	Summer/Winter	Isolation during low flow	Open-cut inside timing window	Clear-Span Bridge	Clear-Span Bridge	Navigable	Abundant cover, deep pools, and pockets of suitable spawning gravels but permanent waterfall barrier ~10 km downstream is barrier to all fish species.	D
BC-592	1004.7	Unnamed Channel	Perennial	S5	10	634040	5495306	None (None)	Low	--	7.10 / 6.70	1.38	Yes	None	Open	Summer/Winter	Isolation during low flow	Open-cut inside timing window	Clear-Span Bridge or other regulatory approved crossing method	Clear-Span Bridge or other regulatory approved crossing method	Potentially Navigable	Waterfall barrier ~10 km downstream on Boston Bar Creek is barrier to all fish species; bedrock and boulder substrate; few pools and low channel complexity.	D
BC-593	1007.6	Unnamed Channel	Seasonal	S6	10	632086	5493332	None (None)	Low	0.04 (18/06/13)	5.00 / 2.80	1.22	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge or Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Channel is highly disturbed and degraded by frequent avalanche activity; a lack of pool depth and abundant debris jams	C or D

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-594	1008.6	Unnamed Channel	Seasonal	S6	10	631583	5492520	None (None)	Low	0.05 (18/06/13)	2.50 / 1.70	0.40	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Multiple cascade sections and culvert barriers to fish passage; limited by shallow residual pool depths	C
BC-595	1009.3	Unnamed Channel	Seasonal	S5	10	631385	5491846	None (None)	Low	--	15.00 / 10.38	1.26	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge	Potentially Navigable	Reach gradient exceeded 30%; large waterfall located 150 m upstream from PPC.	G
BC-596	1011.0	Boston Bar Creek	Perennial	S5	10	630582	5490531	None (DV/BT, RB and SST)	Low	--	15.00 / 12.83	1.35	Yes	August 1 - August 31	Open	Summer/Winter	Isolation during low flow	Open-cut inside timing window	Clear-Span Bridge	Clear-Span Bridge	Navigable	Permanent waterfall barrier in Boston Bar Creek ~2.6 km downstream is barrier to all fish passage	D
BC-597	1011.2	Unnamed Channel	Seasonal	S6	10	630503	5490398	None (None)	Low	0.04 (19/06/13)	1.40 / 1.05	0.80	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Trace amounts of cover throughout ZOI; lack of pool habitat; gradient barrier (42%) downstream from the PPC.	C or D
BC-598	1011.3	Unnamed Channel	Seasonal	S6	10	630506	5490306	None (None)	Low	0.03 (19/06/13)	0.90 / 0.68	0.58	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Gradient barrier (50%) downstream from the PPC	C
BC-599	1011.9	Unnamed Channel	Seasonal	S6	10	630317	5489632	None (None)	Low	0.003 (20/06/13)	1.60 / 1.38	0.33	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Gradient barrier (28%) downstream of the PPC and areas of subsurface flow	C
BC-600	1012.3	Unnamed Channel	Seasonal	S6	10	630253	5489294	None (None)	Low	0.01 (20/06/13)	0.90 / 0.73	0.36	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	Trace cover and a lack of pool habitat; gradient barrier (25%) downstream from the PPC.	C
BC-601	1012.6	Unnamed Channel	Seasonal	S6	10	630115	5489034	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Ramp and Culvert or other regulatory approved crossing method	Class 2 Non-Navigable	Shallow channel; reach gradient >25%; 3 m high perched culvert under Hwy 5 near confluence with Boston Bar Creek	C
BC-602	1013.0	Unnamed Channel	Seasonal	S6	10	629978	5488623	None (None)	Low	--	1.60 / 1.30	0.38	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Small watercourse; limited by shallow depth, lack of cover, steep gradient, 1.2 m falls, and lack of spawning substrate	B or C
BC-603	1013.1	Unnamed Channel	Seasonal	S6	10	629940	5488527	None (None)	Low	0.02 (08/08/13)	2.80 / 1.40	0.34	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Poor channel definition downstream; shallow depth, lack of cover, steep gradient, and lack of spawning substrate.	B or C
BC-604	1013.2	Unnamed Channel	Seasonal	S6	10	629909	5488419	None (None)	Low	0.01 (08/08/13)	2.40 / 1.43	0.37	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Small channel; shallow depth, lack of cover, steep gradient, and lack of spawning substrate.	B or C
BC-605	1013.3	Unnamed Channel	Seasonal	S6	10	629882	5488364	None (None)	Low	--	0.70 / 0.63	0.23	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	32% gradient; insufficient water depth; poor substrate; 2 m high cascade with no plunge pool; sub-surface sections.	B
BC-606	1013.7	Unnamed Channel	Seasonal	S6	10	629810	5487916	None (None)	Low	0.07 (12/05/13)	3.30 / 1.84	0.52	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Limited by shallow depths and steep gradient (30%); 13 m high waterfall near confluence with Boston Bar Creek	D
BC-607	1013.8	Unnamed Channel	Seasonal	S6	10	629805	5487880	None (None)	Low	0.04 (12/05/13)	3.30 / 1.60	0.52	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	26% gradient, insufficient pool depth, lack of instream cover; perched culvert and large waterfall downstream	B or C

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-608	1013.9	Unnamed Channel	Seasonal	S6	10	629749	5487807	None (None)	Low	0.07 (11/05/13)	6.50 / 3.10	0.56	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 3 Non-Navigable	Shallow high velocity channel; 40% reach gradient; steep cascade barriers upstream from confluence with Boston Bar Creek; perched culvert under Hwy 5.	D
BC-609	1013.9	Unnamed Channel	Seasonal	S6	10	629718	5487735	None (None)	Low	0.05 (11/05/13)	1.60 / 1.30	0.34	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	35% reach gradient and cascades near Boston Bar Creek confluence; low potential for fish	D
BC-610	1014.1	Unnamed Channel	Seasonal	S6	10	629703	5487588	None (None)	Low	0.03 (10/05/13)	3.20 / 2.20	1.16	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	35% reach gradient; high velocities; lack of pool formation; poor connectivity at confluence to Boston Bar Creek.	D
BC-611	1014.2	Unnamed Channel	Seasonal	S5	10	629684	5487467	None (None)	Low	0.25 (10/05/13)	9.00 / 4.40	1.85	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge or other regulatory approved crossing method	Class 3 Non-Navigable	25% average gradient, high velocities; lack of suitable substrates; low connectivity to Boston Bar Creek.	D
BC-612	1014.4	Unnamed Channel	Seasonal	S6	10	629655	5487296	None (None)	Low	0.02 (11/05/13)	1.70 / 1.35	0.69	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge or other regulatory approved crossing method	Class 2 Non-Navigable	36% reach gradient; low discharge, poor substrate composition; a perched culvert at confluence with Boston Bar Creek.	C or D
BC-613	1014.5	Unnamed Channel	Seasonal	S6	10	629649	5487203	None (None)	Low	0.01 (12/05/13)	1.60 / 1.10	0.33	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 1 Non-Navigable	40% reach gradient; low discharge; minimal instream cover; steep cascade at confluence with Boston Bar Creek.	C
BC-614	1014.6	Unnamed Channel	Seasonal	S5	10	629652	5487075	None (None)	Low	0.03 (09/05/13)	9.00 / 4.29	0.70	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge or other regulatory approved crossing method	Class 3 Non-Navigable	Shallow braided channel; 30% reach gradient; cascades and sections of overland flow upstream from confluence with Boston Bar Creek; perched culvert at Hwy 5.	C or D
BC-615	1014.8	Unnamed Channel	Seasonal	S5	10	629687	5486849	None (None)	Low	0.04 (09/05/13)	6.00 / 4.10	1.06	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge or other regulatory approved crossing method	Class 3 Non-Navigable	Shallow braided channel; 30% reach gradient; high velocities; lack of suitable spawning substrate; steep cascade upstream from confluence with Boston Bar Creek.	D
BC-616	1015.1	Unnamed Channel	Seasonal	S6	10	629705	5486631	None (None)	Low	0.04 (09/05/13)	3.70 / 2.47	1.17	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge or other regulatory approved crossing method	Class 1 Non-Navigable	Shallow seasonal watercourse; marginal definition; 30-45 % gradients; subsurface and overland flow; lack of pool formation and suitable substrates; overland flows for approximately 100 m downstream before converging with BCRA130 (NFB); steep cascade documented below.	C or D
BC-617	1015.3	Unnamed Channel	Seasonal	S5	10	629866	5486390	None (None)	Low	0.15 (08/05/13)	12.00 / 6.00	0.77	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge or other regulatory approved crossing method	Potentially Navigable	Steep cascade at confluence with Boston Bar Creek; shallow braided channel; the PPC is located along bench with 30% cascade barrier located downstream	D

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-618	1015.5	Unnamed Drainage	Seasonal	NCD	10	629917	5486225	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Steep drainage; evidence of defined channel with flows approximately 100 m upslope; no continuous defined channel at or downslope from PPC; no surface connectivity to Boston Bar Creek.	A
BC-619	1015.7	Unnamed Channel	Seasonal	S6	10	629997	5486080	None (None)	Low	0.05 (08/05/13)	2.80 / 2.20	0.78	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Shallow channel; 50% reach gradient; steep and overland flow sections	D
BC-619a	1015.8	Unnamed Drainage	Seasonal	NCD	10	630034	5486002	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Ramp and Culvert or other regulatory approved crossing method	(None)	Small vegetated drainage; some seepage and overland flow; sections of sub-surface flow; no connectivity to fish habitat; no habitat potential.	A
BC-620	1015.9	Unnamed Channel	Seasonal	S6	10	630055	5485888	None (None)	Low	0.02 (07/05/13)	3.00 / 2.10	0.47	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	43% average reach gradient; overland flow observed downslope with low connectivity to Boston Bar Creek.	D
BC-621	1016.1	Unnamed Drainage	Ephemeral	NCD	10	630174	5485665	None (None)	Low	--	--	--	--	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	(None)	Dry drainage; no continuous defined channel; open swale area prone to landslides; no surface connectivity to Boston Bar Creek.	B
BC-622	1017.9	Unnamed Channel	Seasonal	S6	10	629682	5484197	None (None)	Low	0.02 (07/05/13)	2.60 / 1.55	0.62	Yes	None	Open	Summer/Winter	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Snow/Icefill or other regulatory approved crossing method	Class 2 Non-Navigable	Fish habitat limited by shallow depths, perched culverts and steep reach gradient (>25%)	C or D
BC-623	1018.8	Unnamed Channel	Seasonal	S6	10	628952	5483841	None (None)	Low	0.02 (09/04/13)	5.10 / 2.60	0.97	Yes	None	Open	Summer	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Swamp Mats or other regulatory approved crossing method	Class 2 Non-Navigable	Shallow braided channel; 20-36% gradient; lack of habitat complexity; limited cover; marginal channel definition; sub-surface and overland flow.	C
BC-624	1019.0	Unnamed Channel	Perennial	S2	10	628804	5483822	RB (None)	Low	0.05 (09/04/13)	9.00 / 5.86	0.84	Yes	August 1 - October 31	August 1 - October 31	Summer	Isolation with water quality monitoring	Open-cut (DFO OS) if dry or frozen to bottom	Existing or Clear-Span Bridge	Existing or Clear-Span Bridge	Potentially Navigable	Juvenile RB captured downstream; pools and boulder cover; predominately large angular substrates; suitable depth and discharge provide year-round flow; 25% gradient; perched culvert upstream from the existing TMPL ROW; steep cascade downstream; Coquihalla River is within the ZOI.	G

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-625	1019.1	Unnamed Channel	Perennial	S3	10	628627	5483858	RB (None)	High	0.03 (10/04/13)	3.90 / 2.75	0.58	No	August 1 - October 31	August 1 - October 31	Summer	Isolation with fish salvage and water quality monitoring(1)	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge or other regulatory approved crossing method	Class 2 Non-Navigable	Juvenile RB captured within ZOI; perennial channel; cover from OHV, SWD and pools; step-pool morphology; lack of deep pools; shallow, narrow channel; angular substrate; shallow pool depths, narrow channel; 20% gradient near the existing TMPL ROW; steep falls upstream from existing TMPL ROW; Coquihalla River is located immediately downstream within ZOI.	G
BC-626	1019.5	Unnamed Channel	Perennial	S6	10	628301	5483898	None (None)	Low	0.01 (10/04/13)	2.10 / 1.82	0.02	Yes	None	Open	Summer	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Swamp Mats or other regulatory approved crossing method	Class 2 Non-Navigable	Small shallow channel; 11-35% gradient; lack of pool formation; angular substrates; waterfalls downstream.	C or D
BC-627	1019.6	Unnamed Channel	Perennial	S6	10	628206	5483899	None (None)	Low	0.02 (11/04/13)	4.20 / 2.96	0.20	Yes	None	Open	Summer	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Swamp Mats or other regulatory approved crossing method	Class 2 Non-Navigable	15-35% gradient; no surface connectivity to the Coquihalla River.	C
BC-628	1019.7	Unnamed Channel	Perennial	S5	10	628048	5483865	None (None)	Low	0.08 (11/04/13)	7.00 / 6.65	0.55	Yes	None	Open	Summer	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Existing or Clear-Span Bridge	Clear-Span Bridge or other regulatory approved crossing method	Potentially Navigable	Tributary to the Coquihalla River; 60% gradient downstream.	Comply with Federal and Provincial Regulations
BC-629 (2)	1020.3	Ladner Creek	Perennial	S2	10	627433	5483815	RB (DV/BT, RB, SST)	High	1.59 (11/04/13)	19.00 / 16.00	1.34	No	August 1 - August 31	August 1 - August 31	Summer	Isolation with fish salvage and water quality monitoring (1)	Isolation with fish salvage and water quality monitoring during low flow(3)	Existing or Clear-Span Bridge	Existing or Clear-Span Bridge	Navigable	Juvenile RB captured within the ZOI; multiple back eddies; boulder cover; occasional deep pools and SWD; areas of high percentages of large cobble and boulder; large channel size; perennial flow; close proximity to the Coquihalla River.	G
BC-630	1021.1	Unnamed Channel	Perennial	S3	10	626841	5483283	RB (None)	Low	0.08 (12/04/13)	11.26 / 4.69	0.28	Yes	August 1 - October 31	August 1 - October 31	Summer	Isolation with fish salvage and water quality monitoring(1)	Open-cut (DFO OS) if dry or frozen to bottom	Existing or Clear-Span Bridge	Clear-Span Bridge or other regulatory approved crossing method	Class 3 Non-Navigable	Juvenile RB captured within ZOI; small pools; OHV; woody debris; suitable spawning gravels; some sections with high percentages of fines; perched culvert; waterfalls and 40% gradient downstream from existing TMPL ROW.	G
BC-631 (2)	1021.8	Coquihalla River	Perennial	S1B	10	626828	5482656	BT/DV, RB/ST (BT/DV, CAL,CH, CM, CO, CSU, CCT, LDC, MW, PK, RB, SK, SST, ST)	High	3.26 (28/07/13)	43.00 / 34.42	0.93	No	August 1 - August 31	August 1 - August 31	Summer	Isolation with fish salvage and water quality monitoring during low flow (3)	Open-cut with water quality monitoring inside timing window (4)	Clear-Span Bridge	Clear-Span Bridge	Navigable	Juvenile RB/ST and BT/DV captured within the ZOI; historical presence of all 5 Pacific salmon species; abundant run sections with eddy pools along banks; perennial flow; pool and boulder cover; abundant unembedded gravels; deep residual pools; no barriers; low gradient; important migration corridor for spawning salmon.	Comply with Federal and Provincial Regulations

