SITE C FISHERIES STUDIES
– 2010 COLDWATER SPECIES FISH SURVEY

Prepared for

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EXECUTIVE SUMMARY

B.C. Hydro is presently considering the Peace River Site C Hydroelectric project (Site C) in north eastern British Columbia as a potential resource option to help meet BC's future electricity needs. Tributary fisheries studies are presently underway to add to existing baseline information and to address data gaps that have been identified.

The purpose of this study was to describe the fish community in the upper catchments of Maurice Creek, Lynx Creek, and Farrell Creek. The survey was completed during a three-day period from 14 to 16 September, 2010.

General Water Quality

Water quality parameters measured were generally consistent among sites and creeks. Water pH was neutral to slightly alkaline and water conductivity was elevated. Water temperature generally decreased with increased distance upstream in each creek. Water clarity was generally high during the survey. Runoff from a landslide on Brenot Creek (a tributary to Lynx Creek) was contributing significant amounts of sediment to the system at the time of the survey; which adversely affected fish habitat in Brenot Creek downstream of the landslide.

Fish Habitat

Falls are located on Maurice Creek and on Lynx Creek that hinder or prevent upstream fish passage. In Maurice Creek, the 2.5 m – 30 m high falls are permanent barriers to fish passage and in Lynx Creek, the 2 m – 4 m high falls are likely barriers for the majority of the year, depending on flow conditions.

The survey identified three dominant fish habitats in all study tributaries – pools, riffles, and runs (or glides) suggesting a consistent, uniform distribution of habitats. Additionally, beaver impoundments were prevalent at the most upstream sites in each catchment. Water depth and water velocity reflected base flow conditions at the time of the survey, which limited the surface area and water depth of habitats in all creeks. At the time of the survey, spawning, rearing and feeding habitats for coldwater fish species were considered to be moderate quality at the sites surveyed in Maurice Creek and in Farrell Creek. At the time of the survey, spawning, rearing and feeding habitats for coldwater fish species were considered to be low quality in Lynx Creek due primarily to an abundance of fine substrates. Wintering habitats in all streams was limited at the time of the survey due to the absence of deep water areas.

Fish Composition, Relative Abundance and Distribution

In total, 10 fish species were recorded during the study. There was representation by sportfish (two species), suckers (two species), minnows/trout-perch (five species), and sculpins (one species). One species was recorded in Maurice Creek, two species were recorded in Lynx Creek and nine species were recorded in Farrell Creek. The low number of species recorded in Maurice Creek and Lynx Creek maybe due to falls on each system that are located downstream of study sections.

Species distribution and catch rates varied among streams. Only two species were recorded in more than one tributary. Rainbow trout, a sportfish, and slimy sculpin were recorded in the Lynx Creek catchment and in Farrell Creek. Slimy sculpin were the dominant species in Farrell Creek; however, they were rare in the Lynx Creek catchment.

In Lynx Creek, relative differences in the catch rate data indicated that rainbow trout were more abundant at the downstream sites in the study area. In Farrell Creek and Brenot Creek, fish catch rates for most species were generally higher at the upstream sites than the downstream sites. Age 0 and suspected Age 1 and 2 rainbow trout were present in Lynx Creek and Farrell Creek.

Conclusions

The physical characteristics of fish habitats in the study tributaries were influenced primarily by low flow conditions at the time of the survey, barriers, and relative stream size. The physical characteristics of fish habitats were generally similar among and within the creeks surveyed. Habitats were dominated by riffle-pool-run complexes and bed materials were dominated by cobbles.

Ten fish species were recorded during the study, which represented four groups that included sportfish, suckers, minnows/trout-perch, and sculpins. Species assemblage varied substantially between catchments, with only one species recorded in the Maurice Creek catchment, two species recorded in the Lynx Creek catchment and nine species recorded in Farrell Creek.

Notable findings of the study were as follows:

1. The 2.5 m – 30 m falls in Maurice Creek are permanent barriers to upstream fish passage and there are no known records of coldwater fish species above the falls.
2. The 2 m – 4 m falls in the Lynx Creek catchment maybe barriers to upstream passage during most flows.
3. Sediment ladened discharge originating from a landslide located on Brenot Creek reduces the quality of downstream fish habitats in Brenot Creek and Lynx Creek downstream of the confluence with Brenot Creek.

4. The physical characteristics of fish habitats in Maurice, Lynx, and Farrell Creeks were generally similar. Habitats were dominated by riffle-pool-run complexes and bed materials were dominated by cobbles. Fish habitats in Lynx Creek were considered to be lower quality compared to the other study streams due to the abundance of fine substrates.
5. Farrell Creek supports a diverse fish community including two coldwater species: rainbow trout and slimy sculpin. Lynx Creek and Maurice Creek upstream of fish barriers do not support diverse fish communities. However, the Lynx Creek catchment (Lynx Creek and Brenot Creek) do support rainbow trout populations.

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The following Mainstream Aquatics Ltd. personnel participated in the program:

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TABLE OF CONTENTS

Page #

LIST OF TABLES

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LIST OF FIGURES

Page #

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1.0 INTRODUCTION

1.1 BACKGROUND

B.C. Hydro is considering the Peace River Site C Hydroelectric Project (Site C) in north eastern British Columbia (BC) as a potential resource option to help meet BC's future electricity needs (Figure 1.1). Fisheries studies have been completed to add to existing baseline information and to address data gaps that have been identified.

