Technical Data Report

Freshwater Fish and Fish Habitat

ENBRIDGE NORTHERN GATEWAY PROJECT

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Preface

This Technical Data Report (TDR) primarily relies on data collected up to October 2009. These data are used in the Environmental and Socio-economic Assessment (ESA) for the Enbridge Northern Gateway Project, Volume 6A, Part 2, Section 11.

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Abbreviations

AENV ..... Alberta Environment
ANHIC ..... Alberta Natural Heritage Information Centre
ASRD ..... Alberta Sustainable Resource Development
asl ..... above sea level
ATK ..... Aboriginal Traditional Knowledge
BC CDC ..... British Columbia Conservation Data Centre
BC MELP ..... Ministry of Environment, Lands and Parks (British Columbia)
BC MoE ..... British Columbia Ministry of Environment
BC MoF ..... British Columbia Ministry of Forests
BC MoFR ..... British Columbia Ministry of Forests and Range (post 2005)
BC MSRM ..... British Columbia Ministry of Sustainable Resource Management
BC MWLAP ..... British Columbia Ministry of Water, Land, and Air Protection
BCAWQG ..... B.C. Approved Water Quality Guidelines for Fresh Water Aquatic Life
BEC ..... Biogeoclimatic Ecosystem Classification
CCME ..... Canadian Council of Ministers of the Environment
CEA Act ..... *Canadian Environmental Assessment Act*
Cond ..... conductivity
COSEWIC ..... Committee on the Status of Endangered Wildlife in Canada
DFO ..... Fisheries and Oceans Canada
DO ..... dissolved oxygen
EcoCat ..... Ecological Reports Catalogue
ESA ..... environmental and socio-economic assessment
FDIS ..... Fisheries Data Information System (British Columbia)
FISS ..... Fisheries Inventory Summary System (British Columbia)
FWMIS ..... Fisheries and Wildlife Management Information System (Alberta)
FSR ..... forest service road
FSZ ..... fisheries sensitive zone
GIS ..... geographic information system
GPS ..... global positioning system
HADD ..... harmful alteration, disruption or destruction of fish habitat
ILMB ..... Integrated Land Management Bureau (British Columbia)
KP ..... kilometre post
LNG ..... liquid natural gas
LRMP ..... land and resource management plan
LRP ..... least-risk period
LWD ..... large woody debris
mg/L ..... milligrams per litre
m/s ..... metres per second
NCD ..... non-classified drainage
NEB ..... National Energy Board

NTS ..... National Topographic Service
NVC ..... no visible channel
PDA ..... project development area
PEAA ..... project effects assessment area
ppm ..... parts per million
QAES ..... qualified aquatic environmental specialist
RISC ..... Resources Information Standards Committee
RoW ..... right-of-way
SARA ..... *Species at Risk Act*
SWD ..... small woody debris
TDR ..... technical data report
TRIM ..... terrain resource information management
UTM ..... Universal Transverse Mercator
µS/cm ..... microSiemens per centimetre
WET ..... wetland
ZOI ..... zone of influence

Glossary

adfluvial	Fish that live in lakes but migrate to rivers or streams to spawn.
alevin	Newly hatched, incompletely developed fishes (usually salmonids) still in nest or inactive on bottom, living off stored yolk.
algae	Simple rootless plants that grow in sunlit waters at a rate proportional to the amount of available nutrients
anadromous	Fish that breed in freshwater, but live their adult life in the sea. On the Pacific coast, anadromous fish include all of the Pacific salmon, steelhead trout, some coastal cutthroat trout and Dolly Varden char, lampreys and eulachons.
backwater	Shallow wetted areas adjacent to the main course of a river.
bog	Wetted area that accumulates a deposit of dead plant material.
braided	A stream or river pattern formed by a network of interlaced stream channels separated from each other by islands or bars of bedload material.
coarse fish	Large bodied fish that are not sportfish
commercial fishing	Capturing fish and seafood for the purpose of selling to others.
confluence	The flowing together of two or more bodies of water.
deleterious substances	A substance that is harmful to fish, or a substance that limits the use of fish by humans, or if by going through some process of degradation, it harms the water quality.
detritus	Freshly dead or partly decomposed plant or animal matter.
diatoms	Freshwater and marine microscopic unicellular algae.
embayment	An indentation of a shoreline.
emigration	Permanent movement of individuals of a population away from the area occupied by that population to a new area
endemic	Native to a particular area.
entrainment	The incidental trapping of fish and other aquatic organisms in the water, for example, used for cooling electrical power plants or in waters being diverted for irrigation or similar purposes.
epibenthic	Living on the surface of bottom sediments in a waterbody.
estuarine	Aquatic coastal environment that is partially enclosed with one or more rivers flowing into it.

extinction	The termination of a species caused by failure to reproduce and death of all remaining members of the species.
extirpation	The elimination of a species from a particular area but not from its entire range.
fish habitat	Spawning grounds and nursery, rearing, food supply and migration areas on which fish depend directly or indirectly in order to carry out their life processes
floodplain	Flat land bordering a stream or river onto which a flood will spread.
fluvial	A comprehensive term for several stream or river processes involving the transportation and deposition of materials by water.
forage fish	Small freshwater fish that serve as prey items for larger fish and include the minnows, sculpins, sticklebacks, and darters.
foraging	The act of looking for food.
free embryo	First life interval after hatching.
freshet	A rapid rise in river discharge and level caused by heavy rains or melting snow.
fry	The life stage of fish between full absorption of the yolk sac and less than one year old.
interstitial	Referring to the interstices, or pore spaces, in rock, soil or other material subject to filling by water.
instream	Located within the channel boundaries of a river or stream.
iteroparous	Able to spawn more than one time; reproducing annually, or having more than one brood.
inundated	Flooded or covered with water.
lacustrine	Relating to a lake.
laminar flow	Smooth, non turbulent flow.
larvae	Distinct juvenile form before metamorphosing into adult form.
lentic	Relating to slow moving water, such as those in a lake or wetland.
littoral	Pertaining to the shore of a water body.
lotic	Relating to flowing water, such as those in a stream or river.
mainstem	The principal, largest, dominating stream or channel of any given drainage system.
marine	Relating to the ocean.

natal	Relating to birth.
oligotrophic	Waters that are poor in dissolved nutrients, of low photosynthetic productivity and rich in dissolved oxygen at all depths.
orthophoto	Aerial photographs corrected for curvature.
overwintering	The stage at which an organism endures winter.
pelagic	Organisms that swim or drift in open waters, as opposed to those that live in waters close to shore.
piscivore	An organism that eats fish.
pool	A portion of stream with reduced current velocities; it is usually deeper than the surrounding area.
primary productivity	The rate at which energy produced by photosynthetic activity as organic compounds is stored in an ecosystem or group of communities.
rear(ing)	Process of finding food and shelter by juvenile fish to grow and live.
recreational fishing	Fishing for pleasure or competition.
redd	The gravel nest of salmonid fishes.
regulated river	River in which a dam or series of dams control the rate of flow of water.
riffle	A shallow rapids where water flows swiftly over submerged or partially submerged obstructions to produce surface disturbances.
riparian	Area immediately adjacent to a waterbody.
riverine	All habitats contained within a natural or artificial channel that periodically or continuously contains moving water.
run	A swiftly flowing stream reach with little surface agitation and no major flow obstructions.
salmonid	Refers to a member of the fish family classed as Salmonidae, including the salmon, trout, char, whitefish and grayling.
Secchi depth	Measure of water clarity using a disc marked with alternating black and white quarters. The depth at which you can no longer see the disc is the Secchi depth.
secondary productivity	Consumption of primary producers to produce biomass through tissue growth.
side channel	Area of river in which water is present but does not receive the majority of the flow.
slough	Low, swampy ground in which water flows sluggishly for long stretches.

smolt	Juvenile salmonid one or two years old that has undergone physiological changes to cope with a marine environment.
spawn(ing)	Production or deposition of large quantities of eggs in water.
sport fish	Fish that are captured for recreational purposes.
strain	A variant of a species.
stray	To move away from a group.
sympatrically	Occupying the same or overlapping geographic areas without interbreeding.
tailout	Pool tailouts, the elongated transitional zone of moderately shallow, flat-bottomed water with smooth, laminar flow that occur between pools and riffles in low-gradient channels, are a common form of glide.
tributary	A stream flowing into a larger stream.
turbidity	The degree to which water is opaque due to suspended silt or other sediments
undercut bank	A stream bank that has had its base cut away by water action.
yolk sac	Membranous sac attached to an embryo that provides nourishment.
young-of-the-year	Fish that have been born in the past year.
zooplankton	Tiny invertebrates that float freely throughout the seas and other bodies of water.

1 Introduction

1.1 Background

Northern Gateway Pipelines Limited Partnership (Northern Gateway) proposes to design, construct and operate two pipelines extending from the terminus at Bruderheim, Alberta (near Edmonton) to the Kitimat Terminal in British Columbia. One pipeline will transport crude oil from Alberta to British Columbia, whereas the second pipeline will transport condensate from the Kitimat Terminal to Bruderheim. The marine terminal will be used to load tankers with oil for export to international or Pacific Rim markets and will also be used to unload tankers carrying condensate.

The primary goal of the Freshwater Fish and Fish Habitat Technical Data Report (TDR) is to provide information on fisheries and aquatic resources to support the Environmental and Socio-economic Assessment (ESA) for the Enbridge Northern Gateway Project (the Project). In addition, the information will be used in regulatory decision making under the *Fisheries Act*, *Canadian Environmental Assessment Act*, the *Species at Risk Act* (*SARA*), and the *National Energy Board Act* (*NEB Act*).

The Project will be reviewed under a joint review panel process pursuant to the *NEB Act* process and the *Canadian Environmental Assessment (CEA) Act*. To aid proponents in their applications, the NEB has developed a filing manual (NEB 2005, Internet site). For projects potentially affecting fish and fish habitat, the NEB Filing Manual lists information requirements including:

- determination of fish-bearing status of each watercourse
- determination of the effect of construction timing on any life stage of fish
- the potential for a release of a deleterious substance into the watercourse
- the presence or absence of steep embankments or other erosive features

These requirements formed the basis for the literature review and for field surveys conducted along the pipeline right-of-way (RoW) in 2005, 2006, 2008 and 2009. Field surveys included sampling of fish species assemblages and habitat biophysical data from watercourses crossed by the RoW. Methods used and results from the literature review and field surveys are described in this TDR.

1.2 Regulatory Setting

Fisheries resources in Canada, including the protection and management of fish and fish habitat, are regulated by the *Fisheries Act* and administered by Fisheries and Oceans Canada (DFO). The following five sections of the *Fisheries Act* are relevant to the construction and operation of the Project:

- Section 21(3) prohibits leaving unused obstructions detrimental to fish passage in fish-bearing waters.
- Section 22(2) requires proponents to make provisions necessary for the free passage of both ascending and descending migratory fish during the construction of any obstruction to fish passage.
- Section 22(3) requires proponents to provide flows downstream of the obstruction sufficient for the safety of fish and for the flooding of spawning grounds.
- Section 32 prohibits the destruction of fish by any means other than fishing.

- Section 35(1) prohibits the harmful alteration, disruption or destruction (HADD) of fish habitat.
- Section 36(3) prohibits the deposition of deleterious substances of any type in water frequented by fish.

Baseline fish and fish habitat data is necessary to adequately address and make decisions on specific sections of the *Fisheries Act* relating to potential impacts to fish and fish habitat from proposed development projects. This data requirement is specified in Section 37(1) of the *Fisheries Act* which requires that proponents provide plans, specifications, studies, procedures, schedules, analyses, samples or other information that will enable the Minister to determine whether the work or undertaking will result in the HADD of fish habitat, if the deposition of deleterious substances in waters frequented by fish will occur, and if any measures to prevent the HADD or release of deleterious substances can be implemented.

As part of its Environmental Process Modernization Plan to streamline reviews and referrals, DFO has developed Operational Statements which outline measures to avoid negative impacts to fish and fish habitat. The Operational Statements describe the conditions under which a proponent may conduct a project, or components of projects, without further regulatory review. The Alberta Interim Operational Statement for Pipeline Crossings was replaced on April 1, 2008 with the following DFO Operational Statements:

- High Pressure Directional Drill Alberta Operational Statement (DFO 2007a, Internet site)
- Punch and Bore Crossings Alberta Operational Statement (DFO 2007b, Internet site)
- Isolated or Dry Open-Cut Stream Crossings Alberta Operational Statement (DFO 2007c, Internet site)

In British Columbia, the following DFO (Pacific Region) Operational Statements are relevant to this project (DFO 2008, Internet site):

- Bridge Maintenance
- Culvert Maintenance
- Clear Span Bridges
- Directional Drilling
- Dry Open-cut Stream Crossings
- Maintenance of Riparian Vegetation in Existing Right-of-Ways
- Overhead Line Construction
- Punch and Bore Crossings
- Temporary Ford Stream Crossings

Endangered, threatened and species of special concern are governed by the federal *SARA*. *SARA* was created to protect wildlife species from extinction by facilitating the recovery of species at risk due to human activity and ensuring that species of special concern do not become endangered or threatened through sound wildlife management.

1.3 Objectives

Objectives of this TDR are to:

- review, analyze and interpret existing information on freshwater fish and fish habitat within the pipeline RoW
- present results of baseline field programs conducted to identify and map fish-bearing and non-fish-bearing watercourses within the RoW and, at fish-bearing watercourses, to determine fish species and life history stage composition, fish species distribution, habitat availability and habitat utilization at pipeline watercourse crossings
- identify fish species of concern (e.g., federally listed species at risk, provincially listed species) within the RoW that are vulnerable to potential project effects and identify their distribution, relative abundance and habitat use in relation to watercourse crossings within the RoW

The fisheries and aquatics study team addressed the objectives of the baseline programs by using existing data, supplemented with field surveys conducted in 2005, 2006, 2008 and 2009, to develop a comprehensive baseline data set from which potential project effects could be assessed.

This report describes fish and fish habitat presence and habitat quality associated with the pipeline RoW, powerline easement, access road and terminal site watercourse crossings only. Field investigations associated with other aspects of the Project, including construction camps, stockpile sites, and borrow pits or staging areas have not been conducted as of October 2009.

2 Methods

2.1 Study Area Boundaries

The pipeline route will cross six major river drainages in British Columbia and Alberta (see Figure 2-1) that range in area from 3,964 km^2 (Kitimat River drainage) to 302,500 km^2 (Peace River drainage) (see Table 2-1). In Alberta, the pipeline route crosses watercourses of the North Saskatchewan, Athabasca and Peace River drainages. In British Columbia, the pipeline route will cross watercourses of the Peace, Fraser and Skeena and Kitimat River drainages. Major drainages consist of two to four watersheds in Alberta and one to four watersheds in British Columbia. ROW centreline summit elevations in each major drainage, estimated from 1:50,000 National Topographic Service (NTS) maps, vary from about 700 m asl (above sea level) in the North Saskatchewan River drainage in Alberta to 4,300 m in the Skeena River drainage in British Columbia.

Table 2-1 Major Drainage and Watershed, Summit Elevations, Biogeoclimatic Zones and Natural Subregions

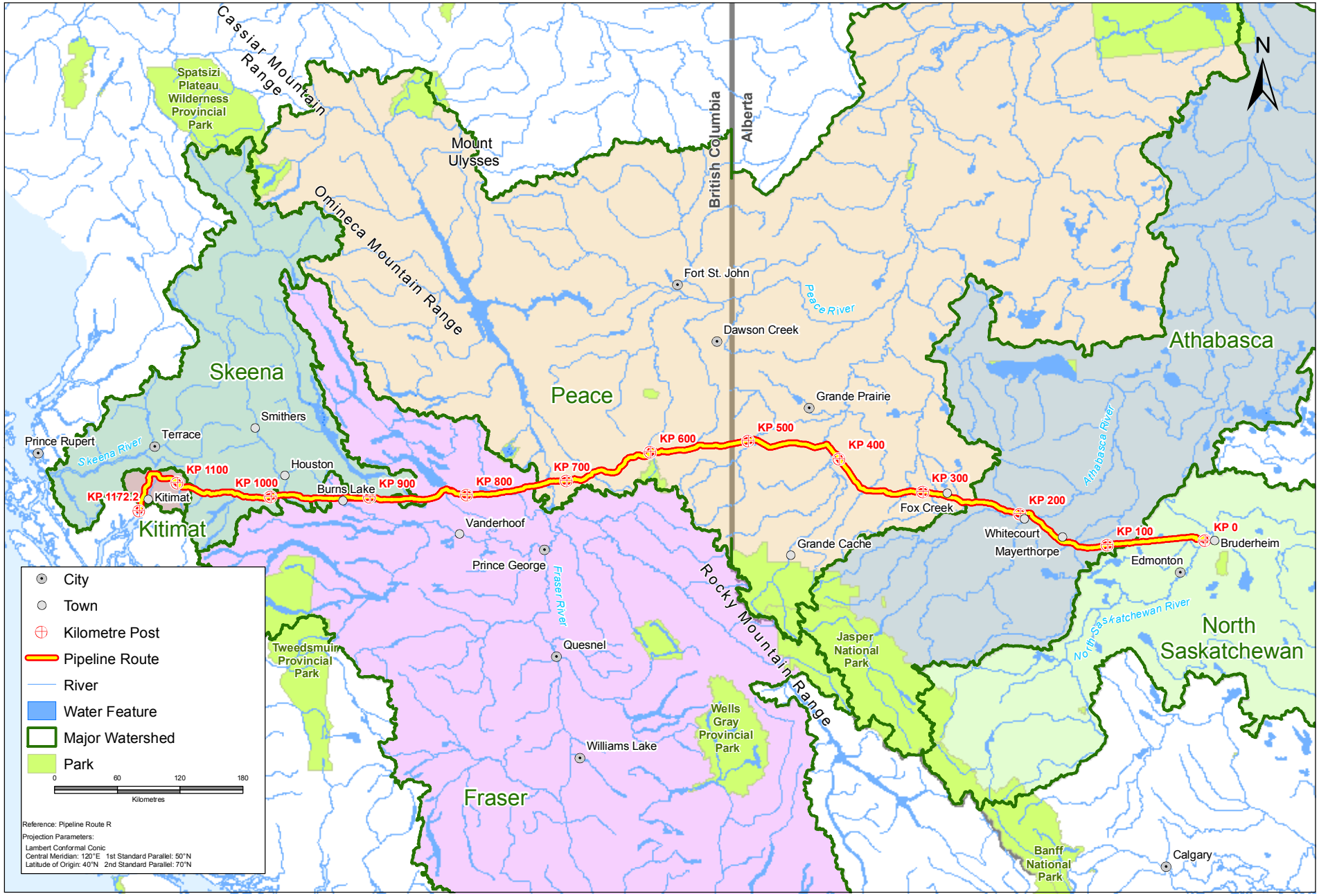
Major Drainage and Watershed	Drainage Area (km^2)	Mainstem Length (km)	Centreline Summit Elevation (m asl)	Alberta Natural Subregions[4] and BC BEC Zones[5]
Alberta				
North Saskatchewan River	122,800	1,287	700	CP
North Saskatchewan River Watershed[1]	1,400	60		
Sturgeon River Watershed	3,300	150		
Athabasca River	95,300	1,231	2,350	LF, DM
Athabasca River Watershed[2]	34,800	430		
Pembina River Watershed	11,600	410		
Paddle River Watershed	2,500	110		
Peace River (AB)[6]	302,500	1,923	3,000	CM, LF
Smoky River Watershed	18,300	500		
Simonette River Watershed	5,000	200		
Little Smoky River Watershed	13,400	350		
Wapiti River Watershed[3]	10,100	200		

Table 2-1 Major Drainage and Watershed, Summit Elevations, Biogeoclimatic Zones and Natural Subregions (cont'd)

Major Drainage and Watershed	Drainage Area (km^2)	Mainstem Length (km)	Centreline Summit Elevation (m asl)	Alberta Natural Subregions[4] and BC BEC Zones[5]
British Columbia				
Peace River (BC)[6]	302,500	1,923	3,000	SBS, ESSF, BWBS, AT
Wapiti River Watershed	5,088			
Murray River Watershed	6,489	217		
Parsnip River Watershed	5,612	231		
Crooked River Watershed	2,190	70		
Fraser River	232,300	1,370	3,600	SBS, ESSF, AT
Salmon and Lower Salmon River Watersheds	3,613	290		
Muskeg River Watershed	8,470	92		
Stuart River Watershed[3]	1,985	415		
Stuart Lake Watershed	3,360	N/A		
Francois Lake Watershed	6,653	N/A		
Skeena River	54,400	579	4,300	CWH, MH, SBS, ESSF, ICH, AT
Babine Lake Watershed	6,584	N/A		
Bulkley River Watershed	7,806	257		
Morice River Watershed	4,349	108		
Zymoetz River Watershed	3,028	130		
Kitimat River (includes Douglas Channel)	3,964	98	3,500	CWH, MH, AT

NOTES:
[1] Unnamed sub-basin in the City of Edmonton
[2] Upper sub-basin of the Athabasca River drainage
[3] The Wapiti River east of the Alberta–British Columbia border
[4] Natural Subregions of Alberta: CP: Central Parkland; DM: Dry Mixedwood; CM: Central Mixedwood; LF: Lower Foothills
[5] British Columbia Biogeoclimatic Ecosystem Classification (BEC) Zones: SBS: Sub-Boreal Spruce; ESSF: Engelmann Spruce - Subalpine Fir; BWBS: Boreal White and Black Spruce; AT: Alpine Tundra; CWH: Coastal Western Hemlock; MH: Mountain Hemlock; ICH: Interior Cedar Hemlock
[6] Values are for Peace River are for both British Columbia and Alberta sections combined.

SOURCE: Adapted in part from Natural Resources Canada 2005, Internet site.



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PREPARED FOR: ENBRIDGE NORTHERN GATEWAY PIPELINES

ENBRIDGE NORTHERN GATEWAY PROJECT

Major Drainages Crossed by the RoW in Alberta and British Columbia

FIGURE NUMBER:	DATE:
2-1	20090519
SCALE: 1:5,000,000	AUTHOR: EO / APPROVED BY: TS
PROJECTION: LCC	DATUM: NAD 83

Y:\GIS\Projects\CE\CE03210_GatewayMapping\MXD\route_overview\RevR\watershed_overview_v2.mxd

In the three major drainages in Alberta, the pipeline route crosses the Central Parkland, Lower Foothills and Dry and Central Mixedwood natural subregions. In British Columbia, the pipeline route crosses the Sub-Boreal Spruce, Engelmann Spruce – Subalpine Fir, Boreal White and Black Spruce, Alpine Tundra, Coastal Western Hemlock, Mountain Hemlock and Interior Cedar Hemlock zones of the BEC (British Columbia Ministry of Forests and Range [BC MoFR] 2009, Internet site). The most common BEC zones, Sub-Boreal Spruce and Engelmann Spruce – Subalpine Fir, occur in three of the four major British Columbia drainages: Peace, Fraser and Skeena River. Detailed baseline descriptions of BEC zones, vegetation (rare plants and communities) and variants are provided in the Vegetation Technical Data Report (Reid et al. 2010).

2.1.1 Study Area for Existing Data Review

Spatial boundaries for the review of existing data included British Columbia watersheds in each of the four drainages listed above and Alberta watersheds in the three major river drainages crossed by the pipeline route. Geographic Information System (GIS) computer software (ArcGIS, ESRI), in association with various historic and contemporary fisheries-related databases (see Section 2.2), were used to spatially identify species assemblages and distributions and migratory obstructions and other relevant features (e.g., fisheries management initiatives) in watersheds where pipeline crossings occur. The spatial identification of these attributes encompassed aquatic habitats upstream and downstream from watercourse crossings inside and outside the study area (see Section 2.1.2) to facilitate confirmation of species presence or absence at each crossing.

2.1.2 Study Area for Field Surveys

For baseline purposes, a 1-km-wide area along the pipeline route was used to define the study area. For consistency with the Freshwater Fish and Fish Habitat Section, the study area is referred to as the project effects assessment area (PEAA) and the area encompassing the proposed pipeline RoW, powerline easements and access roads is referred to as the project development area (PDA).Within the PEAA, physical and biological surveys were completed up to 100 m upstream and 300 m downstream from the pipeline crossing or for the entire zone of influence (ZOI[1]) (see Section 2.3.7.1), whichever was greater. Surveys covered all riparian, ephemeral and instream areas as defined by the British Columbia Forest Practices Code (British Columbia Ministry of Forests [BC MoF] 1995). These boundaries were applied to both Alberta and British Columbia watersheds. Detailed site survey procedures are provided in Section 2.3.

2.2 Review of Existing Data Sources

2.2.1 Species Distributions, Fish Assemblages, and Barriers

A literature review was conducted for information on fisheries, aquatic resources and habitats along the pipeline route. The information reviewed included maps, aerial photographs, government databases and reports, and consultant reports including the Critical Work Plan (Jacques Whitford Limited 2005).

[1] ZOI describes the likely downstream extent of an extreme disturbance during construction and with standard mitigation measures in place.

Table 2-2 lists the information that was required and the associated sources for this information. These sources of information were used to identify data gaps and to provide historical accounts of species distributions, fish assemblages and migratory obstructions for many of the watercourses.

Table 2-2 Major Information Requirements and Sources for Freshwater Fish and Fish Habitat

Information Required	Source
Confirmation of preferred route	Northern Gateway
1:20,000 TRIM datasets, 1:50,000, 1:250,000 and 1:1,000,000 NTS datasets of the pipeline route	Natural Resources Canada British Columbia Integrated Land Management Bureau, Terrain Resource Information Management (TRIM) Program
Universal Transverse Mercator (UTM) coordinates, latitudes and longitudes and kilometre posts for all watercourse crossings along the pipeline route	Derived using GIS
Identification and classification of watercourses including hydrologic characteristics with specific focus on the identification of those that will be frozen to the bottom or dry during crossing construction. Determine the zone of influence for larger streams	The Project's hydrology study team
Stream names, British Columbia watershed groups and codes, ASRD management areas, AB public lands classification and stream classes, British Columbia forest regions, districts and timber supply areas (TSAs), BC MWLAP regions	Available mapping and aerial photographs, British Columbia Watershed Atlas (BC MoE 2001, Internet site) and BC MoF[1], BC MWLAP[3], ASRD, Forest Licensees
Aboriginal Traditional Knowledge (ATK)	Public Consultation, Volume 5B of the ESA Discussions with local Aboriginal assistants Indian and Northern Affairs Canada
Fish distribution, abundance and fish habitat attribute data	• BC MoF[1], BC MWLAP[3], BC ILMB[4] • AENV[5], ASRD[2] • DFO[6] • Spawning escapement catalogues (DFO[6]); FISS[7], FDIS[8] and EcoCat[15] (BC MoE[4] 2009a,b Internet sites), FWMIS[9] (ASRD[2] 2009, Internet site); DFO[6] and British Columbia Fisheries Project Registry and land and resource management plans (LRMPs)[10] • Consultants' reports (refer to notes below). • Internet search (World Wide Web) • Alberta angling guides • Alliance Pipeline data (Golder Associates 1997a-f) • LRMPs (refer to notes below)

Table 2-2 Major Information Requirements and Sources for Freshwater Fish and Fish Habitat (cont'd)

Information Required	Source
Fish Species at Risk and Species of Special Concern	• COSEWIC[11], BC CDC[12], ASRD[2] and BC MoF[1] Identified Wildlife Management Strategy
Habitat and water quality requirements for representative fish species	• BC MWLAP[3], BC MoF[1], ASRD[2], BC Approved Water Quality Guidelines for Fresh Water Aquatic Life (BCAWQG[13]), Canadian Water Quality Guidelines for Fresh Water Aquatic Life (CCME[14]) and Summary of Guidelines for Canadian Drinking Water Quality (federal)

NOTES:
[1] BC MoF: British Columbia Ministry of Forests.
[2] ASRD: Alberta Sustainable Resource Development.
[3] BC MWLAP: British Columbia Ministry of Water, Land and Air Protection.
[4] ILMB: Integrated Land Management Bureau.
[5] AENV: Alberta Environment.
[6] DFO: Fisheries and Oceans Canada.
[7] FISS: Fisheries Inventory Summary System (British Columbia).
[8] FDIS: Fisheries Data Information System (British Columbia).
[9] FWMIS: Fisheries Management Information System (Alberta).
[10] LRMPs: Land and Resource Management Plans (British Columbia).
[11] COSEWIC: Committee on the Status of Endangered Wildlife in Canada.
[12] BC CDC: British Columbia Conservation Data Centre.
[13] BCAWQG: British Columbia Approved Water Quality Guidelines (Criteria).
[14] CCME: Canadian Council of Ministers of the Environment.
[15] EcoCat: Ecological Reports Catalogue.

CONSULTANTS' REPORTS:
Applied Aquatic Research Ltd. 2007; Aquatic Resources Ltd. 2000; Avison Management Services 1999; BC MoE 1984, 1986; Beere 1993, 1995; Blackman 2001, 2002a,b,c; Blackman and Hunter 2001; British Columbia Ministry of Environment Land and Parks (BC MELP) 1987; Carmanah Research 1998; Cascadia Natural Resource Consulting 1999, 2000; Chudyk 1979; Chudyk and Whatley 1980; David Bustard & Associates 1990, 1997, 1998, 1999; Diversified Environmental Services 2002; Eccles et al. 1977; EDI Environmental Dynamics Inc. 1997a,b, 1999, 2000, 2001a,b,c; FINS Consulting Ltd. 1998a,b,c, 1999, 2000; Golder Associates 1997a-f; Hatfield Consultants Ltd. 1998; Hatlevik 1981; Kitimat LNG Inc. 2005; Lough 1990; Morris and Eccles 1975; Morris and Eccles 1976a,b, 1978; Morris et al. 1977; Northcote 1993; Taylor 1995; The Fisheries and Marine Service and the International Pacific Salmon Fisheries Commission 1979; Tredger 1981, 1986, 1987; Tripp Biological Consultants 1998; Triton Environmental Consultants Ltd. 1998, 1999a,b, 2000a,b; Whatley et al. 1978.

LAND AND RESOURCE MANAGEMENT PLANS (LRMPs):
ILMB 1997, 1998, 1999a, 1999b, 2002, 2004, Internet sites.

All historic fisheries information was entered into the fisheries database (see Section 2.3.2). Orthophoto maps (1:20,000) were annotated in a GIS database with relevant historic data and used in the field to identify additional fish sampling requirements. Relevant historic data for all RoW pipeline watercourse crossings associated with the current pipeline alignment, including unsurveyed sites, are presented in this report. Historic data associated with new access roads, new powerlines and PDA anciliary facilities (e.g., stockpile sites, work areas, and construction camps) are not presented in this report.

The Northern Gateway pipeline route is similar to that of three other pipeline projects. Data from these projects were used to supplement information for this report. The Alliance Pipeline Project (Golder Associates 1997a-f) provided information on fish species and habitats at watercourse crossings common to both pipeline routes in Alberta. The Kitimat-Summit Lake Pipeline (Applied Aquatic Research Ltd. 2007) and Kitimat Liquid Natural Gas (LNG) Pipeline (Kitimat LNG Inc. 2005) projects also provided recent fish species presence/absence information at several watercourse crossings common to both routes in the Kitimat and Skeena drainages.

2.2.2 Species at Risk

Both federal and provincial species conservation databases were examined for species of conservation concern present along the pipeline RoW. These databases list the conservation status of species provincially, federally and globally. The following online databases were reviewed:

- Alberta Natural Heritage Information Centre (ANHIC 2008a, Internet site)
- British Columbia Conservation Data Centre (BC CDC 2008, Internet site)
- British Columbia Species and Ecosystems Explorer
- British Columbia Habitat Wizard (British Columbia Ministry of Environment [BC MoE] 2009c, Internet site)
- Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2008, Internet site)
- Species at Risk Public Registry (Government of Canada 2009, Internet site)

ANHIC maintains tracking and watch lists based on global and provincial ranks. The ranking system is based on the following scale:

- S1/G1 – Five or fewer occurrences or only a few remaining individuals; may be especially vulnerable to extirpation because of some factor of its biology
- S2/G2 – 6 to 20 or fewer occurrences or with many individuals in fewer locations; may be especially vulnerable to extirpation because of some factor of its biology
- S3/G3 – 21 to100 occurrences may be rare and local throughout its range or in restricted range (may be abundant in some locations); may be susceptible to extirpation because of large scale disturbances
- S4/G4 – Typically more than 100 occurrences; apparently secure
- S5/G5 – Typically more than 100 occurrences; demonstrably secure

The British Columbia Conservation Data Centre (BC CDC) also maintains lists based on a global and provincial ranking system. The provincial Status rank is based on the following criteria:

- Red – Includes any indigenous species or subspecies that have (or are candidates for) the status of Extirpated, Endangered or Threatened in British Columbia. Extirpated taxa no longer exist in the wild in British Columbia, but do occur elsewhere. Endangered taxa are facing imminent extirpation or extinction. Threatened taxa are likely to become endangered if limiting factors are not reversed. Not all Red-listed taxa will necessarily become formally designated. Placing taxa on these lists flags them as being at risk and requiring investigation.
- Blue – Includes any indigenous species or subspecies considered to be of Special Concern (formerly Vulnerable) in British Columbia. Taxa of Special Concern have characteristics that make them particularly sensitive or vulnerable to human activities or natural events. Blue-listed taxa are at risk, but are not Extirpated, Endangered or Threatened.
- Yellow – Includes species that are apparently secure and not at risk of extinction. Yellow-listed species may have Red- or Blue-listed subspecies.

Species at risk need particular attention to ensure their continued existence. These species are afforded protection and managed under *SARA*. *SARA* makes it an offence to kill, harm, harass, capture, possess, collect and sell species at risk protected by the Act. It is also an offence to possess, collect, trade and sell parts or products derived from protected species. Under the Act, it is also illegal to destroy or damage the critical habitat of the species necessary for their survival and recovery.

SARA has required a Public Registry to be maintained and updated since its inception. The registry provides status reports on wildlife species and the most up to date list (Schedule 1) of wildlife species at risk. The prohibitions of *SARA* apply to all species listed in *SARA* Schedule 1 as endangered, threatened or extirpated species. The Act stipulates that other species may be added to the registry list of species protected by the Act.

These species are assessed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), an independent scientific committee which is established under *SARA* by law. COSEWIC assesses and classifies wildlife species using the best available scientific, community and ATK. The COSEWIC ranking system classifies species into the following categories:

- Extinct – a species that no longer exists
- Extirpated – a species that no longer exists in the wild in Canada, but occurs elsewhere
- Endangered – a species facing imminent extirpation or extinction
- Threatened – a species that is likely to become endangered if limiting factors are not reversed
- Special Concern – a species with characteristics that make it particularly sensitive to human activities or natural events
- Not at Risk – a species that has been evaluated and found not to be at risk

Endangered or threatened species listed under *SARA* and the Alberta *Wildlife Act* are designations that have legislated protection. A COSEWIC, ANHIC or Alberta status does not provide legislated protection unless it is also listed under *SARA* or the Alberta *Wildlife Act*.

2.3 Right-of-Way Field Surveys

Field surveys were conducted in 2005, 2006, 2008 and 2009 to collect fish and fish habitat information from proposed watercourse crossings in Alberta and British Columbia. Table 2-3 shows the schedule of field crew orientations and field surveys conducted in all years. Prior to initiation of field surveys, a number of tasks were completed. These tasks included:

- identification of watercourse crossing sites
- development of a watercourse crossings database
- acquisitions of sampling permits
- field crew orientations
- review of provincial stream classification systems and their application during field surveys
- determination of least-risk periods for instream construction

Each of these tasks is described in greater detail in the sections that follow.

Table 2-3 Schedule of Freshwater Fish and Fish Habitat Field Programs

Orientations and Field Programs	2005	2006	2008	2009
Field Crew Orientations				
Calgary	June 23–24			
Edmonton		June 1		
Smithers	July 13–15; August 10–12			
Burnaby			May 21	February; July 17
Field Programs[1]				
Alberta watercourse crossings	September 26 to October 26	May 26 to July 28	September 23 to October 17	March 16–20; August 5–10
British Columbia watercourse crossings	July 16 to October 21	June 17 to August 07	September 23 to October 17	March 10–16; August 5 to September 11

NOTE:
[1] Field programs were suspended from July 29 to August 12, 2005 and from July 13 to July 23, 2006 because of site access issues and changes in route alignment.

2.3.1 Identification of Watercourse Crossing Sites

Watercourse crossings were identified using 1:20,000 scale terrain resource information management (TRIM) maps. The pipeline route was overlaid on the TRIM maps and an automated GIS process was used to place a waypoint at each intersection of the pipeline route with a watercourse. The waypoints were reviewed by a GIS technician for accuracy. Each waypoint was assigned a kilometre post (KP) location along the route and a unique identification number (site number). The zero KP is located in Bruderheim, Alberta, north of Edmonton.

Rerouting of the RoW has required the adjustment of KP values for each site. Any new sites added to the pipeline route over the duration of the Project receive new unique identification numbers. New sites on the same watercourse but greater than 100 m in distance from the original site are also given a new identification number.

New access roads, powerline easements and PDA ancillary facilities (e.g. construction camps, stockpile sites and work areas) were also given unique identification numbers and assigned a KP value along the route. Where a new road, powerline or PDA site occurred within 100 m of a watercourse crossing, the site was counted as a pipeline RoW crossing and assigned the same stream classification and fish bearing status as that watercourse crossing.