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-632 [2]	1022.9	Dewdney Creek	Perennial	S1B	10	626659	5481660	RB/SST (BT/DV, RB, SST)	High	0.77 (29/07/13)	32.00 / 21.73	1.53	No	August 1 - August 31	August 1 - August 31	Summer	Isolation with fish salvage and water quality monitoring [1]	Isolation with fish salvage and water quality monitoring during low flow[3]	Clear-Span Bridge	Clear-Span Bridge	Potentially Navigable	Juvenile RB/SST captured within the ZOI; historical presence of BT/DV and SST; perennial flow; pool and boulder cover; abundant unembedded gravels; numerous residual pools; no barriers; low gradient; good connectivity.	G
BC-633	1023.6	Unnamed Drainage	--	NVC	10	626584	5480911	None (None)	None	--	--	--	--	None	Open	Summer	Open-cut	Open-cut	Ford	Ford	(None)	Open vegetated area; no evidence of channelization or fluvial processes.	A
BC-634	1024.5	Karen Creek	Perennial	S2	10	626502	5480112	RB (RB, DV/BT)	High	0.10 (29/05/13)	9.00 / 6.27	0.82	No	August 1 - August 31	August 1 - August 31	Summer	Isolation with fish salvage and water quality monitoring [1]	Isolation with fish salvage and water quality monitoring during low flow[3]	Clear-Span Bridge	Clear-Span Bridge or other regulatory approved crossing method	Potentially Navigable	RB were captured within the ZOI, upstream of Hwy 5; abundance of cover and low velocities; abundance of suitable residual pools throughout; suitable spawning substrate; no barriers observed downstream of the PPC, gradient increases upstream of the PPC.	G
BC-635	1025.4	Unnamed Channel	Seasonal	S3	10	626133	5479285	RB (None)	High	0.01 (28/05/13)	4.20 / 2.93	0.58	No	August 1 - October 31	August 1 - October 31	Summer	Isolation with fish salvage and water quality monitoring if flowing[1]	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge or other regulatory approved crossing method	Class 2 Non-Navigable	Nine RB were caught downstream of the Hwy and two were caught upstream; abundant pools and in stream cover; shallow residual pool depths; suitable spawning substrates found downstream of the PPC; direct connectivity to Coquihalla River.	F or G
BC-636 [2]	1026.5	Coquihalla River	Perennial	S1B	10	625423	5478527	RB (BT/DV, CAL, CC, CCT, CT, CH, CM, CO, CSU, LDC, MW, PK, RB, SK, SST, ST)	High	--	59.00 / 43.67	0.91	No	August 1 - August 31	August 1 - August 31	Summer	Isolation with fish salvage and water quality monitoring during low flow [3]	Open-cut with water quality monitoring inside timing window [4]	Access both banks	Access both banks	Navigable	Juvenile RB were captured within the PPC; abundance of cover and low velocity pools along margins; sufficient residual pool depths, perennial flows, and no barriers observed; suitable spawning substrate).	Comply with Federal and Provincial Regulations
BC-637	1027.3	Unnamed Drainage	Ephemeral	NCD	10	624727	5478166	None (None)	Low	--	--	--	--	None	Open	Summer	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Swamp Mats or other regulatory approved crossing method	(None)	Dry drainage; no continuous defined channel; steep confined gully; overland and subsurface flow; no surface connectivity to fish habitat.	B
BC-638	1027.6	Unnamed Drainage	--	NVC	10	624482	5477979	None (None)	None	--	--	--	--	None	Open	Summer	Open-cut	Open-cut	Ford	Ford	(None)	Steep slide area; no sign of water or fluvial processes.	A

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-639 [2]	1028.6	Coquihalla River	Perennial	S1B	10	623566	5477661	RB (DV/BT, CAL, CH, CM, CO, CSU, CCT, LDC, MW, PK, RB, SK, SST, ST)	High	4.94 (10/02/13)	63.00 / 43.83	2.86	No	August 1 - August 31	August 1 - August 31	Summer	Isolation with fish salvage and water quality monitoring during low flow [3]	Open-cut with water quality monitoring inside timing window [4]	Access both banks	Access both banks	Navigable	Juvenile RB captured within the ZOI; abundant run sections with eddy pools along banks; perennial flow; pool and boulder cover; mixture of unembedded course substrate material; some sections of high percentage of large cobble and boulder; abundant run sections and pools; winter discharge of 4.94 m3/s February 2012); the Coquihalla River lies within the PPC.	G
BC-640	1028.9	Unnamed Channel	Seasonal	S5	10	623369	5477436	None (None)	Low	0.04 (13/04/13)	6.20 / 4.92	0.70	Yes	None	Open	Summer	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge	Class 3 Non-Navigable	No fish captured or observed; low habitat potential during low flows (becomes subsurface within PPC); at high flows there are deep pools; abundant cover from log jams; abundant pockets of suitable spawning gravels; poor connectivity upstream and downstream at low flow; debris jams; steep gradient upstream from PPC, but good surface connectivity during high flows.	D
BC-641	1030.6	Unnamed Drainage	Ephemeral	NCD	10	622640	5476053	None (None)	Low	--	--	--	--	None	Open	Summer	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Swamp Mats or other regulatory approved crossing method	(None)	Dry gully; no continuous defined channel; no evidence of recent flow; 60% gradient; no surface connectivity to fish habitat.	B
BC-642	1030.8	Unnamed Drainage	Ephemeral	NCD	10	622605	5475912	None (None)	Low	--	--	--	--	None	Open	Summer	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Swamp Mats or other regulatory approved crossing method	(None)	Melt-water drainage; 78% reach gradient; no continuous defined channel; no surface connectivity to fish habitat.	B
BC-643	1030.9	Unnamed Drainage	Intermittent	NCD	10	622572	5475810	None (None)	Low	--	--	--	--	None	Open	Summer	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Swamp Mats or other regulatory approved crossing method	(None)	58% reach gradient; short sections of scour; no continuous channel; overland flows upslope and downslope from existing TMPL ROW; subsurface flow within PPC; no direct connectivity to fish habitat.	B
BC-644	1031.4	Unnamed Channel	Seasonal	S5	10	622323	5475360	None (None)	Low	0.05 (13/04/13)	5.80 / 4.14	0.56	Yes	None	Open	Summer	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge	Class 3 Non-Navigable	Deep pools, good substrate composition downstream but angular substrates upstream from PPC; deep pools; 50% gradient upstream of existing TMPL ROW; multiple perched culverts at resource road and confluence to Coquihalla River.	D

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-645 [2]	1032.6	Coquihalla River	Perennial	S1B	10	622174	5474218	RB (DV/BT, CAL, CH, CM, CO, CSU, CCT, LDC, MW, PK, RB, SK, SST, ST)	High	--	61.00 / 47.50	1.48	No	August 1 - August 31	August 1 - August 31	Summer	Isolation with fish salvage and water quality monitoring during low flow [3]	Open-cut with water quality monitoring inside timing window [4]	Access both banks	Access both banks	Navigable	Juvenile RB captured in low velocity and off-channel habitat; Coquihalla River is known to support all 6 species of Pacific Salmon; side channel habitat present at CL; predominately larger substrates (cobble/boulder); extensive fast riffles; large perennial channel; year-round flow; no barriers observed.	G
BC-646	1033.2	Railway Creek	Perennial	S2	10	622080	5473623	RB (CM)	High	0.09 (31/10/12)	11.00 / 6.20	1.44	No	August 1 - September 15	August 1 - September 15	Summer	Isolation with fish salvage and water quality monitoring [1]	Isolation with fish salvage and water quality monitoring during low flow[3]	Clear-Span Bridge	Clear-Span Bridge	Potentially Navigable	Unidentified juvenile salmonid observed; previous records of CM; small pools; woody debris; OHV; good mixture of gravel and small cobble; areas of 40% gradient; a 16% cascade downstream; 40% gradient upstream from the proposed ROW; Coquihalla River located less than 250 m DS.	G
BC-647	1034.3	Unnamed Drainage	Seasonal	NCD	10	621855	5472615	None (None)	Low	--	--	--	--	None	Open	Summer	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Swamp Mats or other regulatory approved crossing method	(None)	Sections of scour and alluvial material upslope from PPC where gradient is steep (40%); no defined channel downslope; flow dissipates overland at existing TMPL ROW; no connectivity to fish habitat.	B
BC-648	1035.1	Unnamed Drainage	--	NVC	10	621937	5471849	None (None)	None	--	--	--	--	None	Open	Summer	Open-cut	Open-cut	Ford	Ford	(None)	Grassy depression between Othello Road and Coquihalla Hwy; no visible scour or seepage.	A
BC-649	1036.7	Unnamed Drainage	Seasonal	NCD	10	620583	5471250	None (None)	Low	--	--	--	--	None	Open	Summer	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Swamp Mats or other regulatory approved crossing method	(None)	Sections of scour and overland flow; 60% gradient; no defined channel downslope; no connectivity to fish habitat.	A
BC-650	1037.6	Unnamed Drainage	--	NVC	10	619757	5471047	None (None)	None	--	--	--	--	None	Open	Summer	Open-cut	Open-cut	Ford	Ford	(None)	Steep hillside; or crossing structure; no sign of water or fluvial processes.	A
BC-651*	1037.8	Unnamed Channel	TBD	TBD (S3 or S6)	10	619658	5471315	TBD (None)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
BC-652	1040.2	Unnamed Drainage	Seasonal	NCD	10	617359	5471054	None (None)	Low	--	--	--	--	None	Open	Summer	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Ramp and Culvert or other regulatory approved crossing method	(None)	Dry vegetated drainage; steep gradient downslope; potential for overland flow but no habitat potential or connectivity to fish habitat.	B
BC-653	1040.9	Unnamed Channel	Seasonal	S5	10	616819	5470795	None (None)	Low	--	4.20 / 3.16	1.24	Yes	None	Open	Summer	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Swamp Mats or other regulatory approved crossing method	Class 3 Non-Navigable	Reach gradient exceeds 30%; poor connectivity to Kawkawa Lake; fish habitat potential limited by gradient, poor discharge and lack of pool formation.	B or C

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-654 [2]	1043.2	Coquihalla River	Perennial	S1B	10	614660	5470366	RB, CAL (DV/BT, CAL, CH, CM, CO, CSU, CCT, LDC, MW, PK, RB, SK, SST, ST)	High	--	78.00 / 63.60	1.62	No	August 1 - August 31	August 1 - August 31	Summer	Trenchless with water quality monitoring	Isolation during low flow [3] or open-cut inside timing window [4]; fish salvage and water quality monitoring	Access both banks	Access both banks	Navigable	Juvenile RB captured along channel edges; moderate cover; boulders; OHV; woody debris; predominately fast riffles with large boulders; high percentage of large cobble and boulder; large perennial channel; confluence with Fraser River approximately 3 km downstream; stream is a known migratory corridor for all 6 species of Pacific Salmon.	Comply with Federal and Provincial Regulations
BC-655	1045.3	Unnamed Channel	Seasonal	S6/NC D-W (FB)	10	612871	5469900	CAL, RSC (None)	Low	--	4.50 / 2.52	0.69	Yes	None	Open	Summer	Isolation if flowing	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Swamp Mats or other regulatory approved crossing method	Class 1 Non-Navigable	RSC and CAL captured in wetland 200 m downstream from PPC; 30% reach gradient upstream from wetland precludes fish presence within PPC; low fish habitat potential (poor substrate, shallow depths, low discharge, lack of pools).	A; Refer to Wetland Evaluation Technical Report of Vol. 5C, for additional reclamation
BC-656	1047.0	Unnamed Drainage	--	NVC	10	611578	5469320	None (None)	None	--	--	--	--	None	Open	Summer	Open-cut	Open-cut	Ford	Ford	(None)	No crossing structure along existing TMPL ROW; no sign of water or fluvial processes.	A
BC-657 [2]	1047.2	Silverhope Creek	Perennial	S1B	10	611321	5469320	RB, CM, CAL (DV/BT, CAL, CCT, CM, CO, CSU, MW, PK, RB, ST, SST)	High	--	45.00 / 39.67	3.02	No	August 1 - August 31	August 1 - August 31	Summer	Isolation with fish salvage and water quality monitoring during low flow [3]	Open-cut with water quality monitoring inside timing window [4]	Access both banks	Access both banks	Navigable	Juvenile RB/ST, adult CM and CAL (COSEWIC) captured and/or observed within ZOI; boulder cover, velocity breaks; occasional side pools; fast riffles; unembedded course spawning substrate; sections of high percentage of large cobble and boulder; identified as a key spawning area for lower Fraser River ST; adult CM spawner observed; lake-fed, perennial system; deep pools; perennial flows; high velocity; no barriers observed.	G