2.3.2 Development of the Watercourse Crossings Database

Prior to field surveys, an MS Access database was developed to store the fish and fish habitat information collected in the field and during the literature review. This database was developed based on data requirements for the stream survey methodology described in the:

- British Columbia Resources Information Standards Committee (RISC) Reconnaissance (1:20,000) Fish and Fish Habitat Inventory: Standards and Procedures (RISC 2001, Internet site)
- Alberta Code of Practice for Pipelines and Telecommunication Lines Crossing a Waterbody (AENV 2001)

Site georeference coordinates (UTM and latitudes and longitudes), channel characteristics, biophysical habitat characteristics, fish collection, and fish assemblage data were incorporated into the database. Specific data fields in the database included:

- digital photographs of each watercourse at the watercourse crossing (upstream and downstream from the RoW and right and left banks)
- global positioning system (GPS) confirmation of each location
- evaluation of the quality of fish habitat (spawning, overwintering, rearing, migration and staging, and holding)
- study section length
- geomorphologic features (channel morphology, confinement, pattern, islands, bars and coupling)
- channel features (mean bankfull depth and width, mean depth, mean wetted width, gradient and barriers to fish movement)

- hydrologic features (stage in British Columbia; velocity, stage, discharge, streambed groundwater upwelling and stream bank seepage in Alberta)
- water quality (dissolved oxygen [Alberta], temperature, pH, conductivity and turbidity)
- composition of channel bed materials (percent fines, gravels, cobbles, boulders and bedrock)
- bank features (shape, height, slope, texture and stability)
- riparian features (vegetation type and structural stage, percent crown closure)
- habitat units (pool, riffle, glide, run and flat in Alberta)
- disturbance indicators (e.g., abandoned channels, eroding banks, sediment fingers and wedges)
- composition of cover (small woody debris, large woody debris, boulders, undercut banks, deep pools and overhanging and instream vegetation)
- fish species, life stage and length of sport fish species

2.3.3 Permit Acquisitions and Conditions

2.3.3.1 Federal

Federal (DFO) Scientific Fisheries Licenses were obtained in mid-July 2005 (DFO License No: 2005 - 047; 2005 - 904), May and June 2006 (DFO License Nos.: XHAB 132, 133 and 167, 2006), April 2008 (XHAB 327 2008), May 2008 (XHAB 352 2008), January 2009 (XHAB 6 2009) and March 2009 (XHAB 21 2009) prior to initiation of field survey programs. The DFO licenses listed terms and conditions for fisheries sampling in British Columbia and required a summary report 90 days after the License expiry date.

2.3.3.2 British Columbia

Pursuant to the *Wildlife Act* and Section 18 of the Angling and Scientific Regulations of British Columbia (Reg. 125/90), Provincial Fish Collection Permits for Regions 6, 7 and 9 were applied for and received from the British Columbia Ministry of Water, Land and Air Protection (BC MWLAP) in 2005 and 2006 prior to initiation of field sampling (Permit No. SM/PG/FJ05-13738 and Permit No. SM/PG/FJ06-21952, respectively) and in 2008 (SM/PG/FJ08-43745) and February 2009 (SM/PG/FJ09-51047) prior to initiation of field programs.

The original 2005 permit validation period (July 1 to September 30, 2005) was extended verbally for Region 6 (Atagi 2005, pers. comm.) and Region 7A (Zimmerman 2005, pers. comm.) to October 30, 2005, to accommodate extension of the 2005 field program. However, no electrofishing in Region 7B was allowed after September 30 in compliance with Region Specific Conditions for bull trout streams with water temperatures less than 5°C (Leering 2005, pers. comm.). Accordingly, only minnow trapping and beach seining were allowed in Region 7B after September 30 in 2005 and 2006. As part of the terms and conditions of these permits, a summary report of collection activities was submitted to BC MWLAP within 90 days of permit expiry.

A Park Use Permit (Permit No. SK0610538) was also obtained for the purpose of fish and fish habitat research in the Sutherland River Provincial Park. British Columbia Parks permit conditions required similar reporting of all results of the research conducted under the permit.

2.3.3.3 Alberta

Fish Research Licenses (License Nos. 05-2018, 05-2836FR, 05-1086FR and 05-3014FR) were received from Alberta Sustainable Resource Development (ASRD) prior to initiation of field work. Both licenses were valid from July 1 to November 15, 2005 and listed Fish and Wildlife Division notifications, approved sample locations, gear restrictions and fish handling and reporting requirements. Similarly, a Fish Research Licence (License No. 06-2006 FR) was obtained from ASRD for 2006 field investigations in Alberta. This license was valid from May 2 to November 15, 2006. A Fish Research Licence (License No. 08-3007 FR) was obtained from ASRD for 2008 field investigations. This license was amended (Amendment 1) to extend the sampling (angling and minnow trapping) period to March 31 2009. In April 2009, licence FRL No. 09-3001 FR was issued (valid until November 01 2009) for boat and electrofisher, seine net, minnow trap and rod and reel sampling.

Summary data reports were required within 90 days of each license's expiry date. A comprehensive list of provincial and federal agencies, personnel and offices contacted is provided in Appendix A.

2.3.4 Field Crew Orientations

Field crew leaders attended a pre-field project orientation program in Calgary (June 23 to 24, 2005) and in Smithers (July 13 to 15 and August 10 to 12, 2005) to establish data collection protocols and data management procedures to ensure consistency in data collection and management between crews during the field program (see Table 2-3). Field crew orientations were also provided in Edmonton on June 1, 2006. Field crew orientations were also provided in Burnaby (May 21, 2008, February 2009 and July 17, 2009) to familiarize crews with updated data requirements for late summer to fall spawning and rearing and overwintering field programs.

Field forms, digital photograph requirements, quality assurance and quality control procedures, and database transfer protocols (e.g., file transfer protocol [FTP] site uploading, e-mail and courier) were established with the senior GIS Leader in Burnaby at these orientations. Field crew orientations also addressed British Columbia RISC and Alberta Code of Practice data collection procedures, data entry (electronic and paper), and database management.

2.3.5 Stream Classification Systems

Two different but similar stream classification systems exist in British Columbia and Alberta. Each system was used in its respective jurisdiction during the field programs to classify streams at each watercourse crossing; to determine least-risk periods for instream works, and to assist in the determination of appropriate watercourse crossing techniques.

In British Columbia, streams are classified as either fish-bearing or non-fish-bearing. A fish-bearing stream is a stream that has a slope gradient of less than 20% and is frequented at any time of the year by anadromous salmon, freshwater sport fish, threatened or endangered fish, or regionally important fish (BC MoF 1998). Fish-bearing streams are classified based on the following channel width criteria:

- S1 – channel width of 20 to 100 m wide
- S2 – channel width of 5 to 20 m wide
- S3 – channel width of 1.5 to 5 m wide
- S4 – channel width less than 1.5 m wide

Fisheries sensitive zones (FSZs) are also fish-bearing and include side and back channels, ponds, swamps, seasonally flooded depressions, lake littoral zones and estuaries that are seasonally occupied by over-wintering fish (BC MoF 1995). Along with wetlands, fisheries sensitive zones provide important habitat for fish.

Non-fish-bearing streams are streams that are greater than 20% gradient, or less than 20% gradient but do not have fish present at any time of the year due to the presence of an upstream migration barrier. Non-fish-bearing streams are classified based on the following channel width criteria:

- S5 – channel width greater than 3 m wide
- S6 – channel width less than 3 m wide

Barriers are usually based on stream gradients over 20%, and can also be falls, canyons or cascades that are known to restrict upstream fish passage. Known barriers for streams crossed by the pipeline RoW were identified using the British Columbia Fisheries Inventory Summary System (FISS) (BC MoE 2009a, Internet site).

In British Columbia, a stream is defined (BC MoF 1998) as “a reach, flowing on a perennial or seasonal basis having a continual channel bed, whether or not the bed or banks of the reach are locally obscured by overhanging or bridging vegetation or soil mats, if the channel bed is scoured by water, or contains observable deposits or mineral alluvium.” Sites that are identified as either no visible channel (NVC) or non-classified drainage (NCD) do not meet this definition of a stream and are classified as non-fish-bearing. NVCs are terrestrial vegetated areas with no fish habitat value. NCDs are areas that are less than 100 m channel length and are not a direct tributary to a fish-bearing reach. NCDs have no scour or fluvial deposition and no fish value at any time of year.

In British Columbia, the following assumptions were made in the field:

- Sites where no fish were captured but were accessible to downstream fish-bearing reaches (i.e., no observed or historic migration obstruction) were assumed to be fish-bearing (S1, S2, S3, or S4), at least during part of the year.
- Sites where no fish were captured and with known barriers to fish migration downstream of the site, with ephemeral flow, or no headwater lake were classed as non-fish-bearing (S5 and S6).
- Sites with gradients greater than 30% were sampled to confirm fish presence or absence even though channel gradients in excess of 20% default to non-fish-bearing status according to provincial criteria (BC MoF 1995).

In Alberta, stream classifications consider the sensitivity of fish habitat. Stream classifications are then used to establish crossing methods and to determine restricted activity periods (RAPs) for all mapped and classified watercourses. Definitions for Class A, B, C, and D watercourses in Alberta are provided in Table 2-4. Class A watercourses have the highest sensitivity, followed in descending order of sensitivity by Class B, Class C, and Class D.

Table 2-4 Alberta Stream Classification System

Sensitivity	Stream Class	Description
Highest	A	Habitat areas are sensitive enough to be damaged by any type of activity in the waterbody; known habitats in waterbody are critical to the continued viability of a population of fish species in the area.
High	B	Habitat areas are sensitive enough to be potentially damaged by any type of activity in the waterbody; habitat areas are important to the continued viability of a population of fish species in the area.
Moderate	C	Habitat areas are sensitive enough to be potentially damaged by unconfined or unrestricted activities in a waterbody; habitats are broadly distributed, supporting local fish species populations.
Low	D	Fish species as defined under the Code of Practice not present.
SOURCE: AENV 2001		

All mapped and unclassified watercourses within 2 km of entering a Class A, B or C waterbody were assumed to have the same classification as the downstream receiving waterbody. All unmapped watercourses within 2 km of a Class A, B or C waterbody were subject to the same conditions as a mapped waterbody. Alberta defines “fish” as those species used for domestic, sport and commercial purposes and “fish of special concern” as those species including but not limited to rare, endangered, threatened or vulnerable species (AENV 2001).

Alberta Class C watercourses range in size from small first-order ephemeral streams to large perennial rivers with extensive tributary networks. To some extent, directly and indirectly, these watercourses support fish species at all times of year. However, they do not contain critical or important habitat for the continued viability of a population of fish. In a majority of Alberta drainages, Class C streams are the most common watercourses because all unmapped tributaries that flow into Class C watercourses are classified as Class C by default for their entire watershed.

2.3.6 Least-Risk Periods for Instream Construction

Restricted activity periods (RAPs) in Alberta and instream work windows in British Columbia have been established to protect egg incubation and early life stages of spring and fall spawning species and habitat values at a particular watercourse crossing. Because the two provinces use different terminology and approaches, the term “least-risk period” (LRP) was adopted for the Project to describe the preferred instream construction period. Fish species that determined the least-risk periods (i.e., construction sensitive species) are discussed in Section 3.3.

In British Columbia, LRPs for instream construction at watercourse crossings with known fish species presence data (i.e., information from historic databases or from the 2005 and 2006 field programs) were determined according to BC MoE regional and forest district-specific criteria (BC MWLAP 2004 a,b,c,d Internet site; BC MWLAP 2005, Internet site). These criteria are based on known or suspected fish species presence in the stream or watershed and provide for instream work windows by species, which protect critical life stages such as spawning and incubation.

For watercourse crossings with insufficient species assemblage information to determine the LRP (i.e., situations where no historic information was found or no fish were captured during the field survey), fish species information from downstream and adjacent watercourses was used. Provincial databases such as FISS and FWMIS (BC MoE 2009a, Internet site; ASRD 2009, Internet site), along with annotated 1:20,000 scale orthophotos, were used to determine the extent of known fish species presence upstream, and whether any barriers were present downstream.

In Alberta, LRPs were based on the RAPs assigned to the different stream classifications by the Alberta Code of Practice for Watercourse Crossings (AENV 2001). The Code of Practice includes colour-coded maps depicting the RAPs for all streams in Alberta.

In both provinces, LRPs vary with fish species present and the sensitivity of habitat downstream or adjacent to the watercourse crossing. Instream construction timing is often constrained where spring and fall spawning species are present at a crossing. However, timing constraints are less restrictive under the province-specific criteria described below.

2.3.6.1 British Columbia (Class S5 and S6 Streams)

A year-long instream construction LRP (January 1 to December 31) can occur for non-fish-bearing and dry streams under any of the following conditions (BC MoF 2002):

- The structure does not encroach into the stream channel width, no related work is proposed within the channel of a fish-bearing stream (S1-S4) or fisheries-sensitive zone, and the risk of sediment delivery is low.
- The work is on a non-fish-bearing stream and the appropriate measures are taken to prevent the delivery of sediments into downstream fish habitats.
- During construction, the stream channel is completely dry.
- Construction activities on a non-fish-bearing stream that is a direct tributary to a fish-bearing stream require isolation of the work area and keeping dry conditions by temporarily pumping or otherwise diverting the flow around the work site while instream activities occur.

2.3.6.2 Alberta (Class C and D Streams)

An instream LRP from January 1 to April 15 and from July 1 to December 31 is established under any of the following conditions (AENV 2001):

- During construction, the stream channel is completely dry or frozen surface-to-substrate.

- Class C - Isolation method is recommended but if unfeasible, considers open-cut construction under Qualified Aquatic Environment Specialist (QAES) recommendations.
- Class D - Open-cut construction methods might be used; QAES recommendations not required.

2.3.7 Habitat Evaluation

2.3.7.1 Zone of Influence

To ensure fish and fish habitat evaluations encompassed the ZOI for potential downstream sedimentation effects, the fisheries and aquatics study team adopted the criteria used in the Guide to the Code of Practice for Pipelines and Telecommunication Lines Crossing a Waterbody (AENV 2001) to determine the study section length at each watercourse crossing (Table 2-5). Prior to field studies the ZOI for each watercourse was defined as the area of bed and banks of the waterbody that will be altered or disrupted because of the works, and where 90% of the sediment discharged because of the works will be deposited.

Table 2-5 Criteria for Zone of Influence Downstream from Watercourse Crossings

Stream Characteristics						Length of Zone (m)
Width (m)	**Slope**	**Energy**	**Dominant Substrate**	**Velocity**	**Habitat**	
<10	Low	Low	Fines	Low	Runs and flats	200
>10	Low	Low	Fines	Low	Runs and flats	500
<10	Moderate	Moderate	Fines and coarses	Moderate	Long runs separated by short riffles	200
>10	Moderate	Moderate	Fines and coarses	Moderate	Long runs separated by short riffles	500
<10	Moderate to High	High	Coarses	Moderate to high	Frequent riffles and cascades	300
>10 <20	Moderate to High	High	Coarses	Moderate to high	Frequent riffles, cascades and high velocity runs	1,000
>20	Moderate to High	High	Coarses	Moderate to high	Frequent riffles, cascades and high velocity runs	>1,000

SOURCE: Adapted from AMEC 2005.

Physical evaluations were completed to determine waterbody conditions and to characterize fish habitat in the study sections immediately upstream from the crossing site and within the ZOI. Sampling consisted of at least two sections including a minimum 100 m section immediately upstream from the pipeline crossing site and a minimum length of 300 m downstream or encompassing the entire zone of influence, whichever is greater.

Because of these criteria, fish and fish habitat were surveyed over either 400 m of stream, or 10 times mean channel width at each watercourse crossing, whichever was greater. Where fish presence was suspected but none were captured during the initial sampling, an additional distance of 20 to 100 m was surveyed. Care was taken to ensure all habitat types present in the stream were included in the surveyed section.

2.3.7.2 Habitat Inventory Methods

Fish habitat inventory methods in British Columbia generally followed those described in the Reconnaissance (1:20,000) Fish and Fish Habitat Inventory: Standards and Procedures April 2001 (RISC 2001, Internet site), and Forest Practices Code Guidebooks (BC MoF 1995, 1998, 2002). Fish habitat inventory methods in Alberta generally followed the Guide to the Code of Practice for Pipelines and Telecommunication Lines Crossing a Waterbody (AENV 2001). Custom site cards were developed for each province prior to initiation of the field programs in 2005. These site cards were based on the standard site cards developed for the Reconnaissance (1:20,000) Fish and Fish Habitat Inventory methods and the Alberta Code of Practice. Site cards were reviewed by the field crew before leaving the field site to ensure that no data were missed.

In 2005, data collected for the two provinces differed, as dissolved oxygen concentration, substrate composition (%), cover composition (%), bank stability, water velocity and depth were determined only at Alberta watercourse crossings (Table 2-6). In 2006, with the sole exception of turbidity in British Columbia, identical standard habitat parameters were measured at all watercourse crossings in Alberta and British Columbia. Data collected in both provinces in 2006 also included comment regarding the degree of construction difficulty, bank stability, water velocity and depth at centreline, and detailed comments on habitat type, availability and quality. During fall and summer 2008 and 2009, approach slope angles, bank height, water velocity, compensation opportunities, construction access, and stream classification justification were also collected.

In British Columbia, physical habitat data collection differed from the standard Reconnaissance (1:20,000) Fish and Fish Habitat Inventory methods in the following ways:

- Fish cover, channel bottom and bank substrate composition were estimated to the nearest 5% contribution to the total (as opposed to general descriptions such as D for dominant).
- Dissolved oxygen, bank stability, height and slope angle, water velocity and depth measurements were collected from 2006 to 2009.
- Site lengths surveyed were generally four times longer (400 m) than the RISC standard (100 m).

Table 2-6 Habitat Parameters Collected During Field Surveys, 2005 to 2009

2005	2006	2008 - 2009
• site length • channel and wetted widths • residual pool depth • bankfull depth • stream gradient • water temperature • pH • turbidity • conductivity • percent cover (small woody debris [SWD], large woody debris [LWD], boulder, cutbank, deep pool, overstream vegetation and instream vegetation) • functioning LWD distribution • crown closure • bank shape and texture • predominant riparian vegetation type and stage • bed materials (percent composition) • channel morphology • disturbance indicators • channel pattern • islands, bars, coupling and confinement • features • dissolved oxygen concentration (Alberta only) • turbidity (NTUs; Alberta only) • bank stability, water velocity and depth (Alberta only)	• same as 2005 with the following additions: • dissolved oxygen concentration and % saturation (all streams) • stream stage • bed materials (percent composition) • channel morphology (British Columbia), pool, riffle, run and flat ratio (Alberta) • bank stability, water velocity and depth at centreline (all streams) • degree of construction difficulty (i.e., access, topography, bank stability). • habitat type (e.g., spawning, rearing overwintering) availability and quality	• same as 2006 with the following additions: • approach slope angle • bank height • compensation opportunities • construction access comments • stream class justification comments • habitat mapping

Site documentation included 4 (2005 to 2006) to 12 (2008 to 2009) photographs. Photographs were taken of all:

- sample sites (upstream and downstream, and left and right bank)
- stream riparian areas
- unique habitat features
- fish barriers
- erosion sites
- lake inlets and outlets (where possible)
- fish voucher samples

- reach-specific representative habitat
- oblique aspect photographs (from a helicopter) were taken to capture approach slopes

2.3.7.3 Special Habitat Attributes

Each site card included space for site-specific comments. These comments included, but were not limited to:

- flood signs
- special features and obstructions
- FSZs (tributaries, side-channels, flood channels, swamps, sloughs and beaver dams)
- potential factors limiting fish production
- habitat quality for different life stages (e.g., rearing, spawning and overwintering) for different fish species (e.g., salmonids, pike and walleye) that occupied the particular reach or watershed
- mean channel width at beaver ponds as determined from inlet and outlet channel measurements and pond dimensions (wetted width)
- changes in stream gradient (within 15%) within the 400 m site length (e.g., fish migration barrier); the gradient that best represented channel slope at the pipeline route was recorded in the database
- all fish migration obstructions (perennial and ephemeral) or points of difficult access

Habitat features not identified during pre-fieldwork literature research were located using UTM coordinates and recorded on the site cards. Unmapped watercourse crossings not identified during initial map and aerial photograph analyses were sampled in a similar way to sampling of identified crossings and recorded on site and fish collection cards. Unmapped stream sites were identified with a decimal point (i.e., site 125.1 indicates an unmapped watercourse crossing between sites 125 and 126).

Habitat types (potential and actual spawning, rearing, overwintering, migration or holding and staging) and quality (none, poor, moderate, good or excellent) were evaluated at each watercourse crossing by a professional biologist, based on the presence of migration barriers, relative abundance of gravel spawning substrates suitable for salmonids, cover composition, depth, flow persistence, gradient and morphology, bank stability and riparian features. These professional judgments considered life-stage-specific habitat and water quality requirements of construction-sensitive species affected by the Project (see Section 3.3).

2.3.7.4 Winter Site Surveys

In March 2009, fish overwintering surveys were conducted at 35 selected watercourse crossings in Alberta and British Columbia (Table 2-7). These sites were selected for the following reasons:

- Construction (isolation or open cut) may occur at these crossings during the winter months, potentially affecting fish overwintering, egg incubation, and traditional, and/or recreational use.
- The watercourse crossings are known fish-bearing streams and therefore confirmation of species assemblage (and life stage) and habitat availability (e.g., water depth, ice depth and dissolved oxygen in both deep pool and glide habitat) during the winter months was required.

Table 2-7 Winter 2009 Survey Sites

Province	Watershed	KP	Site Name
Alberta	Athabasca	131.592	Pembina River
		187.349	Athabasca River
		200.385	Sakwatamau River
		218.917	Chickadee Creek
		241.754	Two Creek
	Peace	272.084	Tributary to Iosegun Lake
		272.242	Tributary to Iosegun Lake
		272.300	Tributary to Iosegun Lake
		272.500	Tributary to Iosegun Lake
		274.406	Tributary to Iosegun Lake
		275.081	Tributary to Iosegun Lake
		318.183	Waskahigan River
		338.764	Deep Valley Creek
		340.700	Tributary to Deep Valley Creek
		359.976	Simonette River
		371.876	Latornell River
		395.716	Patterson Creek
		404.315	Tributary to Smoky River
		421.361	Smoky River
		431.820	Gold Creek
		435.262	Big Mountain Creek
		493.310	Wapiti River
British Columbia	Peace	517.870	Hiding Creek
		531.909	South Redwillow River
		598.614	Murray River
		670.961	Parsnip River
	Fraser	748.083	Muskeg River
		763.020	Salmon River
		780.327	Tributary to Great Beaver Lake
	Skeena	948.152	Maxan Creek
		1058.971	Gosnell Creek
		1071.215	Tributary to Burnie River
		1072.397	Clore River
	Kitimat	1123.097	Chist Creek
		1148.652	Little Wedeene River

Survey methodology was adapted from the 1:20,000 RISC inventory standards and modified to collect habitat attribute information specific to overwintering requirements. Data attributes collected included:

- pool identification number
- pool length and width
- distance from watercourse crossing centreline (upstream or downstream)
- water depth
- velocity (m/s)
- ice depth
- dissolved oxygen concentration and % saturation
- water quality parameters (temperature, pH, conductivity)
- overwintering habitat present and description
- photographs of pools or suspected overwintering habitat
- alternative crossing locations (if any)
- comments on approach slopes
- mask-snorkel survey (fish/redd presence) at ice-free sites with appropriate depth

Suspected pool sites were identified at the watercourse crossing and holes were cut in the ice using either an ice auger or chainsaw. Depth and flow measurements along with water quality data were collected at the holes. In areas with sufficient depth an electronic fish finder was used to detect fish presence under the ice. If the ice was not thick enough to walk across safely, measurements were taken at the edge of the watercourse. Site survey information was recorded onto customized field cards. Annotated field orthophotos with ZOI and site centreline were used to map pools and all potential overwintering habitat features.

Only one site (KP 1072.397, Clore River) had appropriate conditions for a mask-snorkel survey. Prior to the survey, a streamside risk assessment was conducted to observe any rapids, large woody debris (LWD) jams or hydraulic undertows and to establish points of exit and tether lines. The diver drifted through a large pool that was free of ice-cover to observe any fish present. Habitat conditions in the pool were also assessed.

2.3.7.5 Equipment

Specific equipment used to complete habitat evaluations included:

- a SUUNTO clinometer or Abney level, or both
- a 50-m Elson tape measure
- a hip chain or surveyor’s chain, or both
- graduated metre sticks
- a Bushnell laser range finder
- a field notebook with waterproof site cards
- a hand-held GPS unit
- a digital camera
- a 1:20,000 annotated map (with pipeline route, KP and site numbers) and interim field maps
- hand-held alcohol thermometers (accurate within 0.5°C)
- an Oakton pH meter (accurate within 0.2 units)

- Oakton conductivity meters (DiST WP 3, 10–1990 µS/cm)
- a dissolved oxygen meter
- a turbidity meter
- a velocity meter
- ice auger
- dry-suit, non-slip boots, mask, snorkel

2.3.8 Fish Sampling

2.3.8.1 Fish Collection Methods

Similar to habitat evaluations, fish sampling in British Columbia and Alberta followed standardized procedures described in the Reconnaissance (1:20 000) Fish and Fish Habitat Inventory: Standards and Procedures (RISC 2001, Internet site) and Forest Practices Code Guidebooks (BC MoF 1995, 1998, 2002; RISC 1999a, 1999b, Internet sites).

Fish distribution and species composition were determined at all sample sites. The primary sampling method in wadeable streams was backpack electrofishing with either Smith-Root models 15C (generator) or 12B (battery) electrofishers. Baited (canned salmon) minnow traps were set in pairs overnight at sites where no fish were captured by electrofishing but fish presence was suspected and where logistics and habitat conditions permitted. Where conditions or logistics did not allow the use of these methods (e.g., too shallow, too deep, too fast, low conductivity, too turbid), other sampling methods were used. These methods included beach seining, dip netting and angling. Winter survey sites were sampled using minnow traps and/or snorkel floats as previously discussed in Section 2.3.7.4.

Fishing effort duration was recorded by second for electrofishing and by hour for minnow trapping and angling. If no fish sampling could be completed due to unsafe conditions (e.g., too deep to safely wade), then historical records were used to determine fish species composition.

According to fish collection permit conditions, electrofishing in BC MoE Regions 7 and 9 was not allowed in known or suspected bull trout streams after September 30. Electrofishing was discontinued at most sites in British Columbia and Alberta in fall when water temperatures decreased to 5°C. Baited minnow traps were used instead as the primary fish capture method.

2.3.8.2 Fish Processing

At each site where fish were captured fish were identified to species, enumerated by life-stage (i.e., juvenile, fry, or adult), and measured for length (fork-length for all species except burbot and sculpin which were measured for total length). Fish were identified in the field using field-ready keys based on:

- Field Key to the Freshwater Fishes of British Columbia (McPhail and Carveth 1994)
- Freshwater Fishes of Canada (Scott and Crossman 1998)
- The Fishes of Alberta (Nelson and Paetz 1992)

2.3.8.3 Equipment

The following equipment was used to conduct fish sampling in 2005 and 2006:

- a 3-m inflatable raft (large rivers)
- a 4-m aluminum skiff (large rivers)
- Smith-Root Model 15C/12B back-pack electrofishers
- Gee minnow traps and bait
- beach seine, pole seine and dip nets
- a sample collection bucket
- a hand-held GPS unit
- fish collection and individual fish data forms
- length scales (mm)
- Polaroid sunglasses
- a digital camera
- a 1:20,000 annotated map (with pipeline route, KP and site numbers) and interim field maps
- annotated orthophotos

2.3.9 Data Management, Quality Assurance and Control

All watercourse crossing biophysical and biological data (fish species distribution, composition, enumeration and meristic data for individual fish), photographic annotations, observations and comments and habitat quality evaluations were recorded in the field on individual fish collection and habitat data cards. All data cards were quality assured and quality controlled at day's end for completeness, accuracy and consistency by a professional biologist from a different crew, then scanned into field designated laptop computers, copied onto a compact disc and uploaded daily to the fisheries study team's FTP site for retrieval and merging by senior Database Management and GIS personnel. All data were then entered into a FDIS summary convertible, MS Access database. Regular in-field reviews of data collection procedures and standards were also completed by the senior field biologist. All original site, fish collection and individual fish data cards data and compact discs were archived at AMEC (Burnaby).

A final review of database completeness, water quality, habitat features, morphology and stream classification accuracy based on the presence of known or historic downstream fish migration barriers was completed by senior biologists in Alberta and British Columbia at the end of the field programs.

3 Results of Baseline Investigations

The following sections summarize the results of fish and fish habitat surveys conducted between 2005 and 2009 for the pipeline RoW, new access roads, powerlines and PDA (comprises the pipeline ROW, access roads, powerlines and Kitimat terminal). Biophysical data collected from all watercourse crossings are provided in Appendix B on CD. A key for the codes used in the Aquatic Catalogue is provided in Appendix C. Ancillary project facilities such as construction camps, stockpile sites and staging areas will be constructed at a minimum distance of 30 m away from any watercourse and therefore have not been surveyed as part of the baseline programs.

The following sections focus on fish-bearing crossings however crossings on non-fish-bearing tributaries where the pipeline route occurs 300 m upstream from the tributary's confluence with a larger fish-bearing watercourse are also discussed.

3.1 Watercourse Crossing Enumeration and Distribution

The PDA crosses a total of 1,564 mapped watercourses between the terminus at Bruderheim and the Kitimat Terminal (see Table 3-1). Approximately 42% of these crossings lie within the Peace River drainage in British Columbia and Alberta. After the Peace River, crossings occur with greatest frequency in the Skeena River (18%), Fraser River (16%), Kitimat River (14%), Athabasca River (7%), North Saskatchewan River (2 %) and Douglas Channel (1%) drainages. These watercourse crossings were based on streams identified using 1:20,000 scale maps and unmapped streams identified during the field programs.

During the field programs 1,276 sites were surveyed. As of October 2009, 288 sites remain unsurveyed. These sites have been identified (enumerated by major drainage) but have not been surveyed for habitat quality and fish presence. Additional site surveys will be conducted prior to permitting to account for the remaining unsurveyed sites and any sites added in any future route-revisions.

A total of 1,299 mapped watercourse sites were identified along the pipeline RoW. Of these, 1,168 were surveyed during the 2005 to 2009 field programs (Table 3-1). In Alberta, 211 sites were surveyed including 8 sites for which data from the Alliance Pipeline Limited Partnership's Project (Alliance Pipeline) also existed (Golder Associates 1997a-f). In British Columbia, there were 957 surveyed sites, including 15 sites where data was available from Kitimat-Summit Lake Natural Gas Pipeline Looping Project and Kitimat Liquid Natural Gas Inc.

The remaining 131 crossings along the pipeline RoW (46 in Alberta and 85 in British Columbia) were not surveyed between, either because of private landownership access limitations or unresolved Aboriginal land claim settlements, or because they resulted from pipeline route re-alignments after the sampling program was completed. Sites for the 2009 sampling program were selected based on mean annual discharge of greater than 0.1 m^3/s to select for sites where fish habitat was probable. The majority of unsurveyed sites along the pipeline RoW as of October 2009 have a mean annual discharge of less than 0.1 m^3/s.

Table 3-1 Watercourses Crossed by the RoW, new Access Roads, Powerlines and Ancillary Facilities in Major Drainages of Alberta and British Columbia

Major Drainage	KP	Surveyed					Unsurveyed					Total
		RoW	AR	PL	Term	Total	RoW	AR	PL	Term	Total	
North Saskatchewan	0 – 77.3	25[1]	0	0	0	25	8	0	0	0	8	33
Athabasca	77.3 – 257.2	101[2]	0	1	0	102	11	0	2	0	13	115
Peace AB	257.2 – 516.8	85	0	12	0	97	27	1	0	0	28	125
Peace BC	516.8 – 730.1	421	1	52	0	474	27	14	10	0	51	525
Fraser	730.1 – 847.1 864.8 – 876.53 882.5 – 886.3 908.6 – 942.8 990.9 – 993.9	213	0	0	0	213	35	0	0	0	35	248
Skeena	847.1 – 864.8 876.5 – 882.5 886.3 – 908.6 942.8 – 990.9 993.9 – 1083.5	199[3]	3	36	0	238	20	5	16	0	41	279
Kitimat	1083.5 – 1166.5	118[4]	0	0	0	118	3	4	94	0	101	219

Table 3-1 Watercourses Crossed by the RoW, new Access Roads, Powerlines and Ancillary Facilities in Major Drainages of Alberta and British Columbia (cont'd)

Major Drainage	KP	Surveyed					Unsurveyed					Total
		RoW	AR	PL	Term	Total	RoW	AR	PL	Term	Total	
Douglas Channel	1166.5 – 1172.2	6[5]	0	0	3	8	0	3	7	1	12	20
Totals		1,168	4	101	3	1,276	131	27	129	1	288	1,564

NOTES:
RoW: Pipeline Right-of-Way; AR: new Permanent or Temporary Access Road; PL: new Powerline; Term: Kitimat Terminal Facilities
PL, AR, and Term sites that occur within 100 m of a pipeline RoW site have been counted as a pipeline RoW site only
[1] Includes one site with Alliance Pipeline data (Golder Associates 1997a-f)
[2] Includes seven sites with Alliance Pipeline data (Golder Associates 1997a-f)
[3] Includes seven sites with KSL data (Applied Aquatic Research Ltd. 2007)
[4] Includes seven sites with KSL data (Applied Aquatic Research Ltd. 2007)
[5] Includes one site with KLNG data (Kitimat LNG Inc. 2005)

There are 265 additional sites in the PDA outside of the pipeline RoW. These include 31 sites due to new access roads, 230 sites from powerline crossings and 4 sites from the Kitimat terminal. As of October 2009, 106 of these sites have been surveyed. Survey priority was to sample the pipeline RoW watercourse crossings first, and as such the majority of the new roads, powerlines and Kitimat terminal sites remain are unsurveyed.

The pipeline route alignment has undergone several iterations since fish and fish habitat field investigations were initiated in 2005. Some watercourse crossings sampled in previous years are no longer relevant because of route realignments (i.e., they occur at distances greater than 100 m from the revised crossing location). Other watercourse crossing sites have been added and deactivated throughout the various alignment iterations. Information collected at these deactivated sites has been used to describe fish species present in the watercourse or watershed.

3.2 Species Composition and Species at Risk

3.2.1 Species Composition

Results from the literature review and the field programs indicate the occurrence of 58 fish species near the pipeline RoW. These species include 27 sportfish species, 8 coarse fish species and 23 forage fish species. Of these fish species, 17 are common to both the Pacific (Fraser, Skeena and Kitimat) and Arctic (North Saskatchewan, Athabasca and Peace [both Alberta and British Columbia]) drainages (see Table 3-2).

Sport fish such as salmonids, walleye, sturgeon, sauger and northern pike are commonly targeted by recreational anglers. Of the 27 sportfish species known to occur along the RoW, only rainbow trout are present in every major watershed. Bull trout, mountain whitefish and burbot are also commonly found along the RoW.

All five Pacific salmon species (chinook, coho, sockeye, pink and chum) and steelhead are found in the Skeena and Kitimat River drainages. Chinook, sockeye and coho salmon are also present in the PEAA within the Fraser drainage.

Brook trout and brown trout have been introduced into British Columbia and Alberta for sport fishing opportunities (McPhail 2007; Nelson and Paetz 1992). No brown trout were captured during the field surveys. Brook trout were captured in a tributary to the Murray River in 2005 and the Murray River in 2009.

Dolly Varden occur in the Kitimat River drainage and occur sympatrically with bull trout in the Skeena drainage (McPhail 2007; Feldoff 2009, pers. comm.; Baxter et al. 1997). Both species are thought to be present from the Morice River (Skeena tributary) east to the Stuart River (Fraser drainage). Only bull trout occur east of the Stuart River and no Dolly Varden are present in the Peace River drainage.

Table 3-2 Fish Species in Watercourses Crossed by the RoW

Species	Scientific Name	Species Code AB	Species Code BC	Alberta Major Drainage			British Columbia Major Drainage			
				N. Sask.	Athabasca	Peace	Peace	Fraser	Skeena	Kitimat
Sport Fish										
Arctic grayling	*Thymallus arcticus*	ARGR	GR		X	X	X			
Brook trout	*Salvelinus fontinalis*	BKTR	EB		X	X	X			
Brown trout	*Salmo trutta*	BNTR	GB	X	X					
Bull trout	*Salvelinus confluentus*	BLTR	BT		X	X	X	X	X	X
Burbot	*Lota lota*	BRBT	BB	X	X	X	X	X	X	
Coastal cutthroat trout	*Oncorhynchus clarki clarki*	CTTR	CT						X	X
Chinook salmon	*Oncorhynchus tshawytscha*		CH					X	X	X
Chum salmon	*Oncorhynchus keta*		CM						X	X
Coho salmon	*Oncorhynchus kisutch*		CO					X	X	X
Dolly Varden	*Salvelinus malma*		DV					X	X	X
Goldeye	*Hiodon alosoides*	GOLD	GE	X	X					
Kokanee	*Oncorhynchus nerka*		KO					X	X	X
Lake whitefish	*Coregonus clupeaformis*	LKWH	LW				X			
Lake sturgeon	*Acipenser fulvescens*	LKST		X						
Lake trout	*Salvelinus namaycush*		LT				X	X	X	
Mooneye	*Hiodon tergisus*	MOON		X						
Mountain whitefish	*Prosopium williamsoni*	MNWH	MW	X	X	X	X	X	X	
Northern pike	*Esox lucius*	NRPK	NP	X	X	X	X			

Table 3-2 Fish Species in Watercourses Crossed by the RoW (cont'd)

Species	Scientific Name	Species Code AB	Species Code BC	Alberta Major Drainage			British Columbia Major Drainage			
				N. Sask.	Athabasca	Peace	Peace	Fraser	Skeena	Kitimat
Sport Fish (cont'd)										
Pink salmon	*Oncorhynchus gorbuscha*		PK					X	X	X
Pygmy whitefish	*Pygmy whitefish*	PGWH	PW				X		X	
Rainbow trout	*Oncorhynchus mykiss*	RNTR	RB	X	X	X	X	X	X	X
Sauger	*Stizostedion canadense*	SAUG		X						
Sockeye salmon	*Oncorhynchus nerka*		SK					X	X	X
Steelhead	*Oncorhynchus mykiss*		ST						X	X
Walleye	*Sander vitreus*	WALL	WP	X	X	X				
White sturgeon	*Acipenser transmontanus*		WSG					X		
Yellow Perch	*Perca flavescens*	YLPR	YP	X	X	X				
Coarse Fish										
Bridgelip sucker	*Catostomus columbianus*		BSU					X		
Largescale sucker	*Catostomus macrocheilus*	LRSC	CSU			X	X	X	X	
Longnose sucker	*Catostomus catostomus*	LNSC	LSU	X	X	X	X	X	X	
Mountain sucker	*Catostomus platyrhyncus*	MNSC	MSU	X						
Quillback	*Carpiodes cyprinus*	QUIL		X						

Table 3-2 Fish Species in Watercourses Crossed by the RoW (cont'd)

Species	Scientific Name	Species Code AB	Species Code BC	Alberta Major Drainage			British Columbia Major Drainage			
				N. Sask.	Athabasca	Peace	Peace	Fraser	Skeena	Kitimat
Coarse Fish (cont'd)										
Shorthead redhorse	*Moxostoma macrolepidotum*	SHRD		X						
Silver redhorse	*Moxostoma anisurum*	SLRD		X						
White sucker	*Catostomus commersoni*	WHSC	WSU	X	X	X	X	X	X	
Forage Fish										
Brassy minnow	*Hybognathus hankinsoni*	BRMN	BMC				X	X		
Brook stickleback	*Culea inconstans*	BRST	BSB	X	X	X	X			
Coastrange sculpin	*Cottus aleuticus*		CAL						X	X
Emerald shiner	*Notropis atherinoides*	EMSH	ESC	X	X	X				
Fathead minnow	*Pimephales promelas*	FTMN	FM	X	X					
Finescale dace	*Phoxinus neogaeus*	FNDC	FDC	X	X	X	X			
Flathead chub	*Platygobio gracilis*	FLCH	FHC	X	X	X				
Iowa darter	*Etheostoma exile*	IWDR		X						
Lake chub	*Couesius plumbeus*	LKCH	LKC	X	X	X	X	X	X	
Leopard dace	*Rhinichthys falcatus*		LDC					X	X	
Longnose dace	*Rhinichthys cataractae*	LNDC	LNC	X	X	X	X	X	X	
Northern redbelly dace	*Phoxinus eos*	NRDC	RDC	X	X	X	X			

Table 3-2 Fish Species in Watercourses Crossed by the RoW (cont'd)

Species	Scientific Name	Species Code AB	Species Code BC	Alberta Major Drainage			British Columbia Major Drainage			
				N. Sask.	Athabasca	Peace	Peace	Fraser	Skeena	Kitimat
Forage Fish (cont'd)										
Northern pikeminnow	*Ptycheilus oregonensis*	NRPM	NSC			X	X	X	X	
Pacific lamprey	*Lampetra tridentata*		PL						X	X
Pearl dace	*Margariscus margarita*	PRDC	PDC	X	X	X	X			
Peamouth	*Mylocheilus caurinus*		PCC				X	X	X	
Prickly sculpin	*Cottus asper*	PRSC	CAS				X	X	X	X
Redside shiner	*Richardsonius balteatus*	RDSH	RSC			X	X	X	X	
River shiner	*Notropis blennius*	RVSH		X						
Slimy sculpin	*Cottus cognatus*	SLSC	CCG			X	X	X		
Spoonhead sculpin	*Cottus ricei*	SPSC	CRI	X	X	X				
Spottail shiner	*Notropis hudsonius*	SPSH	STC	X	X	X				
Threespine stickleback	*Gasterosteus aculeatus*		TSB						X	X
Troutperch	*Percopis omiscomaycus*	TRPR	TP	X	X	X	X			

SOURCE: FISS (BC MoE 2009a, Internet site); FWMIS (ASRD 2009, Internet site); McPhail 2007; Nelson and Paetz 1992; Scott and Crossman 1998.

Coarse fish are large-bodied species that are not sport fish. Coarse fish along the RoW include bridgelip, longnose, largescale, mountain and white suckers, along with quillback, shorthead redhorse, and silver redhorse. Longnose sucker and white sucker are commonly found in the watersheds along the RoW. Mountain suckers, quillback, shorthead redhorse and silver redhorse are only found in the North Saskatchewan River in Alberta. Largescale suckers are present in the Peace, Fraser, and Skeena river drainages. Bridgelip suckers are found only in the Fraser River system.

Forage fish species are small freshwater fish that serve as prey items for larger fish and include the minnows, sculpins, sticklebacks, and darters. The minnow family consists of chubs, shiners and dace. Longnose dace and lake chub are commonly found in most watersheds along the RoW.

3.2.2 Species at Risk

3.2.2.1 Alberta

There are 16 fish species of conservation concern with distributions that overlap with the RoW in Alberta (see Table 3-3). Species that have a provincial ranking of S1 or S2 are placed on a fish tracking list, while fish species with ranks of S3 are place on a fish watch list. Inclusion on these lists does not provide legislated protection unless it is also listed under *SARA* or the *Wildlife Act*. Only the lake sturgeon populations in the Saskatchewan River system are under consideration for *SARA* listing by COSEWIC.

Lake Sturgeon

Lake sturgeon in the Saskatchewan River in Alberta are listed as endangered by COSEWIC and are currently under consideration for *SARA* listing. The lake sturgeon faces a variety of threats in Alberta, including over-harvesting and habitat loss from the construction and operation of dams. Historically, commercial fishing caused precipitous declines in many lake sturgeon populations. Many populations have not fully recovered. More recently, the direct and indirect effects of dams have posed major threats. Dams have caused habitat loss and fragmentation, altered flow regimes, and may increase mortality by entrainment in turbines. Habitat degradation resulting from poor land use and agricultural practices has also created an adverse impact on many populations (Government of Canada 2009, Internet site).

3.2.2.2 British Columbia

In British Columbia, freshwater fish species of special conservation status are classified as Red (extirpated, endangered or threatened), Blue (special concern) or Yellow (secure). Six fish species with red or blue list status have distributions that overlap with the RoW in British Columbia (see Table 3-4). These include the red-listed Arctic grayling populations in the Williston Lake watershed, the white sturgeon population in the Nechako River, as well as blue-listed bull trout, coastal cutthroat trout, Dolly Varden and pearl dace.

Table 3-3 Species of Conservation Concern, Alberta

Species	Status		
	Global[1]	Provincial[1]	COSEWIC[2]
Bull trout	G3	S3	
Finescale dace	G5	S3S4	
Lake sturgeon (Saskatchewan. R. populations)	GSG4	S2	Endangered (November 2006)
Largescale sucker	G5	S2	
Mooneye	G5	S2S3	
Northern redbelly dace	G5	S3	
Northern pikeminnow	G5	S1	
Pearl dace	G5	S3	
Rainbow trout	G5	S5	
Redside shiner	G5	S3	
River shiner	G5	S2	
Quillback	G5	S3	
Sauger	G5	S3	
Silver redhorse	G5	S2	
Shorthead redhorse	G5	S3	
Spoonhead sculpin	G5	S3	

NOTES:
S1 – five or fewer occurrences or only a few remaining individuals. May be especially vulnerable to extirpation because of some factor of its biology.
S3/G3 – 21-100 occurrences may be rare and local throughout its range or in restricted range (may be abundant in some locations). May be susceptible to extirpation because of large scale disturbances.
S4/G4 – Typically > 100 occurrences. Apparently secure.
S5/G5 – Typically > 100 occurrences. Demonstrably secure.
S#S#/G#G# - Range rank. A numeric range rank is used to indicate the range of uncertainty in the status of a species or a community.

SOURCE:
[1] ANHIC 2008b, Internet site
[2] COSEWIC 2008, Internet site

Table 3-4 Species of Conservation Concern, British Columbia

Species	Status[1]			
	Global	Provincial	COSEWIC	BC Status
Arctic grayling (Williston Watershed)	G5T1Q	S1		Red
Bull trout	G3	S3		Blue
Coastal cutthroat trout	G4T4	S3S4		Blue
Dolly Varden	G5	S3S4		Blue
Pearl dace	G5	S3?		Blue
White sturgeon (Nechako River population)	G4T1Q	S1	Endangered (November 2003)	Red

NOTES:
G1/S1 – critically imperilled
G2/S2 – imperilled
G3/S3 – special concern, vulnerable to extirpation or extinction
G4/S4 – apparently secure
G5/S5 – demonstrably widespread, abundant, and secure
T# - The status of infraspecific taxa (subspecies or varieties) are indicated by a "T-rank" following the species' global rank
Q - Taxonomic distinctiveness of this entity at the current level is questionable; resolution of this uncertainty may result in change from a species to a subspecies or hybrid, or the inclusion of this taxon in another taxon, with the resulting taxon having a lower-priority conservation priority.
Red - Includes any indigenous species or subspecies that have- or are candidates for- Extirpated, Endangered, or Threatened status in British Columbia. Extirpated taxa no longer exist in the wild in British Columbia, but do occur elsewhere. Endangered taxa are facing imminent extirpation or extinction. Threatened taxa are likely to become endangered if limiting factors are not reversed.
Blue - Includes any indigenous species or subspecies considered to be of Special Concern (formerly Vulnerable) in British Columbia. Taxa of Special Concern have characteristics that make them particularly sensitive or vulnerable to human activities or natural events. Blue-listed taxa are at risk, but are not Extirpated, Endangered or Threatened.

SOURCE: [1] BC CDC 2008, Internet site.

Pearl Dace

Pearl dace are blue listed in British Columbia. Pearl dace exist as a few isolated populations in northeastern British Columbia and are sensitive to local disturbances (McPhail 2007). Pearl dace are commonly found in other regions of Canada and the populations in British Columbia represent the western extent of their range (Scott and Crossman 1998). Near the ROW, pearl dace are reported as present in Hiding Creek (KP 517.870). However none were captured or observed during the field surveys. Little is known about pearl dace in British Columbia but they are known to occasionally hybridize with lake chub and longnose dace.

Arctic Grayling (Williston Watershed)

Arctic grayling are indigenous to the Parsnip, Missinka and Hominka Rivers in the Williston watershed. Populations of Arctic grayling in these rivers are considered critically imperilled (S1; red-listed) because of flooding caused by the creation of Williston Lake with the completion of the W.A.C. Bennett Dam on the Peace River in 1968. These populations have been isolated from the lower Peace River since 1963 and, by 1988, only populations native to the largest river systems continued to persist (BC MWLAP 2002, Internet site). A number of causes contributed to this decline including: loss or degradation of key spawning and rearing areas; changes to the food supply and available cover; disruption of migration patterns; competition with species adapted to lentic ecosystems; and overfishing (British Columbia Ministry of Fisheries 2009a, Internet site).

In 1995, the BC CDC classified the Williston watershed Arctic Grayling as critically imperilled and added it to the provincial red list. A strategic plan was developed by BC Hydro and the provincial government for the conservation and restoration of Arctic grayling in the Williston Reservoir watershed (Blackman 2001).

Bull Trout

Bull trout are threatened throughout much of its traditional range in North America. There has been a considerable reduction in its distribution and numbers in the past 25 years. Contributing factors include changes in habitat due to poor forestry and oil and gas exploration practices, overfishing and deliberate depletion of stocks due to incorrect knowledge of the role of the species in the aquatic ecosystem. Bull trout require clean, cold, sediment-free streams for spawning. The number of these streams is limited and because small changes to stream flow or temperature significantly affect the survival of fry, forestry and other natural resource developments in small headwater watersheds have had significant detrimental effects on many populations.

Under the auspices of the British Columbia *Forest and Range Practices Act* (formerly Forest Practices Code), bull trout are an Identified Wildlife Management Species and are afforded special protection. This protection includes limiting land disturbance within a 500 m radius of known bull trout spawning areas (McPhail 2007).

Coastal Cutthroat Trout

Cutthroat trout are provincially blue-listed and several populations, particularly those on the east coast of Vancouver Island and the Lower Mainland, are in serious decline. They are an indigenous species of special concern and are particularly sensitive to environmental disturbances. Their dependence on small streams for spawning and rearing makes them especially vulnerable, as small streams are easily altered or destroyed and their protection is often overlooked in the planning of industrial developments or forestry (British Columbia Ministry of Fisheries 2009b, Internet site). The main threat to this species is through habitat degradation due to urbanization, particularly in the Lower Mainland and Vancouver Island. Impacts due to logging and land development in the Kitimat Valley and Morice River areas have contributed to the sensitivity of populations in northern British Columbia (McPhail 2007).

Dolly Varden

Dolly Varden are considered vulnerable in British Columbia and the species is blue listed in the province. Many populations have declined due to urbanization, dam construction, industrial activity and road building (British Columbia Ministry of Fisheries 2009c, Internet site). They are sensitive to habitat changes including disruption of migration routes, sedimentation and rising water temperature. Dolly Varden are found in both fresh and marine waters and have anadromous and non-anadromous forms. They are similar in appearance to bull trout, have overlapping geographic distributions (e.g., Skeena drainage), and may hybridize with bull trout, thereby reducing the number of pure strain individuals (McPhail 2007).

White Sturgeon

The white sturgeon is the largest freshwater fish in Canada. It is ranked as critically imperilled by the BC CDC and is an endangered species facing imminent extirpation or extinction according to COSEWIC (COSEWIC 2008, Internet site).

The Nechako River population is in a critical state of decline and has dropped from an estimated 5,000 fish to less than 500, with most individuals over 30 years old (DFO 2005, Internet site). This implies that Nechako River white sturgeon are not reproducing successfully or that many of the young are not reaching adulthood; when these older fish die, they are not replaced by younger ones. Hypotheses for this decline include increased predation on juveniles by visual predators due to the reduced turbidity in the Nechako River following hydro development, decreased food availability, changes to the amplitude and timing of flows, and changes in water temperature that may have affected spawning success (French et al. 2004).

The Nechako River white sturgeon population is Schedule 1 listed on the Species at Risk Public Registry making it illegal to kill, harm, harass or capture individuals. Sturgeon habitat is protected from degradation, disruption and destruction under the federal *Fisheries Act*. Given the status of Nechako white sturgeon and a requirement for a long-term recovery plan, it is necessary to eliminate all potential sources of mortality or habitat impacts to this species (DFO 2009, Internet site).

3.3 Construction-Sensitive Species

This section summarizes the basic life history strategies and stage-specific habitat requirements for the 15 fish species identified as construction-sensitive species, taken mainly from Ford et al. 1995. Construction-sensitive species are defined as species known to occur in streams along or adjacent to the pipeline RoW whose life history requirements (timing of migration, spawning, incubation and rearing) determine the LRP for instream construction in each major watershed.

Northern Pike (Esox lucius) (Alberta and British Columbia)

Northern pike occur in the Peace River in British Columbia and in the Peace, Athabasca and North Saskatchewan River drainages in Alberta. Northern pike are not a conservation-listed species in either province and are an important recreational angling species in Alberta.

Northern pike are spring spawners and migrate to spawning areas immediately following ice-out in April to early May. Spawning areas are often associated with water depth between 0.1 and 0.7 m (ideal 0.2 to 0.4 m) with abundant cover (80%) provided by submerged, vascular instream vegetation. Spawning occurs in flooded channels, sheltered bays and side channels with perennial connectivity between, and in, side channels and watercourse mainstems. Northern pike do not make extensive spawning migrations which limits their use of alternate spawning sites if the preferred spawning area is disturbed.

Following hatching, larval pike attach to instream vegetation and orient vertically for about 10 days before yolk sac absorption. Emergent fry feeding begins within 10 days of hatching when availability of prey (zooplankton) is essential.

Juvenile and sub-adult pike rear in habitats associated with gradual changes in water depth (from 0.1 to 1.6 m) and with moderate cover (50 to 75%) provided by submerged, vascular instream vegetation. Northern pike are ambush predators and require aquatic vegetation or boulders for cover from which to surprise their prey. High-quality pike rearing habitat also includes LWD cover in deep pools with low velocity (less than 0.05 m/s) and connectivity between spawning habitat and rearing habitat.

Overwintering habitat usually consists of deep pools (ideal depth more than 1.5 m) that do not freeze to bottom and have a fresh supply of oxygenated water. Pike can tolerate total dissolved solids (TDS) up to 3,500 ppm and dissolved oxygen concentrations as low as 0.04 mg/L.

Lake Sturgeon (Acipenser fulvescens) (Alberta)

Lake sturgeon do not occur in British Columbia but are an important recreational species in Alberta. Lake sturgeon in the Saskatchewan River in Alberta are listed as endangered by COSEWIC and are currently under consideration for *SARA* listing. The number of sturgeon in Alberta has declined because of pressures from commercial, traditional use and recreational fishing. Habitat loss is also a factor in their decline. Existing populations are primarily in the North and South Saskatchewan River basins.

Lake sturgeon are a long-lived, slow maturing species, with females reaching maturity at 20 to 25 years and males at 15 to 20 years. Sturgeon do not spawn every year. Females spawn once every four to seven years and males once every two to three years. Spawning usually occurs in April to June in large rivers over rocky substrates. Primary foraging habitat for lake sturgeon consists of large, deep pools in large rivers. Lake sturgeon rear in a variety of habitat types but prefer gravel substrate and depths of 3 to 6 m. Spawning migrations of over 100 km have been reported.

Walleye (Sander vitreus) (Alberta and British Columbia)

Walleye are not of conservation concern in British Columbia and Alberta. However, they are an important recreational species in both provinces. In British Columbia, walleye are generally confined to the Liard and Peace River drainages.

Spawning occurs in shallow lake, river, and stream shoals soon after ice-out (March to June). Spawning habitat is often associated with gravel and cobble substrates in riffle habitats with water depths between 0.3 m and 1.5 m. Stable water levels with perennial connectivity are required for spawning in mainstem, side channels and embayment habitats. Walleye generally reside in lakes and large rivers but will spawn

in smaller systems that provide the required habitat characteristics (i.e., riffles with cobble at appropriate depths).

Juvenile walleye rear in habitats associated with diverse substrate types (fines to cobbles) including run and pool habitats with water depths greater than 1 m. Preferred habitats have 20% to 40% cover, high abundance of forage fish (i.e., minnows and suckers), stable water levels, moderate turbidity (i.e., Secchi depths between 1 and 4 m) and good connectivity between mainstem and side channels.

Overwintering habitat consists of deep pools (ideal depth more than 2 m) that do not freeze to the bottom and have a fresh supply of oxygenated water. They are considered a construction-sensitive species for the Project because of their widespread distribution and recreational value in Alberta.

Arctic Grayling (Thymallus arcticus) (Alberta and British Columbia)

Arctic grayling occur throughout the Peace River drainage and are an important recreational species in British Columbia and Alberta. In British Columbia, the Williston watershed (Peace River drainage) population of Arctic grayling is red-listed. In Alberta, the species is important for recreational angling and is considered sensitive. Within British Columbia and Alberta, the species exhibits two life history strategies: adfluvial (lake to river) or fluvial (large to small river) spawning strategies.

In the Parsnip River, young-of-the-year Arctic grayling tend to use shallow (< 0.06 m) and slow (<0.03 m/s) flowing margin habitat while age 1+ Arctic grayling used mid-channel habitats (Blackman and Hunter 2001; Blackman 2002). Arctic grayling in the Parsnip River watershed move into the mainstem between late September and early November to overwinter in deep, slow pool habitat as well as shallow, higher velocity areas. Spawning migrations into the tributaries from Parsnip mainstem occur in late April coinciding with an increase in water temperature and ice breakup. Arctic grayling spawning occurs during peak flows in late May to mid-June in tributaries and along braided channels in the Parsnip mainstem.

Bull Trout (Salvelinus confluentus) (Alberta and British Columbia)

In British Columbia, bull trout are blue-listed. They are considered an important recreational species in British Columbia and Alberta. Bull trout fisheries in both provinces are catch and release only.

Between April and September, mature bull trout migrate from lakes and rivers to spawn in smaller tributaries. Spawning generally occurs between September and November depending on latitude and elevation. Bull trout require spawning habitat that has large clean gravel or cobble substrates and with flows ranging between 0.25 and 0.65 m/s. Eggs hatch between January and February after 34 to 120 days incubation and alevins emerge from the gravel between April and June. Bull trout are iteroparous (capable of spawning more than once).

Bull trout inhabit swift (more than 25% gradient) and slow flowing watercourses and often prefer deep pools (more than 1 m), tributary/mainstem confluences, or both, where available. Given their general intolerance to suspended sediments, bull trout in small, low gradient tributaries are particularly vulnerable to instream and riparian disturbances because of the incapacity of these watercourses to effectively dilute and flush sediments.

Juvenile bull trout food sources include epibenthic drift and terrestrial and aquatic insects. Adults are generally opportunistic piscivores and feed on kokanee, largescale suckers, rainbow and cutthroat trout, peamouth and mountain whitefish.

Dolly Varden (Salvelinus malma) (British Columbia)

Dolly Varden occur throughout coastal British Columbia and are blue-listed in the province.

Life history strategies for Dolly Varden vary widely and include anadromous and freshwater forms. Spawning typically occurs during fall, between August and November, and temperature-dependant egg incubation timing ranges from 34 to 125 days. Hatching occurs between January and February and alevins remain in the spawning substrate for two to three weeks before emergence. Fry remain near spawning sites for two to three weeks and move into side channels and backwaters for the remainder of the year, dispersing to pools and runs in larger systems over the next one to four years. Anadromous Dolly Varden seaward migrations typically occur during spring when fish are one to three years of age. Mature anadromous Dolly Varden migrate to freshwater spawning habitats between April and September. Resident adults migrate seasonally between feeding, spawning and overwintering habitats in lacustrine and fluvial habitats.

Rainbow Trout (Oncorhynchus mykiss) (Alberta and British Columbia)

Rainbow trout are a recreationally important species in lakes and rivers throughout British Columbia and Alberta.

Rainbow trout have developed various life history strategies depending on geographic location and habitat requirements. These strategies include:

- resident (life spent entirely in small streams)
- fluvial (spawn in small streams and move to rivers to rear and mature)
- adfluvial (spawning in small streams and move into lakes to rear and mature)
- lentic or lacustrine (life spent entirely in lakes)
- anadromous (migrate from ocean to spawn and rear in freshwater environments). The anadromous rainbow trout form is referred to as steelhead.

In general, spawning occurs between mid-April and June, primarily in smaller tributary streams, and fry emerge from gravel redds between mid-June and September after a 28- to 40-day egg incubation period. Non-resident forms of rainbow trout migrate from their natal streams between August and October to rear and mature in lake or mainstem river habitats.

Fluvial and resident adult rainbow trout prefer streams with a riffle to pool ratio of 1:1 with stable flows and cold water temperatures (12 to 18ºC), vegetated banks, cover from LWD, undercut banks, or pools, rocky substrates and clear silt-free water. Lakes with good habitat are generally oligotrophic, with inlet or outlet streams containing suitable spawning gravel.

Coastal Cutthroat Trout (Oncorhynchus clarki clarki) (British Columbia)

The coastal cutthroat trout is blue-listed in British Columbia and occurs in the Kitimat and Skeena river drainages where it is an important recreational species.

Similar to rainbow trout, cutthroat trout have numerous life-history strategies depending on geographic location and habitat availability. These strategies include adfluvial, resident and anadromous populations. Adfluvial cutthroat trout migrate from lakes or larger rivers to tributary streams to spawn between May and June. Spawning occurs over clean gravel substrates from June to August depending on latitude and elevation. Following a six- to seven-week incubation period, the eggs hatch between July and September. Cutthroat trout alevins emerge about one to two weeks after hatching and remain in their natal stream until late fall or the following spring freshet period, before emigration to lakes or larger mainstem habitats. Anadromous cutthroat trout typically overwinter another year (two or more to three or more years) before ocean emigration. Resident cutthroat trout remain in their small streams or tributaries for their entire life cycle and make minor migrations to access suitable spawning and overwintering habitat. Adult cutthroat trout prefer riffle-pool type channel morphology in rivers. Cutthroat trout are iteroparous and spawn more than once. Maturity varies between two and four years of age and some cutthroat trout up to eight years of age have been reported.

Cutthroat trout are susceptible to and threatened by habitat degradation. Of the various life history strategies, populations that reside entirely in small, clear, headwater streams are most susceptible to environmental degradation and increases in turbidity.

Pearl Dace (Margariscus margarita) Alberta and British Columbia

Pearl dace are blue-listed in British Columbia (BC CDC 2008, Internet site) and S3 listed on the Alberta Natural Heritage Watch List (ANHIC 2008b, Internet site). Pearl dace range from Nova Scotia to eastern British Columbia and north into southern Northwest Territories (Bramblett and Alexander 2004, Internet site). Pearl dace also inhabit the North Saskatchewan and Athabasca Rivers in Alberta.

Male pearl dace mature after one year whereas females are able to reproduce after two years. Spawning typically occurs in streams during the spring (May to June) when water temperatures reach 17 to 18°C (Eakins 2005, Internet site). Spawning occurs in clear water between 45 and 60 cm depth with sand and gravel substrate in weak to moderate velocity flows (Scott and Crossman 1998). Female fecundity ranges from 900 to 4,240 eggs (Eakins 2005, Internet site).

Pearl dace prefer pool-type habitat in clear headwater streams, bogs, ponds and small lakes with sand or gravel bottom substrates and water temperatures of about 16°C. Unlike salmonids, pearl dace can withstand water temperatures of up to 31.1°C (Becker 1983). Pearl dace prey on zooplankton, terrestrial and aquatic insects, and occasionally small fish. Detritus, algae and diatoms have been found in the stomachs of pearl dace (Scott and Crossman 1998; Tallman and Gee 1982; Becker 1983). Pearl dace life spans range from three to four years for males and females, respectively (Eakins 2005, Internet site).

Steelhead (Oncorhynchus mykiss) (British Columbia)

Steelheads are the anadromous form of rainbow trout and are a highly valued recreational species in British Columbia.

Life history strategies for steelhead include winter- and summer-run populations. Winter-run fish enter streams from November through April and spawn in the spring. Summer-run fish enter rivers between mid-April and November and spawn the following spring. Major steelhead populations occur in several tributaries to the Fraser River (i.e., Thompson River), Skeena River (Kispiox, Kitsumkalum, Kitwanga, Maurice, Babine and Bulkley Rivers), and Kitimat River. Some steelhead spawn several times (repeat spawners) over their life span while others die after a single spawning.

Spawning generally occurs from April to early July in clean gravel reaches of sub-basin mainstems. Adult steelhead prefer moderate to high velocity (60 to 80 cm/s) flows and depths between 30 and 100 cm (Raleigh and Nelson 1985; Ptolemy, unpublished data 2006) in medium to large rivers with large gravel to cobble and boulder substrates in riffle and run habitats. Juvenile steelhead prefer cobble and gravel riffles and run tailout habitats. Two- to four-year-old steelhead smolts typically emigrate from freshwater to estuarine environments during late spring and early summer freshets. Steelhead spend one to three years in the marine environment before migrating back to their natal streams.

Coho Salmon (Oncorhynchus kisutch) (British Columbia)

Coho salmon are an important species in numerous coastal British Columbia watersheds including the Kitimat and Skeena river drainages. Coho salmon are highly prized in recreational, traditional use and commercial fisheries.

Life history strategies for coho vary between drainage systems. Coho spawning timing varies throughout the province from late August in northern environs, to late January on the south coast. Adult coho prefer smaller second- to third-order tributaries with small- to medium-sized gravel substrates for spawning. Egg incubation duration varies from 35 to 175 days. Newly hatched alevins remain in the spawning substrates for 14 to 21 days before emerging. Young-of-the-year remain in their natal streams near spawning sites (low-flow areas) or are passively displaced downstream. Juveniles gradually establish individual territories in small streams or margins of larger rivers. Juvenile coho require clean water with deep pool habitat for summer rearing and overwintering. LWD is an essential cover type for coho production. Smolts migrate to the ocean during late April to May the year following their emergence, during or immediately following the spring freshet period.

Coho typically reside at sea for two years before returning to natal streams to spawn as sexually mature adults. Inter- and intra-specific watershed straying is not uncommon.

Coho salmon are considered a construction-sensitive species for the Project on the basis of their value to sport, commercial and Aboriginal fisheries, and their susceptibility to sedimentation from riparian disturbances.

Chinook Salmon (Oncorhynchus tshawytscha) (British Columbia)

In British Columbia, chinook salmon are important to recreational, commercial and traditional use fisheries.

Chinook salmon spawning timing varies between region and watershed and typically depends on freshwater migration distance requirements. Generally, migration occurs from April to September with spawning occurring from July to October. Upper Fraser River chinook stocks (e.g., Stuart River) typically spawn in mid- to late-September, whereas Kitimat River populations spawn in July and August. Spawning occurs in moderate flow velocities over large gravel and cobble substrates in mainstem habitats of medium to large rivers.

Incubation occurs between September and April (depending on water temperature) and eggs typically hatch during late winter to early spring. Emergence is usually 14 to 21 days after hatching. Newly hatched fry are either displaced downstream to estuarine habitats in three months (ocean type) or remain in freshwater environs for 12 to 18 months (stream type). Juvenile stream residents overwinter in pools and off channel habitats with moderate flows (0.25 to 0.5 m/s).

Marine residence duration usually varies between two and six years. Seaward emigration generally occurs during the spring freshet from late March through April. Most chinook salmon mature between their third and fourth year of ocean residence, although some return as early as the second year (jack springs) or as late as their eighth year.

Chinook salmon are considered a sensitive species for the construction phase of the Project because of their unique habitat requirements (i.e., requirements for larger spawning gravel in large rivers and large holding pools), their unique life history strategies (stream type and ocean type), and their importance to recreational, commercial and traditional use fisheries.

Sockeye Salmon (Oncorhynchus nerka) (British Columbia)

Sockeye salmon is a regionally important species and contributes to sport, commercial and traditional use fisheries throughout coastal and interior British Columbia, including Skeena and upper Fraser river drainages. The Stuart, Nechako and Babine watersheds support world-renowned sockeye populations. A unique population of sockeye that does not use lake habitat for rearing as is known to spawn and rear in the Kitimat River near the Hunter Creek confluence.

In most drainages, sockeye salmon ascend natal rivers during early summer and spawn between August and October. Adult sockeye generally reach maturity in their fourth year and die soon after spawning. Following emergence, sockeye fry typically reside for a year in downstream lake environs (littoral and pelagic) before immigrating to the ocean as smolts. Smolt migrations occur during the late spring freshet period (April to May).

Because juvenile sockeye salmon rear primarily in lake habitats, stream habitat availability is generally not as important for this species as it is for other salmon species. However, they require clean gravel and laminar, low to moderate stream flows for spawning. Events that introduce substantial quantities of suspended sediments into a spawning stream can adversely affect gravel permeability and incubating egg survival through a reduction in interstitial dissolved oxygen levels. Degradation of stream habitat (bank

erosion, increased siltation) can also adversely affect downstream lake water quality through introduction of suspended sediments and subsequent decreases in primary and secondary productivity. A reduction in juvenile sockeye salmon prey availability (and predation success) can reduce growth rates during lake residence which in turn will decrease early marine survival.

White Sturgeon (Acipenser transmontanus) (British Columbia)

Five populations of white sturgeon have been identified in the Fraser River drainage; four of these are in the mainstem Fraser River and the fifth is found in the Nechako River drainage. The Nechako River white sturgeon population is small, is comprised mainly of older fish, and has poor spawning success and recruitment (RL&L 2000). White sturgeon are also found in the Stuart River which extends from the southeast of Stuart Lake and continues to its confluence with the Nechako River to the south and the east. Sturgeon fishing has been observed since the mid 1900s along the Stuart River. However, documented or first-hand information regarding the number of fish caught or observed is rare (Camden 2000). The lower Stuart River provides suitable spawning habitat and may be used for spawning (RL&L 2000).

White sturgeons mature slowly and do not begin spawning until the females are at least 18 years old and males are at least 14 years old. After reaching maturity, white sturgeon may spawn several times during their life.

Sturgeon fecundity is directly proportional to female body size (Scott and Crossman 1973). White sturgeon release large numbers of eggs and sperm over bottom substrates into the water column of turbulent river habitats. Spawning occurs in the late spring and early summer, typically following the highest water levels of freshet as water temperatures are rising. Spawning occurs in fast water velocities; and over coarse substrates (Parsley et al. 1993; Parsley and Kappenman 2000; Paragamian et al. 2002; Parsley et al. 2002; Perrin et al. 2003; RL&L 1994; Sykes et al. 2007) though there are deviations from this general pattern.

Studies conducted in unregulated rivers, such as the Fraser River indicate that white sturgeon spawning may occur over a wider range of habitat conditions than previously reported for impounded areas (Perrin et al. 2003). For example, shallow (1.5 m to 4.0 m), low velocity (0.8 m/s to 2.1 m/s) side channel habitats with sand/gravel substrates were more commonly used in the Fraser River, compared to confined sections of regulated rivers (Perrin et al. 2003). Other studies suggest that eggs, free embryos and larvae can be found within substrate interstices in shallow, inundated riparian habitats downstream of spawning areas (van der Leeuw et al. 2006) and directly within low velocity, shallow side channels (Perrin et al. 2003). This suggests that spawning and rearing habitats may be similar in some cases, especially in lower velocity areas where dense eggs can sink (Perrin et al. 2003). Coutant (2004) noted that successful spawning is most often associated with turbulent or turbid river sections upstream of floodplains.

Juvenile white sturgeon inhabit lower tributary reaches, large backwaters, side channels and sloughs and typically prefer deep water habitat (more than 5 m) with low velocity, variable current direction and relatively high turbidity. White sturgeon have also been reported to undergo distinct migrations from sloughs and backwaters to mainstem habitats as summer progresses (Lane and Rosenau 1993). Older juveniles can occur at depths from 9 to 57 m in lakes and prefer near-substrate velocities of 0.1 to 0.6 m/s in fluvial habitats (Parsley et al. 1993).

*Mountain Whitefish (*Prosopium williamsoni*) (Alberta and British Columbia)*

Mountain whitefish are widely distributed throughout coastal and interior British Columbia and are found in the Peace, Fraser and Skeena drainages. In Alberta, mountain whitefish are found in the Peace, Athabasca and Saskatchewan River drainages where they are often the most common large-bodied fish species.

Mountain whitefish spawn from October to February in streams with riffles with gravel and cobble substrates. Egg incubation occurs over a 36 to 127 day period, after which alevins emerge in March and April. Fry are passively displaced downstream and take up temporary residence in backwaters and ponds, gradually moving into highly velocity habitats (glides and riffles). Maturity is reached at age four and mountain whitefish have been reported to live up to 17 years. Adults migrate seasonally between spawning and overwintering habitats.

3.4 Alberta Drainages

The pipeline route will cross 273 watercourses in Alberta between KP 0 and KP 516.18. Of these 273 crossings, 224 were surveyed between 2005 and 2009 (see Table 3-5). Biophysical data from 8 of these 224 crossings were obtained from Alliance Pipeline Project data (Golder Associates 1997a-f).

Most of the crossings are in the Peace River (46%) and Athabasca River (42%) drainages. The remaining 12% of crossings are located in the North Saskatchewan River drainage. Most (96%) of the crossings in Alberta are on Class C watercourses; only 4% of crossings are on Class B watercourses and none are on Class A or D watercourses.

Of the 273 watercourse crossings in Alberta, 146 are classified as fish-bearing and 78 are classified as non-fish-bearing (see Table 3-6). The remaining 49 watercourses that were not surveyed are assumed to be fish-bearing status until a site survey proves otherwise. The mean watercourse crossing density in Alberta is 0.38 watercourse crossings per kilometre of pipeline (excluding NCDs and NVCs).

Table 3-5 Stream Class Summary by Drainage, Alberta

Drainage	KP Range	AB Stream Class[1]				Surveyed (2005– 2009)	Un-surveyed[2]	Total Sites
		A	B	C	D			
North Saskatchewan River[3]	0 – 77.3	0	0	33	0	25	8	33
Athabasca River[4]	77.3 – 257.2	0	0	115	0	102	13	115
Peace River	257.2 – 516.8	0	11	114	0	97	28	125
Totals		0	11	262	0	224	49	273

NOTES:
[1] Source: AENV 2001
[2] Not Surveyed as of October 2009
[3] Includes one site with Alliance Pipeline Project data (Golder Associates 1997a-f)
[4] Includes seven sites with Alliance Pipeline Project data (Golder Associates 1997a-f)

Table 3-6 Fish Bearing Status of Crossings by Drainage, Alberta

Drainage	KP Range	Fish Bearing	Non-Fish Bearing		Un-Surveyed – Defaulted Fish-Bearing
			NVC	NCD	
North Saskatchewan	0 – 77.3	16	8	1	8
Athabasca River	77.3 – 257.2	55	44	3	13
Peace River	257.2 – 516.8	75	18	4	28
Totals		146	70	8	49

NOTES:
NVC – no visible channel
NCD – non-classified drainage

Fish sampling in Alberta captured several species (see Table 3-7). Only six sportfish species were captured in the 2005–2009 surveys: Arctic grayling, bull trout, burbot, mountain whitefish, northern pike and rainbow trout. Longnose sucker and white sucker were the only coarse fish species captured in these years. Brook stickleback were captured in all three Alberta drainages.