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-658 [2]	1051.5	Chawuthen Creek	Perennial	S2	10	607106	5469038	Salmonid, CAL (CCT, SB)	High	--	25.00 / 20.00	4.12	Yes	August 1 - October 31	August 1 - October 31	Summer	Isolation with fish salvage and water quality monitoring [1]	Isolation with fish salvage and water quality monitoring during low flow [3]	Clear-Span Bridge	Clear-Span Bridge	Potentially Navigable	Unidentified juvenile salmonid observed downstream from the proposed ROW; wetland area; channels with deep pools; ample riparian vegetation; abundant cover; OHV; woody debris; undercut banks; IV; predominately fines; beaver dams within the ZOI; beaver dam pool habitat; seasonal beaver dam barriers; wetland complex (FSZ) located upstream from Hwy 5 with direct connectivity to the Fraser River /Refer to Wetland Evaluation Technical Report of Volume 5C. Potential beaver dam removal.	B
BC-659	1053.0	Unnamed Channel	Seasonal	S5	10	605590	5468876	None (None)	Low	--	5.00 / 4.38	0.85	Yes	None	Open	Summer	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge or other regulatory approved crossing method	Class 3 Non-Navigable	55% gradient cascade downstream from the PPC; dry channel at time of survey; entire reach exceeds 30% gradient.	C or D
BC-660	1053.1	Unnamed Channel	Seasonal	S5	10	605453	5468873	None (None)	Low	0.012 (02/11/12)	6.00 / 4.96	2.25	Yes	None	Open	Summer	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge or other regulatory approved crossing method	Class 3 Non-Navigable	Engineered channel with a 50% riprap cascade downstream from the PPC; minimal flow at time of survey; entire reach exceeded a 30% gradient; subsurface flows downstream from PPC; no connectivity to fish habitat.	D
BC-661	1055.1	Unnamed Drainage	--	NVC	10	603740	5468132	None (None)	None	--	--	--	--	None	Open	Summer	Open-cut	Open-cut	Ford	Ford	(None)	No sign of water or fluvial processes.	A
BC-662 [2]	1055.5	Hunter Creek	Perennial	S1B	10	603499	5467826	RB, CH, CO (CM, CO, CCT, PK, RB, SH, ST)	High	--	35.00 / 22.00	1.00	No	August 1 - September 15	August 1 - September 15	Summer	Isolation with fish salvage and water quality monitoring during low flow [3]	Open-cut with water quality monitoring inside timing window [4]	Clear-Span Bridge	Clear-Span Bridge	Navigable	Juvenile RB/ST, CH and CO captured within ZOI; boulder cover; velocity breaks; occasional deep pools; unembedded course substrate sections of high percentages of large cobble/boulder and fast riffles; large channel; perennial tributary to the Fraser River; no barriers observed.	G
BC-663	1056.7	Unnamed Drainage	Seasonal	NCD	10	602608	5467042	None (None)	Low	--	--	--	--	None	Open	Summer	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Swamp Mats or other regulatory approved crossing method	(None)	No evidence of scour or alluvial material; no connectivity to fish habitat.	A
BC-664	1057.5	Unnamed Drainage	--	NVC	10	602101	5466395	None (None)	None	--	--	--	--	None	Open	Summer	Open-cut	Open-cut	Ford	Ford	(None)	Open grassy swale; no sign of water or evidence of fluvial processes.	A
BC-665	1058.1	Unnamed Drainage	--	NVC	10	601657	5466006	None (None)	None	--	--	--	--	None	Open	Summer	Open-cut	Open-cut	Ford	Ford	(None)	No sign of water or evidence of fluvial processes; no crossing structures at Hwy 1.	A

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-666 [2]	1060.9	Lorenzetta Creek	Perennial	S2	10	600143	5463664	CO, CH, CM, RB, CAL (CC, CM, CO, CCT, PK, RB, ST)	High	1.73 (01/11/12)	14.00 / 10.33	1.23	No	August 1 - September 15	August 1 - September 15	Summer	Isolation with fish salvage and water quality monitoring during low flow [3]	Open-cut with water quality monitoring inside timing window [4]	Existing or Clear-Span Bridge	Existing or Clear-Span Bridge	Navigable	Abundant juvenile salmonids (CO, CH and RB) captured and observed within ZOI; low gradient, low velocity; deep pools; LWD; high percentage of fines; CM spawners observed at confluence with Wahleach Creek and CO spawning pair observed approx. 150 m downstream from proposed ROW; perennial flow; moderate pool depths, (0.3-0.8 m); high migration; no barriers observed; potential beaver dam removal.	F or G
BC-667	1061.2	Unnamed Channel	Seasonal	S6	10	600026	5463422	None (None)	Low	0.009 (14/04/13)	1.80 / 1.52	0.20	Yes	None	Open	Summer	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Swamp Mats or other regulatory approved crossing method	Class 2 Non-Navigable	Dry seasonal channel; marginal channel definition; poor connectivity downstream.	B or C
BC-668 [2]	1061.5	Wahleach Creek	Perennial	S1B	10	599776	5463191	RB, CH, CM, RSC (CM, CO, CCT, KO, PK, RB, SK, ST)	High	3.12 (01/11/12)	61.00 / 31.00	2.14	No	August 1 - August 15	August 1 - August 15	Summer	Isolation with fish salvage and water quality monitoring during low flow [3]	Open-cut with water quality monitoring inside timing window [4]	Existing or Clear-Span Bridge	Existing or Clear-Span Bridge	Navigable	Juvenile RB and CH captured within ZOI; boulders, LWD, OHV; good mixture of unembedded large gravel and small cobble; CM spawners observed approx. 400 m downstream at confluence with Lorenzetta Creek; lake-fed, perennial system; moderate pool depths (0.4-0.7 m); no barriers observed.	G
BC-669	1062.6	Unnamed Drainage	Seasonal	NCD	10	598968	5462452	None (None)	Low	--	--	--	--	None	Open	Summer	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Swamp Mats or other regulatory approved crossing method	(None)	Dry drainage; no continuous defined channel; 60% gradient; no connectivity to fish habitat.	B
BC-670*	1064.0	Unnamed Drainage	TBD	TBD (NCD)	10	597823	5461652	TBD (None)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Summer	TBD	TBD	TBD	TBD	TBD	TBD	TBD
BC-671	1064.5	Unnamed Drainage	--	NVC	10	597783	5461267	None (None)	None	--	--	--	--	None	Open	Summer	Open-cut	Open-cut	Ford	Ford	(None)	Dry grassy median between Hwy 1 and Peters Road; no evidence of fluvial processes.	A
BC-672	1064.5	Unnamed Drainage	--	NVC	10	597766	5461219	None (None)	None	--	--	--	--	None	Open	Summer	Open-cut	Open-cut	Ford	Ford	(None)	Dry grassy median between Hwy 1 and Peters Road; no evidence of fluvial processes.	A
BC-673*	1064.9	Unnamed Drainage	TBD	TBD (NCD)	10	597577	5460939	TBD (None)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Summer	TBD	TBD	TBD	TBD	TBD	TBD	TBD
BC-674	1065.1	Unnamed Channel	Seasonal	S6	10	597434	5460839	None (None)	Low	0.005 (25/04/13)	1.50 / 1.20	0.42	Yes	None	Open	Summer	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Swamp Mats or other regulatory approved crossing method	Class 1 Non-Navigable	Shallow seasonal watercourse; marginal channel definition; low instream cover; lack of suitable depth; 30% reach gradient.	B or C
BC-675	1065.4	Unnamed Drainage	Seasonal	NCD	10	597166	5460714	None (None)	Low	--	--	--	--	None	Open	Summer	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Swamp Mats or other regulatory approved crossing method	(None)	30% reach gradient; short sections of scour and overland flow; no continuous channel; no connectivity to fish habitat.	A

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-676	1065.6	Unnamed Channel	Ephemeral	S5	10	597027	5460598	None (None)	Low	--	5.80 / 5.40	1.64	Yes	None	Open	Summer	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge or other regulatory approved crossing method	Potentially Navigable	Engineered run-off channel; portions of channel near highway are concrete; 25-40% gradient; dry in fall 2012 and spring 2013; no connectivity to fish habitat.	C or D
BC-677	1066.3	Unnamed Drainage	Seasonal	NCD	10	596925	5459911	None (None)	Low	--	--	--	--	None	Open	Summer	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Swamp Mats or other regulatory approved crossing method	(None)	Dry swale; no evidence of scour, alluvium or dominant fluvial processes; no connectivity to fish habitat.	A
BC-678	1066.5	Unnamed Channel	Perennial	S5/S2	10	596902	5459693	RB (None)	Low	0.06 (2/11/12)	10.00 / 6.40	1.10	Yes	August 1 - October 31	August 1 - October 31	Summer	Isolation with water quality monitoring[1]	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge	Potentially Navigable	Juvenile RB captured at the confluence with Fraser River, but none observed or captured upstream from Hwy 1; shallow depths, lack of pool formation; steep gradients; lack of suitable spawning substrate; multiple culvert and gradient fish barriers throughout ZOI.	G
BC-679	1067.1	Unnamed Drainage	Seasonal	NCD	10	596730	5459121	None (None)	Low	--	--	--	--	None	Open	Summer	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Swamp Mats or other regulatory approved crossing method	(None)	25% reach gradient; some sections of scour and overland flow; no continuous channel definition; no connectivity to fish habitat.	B
BC-681	1069.2	Unnamed Channel	Perennial	S3	10	596336	5457111	CT (None)	High	0.03 (02/11/12)	6.20 / 4.94	1.34	Yes	August 1 - October 31	August 1 - October 31	Summer	Isolation with fish salvage and water quality monitoring[1]	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge	Class 3 Non-Navigable	Numerous juvenile and adult CCT captured/observed within ZOI; approx. 20 CCT observed in culvert outlet pool below perched culvert, approx. 85 m downstream; good channel complexity; cascade pool morphology; abundant cover; boulders; woody debris; deep pools); pockets of small spawning gravel exist with sections of high percentage of large substrates; year-round flows; capture of resident fish upstream from culvert barriers; cascade sections; Hwy 1 culverts are temporary barriers to upstream fish migration.	G
BC-682	1069.6	Unnamed Channel	Perennial	S5/S3	10	596246	5456765	CM, CT, RB (None)	Low	0.03 (15/04/13)	4.10 / 3.40	1.70	Yes	August 1 - September 15	August 1 - September 15	Summer	Isolation with water quality monitoring [1]	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge	Class 3 Non-Navigable	Juvenile and YOY CM, RB and CT were captured downstream near the confluence with the Fraser River; abundant woody debris and boulder cover; sufficient rearing pool depths; minimal amounts of suitable spawning substrate; numerous culvert and gradient barriers and cascade morphology.	G

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-683	1070.8	Unnamed Channel	Seasonal	S6/S3	10	596210	5455635	RB (None)	Low	--	3.39 / 2.74	0.52	Yes	August 1 - October 31	Open	Summer	Isolation with water quality monitoring if flowing	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Swamp Mats or other regulatory approved crossing method	Class 2 Non-Navigable	PPC situated on a bench between Hwy 1 North and Hwy 1 South; 55% gradient and a 10 m high cascade falls immediately downstream; 150 m downstream the gradient flattens, a ponded off-channel area to the Fraser River provides rearing habitat for juvenile salmonids; 1 juvenile RB captured.	D or G
BC-684	1071.0	Unnamed Channel	Seasonal	S5/S3	10	596283	5455373	RB, CM (None)	Low	0.04 (17/04/13)	4.90 / 3.53	0.74	Yes	August 1 - September 15	Open	Summer	Isolation with water quality monitoring if flowing	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge	Class 3 Non-Navigable	Hwy 1 and CN rail tracks create points of difficult access for fish; 25% gradient throughout and culvert barriers downstream; adult RB and YOY CM captured in a side channel to the Fraser River downstream from CN tracks; side channel provides good cover for salmonids; limited spawning substrates; deep pool habitat in side channel.	G
BC-685 [2]	1071.4	Unnamed Channel	Perennial	S1B	10	596317	5455056	RB, CM, CO, CAL (None)	High	0.08 (17/04/13)	23.00 / 20.00	5.00	No	August 1 - September 15	August 1 - September 15	Summer	Isolation with fish salvage and water quality monitoring [1]	Isolation with fish salvage and water quality monitoring during low flow[3]	Clear-Span Bridge	Clear-Span Bridge	Potentially Navigable	YOY CM, juvenile RB and CAL, and adult CO captured within ZOI; adult was captured in the fall near confluence with Fraser River; boulder cover; small deep pools; extensive riffle sections; high velocities near proposed ROW; areas of high percentages of large cobble/boulder; frequent movement of bedload material; perennial flow; close proximity/connectivity to the Fraser River.	G
BC-686	1072.1	Unnamed Channel	Seasonal	S6/S3	10	596147	5454321	TSB (None)	Low	0.01 (6/11/12)	3.40 / 2.90	0.80	Yes	None	Open	Summer	Isolation if flowing	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Swamp Mats or other regulatory approved crossing method	Class 2 Non-Navigable	TSB in pond downstream from the railway line within the ZOI; no channel outlet from pond; uniform shallow depths, lack of sufficient pools, high percentage of fine and organic substrate throughout ZOI; multiple barriers [culvert and gradient] downstream from PPC.	C
BC-687	1072.2	Unnamed Channel	Seasonal	S5	10	596090	5454269	None (None)	Low	0.021 (15/04/13)	7.00 / 6.33	1.15	Yes	None	Open	Summer	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge or other regulatory approved crossing method	Class 3 Non-Navigable	No fish captured or observed; shallow watercourse; 50% gradient upstream from PPC; channel converges with BC-686 upstream from Hwy 1 culvert, which drains into Herrling side channel with documented WSG spawning habitat.	D