Table 3-7 Fish Species Captured (Historic and 2005–2009) by Major Drainage, Alberta

Species	Major Drainage		
	North Saskatchewan	Athabasca	Peace
Sport Fish			
Arctic grayling		H, C	H
Brook trout		H	H
Brown trout	H	H	
Bull trout		H	H, C
Burbot	H	H, C	H, C
Goldeye	H	H	
Lake sturgeon	H		
Mooneye	H		
Mountain whitefish	H	H	H, C
Northern pike	H	H, C	H
Rainbow trout	H	H, C	H
Sauger	H		
Walleye	H	H	H
Yellow perch	H	H	H

Table 3-7 Fish Species Captured (Historic and 2005–2009) by Major Drainage, Alberta (cont'd)

Species	Major Drainage		
	North Saskatchewan	Athabasca	Peace
Coarse Fish			
Largescale sucker			H
Longnose sucker	H	H, C	H, C
Mountain sucker	H		
Quillback	H		
Shorthead redhorse	H		
Silver redhorse	H		
White sucker	H	H, C	H, C
Forage Fish			
Brook stickleback	H, C	H, C	H, C
Emerald shiner	H	H	H
Fathead minnow	H	H	
Finescale dace	H	H	H, C
Flathead chub	H	H, C	H, C
Iowa darter	H		
Lake chub	H	H, C	H, C
Longnose dace	H	H, C	H, C
Northern redbelly dace	H	H, C	H
Northern pikeminnow			H, C
Pearl dace	H	H	H, C
Redside shiner			H, C
River shiner	H		
Slimy sculpin			H, C
Spoonhead sculpin	H	H	H, C
Spottail shiner	H	H	H
Troutperch	H	H, C	H, C

NOTES:
C – Captured during 2005–2009 field surveys
H – Historical data. Source: FWMIS (ASRD 2009, Internet site); Nelson and Paetz 1992; Scott and Crossman 1998.

3.4.1 North Saskatchewan River Drainage

The North Saskatchewan River is 1,220 km long and drains an area of about 122,800 km^2. From its headwaters in the Rocky Mountains in Banff National Park, the North Saskatchewan River flows eastward through the Rocky Mountain Foothills and across the plains of central Alberta and Saskatchewan. About 30 km east of Prince Albert in central Saskatchewan, the North and South Saskatchewan Rivers join to form the Saskatchewan River. The Saskatchewan River eventually drains into Hudson's Bay via the Nelson River in Manitoba.

Elevations in the North Saskatchewan River drainage area range from 3,342 m asl at Mount Saskatchewan in the Rocky Mountains to about 400 m at the confluence with the South Saskatchewan River in central Saskatchewan. There are two large dams in the North Saskatchewan basin: the Big Horn Dam (Lake Abraham) on the North Saskatchewan River and the Brazeau Dam on the Brazeau River.

This section of pipeline crosses flat terrain associated with boreal forest, agricultural zones and low-gradient watercourses in the North Saskatchewan River and the Sturgeon River valleys (Allan 1984). The climatic region for the drainage is characterized predominantly by Central Parkland conditions which include mostly grasslands and aspen and balsam poplar forests. A small region of Boreal Forest is found on the eastern and western sections of the RoW in the North Saskatchewan River drainage and is characterized mainly by aspen forests. Most of the land in this section of the pipeline route is used for agriculture. Major watersheds in this drainage include the North Saskatchewan and Sturgeon Rivers.

A total of 33 watercourse crossings were identified in the North Saskatchewan River drainage between KP 0 and KP 77.3 (see Table 3-8 and Figure 3-1). The drainage consists of two watersheds, the North Saskatchewan River watershed (KP 0 to KP 19.7) and the Sturgeon River watershed (KP 19.7 to KP 77.3).

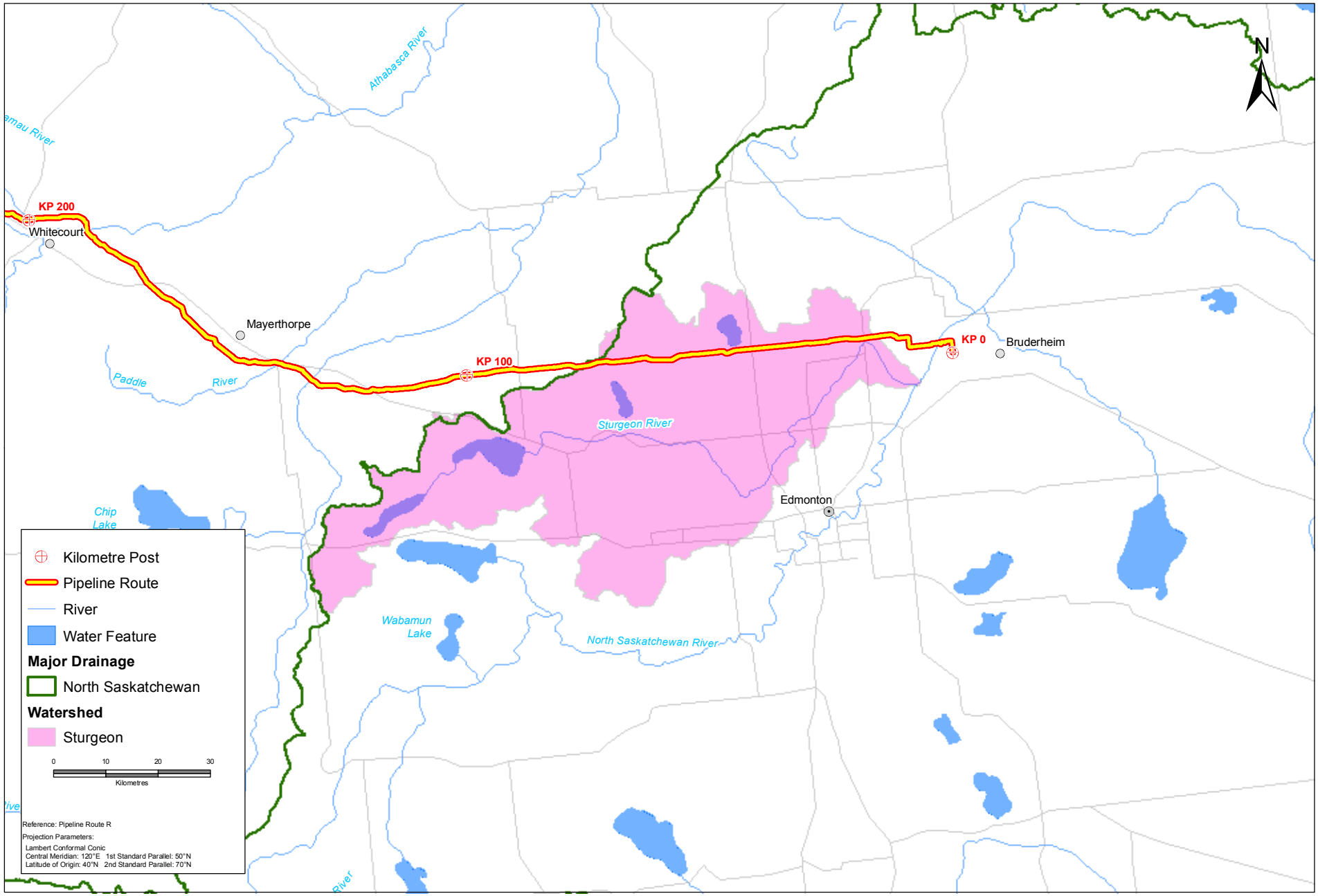
Table 3-8 Stream Class Summary, North Saskatchewan River Drainage, Alberta

Watershed	KP Range	AB Stream Class[1]				Surveyed (2005–2009)	Un-surveyed[2]	Total Sites
		A	B	C	D			
North Saskatchewan River	0 – 19.7	0	0	11	0	4	7	11
Sturgeon River[3]	19.7 – 77.3	0	0	22	0	21	1	22
Totals		0	0	33	0	25	8	33

NOTES:
[1] Source: AENV 2001
[2] Unsurveyed as of October 2009
[3] Includes one site with Alliance Pipeline Project data (Golder Associates 1997a-f)

All 11 watercourse crossings (surveyed and unsurveyed) in the North Saskatchewan River watershed are Class C (see Table 3-8). Four of these sites were surveyed during field programs.

All 22 sites identified in the Sturgeon River watershed are also Class C. Surveys were carried out at 21 sites. Fish and fish habitat data collected for the Alliance Pipeline Project (Golder Associates 1997a-f) at one crossing in the Sturgeon River watershed was used to supplement the dataset for this report.



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ENBRIDGE NORTHERN GATEWAY PROJECT

Overview Map of the North Saskatchewan Drainage

FIGURE NUMBER:	DATE:
3-1	20090527
SCALE: 1:1,000,000	AUTHOR: EO / APPROVED BY: TS
PROJECTION: LCC	DATUM: NAD 83

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Of the 33 identified sites in the North Saskatchewan drainage, 16 were identified as fish-bearing and 9 were identified as non-fish-bearing (see Table 3-9). The remaining 8 unsurveyed sites were classified as fish-bearing by default. In the North Saskatchewan watershed, all 11 sites were classified as fish-bearing (4 surveyed sites and 7 unsurveyed sites). In the Sturgeon River watershed, 12 sites were classified as fish-bearing while nine sites were non-fish-bearing. The average watercourse crossing density in the North Saskatchewan River drainage attributable to the pipeline ROW is 0.31 watercourse crossings per kilometre of pipeline (excluding NCDs and NVCs).

Table 3-9 Fish Bearing Status of North Saskatchewan River Drainage Crossings by Watershed

Watershed	KP Range	Fish Bearing	Non-Fish Bearing		Unsurveyed – Default Fish-Bearing
			NVC	NCD	
North Saskatchewan	0 – 19.7	4	0	0	7
Sturgeon River	19.7 – 77.3	12	8	1	1
Totals		16	8	1	8

NOTES:
NVC – no visible channel
NCD – non-classified drainage

Fish-Bearing (Inferred or Actual) Watercourse Crossings, Associated Habitat and Species Presence

A total of 31 fish species are known to occur in the North Saskatchewan drainage (see Table 3-10). However, surveys in 2005–2009 only captured brook stickleback in a single tributary to Riviere Qui Barre (KP 56.305, Appendix B) in the Sturgeon River watershed. Fish sampling wasn't conducted at the majority of the sites due to insufficient flow at the time of surveys.

The North Saskatchewan River mainstem (KP 4.027, Appendix B) supports a great diversity of recreational and ecologically important fisheries (Allan 1984; Edmonton Transportation and Streets 2000). Near the pipeline route, goldeye, mountain whitefish, walleye and lake sturgeon are the fish species of highest recreational value. The North Saskatchewan mainstem also supports mooneye, silver redhorse and river shiner which have been identified as having ecological importance because of their provincial or federal status (ANHIC 2008c, Internet site). Year-round angling occurs for mountain whitefish, walleye, sauger, northern pike, burbot and goldeye from Drayton Valley downstream to the Saskatchewan border. Fish sampling in the North Saskatchewan River was not completed because of the large amount of existing information already available.

The Sturgeon River watershed contains mostly forage fish species including lake chub, brook stickleback and fathead minnow. Historically, Toad Creek (KP 76.870, Appendix B), a Sturgeon River tributary, has also supported populations of northern pike. Toad Creek was sampled in 2005 but fish were not captured or observed. Site specific watercourse crossing information is provided in Appendix B.

Construction-Timing Constraints (Least Risk Periods)

In general, the North Saskatchewan River drainage instream construction LRPs occur during the mid to late summer (July 1 or August 1) through early spring period (April 15). Restricted instream work periods generally extend from mid-April to July in consideration of spring spawning species such as walleye and northern pike (see Table 3-11). Lake sturgeon spawning in the North Saskatchewan River overlaps with the spawning period of other spring spawners and is therefore protected under this LRP.

Table 3-10 Fish Species (Historic and Captured) by Watercourse, North Saskatchewan River Drainage, Alberta

Watercourse	Sport Fish	Coarse Fish	Forage Fish
North Saskatchewan Watershed			
North Saskatchewan River	**Captured:** no information **Historic:** burbot, goldeye, northern pike, mountain whitefish, walleye, lake sturgeon, brown trout, cutthroat trout, mooneye, rainbow trout, sauger, yellow perch	**Captured:** no information **Historic:** longnose sucker, mountain sucker, white sucker, shorthead redhorse, silver redhorse, largescale sucker, quillback	**Captured:** no information **Historic:** brook stickleback, emerald shiner, fathead minnow, lake chub, longnose dace, finescale dace, northern redbelly dace, pearl dace, river shiner, spoonhead sculpin, spottail shiner, troutperch, flathead chub, Iowa darter
Tributaries to North Saskatchewan River	No historic or captured information		
Sturgeon River Watershed			
Tributaries to Sturgeon River	No historic or captured information		
Tributaries to Manawan Lake	No historic or captured information	No historic or captured information	**Historic:** lake chub, brook stickleback, fathead minnow
Riviere Qui Barre and tributaries	No historic or captured information	No historic or captured information	**Captured:** brook stickleback **Historic:** brook stickleback, lake chub
Toad Creek	**Captured:** no information **Historic:** northern pike	No historic or captured information	No historic or captured information
SOURCES: FWMIS (ASRD 2009, Internet site); McPhail 2007; Nelson and Paetz 1992; Scott and Crossman 1998.			

Table 3-11 Least-Risk Periods for Instream Construction, North Saskatchewan River Drainage, Alberta

Watercourse	CS[1] Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Least Risk Period
North Saskatchewan River	LKST NRPK WALL													Aug 1 – Apr 15
Tributaries to North Saskatchewan River (KP 6.602 – KP 6.876, KP 15.316)	NRPK WALL													July 1 – Apr 15
Tributaries to North Saskatchewan River (KP 12.687 – KP 14.726)														Aug 1 – Apr 15
Tributaries to Sturgeon River														July 1 – Apr 15
Tributaries to Manawan Lake														July 1 – Apr 15
Riviere Qui Barre and tributaries														July 1 – Apr 15
Toad Creek														July 1 – Apr 15

NOTES:
Grey bars indicate restricted work periods; no bars indicate instream work periods
[1] Construction Sensitive Species: LKST – lake sturgeon; NRPK – northern pike; WALL - walleye

3.4.2 Athabasca River Drainage

The Athabasca River originates in the Rocky Mountains in Jasper National Park. It is 1,538 km long and drains an area of about 133,000 km^2. The Athabasca River flows generally in a northeast direction across the boreal plains of central and northeast Alberta before discharging into Lake Athabasca in Wood Buffalo National Park. The Athabasca River drainage area ranges in elevation from 3,747 m at Mount Columbia in the Rocky Mountains to about 300 m at Lake Athabasca in northeast Alberta. There are no impoundments on the Athabasca River system. Major watersheds in this drainage include the Pembina, Paddle and Athabasca Rivers.

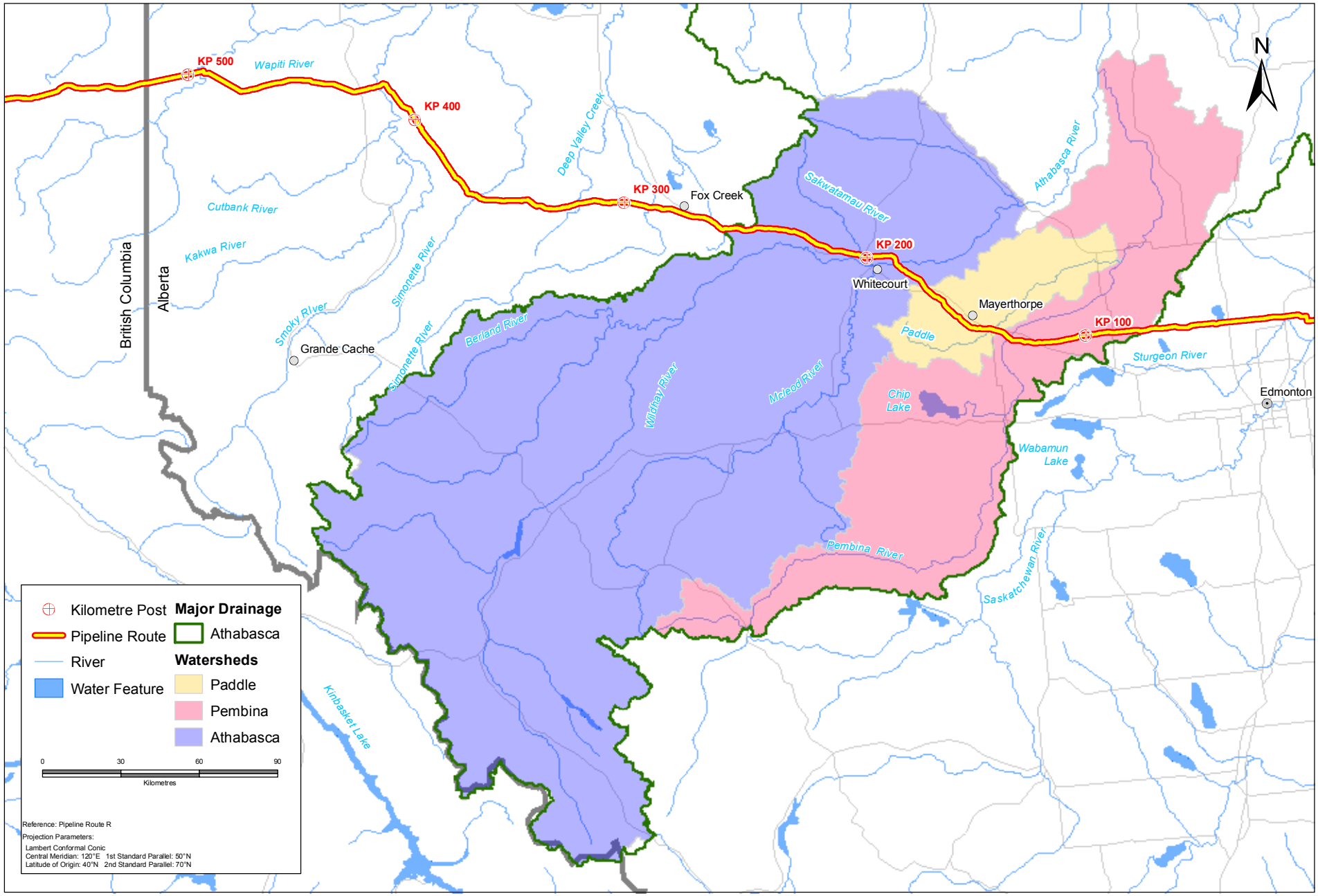
The pipeline route crosses flat terrain associated with forested and agricultural sections separated by low-gradient watercourses in the Pembina, Paddle and Athabasca River valleys (Wallace and McCart 1984). The climatic region is characterized by dry mixed wood conditions (KP 80.976 to KP 164.064) which include mainly aspen forests. In the western portion of the drainage (KP 203.706 to KP 257.938), the climatic region is characterized by Foothills conditions dominated by white spruce, black spruce and birch forests. A transition zone between the two climatic regions occurs between KP 164.064 and KP 203.706. A substantial amount of the land base in this drainage has been cleared for agriculture and logging. Oil and gas developments are also scattered through the western portion of the drainage.

The pipeline route will cross 115 watercourses in the Athabasca River drainage between KP 77.3 and KP 257.2 (see Table 3-12 and Figure 3-2). The pipeline RoW will cross tributaries and mainstems in three watersheds: the Pembina River (KP 77.3 to KP 136.2), the Paddle River (KP 136.2 to KP 173.1) and the Athabasca River (KP 173.1 to KP 257.2). All of the watercourse crossings in the Athabasca River drainage are Class C. Watercourse crossing density in the Athabasca River drainage is 0.38 fish-bearing watercourse crossings per kilometre of pipeline (excluding NVCs and NCDs).

Table 3-12 Stream Class Summary, Athabasca River Drainage, Alberta

Watershed	KP Range	AB Stream Class[1]				Surveyed (2005–2009)	Un-Surveyed[2]	Total Sites
		A	B	C	D			
Pembina River[3]	77.3 – 136.2	0	0	45	0	43	2	45
Paddle River[4]	136.2 – 173.1	0	0	25	0	17	8	25
Athabasca River[5]	173.1 – 257.2	0	0	45	0	42	3	45
Totals		0	0	115	0	102	13	115

NOTES:
[1] Source: AENV 2001
[2] Unsurveyed as of September 2009
[3] Includes five sites with Alliance Pipeline Project data (Golder Associates 1997a-f)
[4] Includes one site with Alliance Pipeline Project data (Golder Associates 1997a-f)
[5] Includes one site with Alliance Pipeline Project data (Golder Associates 1997a-f)



CONTRACTOR: AMEC Earth & Environmental

PREPARED BY: gem Gateway Environmental Management Team

PREPARED FOR: ENBRIDGE NORTHERN GATEWAY PIPELINES

ENBRIDGE NORTHERN GATEWAY PROJECT

Overview Map of the Athabasca River Drainage

FIGURE NUMBER:	DATE:
3-2	20090527
SCALE: 1:2,000,000	AUTHOR: EO / APPROVED BY: TS
PROJECTION: LCC	DATUM: NAD 83

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A total of 102 sites was surveyed in the Athabasca River drainage between 2005 and 2009. Fish and fish habitat data collected for the Alliance Pipeline Project (Golder Associates 1997a-f) is available for five crossings in the Pembina River watershed: one crossing in the Paddle River watershed and one crossing in the Athabasca River watershed. This information was used to supplement the dataset for this report.

Of the 115 identified sites in the Athabasca River drainage, 55 were classified as fish-bearing and 47 were classified as non-fish-bearing (either NVC or NCD) (see Table 3-13). The remaining 13 unsurveyed sites were classified as fish-bearing by default. Many of the non-fish-bearing sites in the watercourses are ephemeral and fish sampling was not possible because of lack of water. In the Pembina River watershed, 29 sites were fish-bearing and 14 were non-fishing-bearing. In the Paddle River watershed, nine sites were fish-bearing and eight were non-fish-bearing. In the Athabasca River watershed, 17 sites were fish-bearing and 25 were non-fish-bearing.

Table 3-13 Fish-Bearing Status of Athabasca River Drainage Crossings by Watershed

Watershed	KP Range	Fish Bearing	Non-Fish Bearing		Unsurveyed – Default Fish Bearing
			NVC	NCD	
Pembina River	77.3 – 136.2	29	14	0	2
Paddle River	136.2 – 173.1	9	7	1	8
Athabasca River	173.1 – 257.2	17	23	2	3
Totals		55	44	3	13

NOTES:
NVC – no visible channel
NCD – non-classified drainage

Fish-Bearing (Inferred or Actual) Watercourse Crossings, Associated Habitat and Species Presence

A total of 25 fish species are known to occur in the Athabasca River drainage (see Table 3-7). According to known fish species distributions, brown trout, yellow perch and finescale dace are present in the Athabasca River drainage. However, none of these species were identified in site surveys or in stream-specific historic information in any of the watercourses crossed by the pipeline RoW (see Table 3-14). Northern pike, Arctic grayling, burbot and rainbow trout were the only four sportfish species captured during surveys in the Athabasca River drainage between 2005 and 2009. Longnose sucker and white sucker captured in the Paddle River watershed were the only coarse fish captured in the Athabasca River drainage during these years. A variety of forage fish species were captured in all three watersheds including lake chub, brook stickleback, flathead chub, pearl dace, troutperch, longnose dace and northern redbelly dace. Site-specific watercourse crossing information is provided in Appendix B.

Table 3-14 Fish Species (Historic and Captured) by Watercourse, Athabasca River Drainage, Alberta

Watercourse	Sport Fish	Coarse Fish	Forage Fish
Pembina River Watershed			
Tributaries to Tamarack Lake		No historic or captured information	
Tributaries to Majeau Lake	No historic or captured information	No historic or captured information	**Captured:** no information **Historic:** brook stickleback
Tributaries to Oldman Lake	No historic or captured information	No historic or captured information	**Captured:** book stickleback **Historic:** brook stickleback
Coyote Creek and tributary	No historic or captured information	**Captured:** no information **Historic:** white sucker	**Captured:** no information **Historic:** brook stickleback
Tributaries to Pembina River (KP 115.897 – KP 128.750)	No historic or captured information	**Captured:** no information **Historic:** white sucker	**Captured:** no information **Historic:** brook stickleback, fathead minnow, lake chub
Tributaries to Kelly Lake	No historic or captured information		
Pembina River and tributaries (KP 131.592 – KP 134.940)	**Captured:** no information **Historic:** bull trout, mountain whitefish, brook trout, Arctic grayling, rainbow trout, northern pike, walleye, goldeye, burbot	**Captured:** no information **Historic:** longnose sucker, white sucker	**Captured:** flathead chub, unidentified cyprinids **Historic:** lake chub, flathead chub, longnose dace, spoonhead sculpin, troutperch
Paddle River Watershed			
Paddle River and tributaries	**Captured:** burbot, northern pike **Historic:** walleye, burbot, northern pike, goldeye, Arctic grayling	**Captured:** longnose sucker, white sucker **Historic:** longnose sucker, white sucker	**Captured:** lake chub **Historic:** pearl dace, lake chub, troutperch, longnose dace
Little Paddle River and tributaries	No historic or captured information	**Captured:** longnose sucker, white sucker **Historic:** longnose sucker, white sucker	**Captured:** brook stickleback, lake chub **Historic:** longnose dace, lake chub, brook stickleback

Table 3-14 Fish Species (Historic and Captured) by Watercourse, Athabasca River Drainage, Alberta (cont'd)

Watercourse	Sport Fish	Coarse Fish	Forage Fish
Paddle River Watershed (cont'd)			
Tributaries to Bull Creek	No historic or captured information	**Captured:** white sucker **Historic:** longnose sucker	**Captured:** brook stickleback, lake chub **Historic:** lake chub
Athabasca River Watershed			
Mink Creek	**Captured:** rainbow trout	No historic or captured information	**Captured:** no information **Historic:** lake chub
Tributaries to Mink Creek		No historic or captured information	
Tributaries to Athabasca River (KP 184.925 – KP 193.333)	**Captured:** northern pike **Historic:** northern pike, burbot	**Captured:** no information **Historic:** white sucker	**Captured:** no information **Historic:** lake chub, fathead minnow, brook stickleback
Athabasca River and tributaries (KP 187.349 – KP 197.288)	**Captured:** northern pike **Historic:** mountain whitefish, walleye, northern pike, rainbow trout, burbot, goldeye, bull trout, Arctic grayling	**Captured:** no information **Historic:** longnose sucker, white sucker	**Captured:** brook stickleback, longnose dace, northern redbelly dace **Historic:** brook stickleback, emerald shiner, lake chub, longnose dace, pearl dace, spoonhead sculpin, spottail shiner, troutperch
Sakwatamau River and tributaries	**Captured:** no information **Historic:** Arctic grayling, burbot, mountain whitefish, northern pike, walleye, rainbow trout	**Captured:** no information **Historic:** white sucker, longnose sucker	**Captured:** lake chub, longnose dace, troutperch **Historic:** lake chub, longnose dace, spoonhead sculpin, troutperch
Chickadee Creek and tributaries	**Captured:** Arctic grayling **Historic:** rainbow trout, Arctic grayling, mountain whitefish	**Captured:** white sucker **Historic:** white sucker, longnose sucker	**Captured:** lake chub **Historic:** longnose dace, lake chub, pearl dace
Tributaries to Athabasca River (KP 222.329 – KP 233.694)	No historic or captured information		

Table 3-14 Fish Species (Historic and Captured) by Watercourse, Athabasca River Drainage, Alberta (cont'd)

Watercourse	Sport Fish	Coarse Fish	Forage Fish
Athabasca River Watershed (cont'd)			
Two Creek and tributaries	**Captured:** no information **Historic:** Arctic grayling, rainbow trout, mountain whitefish	**Captured:** no information **Historic:** longnose sucker, white sucker	**Captured:** lake chub, longnose dace, troutperch **Historic:** lake chub, longnose dace, spoonhead sculpin, troutperch
Tributaries to Pass Creek	No historic or captured information		
SOURCES: FWMIS (ASRD 2009, Internet site); Nelson and Paetz 1992; Scott and Crossman 1998.			

The Pembina River watershed includes Majeau Lake, Oldman Lake, Coyote Creek and the Pembina River. Majeau Lake is known to contain northern pike, walleye and yellow perch and has a moderate recreational value (Hildebrant 2005, pers. comm.). Fish-bearing tributaries of the Pembina River support only coarse and forage fish species. Only the Pembina River mainstem supports sportfish species including northern pike, walleye, bull trout, mountain whitefish, rainbow trout, brook trout and burbot. The Pembina River (KP 131.592) between Highway 16 and Highway 43 has a high recreational value, primarily for walleye and secondarily for northern pike and mountain whitefish (Wallace and McCart 1984; Hildebrant 2005, pers. comm.).

In the Paddle River watershed, only the Paddle River mainstem (KP 138.195) and the Little Paddle River mainstem (KP 163.975) support populations of sport fish. These populations include northern pike, burbot and Arctic grayling. The Paddle and Little Paddle rivers have low to moderate recreational value for northern pike, walleye and yellow perch (Wallace and McCart 1984; Hildebrant 2005, pers. comm.) Tributaries to these two rivers only support populations of coarse and forage fish. However, habitat suitable for sport fish exists in an unsurveyed tributary crossing at KP 163.686. This tributary flows into the Little Paddle River approximately 75 m downstream (within the ZOI) from the RoW. This tributary may be used by northern pike, walleye or rainbow trout as well as by forage and coarse fish species.

Only native strains of rainbow trout are provincially listed (ANHIC 2008c, Internet site) in the Athabasca River watershed; stocked rainbow trout populations are not considered a conservation management priority. Endemic Athabasca-strain rainbow trout may occur within the Athabasca River mainstem as far downstream as the confluence of the Freeman River and have also been recorded within Sakwatamau River, Chickadee Creek and Two Creeks (Rasmussen and Taylor 2009).

The Athabasca River watershed contains several noteworthy watercourse crossings including the Athabasca and Sakwatamau Rivers and the Mink, Chickadee and Two Creeks. The Athabasca River mainstem (KP 187.349) supports a diverse community of sport fish including northern pike, walleye, rainbow trout, Arctic grayling and bull trout. The Athabasca River also supports a diverse recreational fishery. Near the pipeline crossing, the recreational fish species of concern include Arctic grayling, walleye, northern pike, mountain whitefish, rainbow trout, bull trout, burbot and yellow perch (Wallace and McCart 1984; Hawryluk 2005, pers. comm.). Northern pike were captured in a side channel at the Athabasca River crossing (KP 187.349). Northern pike were also captured from one Athabasca River tributary (KP 185.295) known for its upstream lake spawning habitats.

The Sakwatamau River (KP 200.385) also supports a diverse community of sport fish and is an important recreational fishing location for residents from the Town of Whitecourt. A backwater channel to the Sakwatamau River (KP 200.577) flows into the mainstem approximately 200 m downstream from the pipeline RoW.

Chickadee (KP 218.917) and Two (KP 241.754) Creeks contain populations of sport fish (including rainbow trout) and spawning habitat at the pipeline crossings. Arctic grayling were captured in both the Chikadee Creek mainstem (KP 218.917) and a tributary to Chickadee Creek (KP 215.986). These two creeks also provide readily accessible sport fishing opportunities for the residents of Whitecourt. Rainbow trout spawning was identified at the Mink Creek crossing (KP 181.612) during the 2006 survey.

Overwintering Habitat Surveys

Overwintering habitat surveys were conducted at five crossings in the Athabasca River drainage (Table 3-15). Good quality overwintering habitat is available at two of the surveyed crossings (Athabasca River and Sakwatamau River). These sites have sufficient depth, flow, dissolved oxygen and availability of LWD in the channel to support populations of overwintering fish. Overwintering habitat quality at the remaining crossings was considered poor to moderate due to shallow water depths or lack of water under the ice entirely.

Table 3-15 Athabasca Drainage Overwintering Habitat Survey Results

KP	Watercourse	Pool	Ice Depth (m)	Water Depth (m)	Vel (m/s)	Temp (^{o}C)	DO (mg/L)	DO Sat %	Cond (μS /cm)	Habitat Quality
131.592	Pembina River	1	0.72	0.13	0	0	8.08	55.2	636	Poor
187.349	Athabasca River	2	0.75	NA	NA	0.1	8.4	57.8	471	Good
200.385	Sakwatamau River	1	0.5	0.8	0.1	0.1	10.3	70	457	Good
218.917	Chickadee Creek	1	0.9	NA	NA	NA	NA	NA	NA	Poor
241.754	Two Creek	1	0.35	0.15	0.1	0	13.3	91	442	Poor - Mod

NOTES:
NA – not available
Vel – velocity
DO – dissolved oxygen
Cond – conductivity

Construction-Timing Constraints (Least-Risk Periods)

Instream construction LRPs vary between watersheds in the Athabasca River drainage based on species presence and associated habitat sensitivities (see Table 3-16). For the majority of Class C streams in the Athabasca River drainage, the LRP is six to eight weeks (July 1 to August 31 or July 16 to August 31). However, in the Paddle River mainstem and its tributaries, the LRP is nine and a half months (July 1 to April 15) under conditions established by AENV (2001).

Instream construction timing is highly restricted at the Sakwatamau River west throughout the Athabasca River watershed (KP 200.385 to KP 254.847) because of the presence of spring (i.e., northern pike, walleye and Arctic grayling) and fall (i.e., bull trout) spawning species and the presence of sensitive sportfish habitat in the downstream ZOI.

Table 3-16 Least-Risk Period for Instream Construction, Athabasca River Drainage, Alberta

Watercourse	CS[1] Species	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		Least-Risk Period
Tributaries to Tamarack Lake	NRPK WALL																									July 1–Apr 15
Tributaries to Majeau Lake																										July 1–Apr 15
Tributaries to Oldman Lake																										July 1–Apr 15
Coyote Creek and tributary																										July 1–Apr 15
Tributaries to Pembina River (KP 115.897 – KP 128.750)																										July 1–Apr 15
Tributaries to Kelly Lake																										July 1–Apr 15
Pembina River and tributaries (KP 131.592– KP 134.940)	NRPK MNWH BLTR WALL ARGR																									July 1–Aug 31
Paddle River and tributaries	NRPK WALL																									July 1–Apr 15
Little Paddle River and tributaries	NRPK																									July 1–Apr 15
Tributaries to Bull Creek																										July 1–Apr 15

Table 3-16 Least-Risk Period for Instream Construction, Athabasca River Drainage, Alberta (cont'd)

Watercourse	CS[1] Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Least-Risk Period
Mink Creek	NRPK MNWH BLTR WALL ARGR													Jul 1–Aug 31
Tributaries to Mink Creek	NRPK													Jul 1–Apr 15
Tributaries to Athabasca River (KP 184.925 – KP 193.333)														Jul 1–Apr 15
Athabasca River and tributaries (KP 187.349– KP 197.288)	NRPK MNWH BLTR WALL ARGR													Jul 1–Aug 31
Sakwatamau River and tributaries	ARGR MNWH RNTR													Jul 16–Aug 31
Chickadee Creek and tributaries														Jul 16–Aug 31
Tributaries to Athabasca River (KP 222.329 – KP 233.694)														Jul 16–Aug 31

Table 3-16 Least-Risk Period for Instream Construction, Athabasca River Drainage, Alberta (cont'd)

Watercourse	CS[1] Species	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		Least-Risk Period
Two Creek and tributaries	ARGR MNWH																									Jul 16–Aug 31
Tributaries to Pass Creek	RNTR (cont'd)																									Jul 16–Aug 31

NOTES:
Grey bars indicate restricted work periods; no bars indicate instream work periods
[1] Construction Sensitive Species: NRPK – northern pike; WALL – walleye; MNWH – mountain whitefish; RNTR – rainbow tour; BLTR – bull trout; BURB – burbot

3.4.3 Peace River Drainage, Alberta

The Peace River originates west of the continental divide in the Omineca and Cassiar Mountain ranges of northeast British Columbia. It is 1,923 km long and drains an area of about 302,500 km^2. The Peace River flows east through the Rocky Mountains and boreal plains of northern Alberta downstream from the W.A.C. Bennett Dam in British Columbia. From northern Alberta, the Peace River flows east to northeast before discharging into the Slave River, downstream from Lake Athabasca. Major watersheds in the Alberta portion of the Peace River drainage include the Little Smoky, Simonette, Smoky and Wapiti Rivers (see Table 3-17).

Elevations in the Peace River drainage range from 3,024 m at Mount Ulysses in the Rocky Mountains to about 300 m at the confluence with the Slave River. Lake Williston, formed by the W.A.C. Bennett Dam, and Dinosaur Lake, formed by the Peace Canyon Dam in British Columbia, are the only major reservoirs in the Peace River system. Both are operated by BC Hydro. The Dunvegan Dam is currently being constructed by Glacier Power Corp near the town of Peace River, Alberta. This dam is a low-head (<10 m) run-of-river facility.