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-688 [2]	1072.3	Unnamed Channel	Seasonal	S2	10	596065	5454183	CH, CT (None)	High	0.05 (05/11/12)	9.00 / 7.50	0.78	Yes	August 1 - September 15	August 1 - September 15	Summer	Isolation with fish salvage and water quality monitoring if flowing [1]	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge	Potentially Navigable	Juvenile CH and CCT captured approx. 150 m downstream; no fish captured or observed at proposed crossing; deep pools, presence of CH and CCT; pockets of suitable spawning gravels, sections of high percentage of large substrates; sections of steep gradient); numerous deep pools; areas of steep gradient; braided channel DS, good connectivity to Fraser River which is located within the ZOI, culvert is likely a seasonal barrier. This watercourse drains into Herrling side channel which is documented WSG spawning habitat.	G
BC-689	1072.6	Unnamed Channel	Perennial	S5/S2	10	596009	5453952	CO, RB, TSB (None)	Low	0.16 (05/11/12)	13.00 / 9.13	1.21	Yes	August 1 - September 15	August 1 - September 15	Summer	Isolation with water quality monitoring [1]	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge or other regulatory approved crossing method	Potentially Navigable	No fish captured or observed upstream from Hwy 1 and CN tracks; 36% reach gradient; culvert barriers downstream from PPC but gradient flattens downstream from Hwy 1 and CN culverts; watercourse discharges into side-channel area to Fraser River; juvenile and adult CO and juvenile RB captured and observed in off-channel area. This side channel is also known WSG spawning habitat.	G
BC-690	1072.8	Unnamed Channel	Perennial	S2	10	596046	5453690	CH, CM, RB (None)	High	0.60 (04/11/12)	18.00 / 9.42	1.37	Yes	August 1 - September 15	August 1 - September 15	Summer	Isolation with fish salvage and water quality monitoring [1]	Isolation with fish salvage and water quality monitoring during low flow[3]	Clear-Span Bridge	Clear-Span Bridge	Potentially Navigable	No fish captured or observed upstream from the existing TMPL ROW; however, channel is lake-fed and has potential for resident RB; 55% gradients immediately upstream; culvert barriers at the existing ROW; juvenile CH and RB and adult CM spawners captured and observed downstream from culverts within ZOI; rearing and spawning potential downstream from culvert barriers. This watercourse drains into Herrling side channel which is documented WSG spawning habitat.	G

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-691	1072.9	Unnamed Channel	Seasonal	S6	10	595933	5453569	None (None)	Low	0.004 (04/11/12)	1.40 / 1.10	0.16	Yes	None	Open	Summer	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Swamp Mats or other regulatory approved crossing method	Class 1 Non-Navigable	No fish captured or observed over 2 seasons of sampling; small poorly defined channel; shallow depths; barrier at confluence with BC-690 impedes upstream movement of fish. Drains into Herrling side channel which is documented WSG spawning habitat.	C
BC-692	1073.1	Unnamed Channel	Seasonal	S6	10	595817	5453440	None (None)	Low	0.012 (04/11/12)	3.40 / 2.62	0.53	Yes	None	Open	Summer	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Swamp Mats or other regulatory approved crossing method	Class 2 Non-Navigable	No fish captured or observed over 2 seasons of sampling; shallow watercourse; low discharge and steep gradient downstream. Sensitive WSG spawning habitat downstream.	C or D
BC-693	1073.2	Unnamed Channel	Perennial	S6/S3	10	595752	5453360	CO (None)	Low	0.03 (3/11/12)	3.30 / 1.58	0.55	Yes	July 15 - September 15	Open	Summer	Isolation with water quality monitoring if flowing	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert or other regulatory approved crossing method	Swamp Mats or other regulatory approved crossing method	Class 2 Non-Navigable	Juvenile CO captured 150 m downstream from PPC; within PPC there is little cover, shallow residual pool depths, high content of bedrock and boulder material, multiple bedrock cascades, and average reach gradient >30%. Potential beaver dam removal.	C
BC-694	1073.7	Unnamed Channel	Perennial	S6/S4	10	595504	5452961	CT (None)	Low	0.03 (5/11/12)	1.50 / 1.30	0.44	Yes	August 1 - October 31	August 1 - October 31	Summer	Isolation with water quality monitoring if flowing [1]	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Clear-Span Bridge or Ramp and Culvert	Class 2 Non-Navigable	No fish captured upstream from cascade barrier 50 m upstream from confluence; Juvenile and YOY CCT captured downstream from cascade; lack of suitable substrate and deep pools within PPC; cover from woody debris and small pools downstream from cascade; low discharge; reach gradient exceeds 25% upstream from existing TMPL ROW. Sensitive WSG spawning habitat downstream in Fraser River side channel.	G
BC-695	1074.2	Unnamed Channel	Perennial	S3	10	595281	5452423	CT (None)	High	0.03 (04/11/12)	3.80/ 2.63	0.57	No	August 1 - October 31	August 1 - October 31	Summer	Isolation with fish salvage and water quality monitoring [1]	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge	Class 2 Non-Navigable	Capture of juvenile CCT within ZOI; perennial flow, good pool depth; abundant woody debris and OHV; predominantly boulders and fines with some pockets of suitable spawning gravels; Fraser River located <100 m downstream; cascades and moderately steep gradients. Sensitive WSG spawning habitat downstream in Fraser River side channel.	G

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-696	1074.4	Unnamed Channel	Seasonal	S6	10	595149	5452278	None (None)	Low	0.01 (28/04/13)	1.08 / 0.66	0.09	Yes	None	Open	Summer	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Swamp Mats or other regulatory approved crossing method	Class 1 Non-Navigable	Small watercourse; poorly defined channel; multiple sub-surface and overland flow sections; multiple perched culverts. Sensitive WSG spawning habitat downstream in Fraser River side channel.	C
BC-697	1074.8	Unnamed Channel	Perennial	S3	10	594893	5452088	DV/BT, RB, CT (None)	Low	0.13 (04/11/12)	8.14 / 5.76	0.82	Yes	August 1 - August 31	August 1 - August 31	Summer	Isolation with fish salvage and water quality monitoring [(1)]	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge	Potentially Navigable	No fish caught upstream from Hwy 1 culvert; several large drops (>1.5 m) downstream from the existing TMPL ROW and perched culvert at Hwy 1; fish habitat quality improves below Hwy 1; juvenile DV/BT, RB and CCT captured approx. 125 m downstream below Hwy 1. Sensitive WSG spawning habitat downstream in Fraser River side channel.	G
BC-698	1075.0	Unnamed Drainage	Seasonal	NCD	10	594681	5451916	None (None)	Low	--	--	--	--	None	Open	Summer	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Swamp Mats or other regulatory approved crossing method	(None)	No continuous defined channel or evidence of recent flow; dry vegetated draw covered with moss and leaf litter; drainage may have flowed historically; no connectivity to the Fraser River.	B
BC-699	1075.2	Unnamed Drainage	--	NVC	10	594560	5451815	None (None)	None	--	--	--	--	None	Open	Summer	Open-cut	Open-cut	Ford	Ford	(None)	Open vegetated grassy area; no sign of water or fluvial processes; no culvert at Hwy 1.	A
BC-700	1076.0	Unnamed Channel	Seasonal	S4	10	593972	5451287	CO, RB (None)	High	0.001 (24/07/13)	1.80 / 1.40	0.40	No	August 1 - September 15	August 1 - September 15	Summer	Isolation with fish salvage and water quality monitoring if flowing[(1)]	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge or other regulatory approved crossing method	Class 2 Non-Navigable	RB and CO captured downstream from Hwy 1; no fish captured upstream from Hwy 1; good cover from OHV and undercut banks; low channel gradient; some gravel substrates, but high percentage of fines; low flows in fall. Sensitive WSG spawning habitat downstream in Fraser River side channel.	C or D
BC-701	1076.2	Unnamed Drainage	Ephemeral	NCD	10	593881	5451106	None (None)	Low	--	--	--	--	None	Open	Summer	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Swamp Mats or other regulatory approved crossing method	(None)	No continuous defined channel or evidence of recent flow; dry vegetated gully covered with moss, ferns, and woody debris; no connectivity to the Fraser River.	B
BC-702	1076.9	Unnamed Drainage	--	NVC	10	593333	5450669	None (None)	None	--	--	--	--	None	Open	Summer	Open-cut	Open-cut	Ford	Ford	(None)	Open grassy area within mixed forest; no sign of water or fluvial processes.	A
BC-703	1077.1	Unnamed Drainage	Seasonal	NCD	10	593144	5450531	None (None)	Low	--	--	--	--	None	Open	Summer	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Swamp Mats or other regulatory approved crossing method	(None)	No continuous defined channel; flowing water captured 160 m upstream from PPC in pond; no sign of fluvial process at the PPC; heavily disturbed anthropogenic area.	A

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-704	1077.8	Unnamed Channel	Seasonal	S6	10	592663	5450111	None (None)	Low	--	0.70 / 0.45	0.17	Yes	None	Open	Summer	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Swamp Mats or other regulatory approved crossing method	Class 1 Non-Navigable	Poorly defined seasonal watercourse with low fish habitat potential; no connectivity downstream.	B
BC-705	1078.2	Anderson Creek	Perennial	S2	10	592341	5449762	CT (BCB, BNH, CM, CO, CH, ST, CCT, DV/BT, PK, SG, CC, L, SK, TSB, RB, KO)	High	0.10 (11/08/12)	10.00 / 7.42	0.76	No	August 1 - August 15	August 1 - August 15	Summer	Isolation with fish salvage and water quality monitoring (1)	Isolation with fish salvage and water quality monitoring during low flow(3)	Clear-Span Bridge	Clear-Span Bridge	Potentially Navigable	Moderate to high potential for salmonids given suitable habitat value and historical fish presence; no fish were captured upstream from the proposed ROW but juvenile CT were captured downstream within zone of influence; abundant cover from boulders and deep pools; gravel spawning substrates; large perennial channel with abundant pools; no barriers downstream from existing TMPL ROW; steep gradient (24%) US); existing 2700 mm culvert at Hwy 1.	G
BC-706	1079.8	Bridal Creek	Perennial	S3	10	591017	5449193	CO, CT (CCT, CM, CO, CP, MW, PCC, RB, SB)	High	0.34 (08/10/13)	6.00 / 3.53	0.49	No	August 1 - September 15	August 1 - September 15	Summer	Isolation with fish salvage and water quality monitoring (1)	Isolation with fish salvage and water quality monitoring during low flow(3)	Clear-Span Bridge	Clear-Span Bridge	Class 3 Non-Navigable	One CT and one CO captured; good cover from OHV, deep pools and undercut banks; high percentage of fines; deep pools and perennial flow; TSB and Northwestern salamanders caught in wetland complex to the north.	C or D
BC-707	1080.0	Tributary to Bridal Creek	Perennial	S3	10	590839	5449098	CT (None)	High	0.09 (09/10/13)	3.50 / 2.35	0.58	No	August 1 – September 15	August 1 – September 15	Summer	Isolation with fish salvage and water quality monitoring (1)	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge	Class 2 Non-Navigable	Three CT caught in channel and CO and CT caught downstream in Bridal Creek; good cover, adequate depth, no barriers; high percentage of fines; TSB and Northwestern salamanders caught in wetland complex to the west.	C or D
BC-708	1083.4	Nevin Creek	Perennial	S3	10	588119	5447513	CO, CT (C, CAS, CCT, CO, CM, SB)	High	0.22 (01/11/13)	2.70 / 2.43	0.29	No	August 1 - September 15	August 1 - September 15	Summer	Isolation with fish salvage and water quality monitoring (1)	Isolation with fish salvage and water quality monitoring during low flow(3)	Clear-Span Bridge	Clear-Span Bridge	Class 2 Non-Navigable	Numerous CO and CT captured within PPC; abundant cover; OHV; undercut banks; frequent pools; pockets of spawning gravels; areas with high percentage of fines.	C
BC-709	1083.9	Dunville Creek	Perennial	S3	10	587695	5447186	CO (CO, CCT, RB, L, CC, SB, SU)	High	0.14 (06/11/12)	2.50 / 2.30	0.35	No	August 1 - September 15	August 1 - September 15	Summer	Isolation with fish salvage and water quality monitoring (1)	Isolation with fish salvage and water quality monitoring during low flow(3)	Existing or Clear-Span Bridge	Existing or Clear-Span Bridge	Class 2 Non-Navigable	Abundant CO captured and observed within ZOI; perennial channel, abundant riparian cover; OHV; IV); adult CO observed, pockets of suitable spawning gravels, areas of high percentage of fines; no fish movement barriers observed; connectivity to Hope Slough DS.	D or E