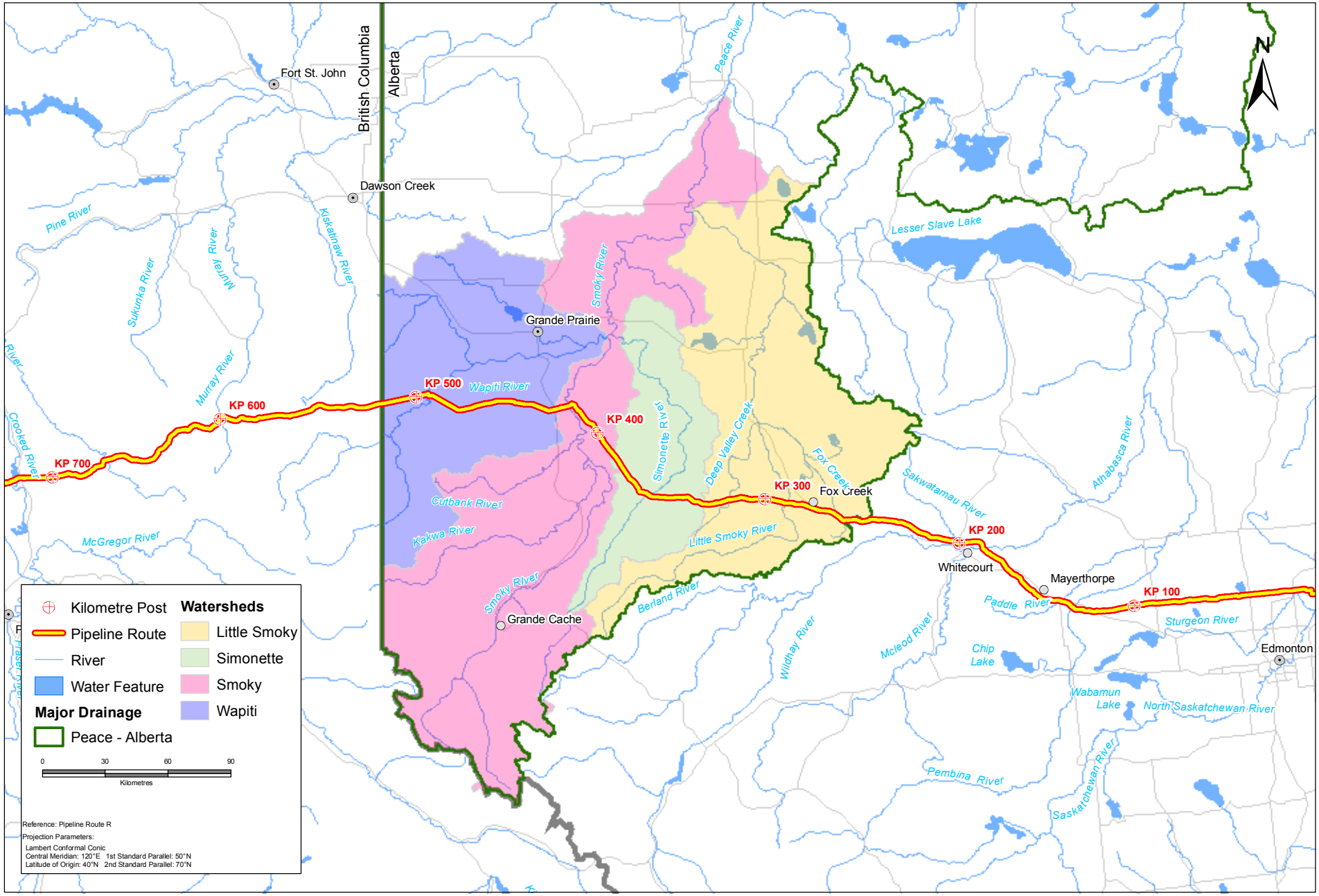
The portion of the RoW in the Peace River drainage crosses Foothills terrain associated with forested sections separated by low-gradient watercourses in the Little Smoky, Simonette, Smoky and Wapiti River valleys (Paetz 1984). The climatic region is characterized as a transitional zone between Foothills and Boreal Forest conditions. Mixed forests of aspen, white spruce, black spruce and birch are found throughout the drainage. Most of the land use in this drainage is dedicated to logging and oil and gas lease developments.

A total of 125 watercourse crossings were identified in the Peace River drainage in Alberta between KP 257.2 and KP 516.8 (see Figure 3-3 and Table 3-17). The drainage consists of four watersheds, the Little Smoky River watershed (KP 257.2 to KP 333.5), the Simonette River watershed (KP 333.5 to 388.2), the Smoky River watershed (KP 388.2 to KP 428.2) and the Wapiti River watershed (KP 428.2 to KP 516.8).

Table 3-17 Stream Class Summary, Peace River Drainage, Alberta

Watershed	KP Range	AB Stream Class[1]				Surveyed (2005–2009)	Un-surveyed[2]	Total Sites
		A	B	C	D			
Little Smoky River	257.2 – 333.5	0	11	31	0	40	2	42
Simonette River	333.5 – 388.2	0	0	26	0	22	4	26
Smoky River	388.2 – 428.2	0	0	29	0	16	13	29
Wapiti River	428.2 – 516.8	0	0	28	0	19	9	28
Totals		0	11	114	0	97	28	125

NOTES:
[1] Source: AENV 2001
[2] Unsurveyed as of October 2009



CONTRACTOR: AMEC Earth & Environmental

PREPARED BY: gem

PREPARED FOR: ENBRIDGE NORTHERN GATEWAY PIPELINES

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Overview Map of the Peace River Alberta Drainage

FIGURE NUMBER:	DATE:
3-3	20090527
SCALE: 1:2,500,000	AUTHOR: EO
APPROVED BY: TS	
PROJECTION: LCC	DATUM: NAD 83

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Table 3-18 Fish-Bearing Status of Crossings by Watershed in the Peace River Drainage, Alberta

Watershed	KP Range	Fish Bearing	Non-Fish Bearing		Unsurveyed – Defaulted Fish-Bearing
			NVC	NCD	
Little Smoky River	257.2 – 333.5	25	13	2	2
Simonette River	333.5 – 388.2	20	1	1	4
Smoky River	388.2 – 428.2	14	1	1	13
Wapiti River	428.2 – 516.8	16	3	0	9
Totals		75	18	4	28

NOTES:
NVC – no visible channel
NCD – non-classified drainage

Of the 125 identified watercourse crossings, 114 are Class C and 11 are Class B (see Table 3-17). All of the Class B watercourse crossings are located in the Little Smoky River watershed. Surveys were completed at 97 sites between 2005 and 2009. Watercourse crossing density is 0.40 watercourse crossings per kilometre of pipeline (excluding NVCs and NCDs).

Of the 125 identified watercourse crossings, 75 sites are fish-bearing and 22 sites are non-fish-bearing (see Table 3-18). The remaining 28 unsurveyed sites were classified as fish-bearing by default. Watercourses in the Peace River drainage are typically fish-bearing and for this reason most of the crossings are in or adjacent to broadly distributed fish habitats (Paetz 1984). The results of the 2005 - 2009 field programs and a review of historical data indicate that many of the watercourses in the Peace River drainage contain forage fish year-round and provide seasonal habitat for other fish species.

Fish-Bearing (Inferred or Actual) Watercourse Crossings, Associated Habitat and Species Presence

A total of 26 fish species are known to occur in the Alberta portion of the Peace River drainage (see Table 3-7). According to known fish species distributions, brook trout, yellow perch, emerald shiner and spottail shiner are present in the Peace River drainage (see Table 3-7). However, none were identified in any of the watercourses surveyed or stream-specific historic information (see Table 3-19). Mountain whitefish were captured in the Little Smoky River (KP 291.040) and bull trout and burbot were captured in Pinto Creek (KP 473.403) in the Wapiti River watershed. Coarse and forage fish species were also captured in at various sites in the watershed.

Table 3-19 Fish Species (Historic and Captured) by Watercourse, Peace River Drainage, Alberta

Watercourse	Sport Fish	Coarse Fish	Forage Fish
Little Smoky Watershed			
Iosegun River	**Captured:** no information **Historic:** Arctic grayling, burbot	**Captured:** white sucker, longnose sucker **Historic:** white sucker	**Captured:** finescale dace, lake chub, troutperch **Historic:** lake chub, slimy sculpin
Tributaries to Iosegun Lake	No historic or captured information	**Historic:** white sucker	**Historic:** lake chub
Little Smoky River and tributaries	**Captured:** mountain whitefish **Historic:** Arctic grayling, bull trout, burbot, mountain whitefish, northern pike, walleye, rainbow trout	**Captured:** white sucker **Historic:** longnose sucker, white sucker	**Captured:** spoonhead sculpin, troutperch, brook stickleback **Historic:** longnose dace, pearl dace, redside shiner, slimy sculpin, troutperch
Tributaries to Crooked Lake	No historic or captured information		
Waskahigan River and tributaries	**Captured:** no information **Historic:** Arctic grayling, mountain whitefish	**Captured:** no information **Historic:** white sucker, longnose sucker	**Captured:** longnose dace, lake chub, redside shiner **Historic:** lake chub, longnose dace, pearl dace, slimy sculpin
Simonette River Watershed			
Deep Valley Creek and tributaries	**Captured:** no information **Historic:** Arctic grayling, northern pike, mountain whitefish, bull trout, burbot	**Captured:** longnose sucker **Historic:** longnose sucker, white sucker	**Captured:** brook stickleback, longnose dace, pearl dace, slimy sculpin, lake chub **Historic:** lake chub, slimy sculpin, longnose dace, pearl dace, redside shiner, spoonhead sculpin

Table 3-19 Fish Species (Historic and Captured) by Watercourse, Peace River Drainage, Alberta (cont'd)

Watercourse	Sport Fish	Coarse Fish	Forage Fish
Simonette River Watershed (cont'd)			
Simonette River and tributaries	**Captured:** no information **Historic:** walleye, burbot, Arctic grayling, mountain whitefish, bull trout	**Captured:** no information **Historic:** longnose sucker, white sucker	**Captured:** flathead chub, longnose dace, slimy sculpin **Historic:** lake chub, longnose dace, redside shiner, slimy sculpin, flathead chub, pearl dace, spoonhead sculpin, troutperch, finescale dace, northern redbelly dace
Latornell River and tributaries	**Captured:** no information **Historic:** burbot, Arctic grayling, northern pike, mountain whitefish, bull trout	**Captured:** longnose sucker, white sucker **Historic:** longnose sucker, white sucker	**Captured:** lake chub, longnose dace, pearl dace, redside shiner, slimy sculpin, troutperch **Historic:** troutperch, longnose dace, redside shiner, pearl dace, flathead chub, slimy sculpin, spoonhead sculpin, finescale dace, northern pikeminnow, lake chub
Tributaries to Moose River	No historic or captured information		
Smoky River Watershed			
Smoky River and tributaries	**Captured:** no information **Historic:** northern pike, walleye, bull trout, rainbow trout, Arctic grayling and burbot	**Captured:** no information **Historic:** white sucker	**Captured:** lake chub **Historic:** lake chub, pearl dace

Table 3-19 Fish Species (Historic and Captured) by Watercourse, Peace River Drainage, Alberta (cont'd)

Watercourse	Sport Fish	Coarse Fish	Forage Fish
Wapiti River Watershed			
Gold Creek and tributary	No historic or captured information	**Captured:** no information **Historic:** longnose sucker, white sucker	**Captured:** no information **Historic:** troutperch, lake chub, longnose dace, redside shiner, brook stickleback, pearl dace
Big Mountain Creek and tributaries	**Captured:** no information **Historic:** Arctic grayling	**Captured:** no information **Historic:** white sucker	**Captured:** no information **Historic:** finescale dace, lake chub, longnose dace, redside shiner, fathead minnow, pearl dace
Bald Mountain Creek and tributaries	No historic or captured information	No historic or captured information	**Captured:** brook stickleback, lake chub, troutperch
Wilson Creek South	No historic or captured information	**Captured:** no information **Historic:** white sucker	**Captured:** no information **Historic:** lake chub, brook stickleback, northern redbelly dace, redside shiner, finescale dace, troutperch
Tributaries to Stony Creek	No historic or captured information	**Captured:** no information **Historic:** longnose sucker	**Captured:** no information **Historic:** brook stickleback
Pinto Creek and tributaries	**Captured:** bull trout, burbot **Historic:** Arctic grayling, bull trout, mountain whitefish	**Captured:** longnose sucker, white sucker **Historic:** longnose sucker, white sucker	**Captured:** lake chub, longnose dace, pearl dace, redside shiner, spoonhead sculpin, troutperch **Historic:** lake chub, longnose dace, redside shiner, slimy sculpin

Table 3-19 Fish Species (Historic and Captured) by Watercourse, Peace River Drainage, Alberta (cont'd)

Watercourse	Sport Fish	Coarse Fish	Forage Fish
Wapiti River Watershed (cont'd)			
Wapiti River and tributaries	**Captured:** no information **Historic:** Arctic grayling, bull trout, mountain whitefish, northern pike, walleye, burbot	**Captured:** no information **Historic:** white sucker, longnose sucker, largescale sucker	**Captured:** no information **Historic:** redside shiner, longnose dace
Calahoo Creek and tributaries	**Captured:** no information **Historic:** Arctic grayling	**Captured:** longnose sucker **Historic:** white sucker, longnose sucker	**Captured:** lake chub **Historic:** lake chub, pearl dace
SOURCES: FWMIS (ASRD 2009, Internet site); Nelson and Paetz 1992; Scott and Crossman 1998.			

In the Little Smoky watershed, (KP 257.967 to KP 332.299), the pipeline route crosses 25 fish-bearing watercourses including the Little Smoky River (KP 291.040) and the Waskahigan River (KP 318.183). Both of these rivers are known to support sport fish including northern pike, walleye, rainbow trout, bull trout and Arctic grayling. Both rivers have a high recreational value because of their productive Arctic grayling fisheries and, to a lesser extent, good walleye, northern pike, mountain whitefish and bull trout fisheries (Paetz 1984; Hawryluk 2005, pers. comm.). Tributaries in the Little Smoky watershed are also known to support seasonal populations of sport fish as well as communities of coarse fish and forage fish species.

The Iosegun River (KP 258.877) supports populations of Arctic grayling, mountain whitefish, northern pike, walleye and burbot. These species make up a recreational fishery of moderate value (Hawryluk 2005, pers. comm.). Bull trout may also be present in the Iosegun River and is a species of recreational and ecological value. A tributary to Iosegun Lake (KP 272.500) contains a spawning population of walleye in the lower reaches and has value as a recreational fishery (Hawryluk 2005, pers. comm.).

There are 11 Class B fish-bearing watercourses between KP 272.084 and KP 281.004. The Class B classification in these tributaries reflects sensitive downstream habitat. Field surveys determined that five of these sites are either NCD or NVC and no fish habitat is present at these crossings. The other six sites were fish-bearing and lake chub and white sucker were captured at one of the sites (KP 272.500).

Twenty fish-bearing watercourse crossings were identified in the Simonette watershed between KP 338.764 and KP 385.816. These include Deep Valley Creek (KP 338.764), the Simonette River (KP 359.976) and the Latornell River (KP 371.876). These watercourses support diverse communities of sport, coarse and forage fish. Sport fish found in the Simonette River watershed include northern pike, walleye, rainbow trout, bull trout and Arctic grayling. Bull trout are also found in the Latornell River (KP 371.876) along with Arctic grayling and mountain whitefish. All three of these species have ecological and recreational value. However, access to these rivers is limited and the game fish populations are moderate in size due to low fishery pressure (Paetz 1984).

The Smoky River watershed contains four known fish-bearing watercourse crossings. The Smoky River mainstem (KP 421.361) supports northern pike, walleye, bull trout, rainbow trout, Arctic grayling and burbot and provides recreational value for these species at the crossing. However, many of the Smoky River's tributaries are relatively unproductive and have poor potential for sport fisheries (Paetz 1984).

The Wapiti watershed contains sixteen known fish-bearing watercourse crossings between KP 431.820 and KP 511.862 including the Wapiti River (KP 493.310) and Big Mountain (KP 435.262), Pinto (KP 473.403) and Calahoo (KP 511.862) Creeks. Of these, the Wapiti River supports the fish community with the largest diversity. This community includes sport fish such as Arctic grayling, bull trout, northern pike and walleye as well as coarse and forage fish species at the crossing location. The other fish-bearing watercourse crossings in the Wapiti River watershed also support populations of sport, coarse and/or forage fish or were inferred as fish-bearing due to the lack of barriers identified within or downstream of the ZOI. Near the Wapiti River pipeline crossing, tributaries to the Wapiti River (KP 431.820 to KP 511.862) offer limited coldwater habitat, scattered populations of warm water sport fish such as northern pike and walleye and few populations of cold-water salmonids such as bull trout and Arctic grayling (Paetz 1984). However, the Wapiti River watershed is considered a regionally important recreational fishery (Paetz 1984).

Overwintering Habitat Surveys

Overwintering habitat surveys were conducted at 17 pipeline crossings in the Peace River drainage in Alberta (Table 3-20). Good to excellent quality overwintering habitat is available at six watercourse crossings. These sites have sufficient depth and flow under the ice to support overwintering fish species, as well as high levels of dissolved oxygen and availability of large woody debris in the channel. Overwintering habitat quality at the remaining crossings ranged between none to moderate based on the lack of pool habitat, absence of flow, shallow water depths and low levels of dissolved oxygen. No overwintering habitat was found at KP 272.084, 272.242, 272.300, or 274.406 where the channel was dry and no ice was present.

Table 3-20 Overwintering Habitat Survey Results, Peace River Drainage, Alberta

KP	Watercourse	Pool	Ice Depth (m)	Water Depth (m)	Vel (m/s)	Temp (^{o}C)	DO (mg/L)	DO Sat %	Cond (μS /cm)	Habitat Quality
272.084	Tributary to Iosegun Lake	NA	NA	NA	NA	NA	NA	NA	NA	None
272.242	Tributary to Iosegun Lake	NA	NA	NA	NA	NA	NA	NA	NA	None
272.300	Tributary to Iosegun Lake	NA	NA	NA	NA	NA	NA	NA	NA	None
272.500	Tributary to Iosegun Lake	1	0.35	0.05	0	0.2	5.4	37.5	147	Poor
272.500	Tributary to Iosegun Lake	2	0.35	0.10	0	0.2	5.4	37.5	147	Poor
274.406	Tributary to Iosegun Lake	1	NA	NA	NA	NA	NA	NA	NA	None
275.081	Tributary to Iosegun Lake	1	0.6	0.5	0	0.1	0.83	6.3	550	Poor
318.183	Waskahigan River	1	0.42	0.38	0	0	13.4	92	365	Good
318.183	Waskahigan River	2	0.05	0.5	0.1	0	13.4	92	365	Exc.
338.764	Deep Valley Creek	1	0.30	0.21	0	0.5	12.22	84.9	376	Mod
340.700	Tributary to Deep Valley Creek	1	0.05	0.27	0.3	0.1	13.25	90.9	546	Mod
340.700	Tributary to Deep Valley Creek	2	0.05	0.28	0.1	0.1	13.25	90.9	546	Good
359.976	Simonette River	NA	NA	NA	0.1	0	11.58	79.2	455	Good
371.876	Latornell River	1	0.32	0.3	0	0	12.99	88.9	615	Good
371.876	Latornell River	2	0.4	0.23	0	0	12.99	88.9	615	Good

Table 3-20 Overwintering Habitat Survey Results, Peace River Drainage, Alberta (cont'd)

KP	Watercourse	Pool	Ice Depth (m)	Water Depth (m)	Vel (m/s)	Temp (°C)	DO (mg/L)	DO Sat %	Cond (µS /cm)	Habitat Quality
395.716	Patterson Creek	1	0.5	0	0	NA	NA	NA	NA	Poor
404.315	Tributary to Smoky River	1	0.4	0	0	NA	NA	NA	NA	Poor
421.361	Smoky River	1	0.6	0.7	0.5	10.8	74.6	1.4	501	Good
421.361	Smoky River	2	0.6	0.6	0.1	10.8	74.6	1.2	501	Good
421.361	Smoky River	3	0.5	0.45	0.1	10.8	74.6	1.2	501	Good
431.820	Gold Creek	1	0.4	0.15	0	0.1	10.2	69.8	756	Poor
435.262	Big Mountain Creek	1	0.45	0.2	0	NA	7.65	52.7	849	Poor
493.310	Wapiti River	2	1.0	0.6	0.8	0.3	NA	NA	374	Good

NOTES:
NA – not available
Exc – excellent
Mod – moderate

Construction-Timing Constraints (Least-Risk Periods)

Instream construction LRPs identified in Table 3-21 are specific to the Peace River drainage based on fish species presence and associated habitat sensitivities (i.e., spawning) within and immediately downstream from the ZOI. Peace River drainage LRPs are established during summer in consideration of the fall spawning period of bull trout and mountain whitefish and their associated winter and early spring egg incubation period. Spring-spawning walleye and northern pike also occur in the Peace River drainage and an instream LRP to protect the spawning and early summer egg incubation periods of these species is also used in watersheds where recreational and/or ecological fisheries values for these species are high.

Instream construction timing is restricted to the second half of July (July 16 to July 31) from KP 305.786 to KP 511.862 (Crooked Lake tributaries to Calahoo Creek and its tributaries) even though these are all Class C watercourses. This LRP occurs because of the presence of spring (walleye and northern pike) and fall (bull trout and mountain whitefish) spawners and habitat sensitivity within the downstream ZOI (see Table 3-21).

The LRP for the Little Smoky River and its tributaries is slightly longer, extending from the beginning of July to the end of August. By comparison, the LRP for the Iosegun River and Iosegun Lake tributaries is nine and one-half months (July 1 to April 15) under conditions established by AENV (2001).

Table 3-21 Least-Risk Periods for Instream Construction, Peace River Drainage, Alberta

Watercourse	CS Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Least-Risk Period
Iosegun River	ARGR													July 1–Apr 15
Tributaries to Iosegun Lake														July 1–Apr 15
Little Smoky River and tributaries	NRPK WALL BLTR ARGR MNWH													July 1–Aug 31
Tributaries to Crooked Lake	BLTR MNWH ARGR													July 16–July 31
Waskahigan River and tributaries														July 16–July 31
Deep Valley Creek and tributaries														July 16–July 31
Simonette River and tributaries														July 16–July 31
Latornell River and tributaries														July 16–July 31
Tributaries to Moose River														July 16–July 31
Smoky River and tributaries														July 16–July 31
Gold Creek and tributary														July 16–July 31
Big Mountain Creek and tributaries														July 16–July 31
Bald Mountain Creek and tributaries														July 16–July 31
Wilson Creek South														July 16–July 31
Tributaries to Stony Creek														July 16–July 31
Pinto Creek and tributaries														July 16–July 31

Table 3-21 Least-Risk Periods for Instream Construction, Peace River Drainage, Alberta (cont'd)

Watercourse	CS Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Least-Risk Period
Wapiti River and tributaries	BLTR MNWH ARGR													July 16–July 31
Calahoo Creek and tributaries														July 16–July 31

NOTES:
Grey bars indicate restricted work periods; no bars indicate instream work periods
[1] Construction Sensitive Species: NRPK – northern pike; WALL – walleye; MNWH – mountain whitefish; RNTR – rainbow trout; BLTR – bull trout; ARGR – Arctic grayling

Table 3-22 Stream Class Summary by Drainage, British Columbia

Drainage	KP Range	Fish Bearing						Non-Fish Bearing				NS[2]	Total Sites
		S1[1]	S2	S3	S4	FSZ	WET	S5	S6	NVC	NCD		
Peace River	516.8 – 730.1	11	15	53	64	7	1	12	86	181	44	51	525
Fraser River	730.1 – 847.1 864.8 – 876.5 882.5 – 886.3 908.6 – 942.8 990.9 – 993.9	3	11	11	23	1	6	0	8	119	31	35	248
Skeena River[3]	847.1 – 864.8 876.5 – 882.5 886.3 – 908.6 942.8 – 990.9 993.9 – 1083.5	3	17	42	55	3	1	2	28	69	18	41	279
KitimatRiver[4]	1083.5 – 1166.5	5	16	24	4	0	1	12	28	21	7	101	219
Douglas Channel[5]	1166.5 – 1172.2	0	0	0	1	0	0	2	6	0	0	11	20
Total		22	59	130	147	11	9	28	156	390	100	239	1,291

NOTES:

[1] BC MoF 1995; S1: channel width greater than 20 m; S2: channel width 5–20 m; S3: channel width 1.5–5 m; S4: channel width less than 1.5 m; FSZ: Fisheries-sensitive zone; WET: Wetland; S5: channel width greater than 3 m; S6 channel width less than 3 m; NCD: Non-Classified Drainage; NVC: No Visible Channel

[2] Unsurveyed as of October 2009

[3] Includes seven sites for which KSL data were incorporated (Applied Aquatic Research Ltd. 2007)

[4] Includes seven sites for which KSL data were incorporated (Applied Aquatic Research Ltd. 2007)

[5] Includes one site for which KLNG data were incorporated (Kitimat LNG Inc. 2005)

3.5 British Columbia Drainages

In British Columbia, the RoW will cross 1,291 watercourses in the Peace, Fraser, Skeena, and Kitimat rivers, and Douglas Channel drainages between KP 516.8 and KP 1,172.2 (see Table 3-22). Of this total, 1,052 sites were surveyed between 2005 and 2009 (see Table 3-23). This includes biophysical data for 15 sites surveyed as part of the KSL Project (Applied Aquatic Research Ltd. 2007) and the Kitimat LNG Project (Kitimat LNG Inc. 2005).

Most (41%) of the watercourse crossings in British Columbia are in the Peace River drainage followed by the Skeena River (22%) and Fraser River (19%) drainages. Each major drainage has 2 to 3 large river crossings (S1; more than 20 m channel width) and 10 to 14 medium-size river crossings (S2; 5 to 20 m channel width). Of the 1,052 watercourse crossings surveyed, most (37%) are classified as no visible channel (NVC). Fish-bearing watercourse crossings (S1-S4, FSZ and wetland [WET]) comprised 36% of all crossings surveyed, while non-fish-bearing crossings (S5, S6, NVC and NCD) comprised 64% of all watercourse crossings surveyed.

The mean watercourse crossing density in British Columbia is 1.2 watercourse crossings per kilometre of pipeline (excluding NVCs and NCDs). This watercourse crossing density is over two times greater than in Alberta which has only 0.38 crossings per kilometre of pipeline. In west-central British Columbia, the pipeline route repeatedly crosses the watershed divide between the Fraser River and Skeena River drainages and alternates between the Francois Lake (Fraser) and Babine Lake (Skeena) watersheds. There are 20 sport fish species, 4 coarse fish species and 18 forage fish species present in British Columbia along the pipeline RoW (see Table 3-23). Rainbow trout, which are common to all drainages along the RoW in British Columbia, were captured in all four drainages in surveys conducted between 2005 and 2009. Bull trout, which are also common to all four drainages, were captured only in the Peace, Skeena and Kitimat river drainages. Chinook, chum and pink salmon were only captured in the Kitimat River drainage, while coho salmon were captured in both the Skeena and Kitimat River drainages. Dolly Varden and cutthroat trout were also captured in both the Skeena and Kitimat River drainages. Mountain whitefish were captured in the Peace and Fraser drainages. Arctic grayling, brook trout and burbot were only captured in the Peace River drainage. Longnose sucker and white sucker were the only coarse fish species captured. Only eight forage fish species were captured between 2005 and 2009.

Table 3-23 Fish Species (Historic and Captured 2005–2009) by Drainage, British Columbia

Species	Drainage			
	Peace	Fraser	Skeena	Kitimat
Sport Fish				
Arctic grayling	H, C			
Brook trout	H, C			
Bull trout	H, C	H	H, C	H, C
Burbot	H, C	H	H	
Chinook salmon		H	H	H, C
Chum salmon			H	H, C

Table 3-23 Fish Species (Historic and Captured 2005–2009) by Drainage, British Columbia (cont'd)

Species	Drainage			
	Peace	Fraser	Skeena	Kitimat
Sport Fish (cont'd)				
Coho salmon		H	H, C	H, C
Cutthroat trout			H, C	H, C
Dolly Varden		H	H, C	H, C
Kokanee		H	H	H
Lake trout	H	H	H	
Lake whitefish	H			
Mountain whitefish	H, C	H, C	H	
Northern pike	H			
Pink salmon		H	H	H, C
Pygmy whitefish	H		H	
Rainbow trout	H, C	H, C	H, C	H, C
Sockeye salmon		H	H	H
Steelhead			H	H
White sturgeon		H		
Coarse Fish				
Bridgelip sucker		H		
Largescale sucker	H	H	H	
Longnose sucker	H, C	H	H	
White sucker	H, C	H	H	
Forage Fish				
Brassy minnow	C	H		
Brook stickleback	H, C			
Coastrange sculpin			H	H
Finescale dace	H			
Lake chub	H, C	H	H	
Leopard dace		H	H	
Longnose dace	H	H, C	H, C	
Northern redbelly dace	H			
Northern pikeminnow	H, C	H	H	
Pacific lamprey			H	H, C
Pearl dace	H			
Peamouth	H	H	H	

Table 3-23 Fish Species (Historic and Captured 2005–2009) by Drainage, British Columbia (cont'd)

Species	Drainage			
	Peace	Fraser	Skeena	Kitimat
Forage Fish (cont'd)				
Prickly sculpin	H, C	H	H	H, C
Redside shiner	H	H, C	H	
Slimy sculpin	H, C	H, C		
Threespine stickeback			H	H, C
Troutperch	H			

NOTES:
C – Captured during 2005–2009 field surveys
H – Historical data. Source: FISS (BC MoE 2009a, Internet site); McPhail 2007; Scott and Crossman 1998.

3.5.1 Peace River Drainage, British Columbia

The Peace River originates west of the continental divide in the Omineca and Cassiar mountain ranges of northeast British Columbia. Major headwater tributary rivers of the Peace River in British Columbia include the Parsnip, Finlay, Nation, Omineca, Mesilinka and Ingenika Rivers. The Peace River is dammed by the W.A.C. Bennett Dam, which forms Williston Lake, and by the Peace Canyon Dam, which forms Dinosaur Lake. Downstream of these dams the Peace River flows east into Alberta where it eventually discharges into the Slave River downstream from Lake Athabasca.

This portion of the pipeline route crosses rugged terrain associated with the Rocky Mountains, Rocky Mountain Foothills, Hart and Misinchinka Ranges. The western section of the pipeline route in the Peace River drainage crosses the Parsnip River (KP 670.961) in the Rocky Mountain Trench and ascends the McGregor and Interior plateaus. Most of the land in this drainage is undeveloped. However, some land has been used for mining, forestry, and oil and gas exploration and distribution.

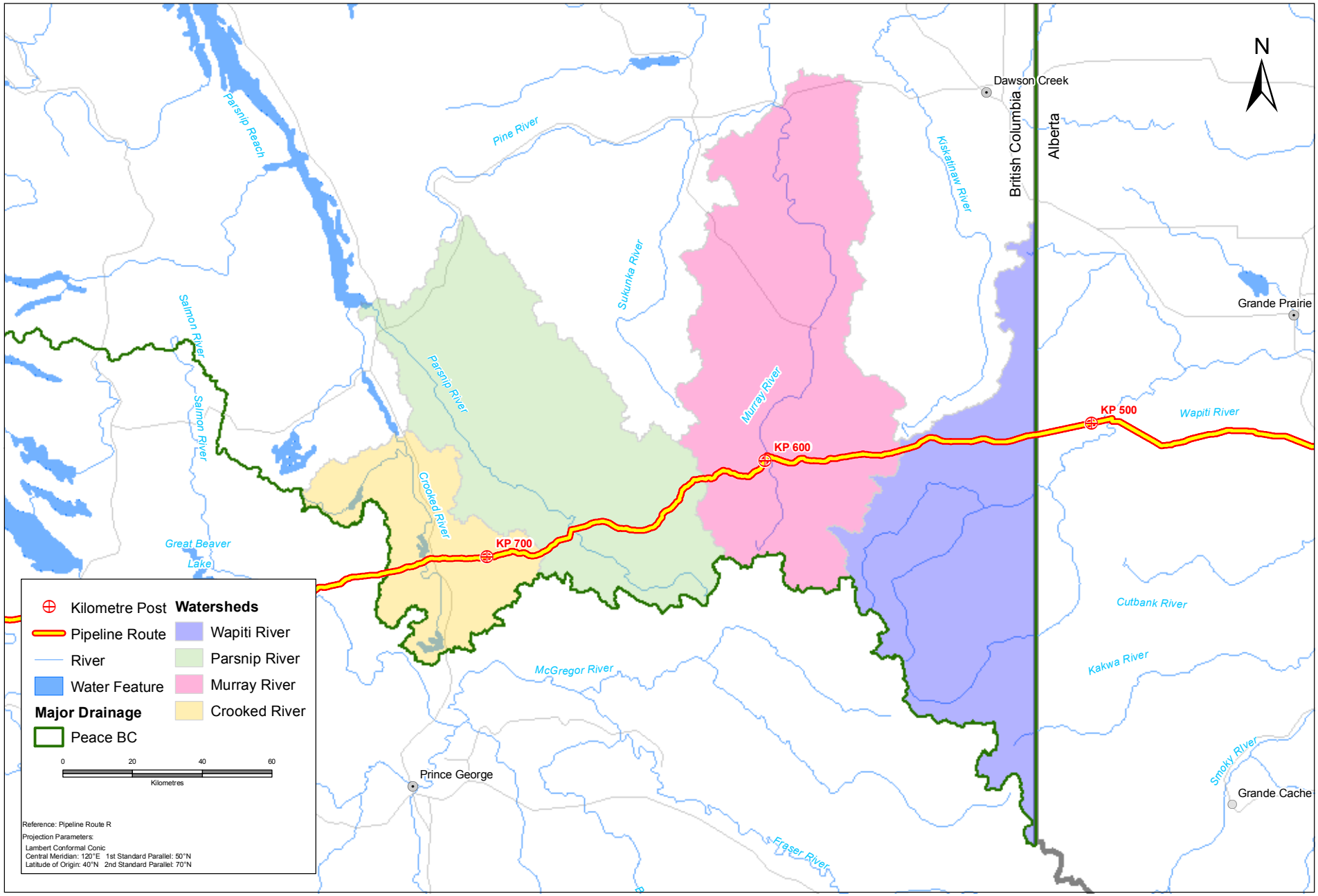
A total of 525 watercourse crossings were identified in the Peace River drainage between KP 516.8 and KP 730.1 (see Table 3-24 and Figure 3-4). The pipeline RoW crosses four watersheds of the Peace River in British Columbia: the Wapiti River watershed (KP 516.8 to KP 557.4); the Murray River watershed (KP 557.4 to KP 623.5); the Parsnip River watershed (KP 623.5 to KP 682.1); and the Crooked River watershed (KP 682.1 to KP 730.1).

Of the sites surveyed, 151 were identified as fish-bearing while 323 sites were identified as non-fish-bearing. Watercourse crossing density in the Peace River (British Columbia) drainage is 1.4 watercourse crossings per kilometre of pipeline (excluding NVCs and NCDs).

Table 3-24 Stream Class Summary, Peace River Drainage, British Columbia

Watershed	KP Range	Fish Bearing						Non-Fish Bearing				NS[2]	Total Sites
		S1[1]	S2	S3	S4	FSZ	WET	S5	S6	NVC	NCD		
Wapiti River	516.8 – 557.4	0	3	9	1	1	0	0	2	14	5	4	39
Murray River	557.4 – 623.5	8	8	12	21	5	0	7	31	93	24	10	219
Parsnip River	623.5 – 682.1	3	1	25	15	1	0	5	49	22	10	33	164
Crooked River	682.1 – 730.1	0	3	7	27	0	1	0	4	52	5	4	103
Total		11	15	53	64	7	1	12	86	181	44	51	525

NOTES:
[1] BC MoF 1995 S1: channel width greater than 20 m; S2: channel width 5–20 m; S3: channel width 1.5–5 m; S4: channel width less than 1.5 m; FSZ: Fisheries-sensitive zone; WET: Wetland; S5: channel width greater than 3 m; S6 channel width less than 3 m; NCD: Non-Classified Drainage; NVC: No Visible Channel
[2] Unsurveyed as of October 2009



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ENBRIDGE NORTHERN GATEWAY PROJECT

Overview Map of the Peace River British Columbia Drainage

FIGURE NUMBER:	DATE:
3-4	20090527
SCALE: 1:1,500,000	AUTHOR: EO / APPROVED BY: TS
PROJECTION: LCC	DATUM: NAD 83

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Most (38%) of the surveyed watercourse crossings within the British Columbia portion of the Peace River drainage are classified as NVC (Table 3-24). Fish-bearing watercourses (S1-S4) comprise approximately 32% of the total surveyed crossings, while non-fish-bearing watercourses (S5, S6, and NVC and NCD) comprise approximately 68% of the total (see Table 3-24). The Parsnip River watershed contains most (39%) of the fish-bearing watercourses in the British Columbia portion of the Peace River drainage crossed by the Project (see Table 3-24).

In the Peace River drainage in British Columbia, S5 and S6 watercourses are small (ephemeral and perennial), generally first or second order streams with steep (greater than 25%) gradients that do not support fish species at any time of year. Most S5 and S6 streams in this drainage are upstream from fish migration barriers. However, both classes of non-fish-bearing streams provide water, nutrients, woody debris and gravel recruitment to downstream fish-bearing reaches. Although the majority of small streams identified in this drainage are non-fish-bearing, their collective discharge contributes to the maintenance, function and integrity of downstream fish-bearing habitats.

Riparian classifications, suspected and known fish species presence, and known fish passage obstructions for each site within the British Columbia portion of the Peace River drainage are provided in Appendix B. Fish passage obstructions are identified because they are key to determining the inferred fish-bearing status of upstream watercourses. Only permanent migration barriers (i.e., waterfalls, cascades and stream gradients greater than 30%) are considered fish passage obstructions. Beaver dams, hanging culverts and log jams were also identified in many watercourses. However, these are considered impediments and not permanent barriers to fish passage because of their temporary nature.

Fish-Bearing (Inferred or Actual) Watercourse Crossings, Associated Habitat and Species Presence

A total of 26 fish species are present in the British Columbia portion of the Peace River drainage (see Table 3-23). According to known fish species distributions, pygmy whitefish and northern red-belly dace are present in the Peace River drainage (see Table 3-23). However, none were identified during surveys of any of the watercourses crossed by the pipeline RoW or in any of the stream-specific historic information (see Table 3-25). Mountain whitefish were captured in the South Redwillow River and were the only sportfish captured in the Wapiti River watershed. Bull trout, Arctic grayling and mountain whitefish were captured in the Murray River watershed. Bull trout and rainbow trout were captured in the Parsnip River watershed. Rainbow trout, burbot, and mountain whitefish were captured in the Crooked River watershed. Longnose sucker and white sucker were the only coarse fish species captured. Seven species of forage fish were also captured.

Within the Wapiti River watershed, the pipeline route crosses Hiding Creek (KP 517.870) and the South Redwillow mainstem (KP 531.909). Fish sampling in Hiding Creek captured brook stickleback, longnose sucker and white sucker. Fish sampling in the South Redwillow River captured mountain whitefish, longnose sucker, lake chub and brook stickleback. The pipeline RoW then parallels the Redwillow River mainstem from approximately KP 548.158 to KP 553.166 (Stony Lake). Fish sampling was conducted in tributaries to the Redwillow River and only white sucker were captured.

Table 3-25 Fish Species (Historic and Captured) by Watercourse, Peace River Drainage, British Columbia

Watercourse	Sport Fish	Coarse Fish	Forage Fish
Wapiti River Watershed			
Hiding Creek and tributaries	No historical or captured information	**Captured:** longnose sucker, white sucker **Historic:** longnose sucker	**Captured:** brook stickleback **Historic:** brook stickleback, finescale dace, longnose dace, pearl dace
South Redwillow River and tributaries	**Captured:** mountain whitefish **Historic:** mountain whitefish	**Captured:** longnose sucker **Historic:** longnose sucker	**Captured:** brook stickleback, lake chub **Historic:** lake chub, troutperch
Tributaries to Redwillow River	No historical or captured information	**Captured:** No information **Historic:** white sucker	No historical or captured information
Tributaries to Stony Lake	No historical or captured information		
Murray River Watershed			
Kinuseo Creek and tributaries	**Captured:** bull trout, Arctic grayling **Historic:** Arctic grayling, bull trout, burbot, mountain whitefish, northern pike	**Captured:** sucker species **Historic:** longnose sucker	**Captured:** sculpin species **Historic:** slimy sculpin
Tributaries to Honeymoon Creek		No historical or captured information	
Quintette Creek	**Captured:** No information **Historical:** bull trout, mountain whitefish	No historical or captured information	**Captured:** sculpin species **Historical:** slimy sculpin
Murray River and tributaries	**Captured:** brook trout **Historic:** Arctic grayling, mountain whitefish, northern pike, bull trout, burbot, rainbow trout	**Captured:** sucker **Historic:** longnose sucker	**Captured:** lake chub, slimy sculpin **Historic:** slimy sculpin, longnose dace, brassy minnow, lake chub
Tributaries to Imperial Creek	No historical or captured information		
Hook Creek	**Captured:** bull trout **Historic:** bull trout, lake trout	No historical or captured information	No historical or captured information

Table 3-25 Fish Species (Historic and Captured) by Watercourse, Peace River Drainage, British Columbia (cont'd)

Watercourse	Sport Fish	Coarse Fish	Forage Fish
Parsnip River Watershed			
Hominka River and tributaries	**Captured:** No information **Historic:** Arctic grayling, bull trout, burbot, rainbow trout, lake whitefish, mountain whitefish	**Captured:** No information **Historic:** largescale sucker, longnose sucker, white sucker	**Captured:** No information **Historic:** peamouth, redside shiner, sculpin
Missinka River and tributaries	**Captured:** bull trout, rainbow trout **Historic:** Arctic grayling, bull trout, rainbow trout	**Captured:** No information **Historic:** largescale sucker	**Captured:** No information **Historic:** slimy sculpin
Parsnip River	**Captured:** No information **Historic:** Arctic grayling, mountain whitefish, burbot, rainbow trout, bull trout, lake whitefish	**Captured:** No information **Historic:** white sucker, longnose sucker, largescale sucker	**Captured:** No information **Historic:** northern pikeminnow, peamouth, longnose dace, prickly sculpin, slimy sculpin, redside shiner
Tributary to Wichcika Creek	**Captured:** rainbow trout	No historical or captured information	No historical or captured information
Crooked River Watershed			
Chuchinka Creek and tributaries	**Captured:** rainbow trout **Historic:** burbot, rainbow trout	**Captured:** No information **Historic:** longnose sucker	**Captured:** No information **Historic:** lake chub
Tributaries to Chuchinka Creek	**Captured:** burbot **Historic:** rainbow trout	No historical or captured information	No historical or captured information
Angusmac Creek and tributaries	**Captured:** No information **Historic:** rainbow trout, burbot, mountain whitefish	**Captured:** No information **Historic:** longnose sucker	**Captured:** No information **Historic:** prickly sculpin, longnose dace, redside shiner, lake chub
Tributaries to Angusmac Creek	No historical or captured information		
Tributary to Killy Lake	No historical or captured information		
Copper Creek and tributaries	No historical or captured information	No historical or captured information	**Captured:** brassy minnow

Table 3-25 Fish Species (Historic and Captured) by Watercourse, Peace River Drainage, British Columbia

Watercourse	Sport Fish	Coarse Fish	Forage Fish
Crooked River Watershed (cont'd)			
Crooked River	**Captured:** rainbow trout **Historic:** rainbow trout, bull trout, lake whitefish, mountain whitefish, burbot	**Captured:** No information **Historic:** longnose sucker, largescale sucker, white sucker	**Captured:** prickly sculpin, northern pikeminnow **Historic:** peamouth, northern pikeminnow, prickly sculpin, lake chub, redside shiner, sculpin
Tributaries to Davie Lake	**Captured:** rainbow trout	No historical or captured information	No historical or captured information
Tributary to Caine Creek	No historical or captured information		
SOURCE: FISS (BC MoE 2009a, Internet site); McPhail 2007; Scott and Crossman 1998.			

The pipeline route will parallel Kinuseo Creek in the Murray River watershed and crosses the Kinuseo Creek mainstem three times at KP 561.459, KP 566.002 and KP 588.131. Kinuseo Creek (S1) supports numerous fish species with various life history strategies (spring and fall spawning) and has an abundance of habitat suitable for spawning, rearing and overwintering upstream and downstream from the crossings. Fish sampling in Kinuseo Creek at KP 588.131 captured juvenile bull trout and Arctic grayling. Adult bull trout were captured in a tributary to Kinuseo Creek (KP 585.022).

The pipeline route wil cross Five Cabin Creek in the Murray River watershed at KP 580.579 (side channel) and KP 580.803 (mainstem). The channel is extensively scoured at the crossing with numerous bank failures, abandoned channels, and evidence of lateral movement and continuous flooding throughout the ZOI.

Brook trout were captured in two tributaries to the Murray River at KP 595.844 and KP 597.078. Brook trout have been introduced into several lakes in the area by the BC MoE and have residualized in some Murray River tributaries. Other researchers have captured brook trout in Murray River tributaries (V.A. Poulin and Associates Ltd. 2006).

Murray River (KP 598.614) supports numerous fish species with various life history strategies and is a valued watercourse for recreational boating and angling. It supports sportfish species such as Arctic grayling, mountain whitefish, northern pike, bull trout, burbot and rainbow trout. Fish sampling completed on the Murray River in August 2009 captured brook trout and slimy sculpin.

Both adult and juvenile bull trout were captured in Hook Creek (KP 602.526). Other fish species common in the Murray River system are also likely to be present in Hook Creek. The pipeline route across Hook Creek was relocated approximately 100 m upstream to an area where the channel is more confined and less susceptible to bank erosion after Route P SWAT analyses were conducted in 2008.

Between KP 603.139 and KP 623.179, the pipeline route will cross 71 tributaries to Imperial Creek. However, only one of these tributaries at the pipeline crossings is fish-bearing (inferred). Imperial Creek along most of this section of pipeline is non-fish-bearing because of impassable falls and a series of velocity barriers (chutes and cascades) 7 km upstream from the Murray River confluence. Most of the crossings are in the upper reaches of these Imperial Creek tributaries and, therefore, do not support any fish species due to upstream migration barriers and limited habitat value (S5 and S6 classification).

Within the Parsnip River watershed, the pipeline route will cross the upper Hominka River at KP 624.080. Although no fish were captured during field surveys (1,850 seconds of effort electrofishing) and numerous falls and canyons are present throughout the upper reaches, this site was classified as fish-bearing because of the presence of high-value spawning, rearing and overwintering habitat and the potential for isolated populations of Arctic grayling and bull trout to exist upstream from these barriers.

The pipeline route will cross the upper Missinka River mainstem at four locations within the Parsnip River watershed (KP 628.274, KP 630.064, KP 641.345 and KP 646.020). This section of the upper Missinka River has numerous canyons and falls and an impassable falls about 2.5 km upstream from KP 641.345. No fish were captured upstream from the falls in the field surveys. Fish sampling conducted for the 1:20,000 fish and fish habitat inventory completed in 1999 also resulted in no fish captured and the Missinka watershed upstream of the barrier has been classified previously as non-fish-bearing by Triton

(1999b). Due to the presence of the falls and no fish captured in both sampling events, this section of the Missinka River was determined to be non-fish-bearing for this assessment as well.

The pipeline route will cross 127 tributaries to Missinka River between KP 627.340 and KP 668.978. Of these tributary crossings, 77 are fish-bearing or are inferred to be fish-bearing based on surveys conducted between 2005 and 2009 or on the historical data. Bull trout were captured in four tributaries to the Missinka River (KP 641.660, KP 643.852, KP 643.963, and KP 650.060). These streams provide spawning and rearing habitat for bull trout. At KP 643.963, the channel morphology at the RoW is braided, with flood signs and evidence of active scouring.

Parsnip River (KP 670.961) supports numerous fish species with various life history strategies and is a valued watercourse for recreational boating and angling. This river supports sportfish species such as Arctic grayling, mountain whitefish, lake whitefish, bull trout, burbot and rainbow trout (Table 3-25). A survey in 2006 captured bull trout, mountain whitefish and suckers.

To the west of Parsnip River (KP 670.961) within the Crooked River Watershed Group, the pipeline route runs parallel to upper Chuchinka Creek from KP 685.671 (Site 601) to KP 697.737 (Site 640). Fourteen tributaries are inferred or known to be fish-bearing along this section. The pipeline route crosses Chuchinka Creek mainstem at KP 703.055 (Site 646). The pipeline route crosses Angusmac Creek (Site 665) at KP 710.421. Angusmac Creek is known to contain rainbow trout, burbot and mountain whitefish.

Crooked River (KP 718.223) supports mountain whitefish, lake whitefish, bull trout, burbot, rainbow trout, three species of sucker and six species of forage fish (Table 3-25). Fish sampling in the Crooked River captured prickly sculpin, northern pikeminnow and rainbow trout.

Overwintering Habitat Surveys

Overwintering habitat surveys were conducted at four crossings in the British Columbia portion of the Peace River drainage (Table 3-26). Good quality overwintering habitat was observed at the Murray and Parsnip River mainstem crossings. Both rivers had sufficient depth in the channel along with appropriate dissolved oxygen levels to support overwintering fish. Both Hiding Creek and the South Redwillow River had poor to moderate habitat quality due to shallow water depths under the ice and low dissolved oxygen levels.

Table 3-26 Overwintering Habitat Survey Results, Peace River Drainage, British Columbia

KP	Watercourse	Pool	Ice Depth (m)	Water Depth (m)	Flow (m/s)	Temp (°C)	DO (mg/L)	DO Sat %	Cond (µS/ cm)	Habitat Quality
517.870	Hiding Creek	1	0.6	0.3	0	0	2.23	NA	579	Poor
517.870	Hiding Creek	2	0.35	0.65	0	0.1	2.23	NA	579	Mod
517.870	Hiding Creek	3	0.4	0.5	0.1	0	2.23	NA	579	Mod
517.870	Hiding Creek	4	0.55	0.02	NA	NA	NA	NA	NA	Poor
531.909	South Redwillow River	1	0.35	0.05	0	0	6.4	NA	223	Poor

Table 3-26 Overwintering Habitat Survey Results, Peace River Drainage, British Columbia (cont'd)

KP	Watercourse	Pool	Ice Depth (m)	Water Depth (m)	Flow (m/s)	Temp (°C)	DO (mg/L)	DO Sat %	Cond (µS/ cm)	Habitat Quality
531.909	South Redwillow River	2	0.5	0.1	0	0	6.4	NA	223	Poor
598.614	Murray River[1]	1	0.03	0.15	0.1	0	13.22	90.5	280	Good
598.614	Murray River	2	0.15	0.2	0.1	0	13.22	90.5	280	Good
670.961	Parsnip River	1	0.5	0.7	0.1	0.8	NA	NA	156	Good
670.961	Parsnip River	2	0.5	1.2	0.3	0.8	NA	NA	156	Good
670.961	Parsnip River	3	0.5	2.3	0.4	0.8	NA	NA	156	Good
670.961	Parsnip River	4	0.5	2.2	0.2	0.8	NA	NA	156	Good

NOTE:
[1] Site was sampled along the river margins due to thin ice over the water.

Construction-Timing Constraints (Least-Risk Periods)

The LRPs for instream construction identified in Table 3-27 are specific to the Peace River drainage, based on fish species presence and their life history habitat requirements (i.e., spawning). Depending on the number of varying life histories of fish species present, the timing and duration of pipeline construction can be severely constrained in the Peace River drainage by overlapping life stage habitat requirements.

Instream construction timing is limited to one month (July 15 to August 15) for all fish-bearing tributaries and mainstem crossings in Kinuseo and Imperial Creeks in the Murray River watershed. This is due primarily to the presence of spring spawning Arctic grayling and fall spawning bull trout at those crossings.

Similarly, timing for instream construction is restricted to a one-month period (July 15 to August 15) in the fish-bearing tributaries and two mainstem crossings in the Missinka River watershed, at the Hominka River mainstem crossing at KP 624.080, and within Chuchinka Creek (KP 682.340 to KP 709.002) in the Parsnip River watershed. This LRP is intended to protect the spring (Arctic grayling, burbot, rainbow trout) and fall (mountain whitefish) spawning fish species known to occur in these rivers.

Within the Angusmac and Crooked River watersheds, (KP 710.421 to KP 712.132 and KP 718.223), instream construction timing is restricted to a one and one-half month period (July 15 to August 31) because of the presence of rainbow trout and mountain whitefish. Instream construction constraints within fish-bearing tributaries to Davie Lake (KP 712.449 to KP 723.264) and Caine Creek (KP 727.628 to KP 729.625) are less restricted (July 15 to April 15) because rainbow trout are the only spring spawning fish species present.

Table 3-27 Least-Risk Periods for Instream Construction, Peace River Drainage, British Columbia

Watercourse	CS[1] Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Least-Risk Period
Hiding Creek and tributaries	BT,GR, BB, MW													July 15 – Aug 15
South Redwillow River and tributaries														July 15 – Aug 15
Tributaries to Redwillow River														July 15 – Aug 15
Tributaries to Stony Lake														July 15 – Aug 15
Kinuseo Creek and tributaries														July 15 – Aug 15
Tributaries to Honeymoon Creek														July 15 – Aug 15
Quintette Creek	BT, MW													June 15 – Aug 15
Murray River and tributaries	NP, BB, BT, GR, MW, RB													July 15 – Aug 15
Tributaries to Imperial Creek	BT, GR													July 15 – Aug 15
Hook Creek														July 15 – Aug 15
Hominka River and tributaries														July 15 – Aug 15
Missinka River and tributaries	BT, GR, RB													July 15 – Aug 15
Parsnip River	BT, GR, MW, BB, RB													July 15 – Aug 15

Table 3-27 Least-Risk Periods for Instream Construction, Peace River Drainage, British Columbia (cont'd)

Watercourse	CS[1] Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Least-Risk Period
Tributary to Wichcika Creek	RB, BT	■	■	■	■	■	■	■		■	■	■	■	July 15 – Aug 15
Chuchinka Creek and tributaries	RB, BB, BT	■	■	■	■	■	■	■		■	■	■	■	July 15 – Aug 15
Tributaries to Chuchinka Creek	RB, MW	■	■	■	■	■	■	■		■	■	■	■	July 15 – Aug 31
Angusmac Creek and tributaries	RB, MW	■	■	■	■	■	■	■		■	■	■	■	July 15 – Aug 31
Tributaries to Angusmac Creek	RB, BT	■	■	■	■	■	■	■		■	■	■	■	July 15 – Aug 15
Tributary to Killy Lake	RB				■	■	■	■						July 15 – Apr 15
Copper Creek and tributaries	RB				■	■	■	■						July 15 – Apr 15
Crooked River	RB, BT, MW, BB	■	■	■	■	■	■	■		■	■	■	■	July 15 – Aug 31
Tributary to Beaver Lake Dam	RB				■	■	■	■						July 15 – Apr 15
Tributary to Caine Creek	RB				■	■	■	■						July 15 – Apr 15

NOTES:
Grey bars indicate restricted work periods; no bars indicate instream work period
[1] Construction Sensitive Species: NP – northern pike; BT – bull trout; GR – Arctic grayling; RB – rainbow trout; MW – mountain whitefish; BB – burbot

SOURCE: BC MWLAP 2004b, Internet site

3.5.2 Fraser River Drainage

The Fraser River is 1,370 km long and drains an area of about 233,100 km^2. Its headwaters are in Mount Robson Provincial Park in the Rocky Mountains near the British Columbia-Alberta border. The upper Fraser River flows west through a broad, mountain-rimmed trench from the British Columbia–Alberta border to Prince George in central British Columbia. From Prince George, the Fraser flows south through the Interior Plateau to Lytton and then through the Fraser Canyon in the Coast Mountains to the lower mainland where it empties into Georgia Strait at the City of Vancouver. Elevations within the Fraser River drainage range from 3,954 m at Mount Robson to sea level at the estuary. Although there are no dams on the Fraser River mainstem, hydro dams occur in the Nechako River (Kenney Dam) and in the Bridge and Seton River watersheds.

Within the Fraser River drainage, the pipeline RoW will be almost entirely within the Nechako (Interior) Plateau, a feature with relatively moderate relief terrain. Unlike the steeper, wetter drainages associated with the pipeline route in coastal areas of British Columbia, the climate within the Fraser River drainage has hotter and drier summers and colder winters. As a result, flows are generally lower during summer and there are more ephemeral tributaries. The primary land uses along the pipeline RoW within the Fraser River drainage include agriculture, ranching and logging.

A total of 248 watercourse crossings will be in the Fraser River drainage between KP 730.1 and KP 993.9 (see Table 3-28 and Figure 3-5). The drainage consists of six watersheds: the Lower Salmon River watershed (KP 730.1 to KP 745.4), Muskeg River watershed (KP 745.4 to KP 756.0), Salmon River watershed (KP 756.0 to KP 795.0), Stuart River watershed (KP 795.0 to KP 823.8), Stuart Lake watershed (KP 823.8 to KP 847.1) and Francois Lake watershed (KP 867.1 to KP 876.5, KP 882.5 to KP 886.3, KP 908.6 to KP 942.8, and KP 990.9 to KP 993.9). From approximately KP 876.5 to KP 993.9 the pipeline route alternates between the Fraser River and Skeena River drainages, specifically between the Francois Lake (Fraser) and Babine Lake (Skeena) watersheds.

Of the 248 watercourse crossings, 213 were surveyed between 2005 and 2009. The remaining 35 sites were unsurveyed as of October 2009. These data will be reported as they become available.

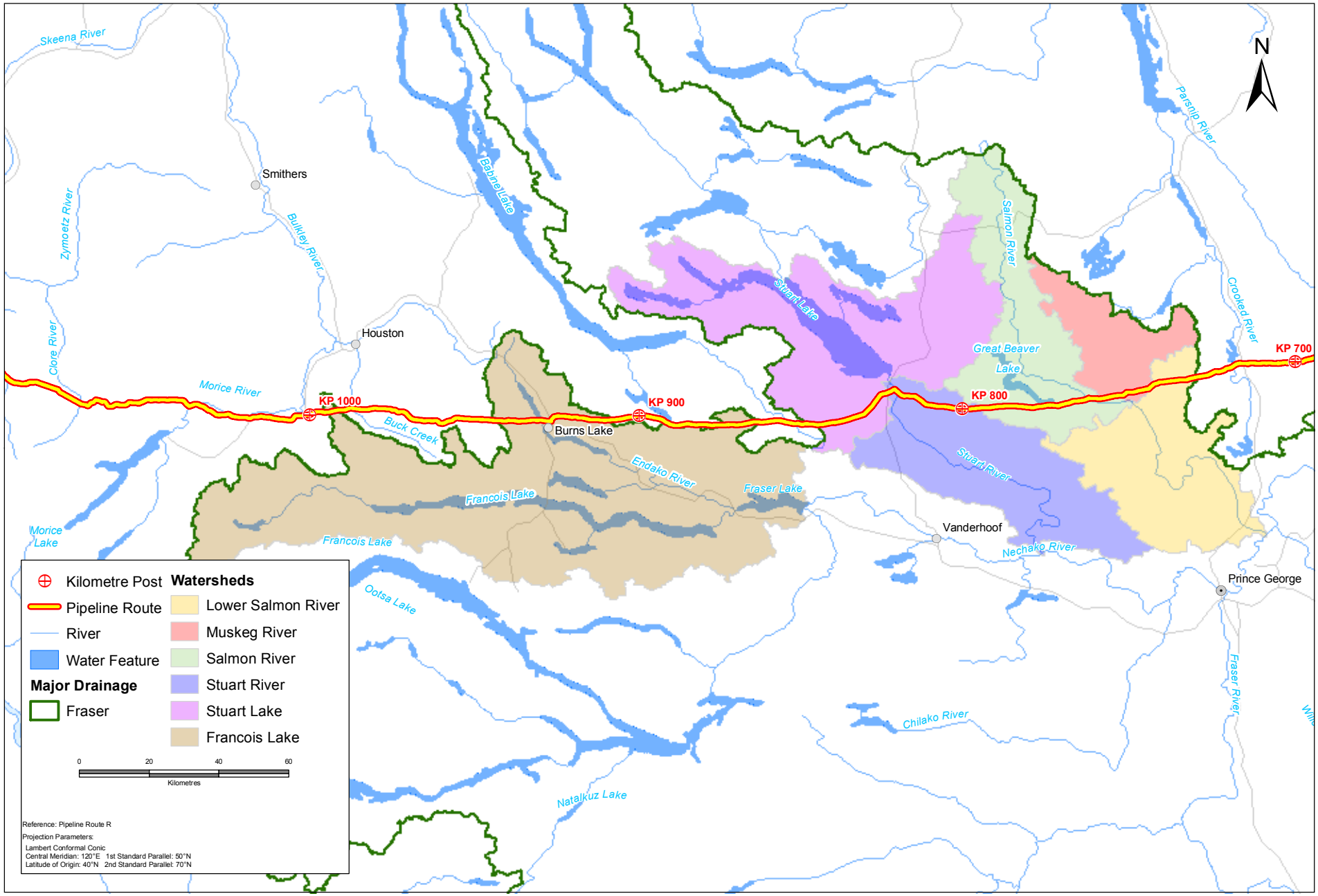
Of the 213 watercourse crossings surveyed, 55 were identified as fish-bearing. The remaining 158 crossings were non-fish-bearing with 119 of those classified as NVC. The Francois Lake watershed contains the most (25%) fish-bearing watercourses crossed by the pipeline route (one S1, three S2, one S3 and nine S4 streams). Watercourse crossing density in the Fraser River drainage is 0.58 watercourse crossings per kilometre of pipeline (excluding NVCs and NCDs).

Non-fish-bearing watercourses in the Fraser River drainage are typically NVC or NCD; few S5 or S6 watercourses exist. This paucity is due to the lower gradient topography and hotter, drier summers and colder winter temperatures in the British Columbia interior. Non-fish-bearing streams in the Fraser River drainage are ephemeral or have minimal flow in summer.

Table 3-28 Stream Class Summary, Fraser River Drainage, British Columbia

Watershed	KP Range	Fish Bearing						Non-Fish Bearing				NS[2]	Total Sites
		S1[1]	S2	S3	S4	FSZ	WET	S5	S6	NVC	NCD		
Lower Salmon River	730.1 – 745.4	0	2	2	5	0	0	0	0	7	4	0	20
Muskeg River	745.4 – 756.0	0	2	1	1	0	1	0	0	12	1	0	18
Salmon River	756.0 – 795.0	1	2	2	3	0	1	0	4	36	7	0	56
Stuart River	795.0 – 823.8	1	1	3	3	1	0	0	1	19	12	18	59
Stuart Lake	823.8 – 847.1	0	1	2	2	0	4	0	1	13	3	0	26
Francois Lake	864.8 – 876.5 882.5 – 886.3 908.6 – 942.8 990.9 – 993.9	1	3	1	9	0	0	0	2	32	4	17	69
Total		3	11	11	23	1	6	0	8	119	31	35	248

NOTES:
[1] BC MoF 1995; S1: channel width greater than 20 m; S2: channel width 5–20 m; S3: channel width 1.5–5 m; S4: channel width less than 1.5 m; FSZ: Fisheries-sensitive zone; WET: Wetland; S5: channel width greater than 3 m; S6 channel width less than 3 m; NCD: Non-Classified Drainage; NVC: No Visible Channel
[2] Unsurveyed as of October 2009



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ENBRIDGE NORTHERN GATEWAY PROJECT

Overview Map of the Fraser River Drainage

FIGURE NUMBER:	DATE:
3-5	20090527
SCALE: 1:1,500,000	AUTHOR: EO / APPROVED BY: TS
PROJECTION: LCC	DATUM: NAD 83

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Table 3-29 Fish Species (Historic and Captured) by Watercourse, Fraser River Drainage, British Columbia

Watercourse	Sport Fish	Coarse Fish	Forage Fish
Lower Salmon Watershed			
Merton Creek and tributaries	**Captured:** rainbow trout **Historic:** burbot, rainbow trout	**Captured:** no information **Historic:** longnose sucker	**Captured:** slimy sculpin, redside shiner **Historic:** prickly sculpin, sculpin species
Tributaries to Slender Lake	No historic or captured information		
Muskeg River Watershed			
Tributaries to Muskeg River	No historic or captured information		
Muskeg River	**Historic:** Chinook salmon, rainbow trout, mountain whitefish, burbot, bull trout (possibly Dolly Varden), kokanee	**Captured:** no information **Historic:** sucker species	**Captured:** no information **Historic:** dace species, brassy minnow, redside shiner, lake chub, northern pikeminnow, sculpin species
Mossvale Creek and tributaries	**Captured:** rainbow trout **Historic:** rainbow trout, burbot	**Captured:** no information	**Captured:** no information **Historic:** northern pikeminnow, redside shiner
Salmon River Watershed			
Tributaries to Salmon River	No historic or captured information		
Salmon River	**Captured:** salmonids (unidentified) **Historic:** chinook salmon, rainbow trout, mountain whitefish, burbot, bull trout (possibly Dolly Varden), kokanee, lake whitefish, pink salmon	**Captured:** no information **Historic:** sucker species, longnose sucker, white sucker, largescale sucker	**Captured:** no information **Historic:** dace species, brassy minnow, northern pikeminnow, redside shiner, sculpin species, prickly sculpin, peamouth, lake chub, longnose dace
Tributaries to Great Beaver Lake	No historic or captured information		

Table 3-29 Fish Species (Historic and Captured) by Watercourse, Fraser River Drainage, British Columbia (cont'd)

Watercourse	Sport Fish	Coarse Fish	Forage Fish
Stuart River Watershed			
Tributaries to Necoslie River	**Captured:** rainbow trout **Historic:** mountain whitefish	No historic or captured information	No historic or captured information
Necoslie River	**Captured:** rainbow trout**,** mountain whitefish **Historic:** mountain whitefish, rainbow trout, bull trout (possibly Dolly Varden), chinook salmon, sockeye salmon, kokanee	**Captured:** sucker species **Historic:** sucker species	**Captured:** longnose dace, redside shiner **Historic:** dace species
Stuart River	**Captured:** no information **Historic:** Chinook salmon, sockeye salmon, kokanee, white sturgeon, burbot, bull trout (possibly Dolly Varden), mountain whitefish, rainbow trout, whitefish, pink salmon, coho salmon	**Captured:** no information **Historic:** bridgelip sucker, largescale sucker, sucker species, longnose sucker	**Captured:** no information **Historic:** longnose dace, northern pikeminnow, lake chub, peamouth, prickly sculpin, redside shiner
Stuart Lake Watershed			
Tributaries to Pitka Creek	No historic or captured information		
Tributaries to Marie Lake	No historic or captured information		
Francois Lake Watershed			
Tributaries to Shovel Creek	No historic or captured information		
Sheraton Creek and tributaries	**Captured:** no information **Historic:** rainbow trout	No historic information	No historic information
Tintagel Creek and tributaries	**Captured:** no information **Historic:** rainbow trout	No historic information	No historic information

Table 3-29 Fish Species (Historic and Captured) by Watercourse, Fraser River Drainage, British Columbia (cont'd)

Watercourse	Sport Fish	Coarse Fish	Forage Fish
Francois Lake Watershed (cont'd)			
Stearns Creek and tributaries	**Captured:** rainbow trout **Historic:** rainbow trout	No historic or captured information	No historic or captured information
Tributaries to Slug Lake		No historic or captured information	
Tributaries to Kager Lake	**Captured:** no information **Historic:** rainbow trout	No historic or captured information	No historic or captured information
Sauls Creek	**Captured:** no information **Historic:** rainbow trout	No historic or captured information	No historic or captured information
Endako River	**Captured:** no information **Historic:** burbot, Chinook salmon, kokanee, mountain whitefish, rainbow trout, sockeye salmon, lake whitefish	**Captured:** no information **Historic:** longnose sucker, largescale sucker	**Captured:** no information **Historic:** lake chub, longnose dace, northern pikeminnow, prickly sculpin, redside shiner, peamouth
Tributary to Gerow Creek	No historic or captured information		
Parrott Creek	**Captured:** rainbow trout **Historic:** burbot, lake trout, rainbow trout, mountain whitefish	**Captured:** no information **Historic:** largescale sucker	**Captured:** no information **Historic:** longnose dace, longnose sucker, prickly sculpin, redside shiner, peamouth
SOURCES: FISS (BC MoE 2009a, Internet site); McPhail 2007; Scott and Crossman 1998.			

Fish-Bearing (Inferred or Actual) Watercourse Crossings, Associated Habitat and Species Presence

A total of 25 fish species are known to occur within the Fraser River drainage (see Table 3-23). According to known fish species distributions, leopard dace are present in the Fraser River drainage (see Table 3-23). However, none were identified in any of the watercourses crossed by the pipeline RoW in site surveys or in any stream-specific historic information (see Table 3-29). Rainbow trout and mountain whitefish were the only sportfish species captured in the Fraser River drainage between the 2005 and 2009 field programs. Unidentified sucker species were captured and the only forage fish species captured were slimy sculpin, redside shiner and longnose dace.

The pipeline RoW through the Fraser River drainage will cross several large (S1 and S2) fish-bearing rivers including the Muskeg, Salmon, Necoslie, Stuart and Endako Rivers and Merton, Mossvale, Sheraton, Stearns and Parrott Creeks. These large rivers and streams provide valuable habitat for various resident fish species and life stages. Some of these rivers also provide spawning and rearing habitat for several upper-Fraser River salmon runs.

All sampled fish-bearing (inferred) crossings within the Lower Salmon River watershed are unnamed tributaries or FSZs associated with Slender Lake. Stream gradients at the crossings are typically low with recent and historic beaver activity common throughout the area. Rainbow trout were captured in a tributary to Merton Creek (KP 733.352).

Within the Muskeg River watershed, the pipeline route will cross several important fish-bearing tributaries. These include the Muskeg River mainstem (KP 748.083) and Mossvale Creek (KP 751.118) which are both tributaries to the Salmon River. The Muskeg River supports chinook salmon, rainbow trout, mountain whitefish, burbot and bull trout. Because of this species mix, the river does not have a pre-determined least-risk period for construction. Sampling in Mossvale Creek captured several rainbow trout.

The pipeline route will cross low-gradient and beaver-influenced tributaries throughout the Salmon River watershed. Most watercourse crossings occur in the upper reaches of tributaries to Great Beaver Lake between KP 773.937 and KP 793.887. Juvenile salmonids were observed at the Salmon River mainstem (KP 763.020) but no other fish were captured.

Rainbow trout were captured in an unnamed tributary to the Necoslie River at KP 808.925 (Site 826). The mainstem Necoslie River (KP 816.406) was sampled in 2005 but revision of the pipeline route has changed the current location of the crossing. Sampling in 2005 captured rainbow trout, mountain whitefish, sucker species, redside shiner and longnose dace. Historical records indicate that mountain whitefish and chinook salmon also occur in the Necoslie River.

The pipeline route will cross the Stuart River at KP 821.898. Chinook salmon spawning occurs throughout in the mainstem Stuart River including upstream and downstream from the pipeline crossing ZOI. Field surveys in 2008 confirmed the presence of three chinook spawning redds downstream of the current crossing location. White sturgeon, sockeye salmon, rainbow trout, Dolly Varden and bull trout also occur throughout the Stuart River in the vicinity of the crossing. Early- and late-run Stuart River sockeye salmon contribute to traditional use, recreational and provincial commercial fisheries.

The pipeline route will cross the mainstem Pitka Creek, an important rainbow trout spawning tributary to Stuart Lake at KP 825.451. The majority of crossings in the Stuart Lake drainage are non-fish-bearing (either NVC or NCD). Of the fish-bearing crossings, five of them are wetlands.

In the Francois Lake watershed, the pipeline route will cross four inferred fish-bearing tributaries to Shovel Creek (KP 868.368 to KP 874.608) and four inferred fish-bearing tributaries to Sheraton Creek (KP 910.246 to KP 913.170). Most tributary crossings in these sections are in low-gradient channels with subsurface flow and beaver impoundments. The pipeline route will cross fish-bearing Tintagel (KP 915.595) and Stearns (KP 919.169) Creeks in this watershed. Both creeks are tributaries to Burns Lake and are known to support rainbow trout. Rainbow trout were captured in Stearns Creek during the field program.

The Endako River will be crossed by the pipeline RoW between Decker and Burns Lakes at KP 929.266. The Endako River supports populations of burbot, chinook salmon, kokanee, mountain whitefish, rainbow trout, sockeye salmon, and lake whitefish. Chinook and sockeye salmon are known to spawn approximately 20 km downstream from the proposed crossing but do not migrate upstream to Burns or Decker Lakes (Aquatic Resources Ltd. 2000). The floodplain (including riparian management area) at this crossing is greater than 500 m wide and includes fish, wildlife and waterfowl habitat.

Overwintering Habitat Surveys

Overwintering habitat surveys were completed at three crossings in the Fraser River drainage (Table 3-30). Good to excellent overwintering habitat quality was present at both the Muskeg and Salmon River maintstem crossings. Both rivers had sufficient depth and flow and favourable water quality conditions at the sample sites. There was sufficient depth at the tributary to Great Beaver Lake (KP 780.327) but dissolved oxygen concentrations were too low to support salmonids. The habitat at this site may be more suitable for forage fish species which have a higher tolerance of low dissolved oxygen levels.

Table 3-30 Fraser River Drainage Overwintering Habitat Survey Results

KP	Watercourse	Pool	Ice Depth (m)	Water Depth (m)	Vel (m/s)	Temp (°C)	DO (mg/L)	DO Sat %	Cond (µS/ cm)	Habitat Quality
748.083	Muskeg River	1	0.8	0.4	0.6	0	7.67	52.6	86.3	Good
748.083	Muskeg River	2	0.7	0.6	0.3	0	7.67	52.6	86.3	Good
763.020	Salmon River	1	0.5	1.0	0.7	0	9.03	61.6	79.9	Exc
763.020	Salmon River	2	0.6	1.15	0.7	0	9.03	61.6	79.9	Exc
763.020	Salmon River	3	0.5	1.8	0.3	0	9.03	61.6	79.9	Exc
780.327	Tributary to Great Beaver Lake	1	1.0	0.95	0	2.3	0.25	0.8	167.8	Poor
780.327	Tributary to Great Beaver Lake	2	0.9	0.5	0	0.9	0.95	4.5	162.9	Poor

Construction-Timing Constraints (Least-Risk Periods)

The LRPs for instream construction identified in Table 3-31 are specific to the Fraser River drainage, based on fish species presence and their life history habitat requirements (i.e., spawning). The timing and duration of pipeline construction could be severely limited in the Fraser River drainage by overlapping life stage habitat requirements.

LRPs for streams with spring spawners, such as rainbow trout, range from July 15 to April 15 or from August 1 to March 31. Streams with spring and fall spawners have an LRP from July 15 to August 31. One tributary of the Necoslie River has a LRP of June 1 to September 15 because of the historical presence of mountain whitefish.