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-710	1084.4	Unnamed Channel	Seasonal	S3	10	587292	5446944	TSB (None)	Low	0.003 (29/04/13)	2.60 / 1.85	0.09	No	None	Open	Summer	Isolation with fish salvage if flowing	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Ramp and Culvert or other regulatory approved crossing method	Class 1 Non-Navigable	TSB captured 100 m DS, no salmonid presence; highly disturbed, small channel that is diverted into ditches through pastureland; shallow depth, lack of pool formation, high percentage of fines.	C or D
BC-711	1086.3	Unnamed Channel	Seasonal	S6	10	585530	5446201	None (None)	Low	--	1.90 / 1.60	0.10	Yes	None	Open	Summer	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Swamp Mats or other regulatory approved crossing method	Class 2 Non-Navigable	Small marginally defined channel; subsurface sections through farmland; low connectivity to fish habitat.	B
BC-712	1086.6	Unnamed Channel	Perennial	S3	10	585256	5446061	CO, TSB (None)	High	0.02 (25/04/13)	3.45 / 2.74	0.25	No	July 15 - September 15	July 15 - September 15	Summer	Isolation with fish salvage and water quality monitoring [1]	Open-cut (DFO OS) if dry or frozen to bottom	Existing or Clear-Span Bridge	Existing or Clear-Span Bridge	Class 2 Non-Navigable	Small irrigation channel; three juvenile CO were captured within the ZOI; abundant OHV and ISV; limited by low DO in summer; high percentage of fines, low gradient, no barriers, connectivity to Elk Creek.	C or D
BC-713	1087.6	Elk Creek	Perennial	S3	10	584311	5445607	CCT, CO, CH (CO, CCT, CM, PK, RB, SB, SU, CP, CC)	High	0.87 (25/04/13)	4.70 / 3.35	0.43	No	August 1 - September 15	August 1 - September 15	Summer	Isolation with fish salvage and water quality monitoring [1]	Isolation with fish salvage and water quality monitoring during low flow[3]	Clear-Span Bridge	Clear-Span Bridge	Potentially Navigable	Straight reach that has been altered for irrigational purposes; CO and CH captured within ZOI; low velocity habitat units; abundant cover; deep pools, OHV; perennial discharge); high percentage of fines, limited gravel deposition; no barriers, low gradient.	C or D
BC-714	1092.7	Semmihault Creek	Perennial	S3	10	579992	5443005	CAS, CC, CSU, NSC, TSB (CCT, CO, CP, LSU, PCC, RSC, SB, SSU)	High	0.08 (31/10/13)	5.40 / 5.00	0.67	No	August 1 - September 15	August 1 - September 15	Summer	Isolation with fish salvage and water quality monitoring [1]	Isolation with fish salvage and water quality monitoring during low flow[3]	Clear-Span Bridge	Clear-Span Bridge	Potentially Navigable	Numerous coarse fish species captured; potential for salmonids and for SARA-listed Salish sucker; low instream complexity; some OHV and ISV cover; high percentage of fines but pockets of gravels occur; suitable channel depths for staging and rearing.	D
BC-715 [2]	1094.0	Chilliwack Creek	Perennial	S2	10	578945	5442276	CO, CAS, CSU, TSB (BCB, BT/DV, CAS, CCT, CH, CM, CO, CP, CSU, NSC, PMB, SB, SSU, ST, WSG)	High	0.28 (26/04/13)	14.00 / 11.33	2.28	No	August 1 - September 15	August 1 - September 15	Summer	Isolation with fish salvage and water quality monitoring [1]	Isolation with fish salvage and water quality monitoring during low flow[3]	Clear-Span Bridge	Clear-Span Bridge	Navigable	Linear reach with laminar flow; four juvenile CO captured within the ZOI; potential for Salish sucker and white sturgeon; abundant OHV and ISV; low velocity habitat units; deep pools, perennial flow; high percentage of organics and fines; deep water, low gradient, no barriers.	F or G

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-716 [2]	1102.1	Chilliwack/Vedder River Side Channel	Perennial	S1B	10	571533	5439092	CO, CH, CM, TSB, CAS (CM, CO)	High	0.71 (08/11/12)	55.00 / 22.67	0.58	No	July 15 - September 15	July 15 - September 15	Summer	Trenchless with water quality monitoring (included with Chilliwack/Vedder River Trenchless)	Isolation with fish salvage and water quality monitoring[1]	Clear-span Bridge, Swamp Mats may be required	Clear-Span Bridge, Swamp Mats may be required	Navigable	Juvenile CO and CH captured within ZOI; perennial channel; abundant ISV, OHV and LWD; high percentage of fines but pockets of gravels occur; adult CM observed spawning at outlet to mainstem; channel constructed as DFO compensation project; abundant deep pools, potential beaver dam removal.	Comply with Federal and Provincial Regulations
BC-717 [2]	1102.3	Chilliwack/Vedder River	Perennial	S1B	10	571493	5438952	RB, CAS (DV/BT, CH, CM, CO, CCT, KO, PK, MW, RB, SK, ST, SU, WF, WSG)	High	--	102.0 / 81.50	0.93	No	August 1 - August 15	August 1 - August 15	Summer	Trenchless with water quality monitoring	Open-cut with water quality monitoring inside timing window[4]	Access both banks	Access both banks	Navigable	High; moderate-high rearing (abundant boulders; slow velocity pool habitat; OHV); moderate-high spawning (good mixture of course unembedded substrate); moderate-high overwintering (large perennial channel; occasional overwintering pools); high migration (low gradient; no barriers observed; known as a key SK migration route); multiple anglers observed near proposed crossing location.	Comply with Federal and Provincial Regulations
BC-718 [2]	1102.4	Chilliwack/Vedder River Side Channel	Perennial	S2	10	571484	5438838	CO, RB, TSB, CAS, CM (None)	High	0.06 (08/11/12)	26.00 / 15.03	0.55	No	August 1 - September 15	August 1 - September 15	Summer	Trenchless with water quality monitoring (included with Chilliwack/Vedder River Trenchless)	Isolation with fish salvage and water quality monitoring[1]	Clear-Span Bridge	Clear-Span Bridge	Potentially Navigable	Juvenile CO and RB captured in abundance; shaded pools; excellent riparian cover; OHV; ISV; suitable course substrate throughout and adult CM observed spawning; perennial channel; moderate discharge; presence of deep pools); good connectivity to Chilliwack/Vedder mainstem.	E or F
BC-719 [2]	1102.7	Unnamed Channel	Seasonal	S2	10	571315	5438591	CO, BSB (None)	High	--	28.00 / 16.33	0.35	No	July 15 - September 15	Open	Summer	Isolation with fish salvage and water quality monitoring if flowing	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge or Ramp and Culvert	Swamp Mats or other regulatory approved crossing method	Potentially Navigable	Juvenile CO captured and observed in abundance in pooled areas; large oxbow lake downstream; slow moving water; off channel habitat; ISV; OHV; high percentage of fines and organic material; good depth in oxbow lake; low flows throughout channel; connectivity to the Chilliwack/Vedder River side channel approx. 200 m downstream; lack of discharge; fluctuating water levels /Refer to Wetland Evaluation Technical Report of Volume 5C.	E or F

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-720	1103.2	Street Creek	Perennial	S3	10	571211	5438091	CO, RB (CO, CM, ST, CCT, PK, RB, L, CC, SB)	High	0.09 (28/07/13)	7.50 / 4.88	0.22	No	August 1 - September 15	August 1 - September 15	Summer	Isolation with fish salvage and water quality monitoring (1)	Isolation with fish salvage and water quality monitoring during low flow(3)	Clear-Span Bridge	Clear-Span Bridge or other regulatory approved crossing method	Class 3 Non-Navigable	Juvenile CO and RB captured; shaded pools; good riparian cover; OHV, ISV, undercut banks; suitable spawning gravel patches interspersed with large sections of fines; numerous pools but shallow residual pools depth; no barriers; low gradient; good connectivity to Chilliwack/Vedder mainstem.	C or D
BC-721	1105.0	Unnamed Channel	Seasonal	S4	10	570016	5436776	CO (None)	High	--	1.60 / 1.35	0.47	No	July 15 - September 15	July 15 - September 15	Summer	Isolation with fish salvage and water quality monitoring if flowing (1)	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge or Ramp and Culvert	Clear-Span Bridge or other regulatory approved crossing method	Class 2 Non-Navigable	Heavily disturbed irrigation ditch; juvenile CO captured within the PPC; abundant ISV and OHV, limited by small channel size; shallow pool depth; seasonal flow regime; 100% fines and organics; no barriers; low gradient; low flows in the late summer.	C
BC-722	1106.0	Stewart Slough	Perennial	S2	10	569056	5436489	CO, TSB (BH, CC, CM, CO, CCT, L, RB, RSC, TSB, NP)	High	0.11 (10/10/13)	10.00/9.33	0.56	No	August 1 - September 15	August 1 - September 15	Summer	Isolation with fish salvage and water quality monitoring (1)	Isolation with fish salvage and water quality monitoring during low flow(3)	Clear-Span Bridge	Clear-Span Bridge or other regulatory approved crossing method	Potentially Navigable	Moderate rearing potential for salmonids (deep pools and abundant ISV); two juvenile CO captured upstream from PPC; high percentage of fines; low D.O. in late summer/fall; no barriers, although choked with vegetation in some sections during low flow.	D
BC-723	1110.1	Unnamed Channel	Perennial	S3	10	565040	5435749	TSB (None)	Low	--	5.40 / 4.47	0.59	Yes	None	Open	Summer	Isolation with fish salvage	Open-cut (DFO OS) if dry or frozen to bottom	Existing or Clear-Span Bridge or Ramp and Culvert	Ramp and Culvert or other regulatory approved crossing method	Class 3 Non-Navigable	TSB captured within ZOI; sufficient amounts of instream and riparian cover; lack of sufficient residual pool depths; limited by high content of fine substrate material; limited by lack of culverts to facilitate un-interrupted flow along ditch-line.	C
BC-724	1110.1	Unnamed Channel	Perennial	S3	10	565020	5435745	TSB, RSC (None)	Low	0.08 (23/05/13)	4.10 / 3.70	0.50	No	None	Open	Summer	Isolation with fish salvage	Open-cut (DFO OS) if dry or frozen to bottom	Existing or Clear-Span Bridge or Ramp and Culvert	Ramp and Culvert or other regulatory approved crossing method	Potentially Navigable	Abundance of instream and riparian cover; limited by a lack of sufficient residual pools; limited by high content of fine substrate material; no barriers observed throughout reach.	C
BC-725 (2)	1110.7	Sumas Lake Canal	Perennial	S1B	10	564480	5435646	TSB, RSC, PMB, NSC, SA (CAS, CM, CO, RSC)	High	--	24.00 / 23.67	1.28	No	July 15 - September 15	July 15 - September 15	Summer	Isolation with fish salvage and water quality monitoring during low flow (3)	Open-cut with water quality monitoring inside timing window (4)	Clear-Span Bridge	Clear-Span Bridge	Navigable	One unidentified adult salmonid observed in channel at time of survey; artificial canal; perennial flow; good depth; ISV along edges; substrate is predominately fines; no barriers observed.	F

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-726 [2]	1114.6	Sumas River	Perennial	S1B	10	560553	5435216	RSC, TSB (BCB, BH, BNH, CBC, CC, CH, CM, CO, CP, CCT, DC, DV/BT, KO, L, MW, NSC, PK, RB, SB, RSC, WSG, SK, ST, SU, WCT, WF)	High	--	43.00 / 38.83	2.38	No	August 1 - August 15	August 1 - August 15	Summer	HDD with water quality monitoring	Other regulatory approved trenchless method	Access both banks	Access both banks	Navigable	No salmonids captured or observed; historical fish presence indicates potential for SG and salmonids, including WCT; modified channel for flood control purposes; good depth; IV; OHV along channel edges; slow water velocity; high percentage of fines; no barriers observed.	Comply with Federal and Provincial Regulations
BC-727	1116.1	Neufeld Creek	Seasonal	S6	10	559232	5435510	None (None)	Low	0.01 (31/10/13)	2.10 / 1.48	0.17	Yes	None	Open	Summer	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Ramp and Culvert or other regulatory approved crossing method	Class 2 Non-Navigable	Small watercourse; shallow depths; poor channel definition; substrate dominated by fines and organics; 40 m high falls with gradient >100% at 300 m downstream.	C
BC-728	1116.5	Tributary to Marshall Creek	Seasonal	S5	10	558821	5435770	None (None)	Low	--	8.50 / 5.15	1.30	Yes	None	Open	Summer	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Existing or Clear-Span Bridge	Clear-Span Bridge or other regulatory approved crossing method	Potentially Navigable	Poorly defined channel near PPC; gradient increases downstream; perched culvert 1.6 m high, 300 m downstream from PPC; poor connectivity to fish habitat downstream (>2.5 km).	C
BC-729[2]	1118.8	Tributary to Clayburn Creek/ Ledgeview Creek	Seasonal	S5	10	556741	5435990	None (None)	Low	0.03 (30/04/13)	12.00 / 5.70	1.94	Yes	None	Open	Summer	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge or other regulatory approved crossing method	Potentially Navigable	Impassable falls (~20 m high) approximately 250 m downstream from the existing TMPL ROW; no fish captured or observed above falls over 2 seasons of sampling.	D
BC-730	1120.2	Unnamed Channel	Perennial	S3	10	555464	5435985	CT, CO (None)	High	0.09 (21/11/12)	7.30 / 4.53	1.00	No	August 1 - September 15	August 1 - September 15	Summer	Isolation with fish salvage and water quality monitoring [1]	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge	Class 3 Non-Navigable	Juvenile CT captured near the proposed crossing location; perennial flow; abundant cover provided by undercut banks, OHV, pools, and LWD; good channel complexity provided by riffle-pool sequences; mixture of fines and course spawning substrate); 2 adult CO spawners observed within ZOI approx. 200m downstream; riffle-pool sequence with good pool depth and perennial flow; no permanent migration barriers but limited by higher gradient section DS).	G
BC-731	1122.4	Clayburn Creek	Perennial	S2	10	553409	5436669	CO, RB, TSB (CO, CM, CH, PK, ST, RB, KO, CCT, CT, SG, CAS, L, TSB, SK, DV/BT, WSG)	High	0.44 (29/04/13)	6.15 / 5.31	0.97	No	August 1 - August 15	August 1 - August 15	Summer	Isolation with fish salvage and water quality monitoring [1]	Isolation with fish salvage and water quality monitoring during low flow[3]	Clear-Span Bridge	Clear-Span Bridge	Potentially Navigable	Moderate rearing potential sufficient instream and riparian cover; OHV; pools; woody debris; perennial flows, sufficient residual pool depths; suitable spawning substrate composition; no barriers observed throughout reach; low gradient.	F or G