A number of streams have no LRP because of the presence of sensitive life stages of important recreational and commercial fish species. There is no LRP for Muskeg River (KP 748.083) because of the presence of anadromous chinook salmon, rainbow trout, bull trout (possibly Dolly Varden) and mountain whitefish. Similarly, there is no LRP on the Salmon (KP 763.020), Necoslie (KP 816.406), Stuart (KP 821.898) and Endako River mainstems (KP 929.266) because of the presence of fall spawning chinook and sockeye salmon, and resident, fluvial or adfluvial Dolly Varden, bull trout, mountain whitefish and spring spawning rainbow trout.

3.5.3 Skeena River Drainage

The Skeena River system is 620 km long and drains an area of 54,400 km^2 within west-central British Columbia. Its headwaters are in the Skeena Range of the Coast Mountains. The Skeena River flows northwest from its headwaters towards its confluence with the Bulkley River at Hazelton. Downstream from Hazelton, the Skeena River flows 228 km southwest towards the port city of Prince Rupert. Elevations within the Skeena River drainage range from 2,588 m asl at Shedin Peak in the Skeena Range to sea level at the estuary.

There are no major impoundments or diversions within the Skeena River drainage. The western section of the Skeena River drainage is primarily logged or remains undeveloped. In the eastern section, logging, agriculture and ranching account for the majority of land use along the pipeline route.

There are 279 watercourse crossings in the Skeena River drainage between KP 847.1 and KP 1083.5 (see Table 3-32 and Figure 3-6). Four watersheds will be crossed by the pipeline RoW in the Skeena River drainage: Babine Lake watershed (KP 847.1 to KP 864.8, KP 876.5 to KP 882.8, and KP 886.3 to KP 908.6), Bulkley River watershed (KP 942.8 to KP 990.9), Morice River watershed (KP 993.9 to KP 1065.5) and the Zymoetz River watershed (KP 1065.5 to KP 1083.5).

Of the 279 identified crossings, site survey data are available for 238 sites of which 231 sites were surveyed between 2005 and 2009. Biophysical data for the additional seven sites are from a common segment of the Kitimat-Summit Lake Pipeline (Applied Aquatic Research Ltd. 2007) and were incorporated into the dataset. Forty-one sites remain to be surveyed as of October 2009.

Table 3-31 Least-Risk Period for Instream Construction, Fraser River Drainage, British Columbia

Watercourse	CS[1] Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Least Risk Period
Tributaries to Merton Lake	RB													July 15 – Apr 15
Tributaries to Slender Creek	RB													July 15 – Apr 15
Tributaries to Muskeg River	RB, BT													July 15 – Aug 31
Muskeg River	SA													No LRP
Mossvale Creek and tributaries	RB													July 15 – Apr 15
Tributaries to Salmon River	RB													July 15 – Apr 15
Salmon River	SA													No LRP
Tributaries to Great Beaver Lake	RB													July 15 – Apr 15
Tributaries to Necoslie River (KP 795.020 – KP 802.677)	RB													July 15 – Apr 15
Tributary to Necoslie River (KP 808.925)	MW													June 1 – Sep 15
Necoslie River	SA													No LRP
Stuart River	SA													No LRP
Pitka Creek and tributaries	RB													July 15 – Apr 15
Tributaries to Pitka Lake	RB													July 15 – Apr 15
Tributaries to Marie Lake	RB													July 15 – Apr 15
Tributaries to Shovel Creek	RB													July 15 – Apr 15
Sheraton Creek and tributaries	RB													Aug 1 – Mar 31
Tintagel Creek and tributaries	RB													Aug 1 – Mar 31
Stearns Creek and tributaries	RB													Aug 1 – Mar 31
Tributaries to Slug Lake	RB													Aug 1 – Mar 31
Tributaries to Kager Lake	RB													Aug 1 – Mar 31

Table 3-31 Least-Risk Period for Instream Construction, Fraser River Drainage, British Columbia (cont'd)

Watercourse	CS[1] Species	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		Least Risk Period
Sauls Creek	RB																									Aug 1 – Mar 31
Endako River	SA																									No LRP
Tributary to Gerow Creek	RB																									Aug 1 – Mar 31
Parrott Creek	RB																									Aug 1 – Mar 31

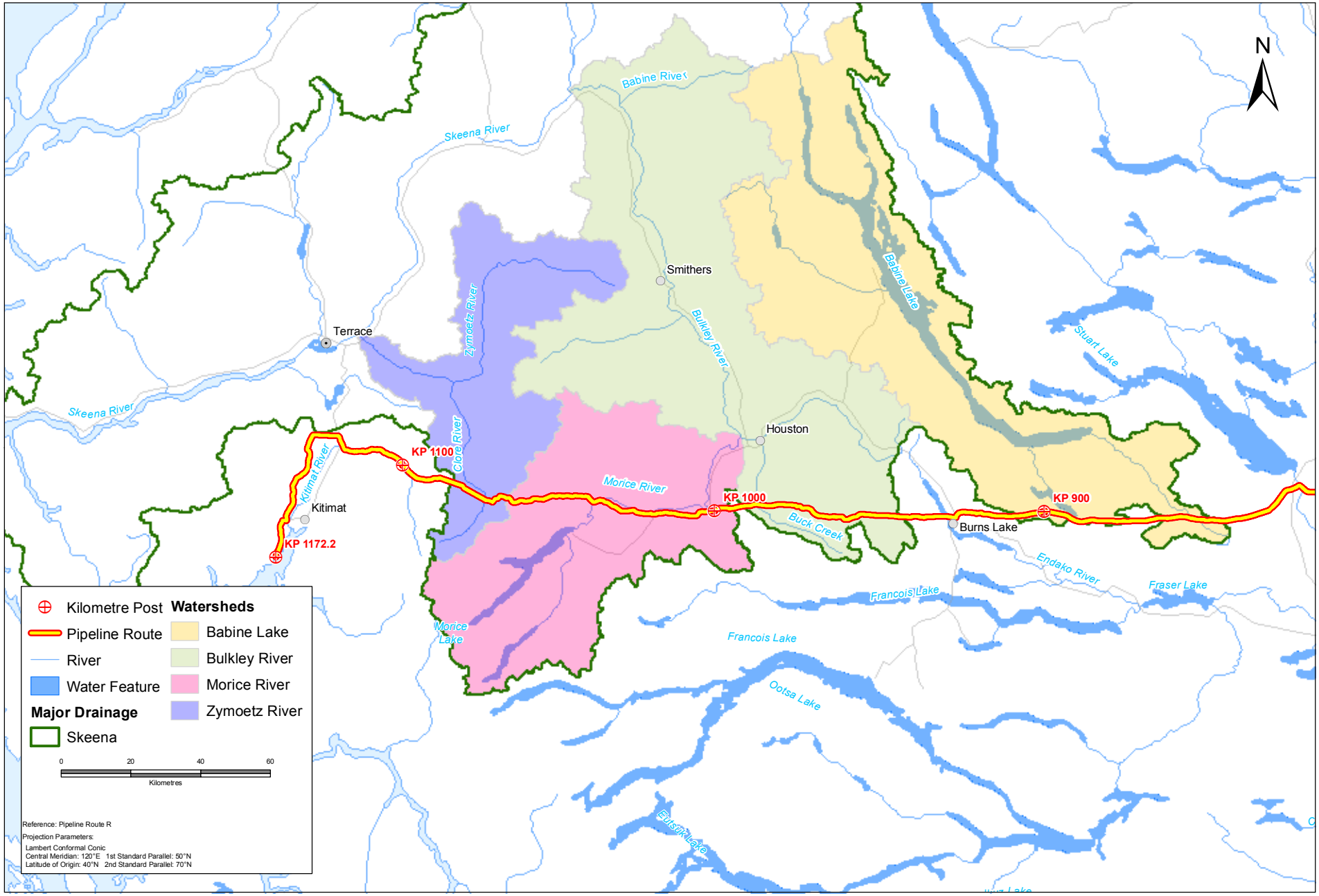
NOTES:
Grey bars indicate restricted work periods; no bars indicate instream work periods
[1] Construction Sensitive Species: SA – anadromous salmon; RB – rainbow trout; MW – mountain whitefish

SOURCE: BC MWLAP 2004a,c, Internet site

Table 3-32 Stream Class Summary, Skeena River Drainage, British Columbia

Watershed	KP Range	Fish Bearing						Non-Fish Bearing				NS[2]	Total Sites
		S1[1]	S2	S3	S4	FSZ	WET	S5	S6	NVC	NCD		
Babine Lake	847.1 – 864.8 876.5 – 882.5 886.3 – 908.6	0	2	7	20	0	0	0	1	44	3	0	77
Bulkley River	942.8 – 990.9	0	4	5	7	0	0	1	3	8	4	6	38
Morice River[3]	993.9 – 1065.5	2	7	27	26	3	0	0	5	16	10	12	108
Zymoetz River	1065.5 – 1083.5	1	4	3	2	0	1	1	19	1	1	23	56
Total		3	17	42	55	3	1	2	28	69	18	41	279

NOTES:
[1] BC MoF 1995; S1: channel width greater than 20 m; S2: channel width 5–20 m; S3: channel width 1.5–5 m; S4: channel width less than 1.5 m; FSZ: Fisheries-sensitive zone; WET: Wetland; S5: channel width greater than 3 m; S6 channel width less than 3 m; NCD: Non-Classified Drainage; NVC: No Visible Channel
[2] Unsurveyed as of October 2009
[3] Includes seven sites for which KSL data were incorporated (Applied Aquatic Research Ltd. 2007)



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ENBRIDGE NORTHERN GATEWAY PROJECT

Overview Map of the Skeena River Drainage

FIGURE NUMBER:	DATE:
3-6	20090527
SCALE: 1:1,500,000	AUTHOR: EO / APPROVED BY: TS
PROJECTION: LCC	DATUM: NAD 83

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Of the 238 sites surveyed (including the KSL data), 121 are fish-bearing while 117 are non-fish-bearing. Of the 117 non-fish-bearing sites, 69 were NVCs. Watercourse crossing density in the Skeena River drainage is 1.0 watercourse crossings per kilometre of pipeline (excluding NVCs and NCDs).

Fish-Bearing (Inferred or Actual) Watercourse Crossings, Associated Habitat and Species Presence

Twenty-eight fish species are known to occur within the Skeena River drainage (see Table 3-23). According to known fish species distributions leopard dace and threespine stickleback are present in the Skeena River drainage. However, neither species were identified in any of the watercourses crossed by the pipeline RoW during site surveys or in stream-specific historic information (see Table 3-33). Sport fish captured in the Skeena River drainage include rainbow trout, cutthroat trout, bull trout, Dolly Varden and coho salmon. Neither coarse nor forage fish were captured during field surveys but species from both groups of fish have been previously reported in watercourses along the RoW in this region. Fish species known to occur within the Skeena River drainage include regionally important (traditional use, commercial and recreational value) populations of chinook, chum, coho, pink and sockeye salmon, cutthroat and rainbow trout, steelhead (summer and winter-run), Dolly Varden, bull trout, kokanee, mountain whitefish and pygmy whitefish as well as various non-salmonid species.

The Babine Lake watershed includes the Sutherland River, Taltapin and Helene Lakes, and Duncan and Pinkut Creeks. Between KP 848.557 and KP 859.612 the pipeline route crosses nine fish-bearing tributaries to the Sutherland River and the Sutherland River itself (KP 856.183). The Sutherland River (S2) is a tributary to Babine Lake which produces exceptionally large (more than 7.6 kg) rainbow trout (Pendray 2005, pers. comm.). It also supports populations of coho and sockeye salmon, mountain whitefish, kokanee and steelhead. Rainbow trout were captured in both Duncan Creek (KP 864.156) and a tributary to Duncan Creek (KP 863.400) during field surveys.

From KP 878.247 to KP 908.027 within the Babine Lake watershed, the pipeline route will cross three fish-bearing tributaries to Helene Lake, eight fish-bearing tributaries to Taltapin Lake and six fish-bearing tributaries to Pinkut Creek. All of these crossings occur on smaller (less than 5 m) fish-bearing streams (S3 or S4). A flow-control structure on Taltapin Creek, upstream from the Pinkut Creek spawning channel, currently restricts upstream fish passage to habitats in the vicinity of the pipeline RoW (Giroux 2005, pers. comm.).

Within the Bulkley River watershed, the pipeline route will cross Maxan (S2), Foxy (S3) and Buck (S2) Creeks between KP 948.152 and KP 989.527. The pipeline route will cross the middle to upper reaches of Maxan Creek where habitat is characterized by beaver dams, a meandering channel and fragmented habitats. Maxan Creek is tributary to the upper Bulkley River and supports coho, chinook salmon, sockeye salmon, rainbow trout, steelhead, Dolly Varden and mountain whitefish. Rainbow trout are thought to be the only sportfish species in the vicinity of the crossing and these fish likely migrate upstream from Maxan Lake to spawn during April and May in gravel riffles (David Bustard & Associates Ltd., unpublished data 2009). Rainbow trout spawning habitat is present near the Maxan Creek crossing.

Table 3-33 Fish Species (Historic and Captured) by Watercourse, Skeena River Drainage, British Columbia

Watercourse	Sport Fish	Coarse Fish	Forage Fish
Babine Lake Watershed			
Tributaries to Sutherland River	**Captured:** rainbow trout	No historic or captured information	No historic or captured information
Sutherland River	**Captured:** rainbow trout **Historic:** coho salmon, kokanee, sockeye salmon, mountain whitefish, rainbow trout, steelhead	No historic or captured information	No historic or captured information
Duncan Creek and tributaries	**Captured:** rainbow trout **Historic:** rainbow trout	No historic or captured information	No historic or captured information
Tributaries to Helene Lake	**Historic:** rainbow trout	No historic or captured information	No historic or captured information
Tributaries to Taltapin Lake		No historic or captured information	
Tributaries to Pinkut Creek	**Captured:** rainbow trout **Historic:** rainbow trout	No historic or captured information	No historic or captured information
Bulkley River Watershed			
Tributaries to Maxan Creek	**Captured:** rainbow trout	No historic or captured information	No historic or captured information
Maxan Creek	**Captured:** unidentified salmonids **Historic:** rainbow trout, steelhead, coho salmon, chinook salmon, sockeye salmon, Dolly Varden, mountain whitefish, burbot, lake trout	**Captured:** no information **Historic:** longnose sucker, largescale sucker	**Captured:** no information **Historic:** prickly sculpin, northern pikeminnow, peamouth, redside shiner, longnose dace
Foxy Creek and tributaries	**Captured:** rainbow trout **Historic:** rainbow trout, mountain whitefish, steelhead, chinook salmon, coho salmon	**Captured:** no information **Historic:** longnose sucker	**Captured:** no information **Historic:** prickly sculpin, longnose dace

Table 3-33 Fish Species (Historic and Captured) by Watercourse, Skeena River Drainage, British Columbia (cont'd)

Watercourse	Sport Fish	Coarse Fish	Forage Fish
Bulkley River Watershed (cont'd)			
Klo Creek and tributaries	**Captured:** cutthroat trout **Historic:** rainbow trout	**Captured:** no information **Historic:** longnose sucker, largescale sucker	**Captured:** no information **Historic:** coastrange sculpin, longnose dace
Tributaries to Buck Creek	No historic or captured information		
Buck Creek	**Captured:** unidentified salmonids **Historic:** burbot, chinook salmon, steelhead, coho salmon, rainbow trout, cutthroat trout, mountain whitefish, Dolly Varden, pink salmon, sockeye salmon, bull trout, summer steelhead	**Captured:** no information **Historic:** white sucker, sucker species	**Captured:** no information **Historic:** longnose dace, lamprey, prickly sculpin
Morice River Watershed			
Tributaries to Owen Creek	No historic or captured information		
Tributary to Morice River	No historic or captured information		
Owen Creek	**Historic:** chinook salmon, rainbow trout, Dolly Varden, coho salmon, steelhead, mountain whitefish, pink salmon, summer steelhead	**Captured:** no information **Historic:** longnose sucker, sucker species	**Captured:** no information **Historic:** longnose dace, Pacific lamprey, northern pikeminnow, redside shiner, sculpin species, prickly sculpin
Tributaries to Fenton Creek	**Captured:** no information **Historic:** Dolly Varden	No historic or captured information	No historic or captured information
Fenton Creek	**Captured:** rainbow trout **Historic:** coho salmon, Dolly Varden, rainbow trout, summer steelhead	**Captured:** no information **Historic:** sucker species	No historic or captured information

Table 3-33 Fish Species (Historic and Captured) by Watercourse, Skeena River Drainage, British Columbia (cont'd)

Watercourse	Sport Fish	Coarse Fish	Forage Fish
Morice River Watershed (cont'd)			
24.5 Mile Creek	**Captured:** no information **Historic:** summer steelhead, cutthroat trout, Dolly Varden, coho salmon, rainbow trout	No historic or captured information	No historic or captured information
Tributary to Lamprey Creek	**Captured:** bull trout/Dolly Varden, rainbow, unidentified salmonid	No historic or captured information	No historic or captured information
Lamprey Creek	**Captured:** no information **Historic:** burbot, chinook salmon, coho salmon, cutthroat trout, Dolly Varden, mountain whitefish, rainbow trout, steelhead	**Captured:** no information **Historic:** sucker species, longnose sucker	**Captured:** no information **Historic:** dace species, Pacific lamprey, longnose dace, prickly sculpin, sculpin species
Morice River and tributaries	**Captured:** no information **Historic:** coho salmon, pink salmon, chinook salmon, sockeye salmon, steelhead, rainbow trout, Dolly Varden, chum salmon, bull trout, lake trout, mountain whitefish, pygmy whitefish	**Captured:** no information **Historic:** longnose sucker	**Captured:** no information **Historic:** longnose dace, sculpin species, northern pikeminnow
Cedric Creek	**Captured:** no information **Historic:** chinook salmon, coho salmon, cutthroat trout, rainbow trout	No historic or captured information	No historic or captured information
Tributary to Morice River	**Captured**: bull trout/Dolly Varden	No historic or captured information	No historic or captured information

Table 3-33 Fish Species (Historic and Captured) by Watercourse, Skeena River Drainage, British Columbia (cont'd)

Watercourse	Sport Fish	Coarse Fish	Forage Fish
Morice River Watershed (cont'd)			
Crystal Creek	**Captured:** bull trout, Dolly Varden, rainbow trout **Historic:** Coho salmon, cutthroat trout, Dolly Varden, bull trout, summer steelhead, mountain whitefish	No historic or captured information	No historic or captured information
Gosnell Creek and tributaries	**Captured:** cutthroat trout, Dolly Varden, rainbow trout, coho salmon, bull trout, **Historic:** Dolly Varden, cutthroat trout, coho salmon, rainbow trout, chinook salmon, summer steelhead, pink salmon, mountain whitefish, bull trout, steelhead	No historic or captured information	**Captured:** no information **Historic:** lake chub, lamprey, longnose dace, sculpin species
Tributaries to Burnie River	**Captured:** Dolly Varden, bull trout	No historic or captured information	No historic or captured information
Clore River and tributaries	**Captured:** Dolly Varden, bull trout **Historic:** chinook salmon, coho salmon, Dolly Varden, mountain whitefish, steelhead, winter steelhead, bull trout, rainbow trout, cutthroat trout, summer steelhead, sockeye salmon	No historic or captured information	No historic or captured information
SOURCES: FISS (BC MoE 2009a, Internet site); McPhail 2007; Scott and Crossman 1998.			

The pipeline route will cross the upper Foxy Creek (a tributary to Maxan Creek) mainstem at three locations (KP 960.463 KP 964.517 and KP 966.985). The downstream-most reach of Foxy Creek supports rainbow trout, mountain whitefish, steelhead, coho salmon, and a small population of chinook salmon. This is the same species composition as Maxan Creek. However, all mainstem crossings of Foxy Creek occur 3 to 7 km upstream from an impassable falls and a series of cascades 4 to 16 m high. Resident rainbow trout were the only fish species captured during the field program upstream of the barriers.

Between KP 971.274 and KP 989.527, the pipeline route will cross four fish-bearing tributaries of Klo Creek, four fish-bearing tributaries of Buck Creek, and the Buck Creek mainstem (KP 986.732). Most of the streams at these crossings are inferred as fish-bearing because of their connection to fish-bearing habitat downstream. Cutthroat trout were captured in a tributary to Klo Creek (KP 978.187).

Lower Buck Creek supports a species composition similar to that of lower Maxan Creek. However, a falls approximately 9 km downstream from the crossing prevents upstream fish passage. Juvenile salmonids, most likely rainbow and/or cutthroat trout, were observed in upper Buck Creek in the vicinity of the crossing.

Within the Morice River watershed, the pipeline route crosses 25 known fish-bearing tributaries of the Morice River between KP 995.434 and KP 1038.078, including Owen Creek (KP 1002.445), Fenton Creek (KP 1007.780), 24.5 Mile Creek (KP 1013.471), Lamprey Creek (KP 1018.486) and Cedric Creek (KP 1025.719). Most of these tributary crossings occur in the lower reaches at distances greater than 300 m upstream (i.e., greater than the ZOI) from their respective confluences with the Morice River mainstem. Coho and steelhead spawning occurs throughout Owen Creek to Owen Lake (upstream from the RoW) as well as in the Morice River mainstem approximately 700 m downstream from the RoW. Pink salmon also spawn throughout the ZOI to the Morice River confluence. Lamprey and Owen Creeks provide important steelhead spawning habitat within the Morice River watershed (Bustard and Schell 2002).

In Lamprey Creek, Dolly Varden, coho salmon and cutthroat trout spawn in the approximately 1.2 km of habitat downstream from the pipeline crossing to the Morice River confluence. Steelhead trout spawn in habitat upstream from the crossing to the Bill Nye Creek confluence. Pink salmon and steelhead are known to spawn in the Morice River at the Lamprey Creek confluence (both banks) while chinook salmon are known to spawn in the Morice River mainstem upstream from the Lamprey Creek confluence.

The Morice River is a Classified Waters river and supports important populations of salmon, trout, steelhead and char species. The Morice River is a major fish-producing tributary of the Skeena River. The pipeline route crosses the mainstem Morice River at KP 1038.001.

Chinook and pink salmon spawning redds were observed downstream from the mainstem crossing of the Morice River to the Thautil River confluence during the field surveys. Chinook spawning occurs throughout the crossing area upstream to the Morice Lake outlet and downstream to Lamprey Creek (a distance of approximately 22 km). In addition, Nanika River sockeye migrate past the crossing in August to early September. Coho and pink salmon migrate (August to mid-October) past the crossing and spawn upstream and downstream of it between the Thautil and Lamprey creek confluences. Several isolated spawning areas also occur between the crossing and Thautil Creek confluence. Morice River chinook

salmon, coho salmon and Nanika River sockeye salmon are important species to local Aboriginal groups in the area.

Coho salmon, chinook salmon, steelhead trout and bull trout are also known to use a holding pool immediately downstream of the Morice River crossing (Pendray 2005, pers. comm.). The holding pool is an important staging area for anadromous and non-anadromous species. For example, adult chinook and coho salmon were observed holding in several large pools in the 2.5-km section of the Morice River between the Thautil Creek confluence and the Morice River pipeline crossing in the fall of 2006. These large holding pools between the crossing and Thautil Creek confluence are culturally sensitive areas because they are historic fishing sites for local Aboriginal groups.

Steelhead spawning and rearing habitat also exists throughout the Morice River mainstem and side channels between the Morice Lake outlet and the Owen Creek confluence. Several isolated steelhead spawning areas have also been identified between the crossing and Thautil River confluence (Bustard and Schell 2002).

Cutthroat trout and bull trout are widely distributed in the Morice tributaries. Spawning and overwintering habitat for adult bull trout and rearing habitat for sub-adult bull trout occurs throughout the Morice River watershed. There is reportedly an adult bull trout staging area at the Thautil River confluence with the Morice River.

Between KP 1041.950 and KP 1065.361, the pipeline route crosses 32 fish-bearing tributaries to Gosnell Creek. None of these tributary crossings encroach on the Gosnell Creek mainstem riparian management area. However, the pipeline route does parallel a fish-bearing tributary and two unnamed lakes for approximately 2 km (KP 1047.480 to KP 1049.654) and also crosses five fish-bearing tributaries within the Gosnell Creek watershed.

Gosnell Creek (KP 1058.971) provides spawning, rearing and overwintering habitat for coho, chinook and pink salmon, cutthroat, rainbow and bull trout, and steelhead, Dolly Varden, and mountain whitefish. Important coho spawning, rearing and holding areas occur throughout the crossing area. A partial barrier (1.9 m falls) to coho and bull trout occurs about 2 km upstream from the crossing. Bull trout spawning occurs from about 0.75 km downstream from the crossing to about 10 km upstream from the crossing. Bull trout holding pools are also located immediately upstream from the crossing and about 20 km downstream from the crossing at the Crystal Creek confluence. Juvenile, sub-adult and adult bull trout are known to rear throughout the Gosnell Creek mainstem and Crystal Creek (David Bustard & Associates Ltd. unpublished data 2009). Cutthroat trout are also widely distributed throughout Gosnell Creek (Bustard and Schell 2002; Hatelvik 1981). All of the Gosnell mainstem and tributaries are reported to provide rearing habitat for steelhead.

Within the Zymoetz River watershed, the pipeline route crosses four fish-bearing tributaries to the Burnie River (KP 1066.935, KP 1067.095, KP 1067.861, and KP 1071.215) and the Clore River (KP 1072.397). Dolly Varden were captured in the Burnie River tributaries and Dolly Varden and rainbow trout were captured in the Clore River. Although previous studies have indicated Dolly Varden as the only char species in this area, it is possible that bull trout are also present. Bull trout are likely located primarily in mainstem habitats while Dolly Varden are more likely to reside in tributary habitats (Bustard 1995, 1996).

The pipeline route crosses the Clore River mainstem at KP 1072.397. This section of the Clore River watershed comprises rugged terrain and has been logged extensively along the southwestern valley. The Clore River mainstem, downstream from the RoW, contains spawning, rearing and overwintering habitat and staging areas for steelhead (winter and summer run), rainbow trout, Dolly Varden and bull trout. A canyon about 20 km downstream from the Clore River crossing is thought to prevent anadromous fish migration upstream. However, this barrier was not verified as a steelhead obstruction and therefore, the possibility remains that juvenile rainbow trout captured upstream to the Burnie River may be steelhead (Lough 1983; Bustard 1996; Triton 1999a).

Overwintering Habitat Surveys

Overwintering habitat surveys were conducted on four watercourse crossings in the Skeena River drainage (Table 3-34). Good to excellent quality overwintering habitat is available in Maxan and Gosnell creeks and the Clore River. These three crossings had sufficient depth and flow for overwintering species along with favourable water quality conditions. A large pool was snorkelled at the Clore River crossing and a single rainbow trout was observed. At the tributary to Burnie River (KP 1071.215), overwintering habitat quality was rated as moderate. Due to the close proximity of the crossing to the Burnie River mainstem, it is likely that fish in this tributary will overwinter in the larger system.

Table 3-34 Overwintering Habitat Survey Results, Skeena River Drainage, British Columbia

KP	Watercourse	Pool	Ice Depth (m)	Water Depth (m)	Vel (m/s)	Temp (°C)	DO (mg/L)	DO Sat %	Cond (µS/cm)	Habitat Quality
948.152	Maxan Creek	1	0.45	0.55	0	0.9	9.64	65.4	184	Good
948.152	Maxan Creek	2	0.2	2.0	0	0.8	9.64	65.4	184	Good
948.152	Maxan Creek	3	0.5	1.1	0	0.9	9.64	65.4	184	Good
948.152	Maxan Creek	4	0.5	0.9	0	0.9	9.64	65.4	184	Good
1058.971	Gosnell Creek	1	0.5	0.4	0.5	0.6	13.68	93.6	44.3	Good
1071.215	Tributary to Burnie River	1	0.1	0.4	0.3	0.9	NA	83.3	84	Mod
1071.215	Tributary to Burnie River	2	0.35	0.45	0.2	0.9	13.17	88.9	48.6	Mod
1072.397	Clore River	1	0	1.65	0	0.9	13.7	93.8	29.9	Exc
1072.397	Clore River	2	0	1.5	0.4	0.9	13.7	93.8	29.9	Exc

Construction-Timing Constraints (Least-Risk Periods)

The Skeena River LRPs for instream construction vary throughout the drainage depending on the fish species mix and the quality, quantity and utilization of available habitat (see Table 3-35). LRPs of July 15 to April 15, August 1 to March 31, and September 1 to January 31 protect late winter and early spring spawners. Streams with both spring and fall spawners have a more restrictive LRP of June 1 to August 31 or August 1 to August 31.

Table 3-35 Least-Risk Period for Instream Construction, Skeena River Drainage, British Columbia

Watercourse	CS Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Least-Risk Period
Tributaries to Sutherland River	RB													July 15 – Apr 15
Sutherland River	SA													No LRP
Duncan Creek and tributaries	RB													July 15 – Apr 15
Tributaries to Helene Lake	RB													Aug 1 – Mar 31
Tributaries to Taltapin Lake	RB													Aug 1 – Mar 31
Tributaries to Pinkut Creek	RB													Aug 1 – Mar 31
Tributaries to Maxan Creek	RB													Aug 1 – Mar 31
Maxan Creek	SA													No LRP
Foxy Creek and tributaries	RB													Aug 1 – Mar 31
Klo Creek and tributaries	RB													Sep 1 – Jan 31
Tributaries to Buck Creek	RB													Sep 1 – Jan 31
Buck Creek	SA													No LRP
Tributaries to Owen Creek	CT													Sep 1 – Dec 31
Tributary to Morice River	CT													Sep 1 – Dec 31
Owen Creek	SA													No LRP
Tributaries to Fenton Creek	BT													June 15 – Aug 31
Fenton Creek	BT, DV, CO													Aug 1 – Aug 31
24.5 Mile Creek	SA													No LRP
Tributary to Lamprey Creek	BT, DV, CO													Aug 1 – Aug 31
Lamprey Creek	SA													No LRP
Morice River and tributaries	SA													No LRP
Cedric Creek	SA													No LRP
Tributary to Morice River	BT													June 15 – Aug 31

Table 3-35 Least-Risk Period for Instream Construction, Skeena River Drainage, British Columbia (cont'd)

Watercourse	CS Species	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		Least-Risk Period
Tributary to Gosnell Creek (KP 1041.950)	CT																									Sep 1 – Dec 31
Gosnell Creek and tributaries	SA																									No LRP
Tributaries to Burnie River	SA																									No LRP
Clore River and tributaries	SA																									No LRP

NOTES:
Grey bars indicate restricted work periods; no bars indicate instream work periods
[1] Construction Sensitive Species: SA – anadromous salmonids; BT – bull trout; DV – Dolly Varden; CT – cutthroat trout; RB – rainbow trout; CO – coho salmon

SOURCES: BC MWLAP 2004d, Internet site; BC MWLAP 2005, Internet site

Instream construction is restricted (no LRP) in:

- the Sutherland River (KP 856.183)
- Maxan Creek (KP 948.152)
- Buck Creek (KP 986.732)
- Owen Creek (KP 1002.445)
- Fenton Creek (KP 1007.780)
- 24.5 Mile Creek (KP 1013.471)
- a tributary to 24.5 Mile Creek (KP 1013.730)
- Lamprey Creek (KP 1018.486)
- Cedric Creek (KP 1025.719)
- nine tributaries to Morice River between KP 1020.576 and KP 1035.964, the Morice River (KP 1038.001)
- Gosnell Creek (KP 1058.971)
- 31 unnamed fish-bearing tributaries to Gosnell Creek (KP 1043.856 to KP 1065.361)

These streams support various anadromous salmon species as well as spring and fall spawning species of cultural and recreational importance.

Within the Zymoetz watershed, instream construction timing is also restricted (no LRP) at unnamed fish-bearing tributaries to the Burnie River (KP 1066.935, KP 1067.095 and KP 1067.861) and at the Clore River mainstem (KP 1072.397) and one of its tributaries (KP 1079.800).

3.5.4 Kitimat River Drainage

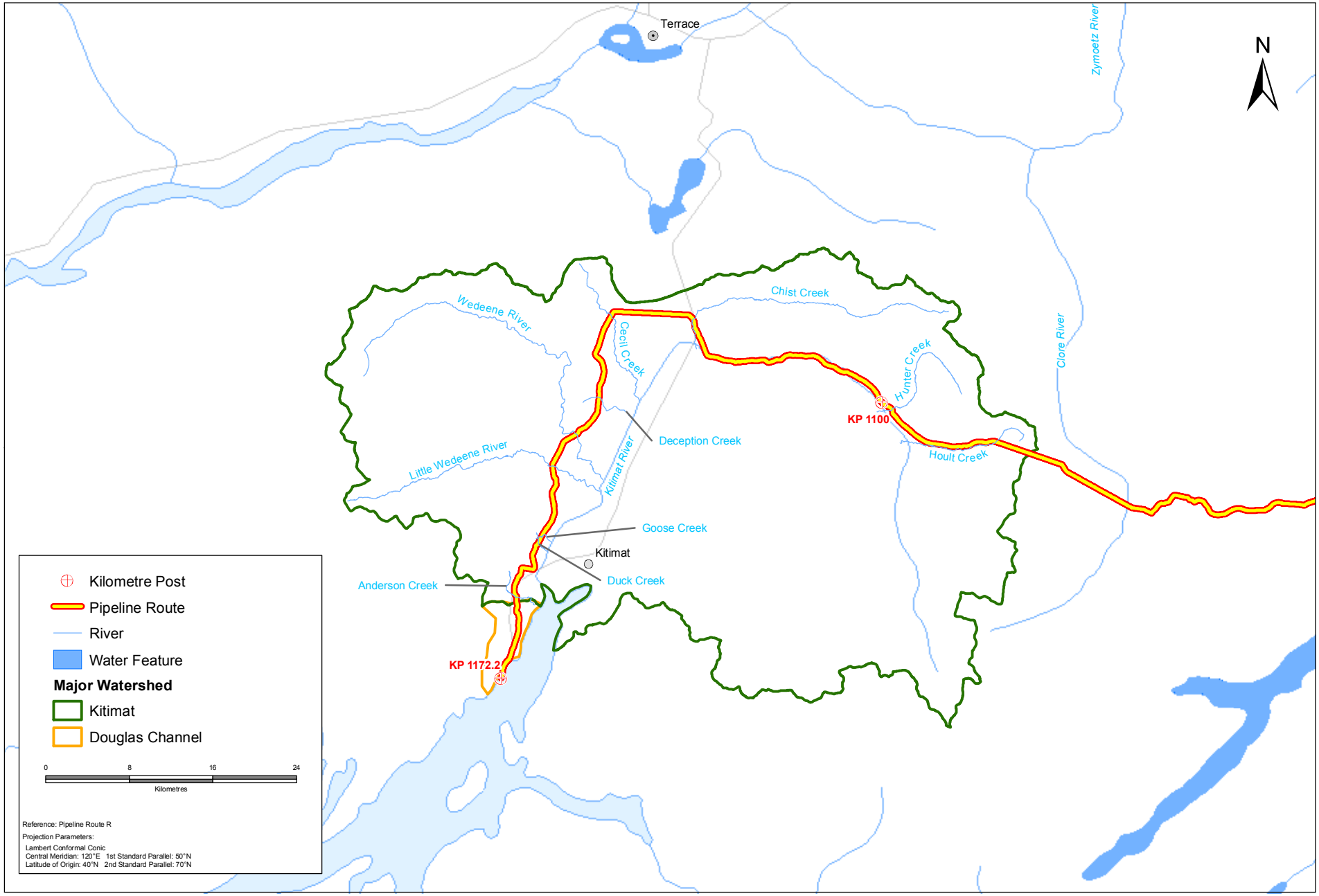
The Kitimat River is 98 km long and drains an area of 3,500 km^2. The Kitimat River originates in the Kitimat Range of the Coast Mountains in west-central British Columbia and discharges into the Pacific Ocean at the head of Douglas Channel near Kitimat. There are no impoundments or diversions in Kitimat River drainage. This section of pipeline crosses steep terrain associated with Coastal and Kitimat Mountain ranges separated by low gradient watercourse crossings in the Kitimat River Valley. A substantial amount of the land in this watershed group has been logged.

A total of 219 watercourse crossings were identified in the Kitimat River drainage (see Table 3-36 and Figure 3-7). The drainage consists of nine watersheds: the Kitimat River tributaries watershed (KP 1083.5 to KP 1166.5), Hoult Creek (KP 1083.5 to KP 1095.6), Chist Creek watershed (KP 1120.9 to KP 1124.1), Cecil Creek watershed (KP 1130.4 to KP 1138.9), Deception Creek watershed (KP 1138.9 to KP 1141.5), Wedeene River watershed (KP 1141.5 to KP 1145.3), Little Wedeene River watershed (KP 1145.3 to KP 1150.1.8), Anderson Creek watershed (KP 1163.1 to KP 1164.1), and Moore Creek watershed (KP 1164.1 to KP 1165.4).

Table 3-36 Stream Class Summary, Kitimat River Drainage, British Columbia

Watershed	KP Range	Fish Bearing						Non-Fish Bearing				NS[2]	Total Sites
		S1[1]	S2	S3	S4	FSZ	WET	S5	S6	NVC	NCD		
Kitimat River tributaries[3]	1083.5 – 1166.5	1	9	20	4	0	1	7	16	8	3	99	168
Hoult Creek	1083.5 – 1095.6	0	0	0	0	0	0	4	11	10	2	1	28
Chist Creek	1120.9 – 1124.4	1	0	0	0	0	0	0	0	1	0	0	2
Cecil Creek	1130.4 – 1138.9	0	4	0	0	0	0	1	0	2	1	0	8
Deception Creek	1138.9 – 1141.5	0	1	1	0	0	0	0	0	0	1	0	3
Wedeene River	1141.5 – 1145.3	1	0	2	0	0	0	0	0	0	0	0	3
Little Wedeene River	1145.3 – 1150.1	1	2	0	0	0	0	0	0	0	0	0	3
Anderson Creek	1163.1 – 1164.1	1	0	1	0	0	0	0	0	0	0	0	2
Moore Creek	1164.1 – 1165.4	0	0	0	0	0	0	0	1	0	0	1	2
Total		5	16	24	4	0	1	12	28	21	7	101	219

NOTES:
[1] BC MoF 1995; S1: channel width greater than 20 m; S2: channel width 5–20 m; S3: channel width 1.5–5 m; S4: channel width less than 1.5 m; FSZ: Fisheries-sensitive zone; WET: wetland; S5: channel width greater than 3 m; S6 channel width less than 3 m; NCD: non-classified drainage; NVC: no visible channel
[2] Unsurveyed as of October 2009
[3] Includes six sites for which KSL data were incorporated (Applied Aquatic Research Ltd. 2007)



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PREPARED FOR: ENBRIDGE NORTHERN GATEWAY PIPELINES

ENBRIDGE NORTHERN GATEWAY PROJECT

Overview Map of the Kitimat River Drainage

FIGURE NUMBER:	DATE:
3-7	20090527
SCALE: 1:500,000	AUTHOR: EO / APPROVED BY: TS
PROJECTION: LCC	DATUM: NAD 83

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Of the 219 identified crossings, 118 sites were surveyed in the field program—including data from six sites surveyed by Kitimat Summit Lake Pipeline Project (Applied Aquatic Research Ltd. 2007).

Of the 118 sites with available information, 50 were identified as fish-bearing while 68 were identified as non-fish-bearing. Of the watercourse crossings sampled in the Kitimat River drainage, 23% were classified as non-fish-bearing S6. These were followed by S3 (21%) and NVC (17%) crossings (see Table 3-36). The Hoult Creek watershed has no fish-bearing watercourse crossings. Watercourse crossing density in the Kitimat River drainage is 2.3 watercourse crossings per kilometre of pipeline (excluding NVCs and NCDs).

Fish-Bearing (Inferred or Actual) Watercourse Crossings, Associated Habitat and Species Presence

A total of 17 fish species are known to occur in the Kitimat River drainage (see Table 3-23). According to known species distributions, kokanee are present in the Kitimat River watershed. However, no kokanee were identified in any of the watercourses crossed by the pipeline RoW in site surveys or stream-specific historic information (see Table 3-37). Char in the Kitimat River drainage are thought to be Dolly Varden and not bull trout (Harris 2009, pers. comm.). Coho, chinook salmon, pink salmon, cutthroat trout, rainbow trout, bull trout and Dolly Varden were all captured in the Kitimat River watershed. Forage fish species captured included prickly sculpin, slimy sculpin, threespine stickleback and Pacific lamprey.

A hatchery in the lower Kitimat River annually releases over 8.5 million juvenile chinook salmon, coho salmon, chum salmon, steelhead trout and cutthroat trout. This results in the return of over 250,000 adults (all species combined). Since 2004, the hatchery has released approximately 307,400 steelhead and cutthroat trout smolts alone.

The pipeline route crosses the Hoult Creek watershed between KP 1083.5 and KP 1095.6. The entire upper Hoult Creek watershed upstream from the falls at about 1.9 km upstream from the Kitimat River confluence is non-fish-bearing. The lower Hoult Creek mainstem between the falls and the Kitimat River confluence provides spawning habitat for chum, chinook salmon, coho salmon, Dolly Varden and rainbow trout.

Hunter Creek mainstem (KP 1098.736) is crossed in an area of active erosion and lateral channel movement. Extensive coho and chum salmon spawning occurs within the ZOI of this crossing. Steelhead trout and a unique run of river-spawning sockeye salmon are known to reproduce throughout the Hunter and Kitimat River confluence area approximately 1.4 km downstream from the RoW.

The pipeline route crosses most of the unnamed tributaries of the Kitimat River along an 18.3-km long section between KP 1097.118 and KP 1118.335. Twenty of the 48 watercourse crossings in this section are known or inferred fish-bearing and support populations of coho salmon, Dolly Varden, cutthroat and rainbow trout.

Table 3-37 Fish Species (Historic and Captured) by Watercourse, Kitimat River Drainage, British Columbia

Watercourse	Sport Fish	Coarse Fish	Forage Fish
Hunter Creek	**Captured:** no information **Historic:** coho salmon, chinook salmon, chum salmon, rainbow trout, Dolly Varden, steelhead	No historic or captured information	No historic or captured information
Tributaries to Kitimat River	**Captured:** coho salmon cutthroat trout, rainbow trout, Dolly Varden, **Historic:** coho salmon, Chinook salmon, cutthroat trout, pink salmon, Dolly Varden	No historic or captured information	**Captured:** sculpin species, threespine stickleback
Chist Creek	**Captured:** chum salmon, coho salmon, cutthroat, pink salmon, rainbow trout **Historic:** Chinook salmon, chum salmon, coho salmon, cutthroat trout, Dolly Varden, pink salmon, rainbow trout, sockeye salmon, steelhead	No historic or captured information	**Captured:** prickly sculpin
Cecil Creek	**Captured:** coho salmon, cutthroat trout, Dolly Varden, rainbow trout, bull trout **Historic:** chinook salmon, chum salmon, coho salmon, cutthroat trout, Dolly Varden, pink salmon, rainbow trout, steelhead	No historic or captured information	**Captured:** Pacific lamprey **Historic:** coastrange sculpin, lamprey, sticklebacks
Tributaries to Deception Creek	**Captured:** rainbow trout	No historic or captured information	No historic or captured information
Deception Creek	**Captured:** rainbow trout **Historic:** chum salmon, coho salmon, pink salmon, rainbow trout, steelhead, Dolly Varden, cutthroat trout	No historic or captured information	No historic or captured information

Table 3-37 Fish Species (Historic and Captured) by Watercourse, Kitimat River Drainage, British Columbia (cont'd)

Watercourse	Sport Fish	Coarse Fish	Forage Fish
Wedeene River	**Captured:** No information **Historic:** pink salmon, steelhead, Dolly Varden, coho salmon, rainbow trout, cutthroat trout, chinook salmon, chum salmon	No historic or captured information	**Captured:** No information **Historic:** prickly sculpin, sculpin species
Little Wedeene River	**Captured:** cutthroat trout, chinook salmon, coho salmon, rainbow trout **Historic:** pink salmon, chum salmon, steelhead, Dolly Varden, rainbow trout, coho salmon, Chinook salmon	No historic or captured information	**Captured:** slimy sculpin **Historic:** coastrange sculpin, prickly sculpin
Goose Creek and tributary	**Captured:** cutthroat trout, chinook salmon, coho salmon, rainbow trout **Historic:** cutthroat trout, chinook salmon, coho salmon, pink salmon	No historic or captured information	**Captured:** threespine stickleback
Duck Creek	**Captured:** coho salmon **Historic:** chum salmon, coho salmon, cutthroat trout, Dolly Varden, pink salmon, rainbow trout	No historic or captured information	**Captured:** prickly sculpin **Historic:** coastrange sculpin, lamprey, stickleback species
Anderson Creek and tributary	**Captured:** cutthroat trout **Historic:** coho salmon, pink salmon, chum salmon	No historic or captured information	No historic or captured information
Moore Creek	**Captured:** No information **Historic:** coho salmon, pink salmon	No historic or captured information	No historic or captured information
SOURCES: FISS (BC MoE 2009a, Internet site); McPhail 2007; Scott and Crossman 1998.			

The pipeline route crosses Chist Creek at KP 1123.097 approximately 50 m downstream from the upper Kitimat Forest Service Road (FSR) Bridge. The channel at the crossing is 67 m wide with evidence of recent lateral movement with substrates aggregation and bar and island formation. Two holding pools occur within the ZOI of this crossing. Chum and pink salmon were seen in a pool about 100 m upstream from the FSR bridge. Chum and chinook salmon spawning also occurs at the Chist Creek and Kitimat River confluence.

Unnamed tributaries of Cecil Creek (KP 1135.647 to KP 1137.716) and the Cecil Creek mainstem (KP 1131.396) are crossed by the pipeline route between KP 1131.396 and KP 1137.716. Coho salmon, Dolly Varden, and cutthroat and rainbow trout were captured in Cecil Creek. Along with these species, Cecil Creek also contains chinook, chum, and pink salmon and steelhead. Unlike the pipeline route along the upper Kitimat River and through the Hoult Creek watershed, most tributary crossings in the Cecil Creek watershed are in the upper reaches more than 300 m upstream from mainstem habitats.

The pipeline route crosses Deception Creek (S2; KP 1139.989) about 200 m downstream from the Deception Lake outlet. The Deception Lake outlet is known to support populations of cutthroat trout and kokanee as well as chum, coho, and pink salmon, adfluvial and fluvial rainbow trout, Dolly Varden and steelhead in downstream reaches. Juvenile rainbow trout were captured rearing within the ZOI during the field program.

The Wedeene River (KP 1144.621) supports populations of salmon, trout and char. Spawning and rearing habitats occur upstream and downstream from the crossing. A large holding pool is present 200 m downstream from the crossing.

The Little Wedeene River (KP 1148.652) also supports pink, chum, coho, and chinook salmon, steelhead and rainbow trout, and Dolly Varden. A canyon located about 3 km upstream from the crossing prevents upstream passage of all fish species.

The pipeline route crosses Anderson (KP 1163.760) and Moore (KP 1165.036) creeks near existing road, utility and pipeline RoWs. Both creeks are known to be salmon- and trout-producing watercourses. Impassable falls are located about 2.8 km and 2.2 km upstream from the Kitimat River mainstem in both creeks, respectively. The lower reaches of both tributaries have been affected extensively by past land use activities.

Overwintering Habitat Surveys

Overwintering habitat surveys were conducted at two watercourse crossings in the Kitimat River drainage (Table 3-38). Excellent quality overwintering habitat is available in the Little Wedeene River. There was no ice cover at the crossing and the channel had favourable depth and water quality conditions to support overwintering fish including salmonids. Overwintering habitat quality at Chist Creek was poor to moderate. No pools or deep runs were observed at the crossing and water depths were too shallow to support overwintering fish.

Table 3-38 Overwintering Habitat Survey Results, Kitimat River Drainage, British Columbia

KP	Watercourse	Pool	Ice Depth (m)	Water Depth (m)	Vel (m/s)	Temp (°C)	DO (mg/L)	DO Sat %	Cond (µS/ cm)	Habitat Quality
1123.097	Chist Creek	NA	NA	NA	NA	0	NA	NA	55	Poor - Mod
1148.652	Little Wedeene River	1	0	0.65	0.1	0	11	100	33	Exc

Construction-Timing Constraints (Least-Risk Periods)

Due to the presence of anadromous salmon, along with spring and fall spawning species, there is no LRP on several watercourses in the Kitimat River drainage (Table 3-39). These include Hunter Creek (KP 1098.736), Chist Creek (KP 1123.097), Cecil Creek (KP 1131.396), Deception Creek (KP 1139.989), Wedeene (KP 1144.621), and Little Wedeene River (KP 1148.652), Goose Creek (KP 1155.842) and Duck Creek (KP 1156.708). A least-risk period of August 1 to August 31 is present on tributaries to the Kitimat River as well as tributaries to Deception, Anderson and Moore Creeks.

3.5.5 Douglas Channel

The RoW extends along the west side of Kitimat Arm in Douglas Channel from KP 1166.6 to the Kitimat Terminal (KP 1172.2), approximately 2 km north of Bish Cove.

A total of 20 watercourse crossings were identified in the Douglas Channel area (see Table 3-40). The drainage consists of 20 individual watercourses, 18 that flow directly into Douglas Channel and 2 that flow into Renegade Creek (a Bish Creek tributary) before discharging into Douglas Channel.

Of the 20 identified crossings, 9 sites were surveyed in the field program. This includes data from 3 sites surveyed by Kitimat Summit Lake Pipeline Project (Kitimat LNG 2005). Of the 9 sites with available information, only 1 was identified as fish-bearing (S4). The remaining sites were all identified as non-fish-bearing (S5 or S6).

Table 3-39 Least-Risk Periods for Instream Construction, Kitimat River Drainage, British Columbia

Watercourse	CS[1] Species	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		Least-Risk Period
Hoult Creek and tributaries																										No restrictions
Hunter Creek	SA																									No LRP
Tributaries to Kitimat River	CT, RB, DV,																									Aug 1 – Aug 31
Chist Creek	SA																									No LRP
Cecil Creek	SA																									No LRP
Tributaries to Deception Creek	CT, RB, DV,																									Aug 1 – Aug 31
Deception Creek	SA																									No LRP
Wedeene River	SA																									No LRP
Little Wedeene River	SA																									No LRP
Goose Creek and tributary	SA																									No LRP
Duck Creek	SA																									No LRP
Anderson Creek and tributary	CT, RB, DV																									Aug 1 – Aug 31
Moore Creek	CT, RB, DV																									Aug 1 – Aug 31

NOTES:
Grey bars indicate restricted work periods; no bars indicate instream work periods
[1] Construction sensitive species: SA – anadromous salmon; CT – cutthroat trout; RB – rainbow trout; DV – Dolly Varden

SOURCES: BC MWLAP 2004d, Internet site; BC MWLAP 2005, Internet site

Table 3-40 Stream Class Summary, Douglas Channel Drainage

Watershed	KP Range	Fish Bearing						Non-Fish Bearing				NS[2]	Total Sites
		S1[1]	S2	S3	S4	FSZ	WET	S5	S6	NVC	NCD		
Douglas Channel[3]	1166.5 - 1172.2	0	0	0	1	0	0	2	6	0	0	11	20

NOTES:

[1] BC MoF 1995; S1: channel width greater than 20 m; S2: channel width 5–20 m; S3: channel width 1.5–5 m; S4: channel width less than 1.5 m; FSZ: Fisheries-sensitive zone; WET: wetland; S5: channel width greater than 3 m; S6 channel width less than 3 m; NCD: non-classified drainage; NVC: no visible channel

[2] Not surveyed as of October 2009

[3] Includes three sites for which KLNG data were incorporated (Kitimat LNG Inc. 2005)

4 Watercourse Crossing Summary

The RoW crosses 1,564 mapped watercourses across seven major drainages (North Saskatchewan, Athabasca, Peace, Fraser, Skeena and Kitimat Rivers, and Douglas Channel) in Alberta and British Columbia (see Table 4-1). Field surveys conducted between 2005 and 2009 surveyed 1,276 of these crossings. For the environmental assessment, the unsurveyed watercourses are assumed to be fish-bearing streams until site surveys prove otherwise.

Of the 1,564 mapped watercourses, 996 (812 fish-bearing and 184 non-fish-bearing) crossings were confirmed or inferred to be streams (defined channel present) and carried forward for environmental assessment (see Volume 6A, Part 2, Section 11). No streams were present at the remaining 568 mapped watercourses (NVC or NCD).

The confirmed or inferred streams and rivers include 195 watercourses in Alberta of which all are fish-bearing, and 801 in British Columbia of which 617 are fish-bearing and 184 are non-fish-bearing. The 617 fish-bearing streams in British Columbia include streams that were classified S1–S4, FSZ or WET. In British Columbia, 73 watercourses were classified as non-fish bearing (S5–S6) but the ZOI at the crossing extends into fish-bearing waters downstream. These 73 crossings were considered as fish-bearing crossings for the environmental assessment.

Table 4-1 RoW Watercourse Crossing Summary

Major Drainage	Total Crossings	Fish-Bearing Crossings[1]	Non-Fish Bearing Crossing – ZOI in Fish-bearing Waters	Non-Fish Bearing Crossings[2]	NVC/ NCD
North Saskatchewan River	33	24	0	0	9
Athabasca River	115	68	0	0	47
Peace River AB	125	103	0	0	22
Peace River BC	525	202	37	61	225
Fraser River	248	90	2	6	150
Skeena River	279	162	9	21	87
Kitimat River	219	151	20	20	28
Douglas Channel	20	12	5	3	0
Totals	1,564	812	73	111	568

NOTES:
[1] Includes identified fish-bearing crossings, as well as the 288 unsurveyed sites
[2] Includes 16 unsurveyed sites above a known fish barrier

5 References

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5.3 Personal Communications

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Zimmerman, T. 2005. Fisheries Biologist. Ministry of Water, Land and Air Protection, Prince George, BC. Phone Conversation.

Appendix A Government Contacts

Table A-1 Government Contacts

Government Agency	Division and Location	Address	Primary Contact	Phone	E-mail
Ministry of Environment	Permit and Authorization Service Bureau, Victoria	By Courier: 4th Floor, 2975 Jutland Road, Victoria, BC V8T 5J9	Tania Boudreaux	250-952-0932	
		By Courier: 4th Floor, 2975 Jutland Road, Victoria, BC V8T 5J9	Therese Starck	250-952-0932	
		By Mail: PO Box 9372 STN PROV GOVT, Victoria, BC V8W 9M3		1-866-433-7272	
	Fish and Wildlife Science and Allocation Section, Skeena Region	Bag 5000, 3726 Alfred Avenue, Smithers, BC V0J 2N0	Paul Giroux, Fish Biologist	250-847-7288	Paul.Giroux@gov.bc.ca
			Troy Larden, Senior Ecosystem Biologist	250-847-7203	Troy.Larden@gov.bc.ca
	Fish and Wildlife Science and Allocation Section, Peace Region	Room 400, 10003 - 110th Avenue, Fort St. John, BC V1J 6M2	Gerry Leering, Fish Biologist	250-787-3294	Gerry.Leering@gov.bc.ca
	Ministry of Environment, Environmental Stewardship Division, Omineca Region	4051 18th Avenue Prince George BC V2N 1B3	Bill Arthur, Section Head, Ecosystems	250-614-9902	Bill.Arthur@gov.bc.ca
			Ray Pillipow, Fisheries Biologist		Ray.Pillipow@gov.bc.ca

Table A-1 Government Contacts (cont'd)

Government Agency	Division and Location	Address	Primary Contact	Phone	E-mail
Fisheries and Oceans Canada (DFO)	Pacific Region Headquarters, Habitat Management Division, Kamloops and Quesnel		Lorraine Roper, Permits	250-851-7705	roperl@pac.dfo-mpo.gc.ca
			Al Charbenneau	250-992-8157	charbenneaua@pac.dfo-mpo.gc.ca
	Habitat Enhancement Branch, Smithers	Box 578, Tatlow Road, Smithers, BC V0J 2N0	Tom Pendray, Skeena and Nass Habitat Biologist	250-847-7909	pendrayt@pac.dfo-mpo.gc.ca
	Habitat Enhancement Branch, Terrace	5235 A Keith Avenue, Terrace, BC V8G 1L2	Rob Dams	250-615-5354	damsr@pac.dfo-mpo.gc.ca
	Habitat Enhancement Branch, Prince George	3690 Massey Drive, Prince George, BC V2N 2S8	Nick Leone, Section Head, Upper Fraser	250-561-5366	leonen@pac.dfo-mpo.gc.ca
			John Summers		summersj@pac.dfo-mpo.gc.ca
			Jayson Kurtz		kurtzj@pac.dfo-mpo.gc.ca
	Habitat Enhancement Branch, Prince Rupert	417 - 2nd Avenue West, Suite 228, Prince Rupert, BC V8J 1G8	Violette Racicot	250-627-3499	racicotv@pac.dfo-mpo.gc.ca
Transport Canada	Navigable Waters Protection Division	Suite 820, 800 Burrard Street, Vancouver, BC V6Z 2J8	Colin Parkinson, NWP Officer Allen Cadenhead, NWP Officer	604-775-8868	parkinc@tc.gc.ca cadenha@tc.gc.ca
Alberta					
Fisheries and Oceans Canada (DFO)	Habitat Management Branch, Central and Arctic Region, Edmonton District	7646 Eighth Street NE, Calgary, AB T2E 8X4	Craig Schell, Fish Habitat Biologist	403-292-5103	schellc@dfo-mpo.gc.ca

Table A-1 Government Contacts (cont'd)

Government Agency	Division and Location	Address	Primary Contact	Phone	E-mail
Alberta (cont'd)					
Alberta Sustainable Resource Development (ASRD)	Fisheries Management, St. Paul	1st Floor Provincial Building, 5025 - 49 Avenue, St. Paul, AB T0A 3A4	Kayedon Wilcox, Area Fisheries Biologist	780-645-6402	kayedon.wilcox@gov.ab.ca
	Fisheries Management, Edson	Provincial Building, 111 - 54 Street, Edson, AB T7E 1T2	George Sterling, Area Fisheries Biologist	780-723-8247	george.sterling@gov.ab.ca
	Fisheries Management, Stony Plain	250 Diamond Avenue, Spruce Grove, AB T7X 4C7	Don Hildebrandt, Area Fisheries Biologist	780-723-8523	don.hildebrandt@gov.ab.ca
			Matthew Otto (AE)	780-960-8639	matthew.otto@gov.ab.ca
			Lily Dam (AE)	780-960-8640	lily.dam@gov.ab.ca
Alberta Sustainable Resource Development (ASRD) (cont'd)	Fisheries Management, Grande Prairie	1st fl Provincial Building, 10320 - 99 Street, Grande Prairie, AB T8V 6J4	John Tehir, Area Fisheries Biologist	780-538-8013	john.tehir@gov.ab.ca
			Dave Heatherington	780-538-8073	dave.heatherington@gov.bc.ca
			James Proudfoot	780-538-8039	james.proudfoot@gov.ab.ca
			Jennifer Keturakis (AE)	780-538-5608	jennifer.keturakis@gov.ab.ca
	Fisheries Management, Edmonton	1st Floor, Twin Atria Building, 4999 - 98 Avenue, Edmonton, AB T6B 2X3	Daryl Watters, Fisheries Technician	780-415-1332	daryl.watters@gov.ab.ca
			Tracy Knight (AE)	780-427-6636	tracy.knight@gov.ab.ca

Table A-1 Government Contacts (cont'd)

Government Agency	Division and Location	Address	Primary Contact	Phone	E-mail
Alberta (cont'd)					
Transport Canada	Navigable Waters Protection Division, Navigable Protection Program	1100 9700 Jasper Avenue, Edmonton, AB T5J 4E6	Steve Drummond, A and NWP Manager	780-495-3701	drumons@tc.gc.ca
	Navigable Waters Protection Division, Environmental Affairs, Prairie and Northern Region	3rd Floor, 344 Edmonton Street, Winnipeg, MB R3C 0P6	Kelly Hunnie, Environmental Officer	204-984-6755	hunniek@tc.gc.ca

Appendix B Freshwater Fish and Fish Habitat Aquatic Catalogue and Watercourse Crossing Data

On CD

Appendix B_Group1_KP0_KP511.pdf

Appendix B_Group2_KP511_KP623.pdf

Appendix B_Group3_KP623_KP681.pdf

Appendix B_Group4_KP681_KP793.pdf

Appendix B_Group5_KP793_KP908.pdf

Appendix B_Group6_KP908_KP1083.pdf

Appendix B_Group7_KP1083_KP1172.pdf

Group 1
Athabasca River
Little Smoky River
North Saskatchewan River
Paddle River
Pembina River
Simonette River
Smoky River
Sturgeon River
Wapiti River
Group 2
Five Cabin Creek
Flatbed Creek
Hiding Creek
Honeymoon Creek
Hook Creek
Imperial Creek
Kinuseo Creek
Murray River
Quintette Creek
Redwillow River
South Redwillow River
Group 3
Hominka River
Missinka River
Parsnip River
Wichcika Creek
Group 4
Angusmac Creek
Caine Creek
Chuchinka Creek
Crooked River
Davie Lake
Fisher Lake
Great Beaver Lake
Merton Creek
Mossvale Creek

Group 4 (cont'd)
Muskeg River
Salmon River
Group 5
Duncan Creek
Henrietta Creek
Marie Lake
Necoslie River
Pinkut Creek
Pitka Creek
Shovel Creek
Stuart River
Sutherland River
Taltapin Lake
Group 6
Buck Creek
Bulkley River
Burnie River
Burns Lake
Clore River
Decker Lake
Eagle Creek
Endako River
Fenton Creek
Foxy Creek
Francois Lake
Gerow Creek
Gosnell Creek
Klo Creek
Lamprey Creek
Maxan Creek
Morice River
Owen Creek
Parrott Creek
Sheraton Creek
Tintagel Creek
Zymoetz River

Group 7
Alwyn Creek
Anderson Creek
Cecil Creek
Chist Creek
Clore River
Deception Creek
Douglas Channel
Duck Creek
Elf Creek
Goose River
Hoult Creek
Hunter Creek
Iron Mine Creek
Kitimat Estuary
Kitimat River
Lakelse River
Little Wedeene River
Moore Creek
Moraine Creek
Renegade Creek
Sockey Creek
Thomas Creek
Trapline Creek
Trout Creek
Unnamed Stream
Wedeene River
Williams Creek

Appendix C Key to the Freshwater Fish and Fish Habitat Aquatic Catalogue and Watercourse Crossing Data

C.1 Stream Class

C.1.1 Alberta

Alberta stream class refers to the habitat and fish population sensitivity at the watercourse crossing and associated restricted activity period (RAPs) according to the Alberta Code of Practice for Watercourse Crossings (AENV 2001).

Table C-1 Alberta Stream Class Descriptions

Stream Class	Sensitivity	Description
A	Highest	Habitat areas are sensitive to being damaged by any type of activity within the waterbody; known habitats in waterbody are critical to the continued viability of a population of fish species in the area (e.g., there are endangered sturgeon in areas of the North Saskatchewan River).
B	High	Habitat areas are sensitive to being damaged by any type of activity within the waterbody; habitat areas important to continued to viability of a population of fish species in the area.
C	Moderate	Habitat areas are sensitive to being damaged by unconfined or unrestricted activities within a waterbody; broadly distributed habitats support local fish species populations.
D	Low	Fish species as defined under the Code of Practice are not present.

All mapped and unclassified watercourses within 2 km of entering a Class A, B, or C mapped waterbody will take on the same class as the receiving waterbody; (i.e., will take on the specified Class A, B or C conditions and construction methods).

All unmapped watercourses within 2 km of a Class A, B or C waterbody will take on the same class as the receiving waterbody.

C.1.2 British Columbia

British Columbia stream classes are determined on the basis of channel width (m) and the presence or absence of fish species as defined under the Forest Practices Code. Construction-timing constraints are determined on the basis of fish-bearing status.

Table C-2 British Columbia Stream Class Descriptions

Stream Class	Channel Width (m)	Riparian Management Area (m)	Fish Bearing Status[1]
S1	20–100	70	Fish-bearing (Forest Practices Code Species)
S2	5–20	50	Fish-bearing (Forest Practices Code Species)
S3	1.5–5.0	40	Fish-bearing (Forest Practices Code Species)
S4	<1.5	30	Fish-bearing (Forest Practices Code Species)
FSZ			Fisheries-sensitive zones are side and back channels, ponds, swamps, seasonally flooded depressions, lake littoral zones and estuaries that are seasonally occupied by over-wintering fish (BC MoF 1995)
S5	>3.0	30	Non-fish-bearing
S6	<3.0	20	Non-fish-bearing
NVC			No visible channel (no visible channel banks; terrestrial vegetation, no fish value at any time of year)
NCD			Non-classified drainage (<100 m channel length; not a direct tributary to fish-bearing reach; no scour or fluvial deposition; no fish value at any time of year)

NOTE:
[1] Forest Practice Code Species: see table C-9 for more details

Table C-3 Habitat Quality, Alberta and British Columbia

E	excellent	**M**	moderate	**N**	nil
G	good	**P**	poor		

C.2 Fish

C.2.1 Fish Capture, Alberta and British Columbia

Table C-4 Method

EF	electrofish	**MS**	mask and snorkel
MT	minnow trap	**DN**	dip net
BS	beach seine	**VO**	visual observation
AG	angle		

Table C-5 Stage

F	fry	**J**	juvenile	**S**	spawner
P	parr	**A**	adult	**A**	all

Table C-6 Maturity and Sex

IM	immature	**M**	mature	**SPT**	spent
MTC	maturing	**SP**	spawning	**U**	undetermined
M	male	**F**	female		

Table C-7 Fish Activity

M	migration (M)	**I**	incubation (I)
S	spawning (S)	**R**	rearing (R)

Table C-8 Fish Codes Alberta

ARGR	Arctic grayling	**NOSP**	no specific species
BKTR	brook trout	**NRDC**	northern redbelly dace
BLTR	bull trout	**NRPK**	northern pike
BNTR	brown trout	**PRDC**	pearl dace
BRMN	brassy minnow	**PRSC**	prickly sculpin
BRST	brook stickleback	**QUIL**	quillback
BURB	burbot	**RDSH**	redside shiner
C	*cyprinids*	**RNTR**	rainbow trout
CISC	cisco	**RVSH**	river shiner
EMSH	emerald shiner	**SAUG**	sauger
FLCH	flathead chub	**SHRD**	shorthead redhorse
FNDC	finescale dace	**SHSC**	shorthead sculpin
FTMN	fathead minnow	**SLRD**	silver redhorse
IWDR	Iowa darter	**SPSC**	spoonhead sculpin
LKCH	lake chub	**SPSH**	spottail shiner
LKST	lake sturgeon	**TRPR**	trout-perch
NFC	no fish captured	**WALL**	walleye
LNDC	longnose dace	**WHSC**	white sucker
LNSC	longnose sucker	**YLPR**	yellow perch
LRSC	largescale sucker		
MNSC	mountain sucker		
MNWH	mountain whitefish		
MOON	mooneye		
NFC	no fish caught		

Table C-9 Fish Codes British Columbia

ACT	anadromous cutthroat trout	**L**	lamprey	**SP**	species present, not identified
ADV	anadromous Dolly Varden	**LDC**	leopard dace	**ST**[1]	steelhead
BB	burbot	**LKC**	lake chub	**TP**	troutperch
BMC	brassy minnow	**LNC**	longnose dace	**TR**	trout
BSB	brook stickleback	**LSU**	longnose sucker	**WP**[1]	walleye
BSU	bridgelip sucker	**LT**[1]	lake trout	**WSG**[1]	white sturgeon
BT[1]	bull trout	**LW**[1]	lake whitefish	**WSU**	white sucker
C	*cyprinids*	**MW**[1]	mountain whitefish		
CAL	coastrange sculpin	**NFC**	no fish caught		
CAS	prickly sculpin	**NP**[1]	northern pike		
CCG	slimy sculpin	**NSC**	northern pikeminnow		
CH[1]	chinook salmon	**PCC**	peamouth chub		
CM[1]	chum salmon	**PDC**	northern pearl dace		
CO[1]	coho salmon	**PK**[1]	pink salmon		
CSU	largescale sucker	**PL**	Pacific lamprey		
CT[1]	cutthroat trout (general)	**PW**	pygmy whitefish		
DV[1]	Dolly Varden	**RB**[1]	rainbow trout		
EB	brook trout	**RSC**	redside shiner		
FDC	finescale dace	**SA**	Salmon		
GR[1]	Arctic grayling	**SB**	sticklebacks, general		
KO[1]	kokanee salmon	**SK**[1]	sockeye salmon		

NOTES:

[1] Forest Practices Code species: designated when a stream is frequented by any of the following species:

i. anadromous salmonids
ii. rainbow trout, cutthroat trout, brown trout, bull trout, Dolly Varden, lake trout, brook trout, kokanee, largemouth bass, smallmouth bass, mountain whitefish, lake whitefish, Arctic grayling, burbot, white sturgeon, black crappie, yellow perch, walleye or northern pike
iii. identified threatened or endangered species classified under section 71 (of the Operational Planning Regulation [OPR])
iv. regionally important species classified under Section 71

SOURCE: Adapted from the *Fish Stream Identification Guidebook*, BC MoF 1998 2nd Edition

C.3 Biophysical

C.3.1 Turbidity

Table C-10 Turbidity British Columbia

T	turbid	**M**	moderately turbid	**L**	lightly turbid	**C**	clear

C.3.1.1 Alberta

NTU (Nephelometric Turbidity Units)

Table C-11 Fish Cover, Alberta and British Columbia

SWD	small woody debris	**U**	undercut	**IV**	instream vegetation
LWD	large woody debris	**DP**	deep pool		
B	boulder	**OV**	overhang		

Table C-12 Bank Shape, Alberta and British Columbia

V	steep	**S**	shallow	**O**	overhang	**U**	undercut

Table C-13 Riparian Vegetation, Alberta and British Columbia

N	none	**S**	shrubs	**W**	wetland
G	grass	**C**	coniferous forest		
D	deciduous forest	**M**	mixed forest		

Table C-14 Riparian Vegetation Stage, Alberta and British Columbia

INIT	initial	**PS**	pole sapling	**MF**	mature forest
SHR	shrub	**YF**	young forest	**NA**	not applicable

Table C-15 Functioning Large Woody Debris, Alberta and British Columbia

N	none	**A**	abundant	**E**	evenly distributed
F	few	**C**	clumped distribution		

Table C-16 Channel Bottom Substrate Composition and Bank Texture, Alberta and British Columbia

O	organic	**sC**	small cobbles (65–128 mm)
F	fines or sands, silts (<2 mm diameter)	**lC**	large cobbles (128–256 mm)
sG	small gravels (2–16 mm)	**B**	small to large boulders (>256 mm)
lG	large gravels (17–64 mm)	**R**	bedrock (>4000 mm)

Table C-17 Features, Alberta and British Columbia

A	amphibian	**DS**	downstream	**HD**	hydroelectric dams
BD	beaver dam	**ECAC**	spawning channel	**LB**	left bank
BED	stream bed or substrate	**ECAH**	hatchery	**LS**	landslide or bank sloughing
BG	crossing (general)	**EOF**	enhancement (general)	**RB**	right bank
BR	bridge	**F**	falls	**RoW**	right-of-way
C	cascade or chute	**FD**	ford	**TRB**	tributary
CL	centreline	**FISH**	representative fish	**US**	upstream
CN	canyon	**FLD**	dewatering	**VB**	velocity barrier
CS	cross-section	**FSB**	subsurface flow	**X**	large woody debris (LWD) Jam
CV	culvert	**GE**	groundwater (field)	**XW**	wedge
D	dam (general)	**HCE**	erosion or sedimentation	**WET**	wetland

Table C-18 Disturbance Indicators, Alberta and British Columbia

B1	abandoned channels	**S1**	homogeneous bed texture	**C2**	minimal pool area
B2	eroding banks	**S2**	sediment fingers	**C3**	elevated channel bars
B3	avulsions	**S3**	sediment wedges	**C4**	multiple channel or braids
D1	small woody debris	**S4**	extensive bars	**C5**	disturbed stone lines
D2	large woody debris	**S5**	extensively scoured zones - stream bed	**O1**	beaver dams
D3	recently formed LWD jams	**C1**	extensive riffles or cascades		

Table C-19 Channel Morphology British Columbia

Code	Morphology	Sub-code	Bed Material	LWD
RP	riffle-pool	RP_{g-w}	gravel	functioning LWD
RP	riffle-pool	RP_{c-w}	cobble	functioning LWD
CP	cascade-pool	CP_{c-w}	cobble	present, minor function
CP	cascade-pool	CP_{b}	boulder	absent
SP	step-pool	SP_{b-w}	boulder	present, minimal function
SP	step-pool	SP_{b}	boulder	absent
SP	step-pool	SP_{r}	boulder-rock	absent

Table C-20 Channel Morphology Alberta

P	pool	**RF**	riffle
R	run	**F**	flat

Table C-21 Channel Pattern, Alberta and British Columbia

TM	tortuous meander	**IM**	irregular meander	**SI**	sinuous
ME	meander	**IR**	irregular	**S**	straight

Table C-22 Channel Confinement, Alberta and British Columbia

EN	entrenched	**FC**	frequently confined	**UN**	unconfined
CO	confined	**OC**	occasionally confined	**NA**	non applicable

Table C-23 Islands, Alberta and British Columbia

N	none	**I**	irregular	**S**	split
O	occasional	**F**	frequent	**AN**	anastomising

Table C-24 Bars, Alberta and British Columbia

N	none	**MID**	mid-stream
SIDE	side deposits	**SPN**	span
DIAG	diagonal	**BR**	braided

Table C-25 Coupling, Alberta and British Columbia

DC	decoupled	**CO**	coupled
PC	partially coupled		

Table C-26 Other Codes

QAES	Qualified Aquatic Environment Specialist
LRP	Least Risk Period for instream construction
FSR	Forest Service Road
JH and JD	Jason Harris and Jason Dorey
RMA	Riparian Management Area
NHDR	no historic data recorded
T1, T2, T3	transect 1, transect 2, transect 3
CW	channel width
WW	wetted width

Table C-27 Crew

Alliance	Golder Associates Ltd., Alliance Pipeline Project
KLNG	Kitimat LNG Inc., Kitimat LNG Project
KSL	Applied Aquatic Research Ltd., Kitimat – Summit Lake Natural Gas Pipeline Looping Project
GEM	Gateway Environmental Management Team

Valley Gradient Calculations

- Route: August 1, 2006 alignment
- Elevation spacing: 500 m (500 m towards the start and 500 m towards the end: total of 1000 m between the two extremes)
- No data: for a number of sites there was no elevation data available.