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-732	1123.4	Clayburn Creek	Perennial	S2	10	552480	5437022	CO, TSB (CO, CM, CH, PK, ST, RB, KO, CCT, CT, SG, CAS, L,TSB, SK, DV/BT)	High	--	10.00 / 8.33	0.10	No	August 1 - August 15	August 1 - August 15	Summer	Isolation with fish salvage and water quality monitoring (1)	Isolation with fish salvage and water quality monitoring during low flow(3)	Clear-Span Bridge	Clear-Span Bridge or other regulatory approved crossing method	Potentially Navigable	Juvenile CO were captured within and upstream from the PPC; low water velocities; deep pool; riparian cover; sufficient depths throughout reach; perennial flow; spawning limited by high content of fine substrate material; no barriers observed.	F or G
BC-733	1125.2	Tributary to Gilford Slough	Perennial	S3	10	550725	5437686	TSB (CO, CCT, TSB, RSC)	Low	--	3.60 / 3.25	0.71	Yes	August 1 - September 15	Open	Summer	Isolation with fish salvage and water quality monitoring	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge	Potentially Navigable	Rearing limited by lack of available cover and low DO; lack of sufficient residual pool depths; high content of fine substrate material; lack of downstream connectivity and floodgate/weir located 100 m downstream from the PPC.	C or D
BC-734 (2)	1127.8	McLennan Creek	Perennial	S2	10	548392	5438571	CO, TSB, RSC (CO, CH, CM, SK, PK, KO, ST, SG, RB, CCT, DV/BT, L, TSB, BNH, CCG, CC, RSC)	High	--	10.00 / 6.83	0.52	No	August 1 - August 15	August 1 - August 15	Summer	Isolation with fish salvage and water quality monitoring (1)	Isolation with fish salvage and water quality monitoring during low flow(3)	Clear-Span Bridge	Clear-Span Bridge	Potentially Navigable	Juvenile CO captured; perennial flow; abundant cover; OHV; ISV deep pools; 100% fines and organics in substrate; low gradient; no barriers.	F or G
BC-735	1129.6	Unnamed Drainage	Seasonal	NCD	10	546722	5439327	None (None)	Low	--	--	--	--	None	Open	Summer	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Swamp Mats or other regulatory approved crossing method	(None)	Dry seasonal drainage; possible surface runoff; no continuous channel or scour present; no connectivity to fish habitat.	A
BC-736	1129.9	Unnamed Channel	Perennial	S2	10	546508	5439407	CT (None)	High	0.56 (20/11/12)	8.50 / 5.72	0.32	No	August 1 - October 31	August 1 - October 31	Summer	Isolation with fish salvage and water quality monitoring (1)	Isolation with fish salvage and water quality monitoring during low flow(3)	Clear-Span Bridge	Clear-Span Bridge	Potentially Navigable	Two juvenile CT captured within PPC; abundant cover; OHV; residual pools; LWD; good channel complexity; good mixture of cobble and gravel; suitable velocities; resting pool; perennial flow, but confined small channel with shallow depth; no barriers observed; 9% gradient; small cascades.	F or G
BC-737	1130.5	Unnamed Drainage	--	NVC	10	545822	5439546	None (None)	None	--	--	--	--	None	Open	Summer	Open-cut	Open-cut	Ford	Ford	(None)	Vegetated agricultural land; no scour or alluvial deposits.	A
BC-738	1132.5	Unnamed Drainage (Wetland)	Intermittent	NCD-W	10	543995	5440176	None (None)	Low	--	32.00 / 16.25	0.35	Yes	None	Open	Summer	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Shallow headwaters to McLennan Creek; low fish habitat potential; ponded water at existing TMPL ROW; surrounded by agricultural land; low instream complexity; no fish captured or observed.	Refer to Wetland Evaluation Technical Report of Vol. 5C
BC-739*	1133.3	Tributary to Hann Creek	TBD	TBD (S6 or NCD)	10	543250	5440430	TBD (None)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Summer	TBD	TBD	TBD	TBD	TBD	TBD	TBD
BC-740	1134.2	Unnamed Channel	Seasonal	S6	10	542391	5440735	None (None)	Low	0.004 (25/04/13)	2.18 / 1.19	0.38	Yes	None	Open	Summer	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Swamp Mats or other regulatory approved crossing method	Class 1 Non-Navigable	Small marginally defined watercourse with seasonal flow; no defined channel through PPC; dry in July 2013.	B

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-741	1134.3	Unnamed Channel	Seasonal	S6	10	542244	5440790	None (None)	Low	0.007 (25/04/13)	3.10 / 1.44	0.27	Yes	None	Open	Summer	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Swamp Mats or other regulatory approved crossing method	Class 2 Non-Navigable	Low habitat potential (small channel size, shallow depths, high percentages of fines, low instream complexity); channel braided across the existing TMPL ROW; low connectivity to Nathan Creek.	C
BC-741a	1134.3	Unnamed Drainage	Seasonal	NCD	10	542211	5440756	None (None)	Low	--	--	--	--	None	Open	Summer	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Ramp and Culvert or other regulatory approved crossing method	(None)	Evidence of overland flow during peak run-off; dry in October 2013; foot bridge present over drainage downslope from PPC.	A
BC-742	1135.4	Unnamed Channel	Seasonal	S6	10	541212	5441196	None (None)	Low	0.006 (01/05/13)	2.70 / 1.79	0.32	Yes	None	Open	Summer	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Swamp Mats or other regulatory approved crossing method	Class 2 Non-Navigable	Habitat potential limited by poor spawning substrate (100% fines), low discharge, lack of pool formation, multiple perched culverts, and poor connectivity to Nathan Creek.	C
BC-743*	1136.1	Tributary to Nathan Creek	TBD	TBD (S6 or NCD)	10	540541	5441420	TBD (None)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Summer	TBD	TBD	TBD	TBD	TBD	Potential beaver dam removal.	TBD
BC-744*	1136.4	Tributary to Nathan Creek	TBD	TBD (S3 or S6)	10	540306	5441511	TBD (None)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Summer	TBD	TBD	TBD	TBD	TBD	TBD	TBD
BC-745*	1136.9	Tributary to Nathan Creek	Seasonal	TBD (S5)	10	539724	5441612	None (None)	TBD	0.621 (05/11/13)	4.50 / 3.35	1.13	No	none	Open	Summer	TBD	TBD	TBD	TBD	Class 3 Non-Navigable	Habitat assessment and sampling carried out from 150 m downstream to 300 m downstream; no fish captured in downstream reach in spring or summer; shallow depths; sections of suitable spawning gravels; OHV and undercut banks provide cover; no barriers observed.	C
BC-746*	1137.3	Unnamed Channel	Seasonal	TBD (S6)	10	539496	5441913	None (None)	TBD	TBD	2.50 / 1.66	0.08	Yes	none	Open	Summer	TBD	TBD	TBD	TBD	Class 2 Non-Navigable	Dry in fall 2013; no defined channel at 100 m upstream from PPC.	TBD
BC-747 [2]	1138.0	Nathan Creek	Perennial	S2	10	538748	5441903	CO, TSB, LMB, (SK, CO, PK, CM, CH, ST, CT, C, PCC, RB, L, SB)	High	0.08 (20/08/13)	13.63 / 10.14	0.83	No	August 1 - September 15	August 1 - September 15	Summer	Isolation with fish salvage and water quality monitoring [1]	Isolation with fish salvage and water quality monitoring during low flow[3]	Clear-Span Bridge	Clear-Span Bridge	Potentially Navigable	CO captured within ZOI; historical presence of all salmon species and RB; good instream complexity; abundant riparian cover; boulders, OHV, woody debris, numerous pools; highly embedded substrate; algae on substrate; numerous pools, perennial flow; no barriers, low gradient/Refer to Wetland Evaluation Technical Report of Volume 5C.	G
BC-748*	1139.8	Tributary to Nathan Creek (Turkey Brook)	TBD	TBD (S3 or S5)	10	537155	5442493	TBD (None)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Summer	TBD	TBD	TBD	TBD	TBD	Refer to Wetland Evaluation Technical Report of Volume 5C.	TBD

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-749	1143.0	West Creek	Perennial	S2	10	534068	5443518	RB, CO (CO, CM, CCT, CH, ST, RB, BNH, CAS, L, TSB)	High	0.02 (20/08/13)	11.75 / 7.86	0.70	No	August 1 - September 15	August 1 - September 15	Summer	Isolation with fish salvage and water quality monitoring (1)	Isolation with fish salvage and water quality monitoring during low flow(3)	Clear-Span Bridge	Clear-Span Bridge	Potentially Navigable	CO and RB captured within ZOI; CM, CH, CT, ST found historically; good instream complexity; abundant cover; undercut banks, OHV, LWD, boulders; moderate amounts of gravel/cobble substrate; may be limited by heavy algal growth in some areas; many deep pools.	G
BC-750*	1143.7	Tributary to West Creek	TBD	TBD (S6)	10	533406	5443691	TBD (None)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
BC-751	1145.6	Davidson Creek	Perennial	S3	10	531449	5444047	CO, CT (CC, CCT, CO, CM, L, RB, TSB)	High	0.08 (05-11-13)	3.10 / 2.08	0.62	No	August 1 - September 15	August 1 - September 15	Summer	Isolation with fish salvage and water quality monitoring (1)	Isolation with fish salvage and water quality monitoring during low flow(3)	Clear-span Bridge	Clear-Span Bridge	Class 1 Non-Navigable	Small channel; numerous juvenile CT and CO captured within ZOI; abundant cover; OHV; deep pools; undercut banks; suitable spawning gravels throughout channel; shallow run habitat.	C
BC-752	1147.0	Unnamed Drainage (Wetland)	Seasonal	NCD-W	10	530142	5444209	None (None)	Low	--	--	--	Yes	None	Open	Summer	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Refer to Wetland Evaluation Technical Report of Vol. 5C	Predominately overland flow upslope and at PPC; large isolated anthropogenic pond downslope; no fish were captured or observed in ponded habitat; barrier at outlet to the artificial pond (200 m downslope); low connectivity to fish habitat. Potential beaver dam site.	Refer to Wetland Evaluation Technical Report of Vol. 5C
BC-753 (2)	1147.4	Salmon River	Perennial	S2	10	529778	5444366	CO, RSC, TSB (CO, DV/BT, ST, CCT, CC, CSU, LSU, NSC, PCC, RSC, CP, BMC, TSB, BNH, SFL, BCB, CH, CM, SK, RB, WCT, L, SSU, NDC, CAS)	High	--	12.00 / 10.50	1.77	No	August 1 - August 31	August 1 - August 31	Summer	Isolation with fish salvage and water quality monitoring during low flow (3)	Open-cut with water quality monitoring inside timing window (4)	Clear-Span Bridge	Clear-Span Bridge	Navigable	Large perennial river; juvenile CO captured within ZOI; low gradient; low velocity; OHV; deep pools; year-round flow; spawning gravel substrates available but high percentages of fines) no barriers observed; river is a known important migration corridor for spawning CO; DFO trap for CO smolt located 50 m downstream from the PPC; numerous other fish species have been recorded in this river, including the Salish Sucker and Nooksack Dace both listed in SARA) /Refer to Wetland Evaluation Technical Report of Volume 5C.	F or G
BC-754	1147.7	Unnamed Drainage (Wetland)	Perennial	NCD-W (FB)	10	529469	5444481	TSB (None)	Low	--	--	--	Yes	None	Open	Summer	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Avoid ponded area; Swamp Mats may be required	Swamp Mats or other regulatory approved crossing method	Refer to Wetland Evaluation Technical Report of Vol. 5C	Modified wetland for golf course with no inlet; outlet drainage is through a pipe, to an S4 channel outside of the ZOI; no surface connectivity to the wetland from the defined channel downstream from the PPC; TSB were captured in the channel. Align construction to avoid golf course ponds.	Refer to Wetland Evaluation Technical Report of Vol. 5C

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-755	1147.8	Unnamed Drainage	Seasonal	NCD	10	529330	5444497	None (None)	Low	--	--	--	--	None	Open	Summer	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Ramp and Culvert or other regulatory approved crossing method	(None)	Dry drainage; less than 100 m of continuous scour; sections of overland flow and sub-surface flow; no connectivity to fish habitat.	A
BC-756*	1149.0	Unnamed Drainage	TBD	TBD (NCD)	10	529123	5445608	TBD (None)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Summer	TBD	TBD	TBD	TBD	TBD	TBD	TBD
BC-757*	1149.4	Tributary to Salmon River	TBD	TBD (S4 or S6)	10	529004	5445965	TBD (None)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Summer	TBD	TBD	TBD	TBD	TBD	TBD	TBD
BC-758*	1149.6	Tributary to Salmon River	TBD	TBD (S4 or S6)	10	528975	5446229	TBD (None)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Summer	TBD	TBD	TBD	TBD	TBD	TBD	TBD
BC-759*	1149.8	Tributary to Salmon River	TBD	TBD (S4 or S6)	10	528976	5446423	TBD (None)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Summer	TBD	TBD	TBD	TBD	TBD	TBD	TBD
BC-760*	1150.0	Tributary to Salmon River	TBD	TBD (S4 or S6)	10	528976	5446537	TBD (None)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Summer	TBD	TBD	TBD	TBD	TBD	TBD	TBD
BC-761*	1150.3	Tributary to Salmon River	TBD	TBD (S4 or S6)	10	528936	5446966	TBD (None)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Summer	TBD	TBD	TBD	TBD	TBD	TBD	TBD
BC-762*	1150.7	Tributary to Salmon River	TBD	TBD (S6 or NCD)	10	528648	5447040	TBD (None)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Summer	TBD	TBD	TBD	TBD	TBD	TBD	TBD
BC-763*	1150.8	Tributary to Salmon River	TBD	TBD (S6 or NCD)	10	528550	5447046	TBD (None)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Summer	TBD	TBD	TBD	TBD	TBD	TBD	TBD
BC-764*	1150.9	Tributary to Salmon River	TBD	TBD (S6 or NCD)	10	528424	5447024	TBD (None)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Summer	TBD	TBD	TBD	TBD	TBD	TBD	TBD
BC-765*	1151.0	Tributary to Salmon River	TBD	TBD (S6 or NCD)	10	528293	5447074	TBD (None)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Summer	TBD	TBD	TBD	TBD	TBD	TBD	TBD
BC-766*	1152.4	Tributary to Yorkson Creek	TBD	TBD (S3)	10	526966	5447469	CO, CM, CT (None)	High	TBD	TBD	TBD	TBD	TBD	TBD	Summer	Isolation with fish salvage and water quality monitoring [1]	Isolation with fish salvage and water quality monitoring during low flow[3]	Clear-span Bridge	Clear-Span Bridge	TBD	TBD	TBD
BC-767*	1154.0	Tributary to Yorkson Creek	TBD	TBD (S3)	10	525489	5447837	TSB, CT, CO (None)	High	TBD	TBD	TBD	TBD	TBD	TBD	Summer	Isolation with fish salvage and water quality monitoring [1]	Isolation with fish salvage and water quality monitoring during low flow[3]	Clear-Span Bridge	Clear-Span Bridge	TBD	Refer to Wetland Evaluation Technical Report of Volume 5C.	TBD
BC-768*	1154.3	Yorkson Creek	TBD	TBD (S3)	10	525186	5447895	CO, CM, PK, CT, ST, RB, TSB, CP, L, PCC (None)	High	TBD	TBD	TBD	TBD	TBD	TBD	Summer	Isolation with fish salvage and water quality monitoring [1]	Isolation with fish salvage and water quality monitoring during low flow[3]	Clear-Span Bridge	Clear-Span Bridge	TBD	TBD	TBD
BC-769	1157.9	Unnamed Drainage	--	NVC	10	521412	5447609	None (None)	None	--	--	--	--	None	Open	Summer	Open-cut	Open-cut	Ford	Ford	(None)	Site located within active lumber-mill yard; historical channel likely diverted through underground stormwater system.	A
BC-770*	1158.4	Unnamed Channel	TBD	TBD (S4 or S6)	10	521592	5447268	TBD (None)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Summer	TBD	TBD	TBD	TBD	TBD	TBD	TBD

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-771	1159.6	Unnamed Channel	Seasonal	S4	10	520050	5448205	CT (None)	High	0.22 (05/11/13)	1.11 / 1.00	0.39	No	August 1 - October 31	August 1 - October 31	Summer	Isolation with fish salvage and water quality monitoring if flowing [1]	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge or other regulatory approved crossing method	Class 1 Non-Navigable	Four juvenile CT captured within ZOI; channel altered for past road development; OHV and undercut banks provide cover; higher quality spawning habitat upstream from PPC; downstream reach has high percentage of fines; Fraser River is 125 m DS.	C
BC-772*	1160.6	Unnamed channel	TBD	TBD (S3 or S6)	10	519349	5448864	TBD (None)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Summer	TBD	TBD	TBD	TBD	TBD	TBD	TBD
BC-773*	1161.7	Tributary to Fraser	Perennial	TBD (S3)	10	518517	5449562	CO, CCT, TSB, (None)	High	TBD	TBD	TBD	TBD	TBD	TBD	Summer	Isolation with fish salvage and water quality monitoring [1]	Isolation with fish salvage and water quality monitoring during low flow[3]	Clear-Span Bridge	Clear-Span Bridge	TBD	Refer to Wetland Evaluation Technical Report of Volume 5C.	TBD
BC-774	1163.8	Centre Creek	Perennial	S3	10	516887	5450814	TSB (None)	High	--	5.50 / 3.82	0.46	No	August 1 - September 15	August 1 - September 15	Summer	Isolation with fish salvage and water quality monitoring [1]	Isolation with fish salvage and water quality monitoring during low flow[3]	Clear-Span Bridge	Clear-Span Bridge	Potentially Navigable	TSB captured; potential for salmonids; Fraser River 300 m downstream; abundant cover; deep pools, LWD, ISV; high percentage of fines and organics in substrate.	C
BC-775	1163.9	Centre Creek	Perennial	S3	10	516786	5450897	TSB (None)	High	--	5.50 / 4.57	0.46	No	August 1 - September 15	August 1 - September 15	Summer	Isolation with fish salvage and water quality monitoring [1]	Isolation with fish salvage and water quality monitoring during low flow[3]	Clear-Span Bridge	Clear-Span Bridge	Potentially Navigable	TSB captured; potential for salmonids; Fraser River 170 m downstream; abundant cover; deep pools, LWD, ISV; high percentage of fines and organics in substrate.	C
BC-776	1164.6	Tributary to Fraser River	Seasonal	S3	10	516091	5450998	CCT/RB (None)	High	--	2.10 / 1.78	0.24	No	August 1 - October 31	August 1 - October 31	Summer	Isolation with fish salvage and water quality monitoring if flowing[1]	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge	Class 2 Non-Navigable	Small channel; Fraser River 180 m downstream; one juvenile trout observed (CCT or RB); LWD and OHV cover; pockets of suitable spawning gravels; shallow depths, low discharge, and multiple culverts potentially limiting during low flows.	C
BC-777	1165.2	Tributary to Fraser River	Seasonal	S3	10	515514	5451070	CCT (None)	High	0.03 (07/11/13)	1.50 / 1.35	0.25	No	August 1 - October 31	August 1 - October 31	Summer	Isolation with fish salvage and water quality monitoring if flowing[1]	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge	Class 1 Non-Navigable	Small channel; Fraser River 100 m downstream; juvenile CCT captured; LWD and OHV cover; pockets of suitable spawning gravels; shallow depths, low discharge, and multiple culverts potentially limiting during low flows.	C
BC-778	1166.9	Tributary to Bon Accord Creek	Perennial	S3	10	513854	5451344	CCT, RB, TSB (CAS, CCT, CO, RB, TSB)	High	0.11 (06/11/13)	3.90 / 3.20	0.20	No	August 1 - September 15	August 1 - September 15	Summer	Isolation with fish salvage and water quality monitoring [1]	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge	Class 1 Non-Navigable	Bon Accord Creek 35 m downstream; juvenile CCT and RB captured downstream from CN culvert; LWD and OHV cover; high content of organics and fines in substrate; low velocities.	C

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-779	1166.9	Bon Accord Creek	Perennial	S3	10	513821	5451360	CCT, RB, TSB (CAS, CCT, CO, RB, TSB)	High	0.13 (06/11/13)	3.84 / 3.31	0.27	No	August 1 - September 15	August 1 - September 15	Summer	Isolation with fish salvage and water quality monitoring (1)	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge	Clear-Span Bridge	Class 3 Non-Navigable	Numerous salmonids captured and observed; abundant cover; LWD, undercut banks, and OHV cover; sections of suitable spawning gravels; high content of organics and fines in some sections; numerous pools.	C
BC-780 (2)	1168.9	Fraser River	Perennial	S1A	10	512317	5451843	None (CAS, TSB, CH, CO, CCT, BB, BCB, BMC, BNH, DV/BT, CAL, CAS, CCG, CLA, BSU, CM, CMC, CP, CSU, ESC, EU, GSG, KO, LDC, LKC, LNC, LSM, LSU, MSU, MW, NSC, PCC, PK, PL, PW, RB, RL, RSC, SFL, SH, SK, SST, SSM, ST, STC, TSB, WCT, WSG, WSU)	High	8351 (17/07/13)	556 / 451	2.83	No	August 1 - August 15	August 1 - August 15	Summer	HDD with water quality monitoring	Other regulatory approved trenchless method	Access both banks	Access both banks	Navigable	Little cover, except along channel margins; low channel complexity; high velocity; 100% fines; large perennial channel with good discharge year-round; high migration (river is an essential migratory corridor for all 6 species of Pacific Salmon).	Comply with Federal and Provincial Regulations
BC-781 (2)	1171.1	Como Creek	Perennial	S2	10	510872	5452973	CAS, RB, TSB (BL, CAS, CCT, CH, CM, CO, CP, CSU, NSC, PCC, RB, RL, TSB)	High	0.06 (25/10/13)	11.20 / 8.80	0.46	No	August 1 - September 15	August 1 - September 15	Summer	Isolation with fish salvage and water quality monitoring (1)	Isolation with fish salvage and water quality monitoring during low flow(3)	Clear-Span Bridge	Clear-Span Bridge	Potentially Navigable	Large channel; low velocities; cover provided by deep pools, OHV, boulders, and undercut banks; poor water quality may be limiting for salmonids in late summer; high percentage of fines and organics in substrate; beaver dams located upstream and downstream from PPC.	D
BC-782	1172.2	Nelson Creek	Perennial	S3	10	509864	5453050	PMB, TSB (BMC, CAS, CCT, CM, CO, CP, PCC, RSC, SB, ST, SU, TSB)	High	0.11 (27/10/13)	7.50 / 6.37	0.73	No	August 1 - September 15	August 1 - September 15	Summer	Isolation with fish salvage and water quality monitoring (1)	Isolation with fish salvage and water quality monitoring during low flow(3)	Clear-Span Bridge	Clear-Span Bridge	Potentially Navigable	Medium channel; low velocities; potential for salmonids; Fraser River 530 m downstream; cover provided by deep pools, OHV, and ISV; poor water quality may be limiting for salmonids in late summer; high percentage of fines and organics in substrate.	D
BC-783	1174.1	Keswick Park Creek (Tributary To Brunette River)	--	NVC	10	508574	5454134	None (None)	None	--	--	--	--	None	Open	Summer	Open-cut	Open-cut	Ford	Ford	(None)	Dry grassy area adjacent to Lougheed Hwy intersection; historical channel likely diverted through underground stormwater system.	A
BC-784*	1175.7	Austin Creek / Willoughby Creek	Perennial	TBD (S3 or S6)	10	507350	5455193	TBD (None)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Summer	TBD	TBD	TBD	TBD	TBD	TBD	TBD

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BC-785 [2]	1176.5	Stoney Creek	Perennial	S2	10	506591	5455438	CM (BL, CCT, CM, CO, NDC, PMB, RB, ST, TSB)	High	0.11 (26/10/13)	9.40 / 6.57	0.28	No	August 1 - September 15	August 1 - September 15	Summer	Isolation with fish salvage and water quality monitoring [1]	Isolation with fish salvage and water quality monitoring during low flow[3]	Clear-Span Bridge	Clear-Span Bridge	Potentially Navigable	High-value spawning and rearing habitat; numerous CM observed spawning and numerous juvenile salmonids observed rearing; COSEWIC classified lower 500 m of creek as potential NDC habitat and recommended it be designated critical habitat under SARA; cover provided by boulders, pools and OHV; numerous culverts.	D
BC-785a	1179.5	Tributary to Eagle Creek	Seasonal	S5	10	504612	5457071	None (None)	Low	--	3.63 / 3.17	0.26	Yes	None	Open	Summer	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Clear-Span Bridge or other regulatory approved crossing method	Ramp and Culvert or other regulatory approved crossing method	Class 1 Non-Navigable	Sub-surface flow downstream from PPC; culvert and gradient barriers to migration; retention pond upstream is nonfish-bearing; insufficient depth and low DO limit fish habitat potential.	C or D
BC-786	1182.5	Unnamed Channel	Seasonal	S6	10	502876	5458851	None (None)	Low	0.03 (06/11/13)	1.50 / 1.25	0.28	Yes	None	Open	Summer	Isolation if water present	Open-cut (DFO OS) if dry or frozen to bottom	Ramp and Culvert	Ramp and Culvert or other regulatory approved crossing method	Class 2 Non-Navigable	Small channel; low discharge and shallow depths; gradient >30% downstream from PPC and 2 m drop into constructed stormwater outfall structure are barriers to all fish species.	C
BCT-1*	--	Unnamed Drainage	TBD	TBD (NCD)	10	694185	5649312	TBD (None)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Not Applicable	Not Applicable	TBD	TBD	TBD	Install poles outside of riparian management area.	TBD
BCT-2	--	North Thompson River	Perennial	S1A	10	643653	5649492	None (BL, BSU, BT, CCG, CH, CO, CRH, CSU, LDC, LKC, LNC, LSU, MSU, MW, NSC, PCC, RB, RSC, RW, SK)	High	--	475.00 / 417.50	3.32	No	July 22 - August 15	July 22 - August 15	TBD	Not Applicable	Not Applicable	Access both banks	Access both banks	Navigable	Important habitat and migration corridor for numerous indicator species and anadromous salmon; deep pools and small amounts of OHV provide cover; sections of suitable spawning gravel but limited by high percentage of fines. Install poles outside of riparian management area.	G
BCT-3	--	Unnamed Drainage	-	NVC	10	693467	5649498	None (None)	None	--	--	--	--	None	Open	TBD	Not Applicable	Not Applicable	Ford	Ford	(None)	Mature deciduous forested area; no visible scour or seepage; no depression or swale.	A
BCT-4	--	Unnamed Drainage	-	NVC	10	693194	5649509	None (None)	None	--	--	--	--	None	Open	TBD	Not Applicable	Not Applicable	Ford	Ford	(None)	Open grassland with no visible scour or seepage; North Thompson River is situated 200 m downslope.	A
BCT-5	--	Unnamed Drainage	-	NVC	10	692909	5649465	None (None)	None	--	--	--	--	None	Open	TBD	Not Applicable	Not Applicable	Ford	Ford	(None)	Open forested area with no defined channel or indication of fluvial processes.	A
BCT-6	--	Unnamed Drainage	-	NVC	10	692894	5649275	None (None)	None	--	--	--	--	None	Open	TBD	Not Applicable	Not Applicable	Ford	Ford	(None)	Open forest with grassy understory; no sign of scour or fluvial processes.	A
BCT-7	--	Unnamed Drainage	-	NVC	10	681115	5611741	None (None)	None	--	--	--	--	None	Open	TBD	Not Applicable	Not Applicable	Ford	Ford	(None)	Open forested area with grass understory; no sign of scour or fluvial process.	A

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BCT-8	--	Unnamed Drainage	-	NVC	10	692848	5648812	None (None)	None	--	--	--	--	None	Open	TBD	Not Applicable	Not Applicable	Ford	Ford	(None)	Open forested area with grass understory; no sign of scour or fluvial processes.	A
BCT-9	--	Unnamed Drainage (Wetland)	Seasonal	NCD-W	10	671249	5535514	None (None)	Low	--	--	--	Yes	None	Open	TBD	Not Applicable	Not Applicable	Ramp and Culvert or Swamp Mats	Snow/Icefill or other regulatory approved crossing method	(None)	Low-lying wetland area; shallow depths; no connectivity to Otter Creek or any other watercourses; no fish habitat potential; heavy cattle use throughout wetland. Install poles outside of riparian management area.	B
BCT-10	--	Unnamed Drainage	Seasonal	NCD	10	670924	5535630	None (None)	Low	--	--	--	--	None	Open	TBD	Not Applicable	Not Applicable	Ramp and Culvert	Ramp and Culvert or other regulatory approved crossing method	(None)	Saturated ground; no defined bed or banks; no fish habitat potential or connectivity to fish habitat; located within cattle pasture. Install poles outside of riparian management area.	A
BCT-11	--	Unnamed Drainage	-	NVC	10	670416	5535566	None (None)	None	--	--	--	--	None	Open	TBD	Not Applicable	Not Applicable	Ford	Ford	(None)	Grassy depression; no evidence of fluvial processes.	A
BCT-12	--	Otter Creek	Seasonal	S6	10	669804	5535460	None (RB)	Low	0.01 (21/08/13)	2.10 / 1.45	0.18	Yes	None	Open	TBD	Not Applicable	Not Applicable	Ramp and Culvert	Swamp Mats or other regulatory approved crossing method	Class 2 Non-Navigable	Very small channel; insufficient water, low DO, poor substrate, no residual pools; wetland located 50 m upstream Kidd Lake (stocked with RB) 2.6 km downstream frogs observed at PPC. Install poles outside of riparian management area.	A
BCT-13	--	Unnamed Channel	Seasonal	S6	10	669058	5535334	None (None)	Low	--	2.7 / 1.17	0.18	Yes	None	Open	TBD	Not Applicable	Not Applicable	Ramp and Culvert	Swamp Mats or other regulatory approved crossing method	Class 1 Non-Navigable	Very small channel; insufficient water, poor substrate, no residual pools; cattle use and pugging throughout reach; stream becomes NCD 250 m DS. Install poles outside of riparian management area.	A
BCT-14*	--	Voght Creek	Perennial	TBD (S3 or S6)	10	667885	5535233	None (RB, RSC, CH, CO, ST)	TBD	0.004 (30/10/13)	1.5 / 0.94	0.18	No	July 22 - August 15	Open	TBD	Not Applicable	Not Applicable	Ramp and Culvert	Ramp and Culvert or other regulatory approved crossing method	TBD	Install poles outside of riparian management area	TBD
BCT-15*	--	Unnamed Channel	TBD	TBD (S6)	10	667117	5535186	TBD (None)	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Not Applicable	Not Applicable	Ramp and Culvert	Ramp and Culvert or other regulatory approved crossing method	TBD	Install poles outside of riparian management area	TBD
BCT-16	--	Kanevale Creek	Perennial	S3	10	663799	5534844	RSC (RB, RSC)	Low	0.01 (22/10/13)	5.05 / 3.72	0.38	Yes	July 22 - October 31	Open	TBD	Not Applicable	Not Applicable	Clear-Span Bridge or other regulatory approved crossing method	Snow/Icefill or other regulatory approved crossing method	Class 3 Non-Navigable	RSC captured but no salmonid presence in creek; historical RB observations likely associated with nearby lakes; shallow residual pools, low flows, poor water quality, poor quality spawning substrate; OHV and SWD cover. Install poles outside of riparian management area.	C

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BCT-17	--	Unnamed Drainage	Seasonal	NCD	10	662986	5534842	None (None)	Low	--	--	--	--	None	Open	TBD	Not Applicable	Not Applicable	Ramp and Culvert or other regulatory approved crossing method	Swamp Mats or other regulatory approved crossing method	(None)	1.5 ha dry wetland area is located approximately 40 m downslope; no fish habitat potential. Install poles outside of riparian management area.	A
BCT-18	--	Unnamed Drainage	-	NVC	10	662166	5534837	None (None)	None	--	--	--	--	None	Open	TBD	Not Applicable	Not Applicable	Ford	Ford	(None)	Dry grassy swale; no evidence of fluvial processes.	A
BCT-19	--	Kimble Creek	Seasonal	NCD	10	661575	5534735	None (None)	Low	--	--	--	--	None	Open	TBD	Not Applicable	Not Applicable	Ramp and Culvert	Swamp Mats or other regulatory approved crossing method	(None)	Ponded water 50 m upstream from centre of PPC; no evidence of scour or channelization at PPC; no fish habitat potential or connectivity to fish habitat. Install poles outside of riparian management area.	A
BCT-20	--	Unnamed Drainage	Seasonal	NCD	10	660490	5534792	None (None)	Low	--	--	--	--	None	Open	TBD	Not Applicable	Not Applicable	Ramp and Culvert	Ford	(None)	Dry forested depression; likely has seasonal seepage or standing water; no sign of channelization or scour; no connectivity to fish habitat. Install poles outside of riparian management area.	B
BCT-21	--	Howarth Creek	Perennial	S3	10	659763	5534861	RB (RB)	High	0.02 (22/08/13)	4.70 / 3.32	0.38	No	July 22 - October 31	July 22 - October 31	TBD	Not Applicable	Not Applicable	Clear-Span Bridge	Clear-Span Bridge or other regulatory approved crossing method	Class 3 Non-Navigable	Seven juvenile RB captured within ZOI; abundant LWD, OHV and pools; pockets of suitable spawning gravel; numerous shallow pools; low channel gradient, no barriers; cattle pugging and channel degradation throughout reach; recommend installing poles outside of riparian management area. Install poles outside of riparian management area.	C
BCT-22	--	Unnamed Drainage	--	NVC	10	658245	5534723	None (None)	None	--	--	--	--	None	Open	TBD	Not Applicable	Not Applicable	Ford	Ford	(None)	Dry upland area with no visible scour or seepage.	A
BCT-23	--	Unnamed Drainage	--	NVC	10	657801	5534617	None (None)	None	--	--	--	--	None	Open	TBD	Not Applicable	Not Applicable	Ford	Ford	(None)	Grassy swale with no visible scour or discernible seepage.	A
BCT-24	--	Unnamed Drainage	--	NVC	10	657278	5534466	None (None)	None	--	--	--	--	None	Open	TBD	Not Applicable	Not Applicable	Ford	Ford	(None)	Dry forested area; no evidence of fluvial processes; cattle present within PPC.	A
BCT-25	--	Unnamed Drainage	Seasonal	NCD	10	656656	5534268	None (None)	Low	--	--	--	--	None	Open	TBD	Not Applicable	Not Applicable	Ramp and Culvert	Ford	(None)	Dry forested depression; likely has seasonal seepage or standing water; no sign of channelization or scour; no connectivity to fish habitat. Install poles outside of riparian management area.	B
BCT-26	--	Unnamed Drainage	--	NVC	10	656357	5534165	None (None)	None	--	--	--	--	None	Open	TBD	Not Applicable	Not Applicable	Ford	Ford	(None)	Dry forested area; no evidence of fluvial processes; heavy cattle use in area.	A
BCT-27	--	Unnamed Drainage	--	NVC	10	656098	5534144	None (None)	None	--	--	--	--	None	Open	TBD	Not Applicable	Not Applicable	Ford	Ford	(None)	Dry grassy area; no evidence of fluvial processes; heavy cattle use in area.	A

Watercourse Crossing ID	RK	Watercourse Name	Flow Regime	Class	UTM Coordinates (NAD 83)			Fish Spp. Captured or Observed (Previously Documented)	Sensitivity Rating	Morphological Parameters				Provincial Instream Work Window (MoE and DFO)	Least Risk Biological Window Proposed	Construction Season	Pipeline Crossing Method		Vehicle Crossing Method		Navigability Status	Site Specific Comments	Reclamation
					Zone	Easting	Northing			Flow (m^3/s) (d/m/y)	Max/Mean Channel Width (m)	Mean Bank Height (m)	Movement Barriers				Recommended Primary	Recommended Contingency	Recommended Crossing Method Flowing	Recommended Crossing Method Dry/Frozen			
BCT-28	--	Nilsson Creek	Seasonal	S6	10	655596	5533980	None (RB)	Low	0.01 (24/08/13)	2.50 / 1.83	0.21	Yes	None	Open	TBD	Not Applicable	Not Applicable	Ramp and Culvert	Swamp Mats or other regulatory approved crossing method	Class 2 Non-Navigable	Abundant pools and LWD cover; habitat limited by poor spawning gravels, 20.5 m high LWD cascades, and low DO; banks degraded by cattle use. Install poles outside of riparian management area.	A
BCT-29	--	Unnamed Drainage	-	NVC	10	655041	5533833	None (None)	None	--	--	--	--	None	Open	TBD	Not Applicable	Not Applicable	Ford	Ford	(None)	Dry forested site; no evidence of scour or alluvial deposition.	A
BCT-29a	--	Unnamed Channel	Seasonal	S6	10	654855	5533805	None (None)	Low	0.02 (24/08/13)	2.20 / 1.70	0.23	Yes	None	Open	TBD	Not Applicable	Not Applicable	Ramp and Culvert	Swamp Mats or other regulatory approved crossing method	Class 2 Non-Navigable	Habitat limited by poor water quality, shallow residual pool depths and multiple 0.5 m LWD cascades; heavy cattle use. Install poles outside of riparian management area.	A
BCT-30	--	Unnamed Drainage	Seasonal	NCD	10	654376	5533641	None (None)	Low	--	--	--	--	None	Open	TBD	Not Applicable	Not Applicable	Swamp Mats or other regulatory approved crossing method	Ford	(None)	Dry drainage; no channelization or evidence of scour or alluvial deposition; water likely pools in low-lying area during wet periods; pugging from cattle; no connectivity to fish habitat. Install poles outside of riparian management area.	B
BCT-31	--	Unnamed Drainage	-	NVC	10	653175	5533292	None (None)	None	--	--	--	--	None	Open	TBD	Not Applicable	Not Applicable	Ford	Ford	(None)	Dry forested site; no evidence of scour or alluvial deposition; cattle use in area.	A
BCT-32	--	Unnamed Drainage	-	NVC	10	653117	5533260	None (None)	None	--	--	--	--	None	Open	TBD	Not Applicable	Not Applicable	Ford	Ford	(None)	Dry forested site; no evidence of scour or alluvial deposition; evidence of cattle use in area.	A
BCT-33	--	Unnamed Drainage	-	NVC	10	653053	5533265	None (None)	None	--	--	--	--	None	Open	TBD	Not Applicable	Not Applicable	Ford	Ford	(None)	Dry grassy area within mixed forest; no evidence of scour or alluvial deposition.	A
BCT-34	--	Unnamed Drainage	Seasonal	NCD	10	652285	5533036	None (None)	Low	--	--	--	--	None	Open	TBD	Not Applicable	Not Applicable	Swamp Mats or other regulatory approved crossing method	Ford	(None)	Dry depression within forest; no evidence of scour or alluvial deposition; water may pool in low-lying area during wet periods. Install poles outside of riparian management area.	B
BCT-35	--	Unnamed Drainage	Seasonal	NCD	10	649901	5533018	None (None)	Low	--	--	--	--	None	Open	TBD	Not Applicable	Not Applicable	Ramp and Culvert	Ford	(None)	Culvert 50 m downstream indicates likely seasonal overland flow; no sign of channelization or scour within PPC; no fish habitat potential or connectivity to fish habitat. Install poles outside of riparian management area.	B

Notes:

1 Work should be completed within the Least Risk Biological Window Proposed.

2 Site requires Stage 2 review.

3 Timing variance may be required (DFO case-specific review).

4 DFO case-specific review is required.

(c) Site is in a community watershed.

* Site requires a second season assessment or was not visited during the 2012-2013 field program.