Investigations completed in 2005 and 2006 described fish use and habitat characteristics of Peace River tributaries. These investigations focused primarily on collection of detailed habitat and fish data from tributary sections that would be affected by the Site C reservoir (AMEC and LGL 2006; Mainstream 2009a). In 2008, Mainstream Aquatics Ltd. was contracted by B.C. Hydro to continue these investigations. Two studies were completed on Peace River tributaries, including an assessment of fish use of tributaries in spring and fall and a juvenile fish and habitat survey in summer (Mainstream 2009b, c). The outcome of the work completed from 2005 to 2008 was a good description of fish habitat, fish species composition, abundance, distribution, and general population characteristics in the lower sections of investigated tributaries.

These baseline fish studies indicated that three small Peace River tributaries, Maurice Creek, Lynx Creek, and possibly Farrell Creek, may support populations of coldwater species such as rainbow trout, mountain whitefish, and/or Arctic grayling (Mainstream 2009c); therefore, these systems may be potential recruitment sources for Peace River fish populations. However, there is limited data currently available that describes coldwater fish species populations in the upper catchments of each of these tributaries.

This report presents the results from the 2010 coldwater species fish survey on Maurice Creek, Lynx Creek, and Farrell Creek conducted by Mainstream Aquatics Ltd.

1.2 PURPOSE AND OBJECTIVES

The purpose of the study was to describe the fish community in the upper catchments of Maurice Creek, Lynx Creek, and Farrell Creek.

The objectives of the study were as follows:

1. Complete a synoptic level fish survey in each tributary.
2. Describe the general stream and habitat characteristics in sampled sections.
3. Collect biological data from captured fish.
4. Summarize the information in a concise report.

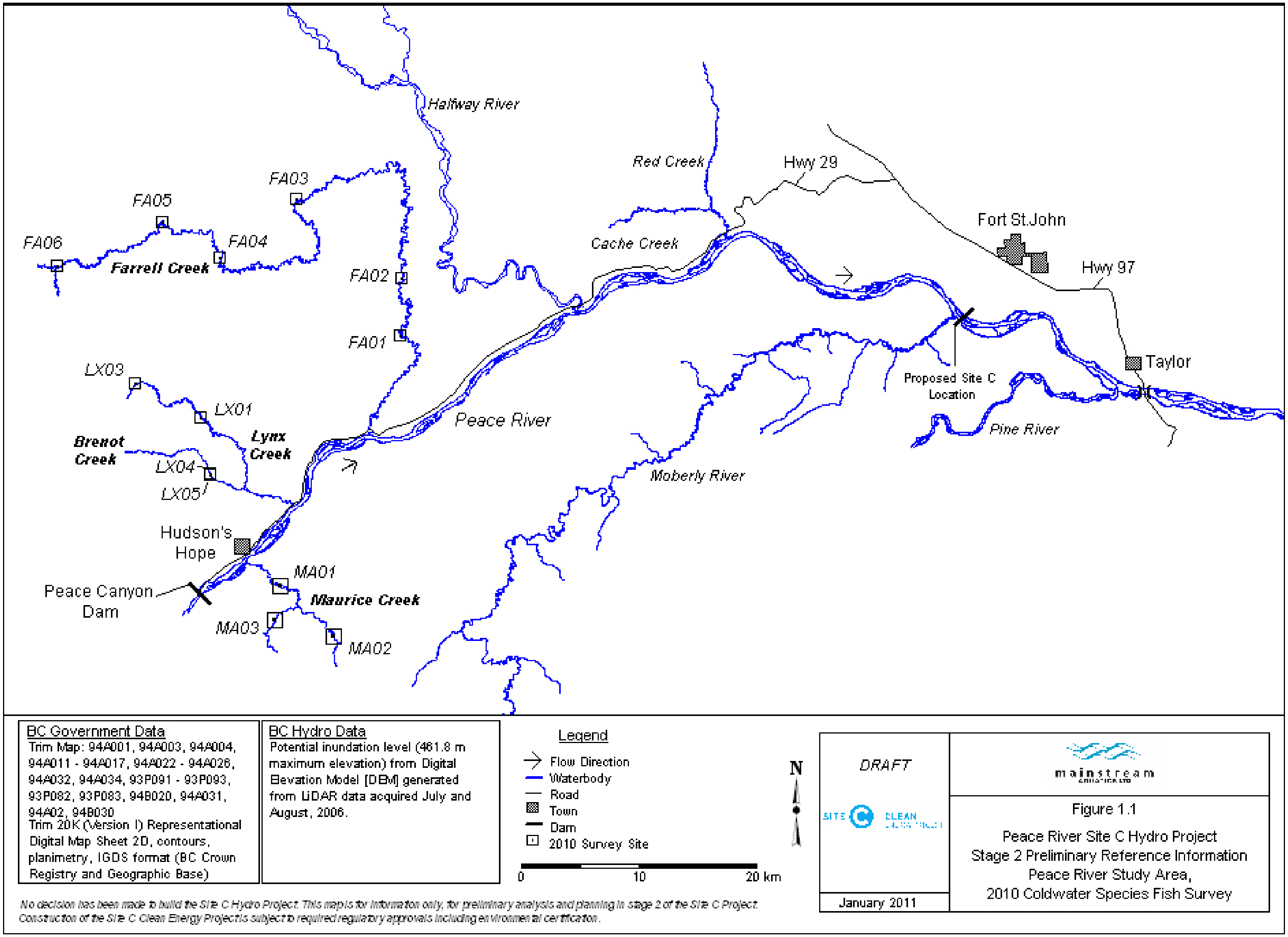
1.3 STUDY AREA AND PERIOD

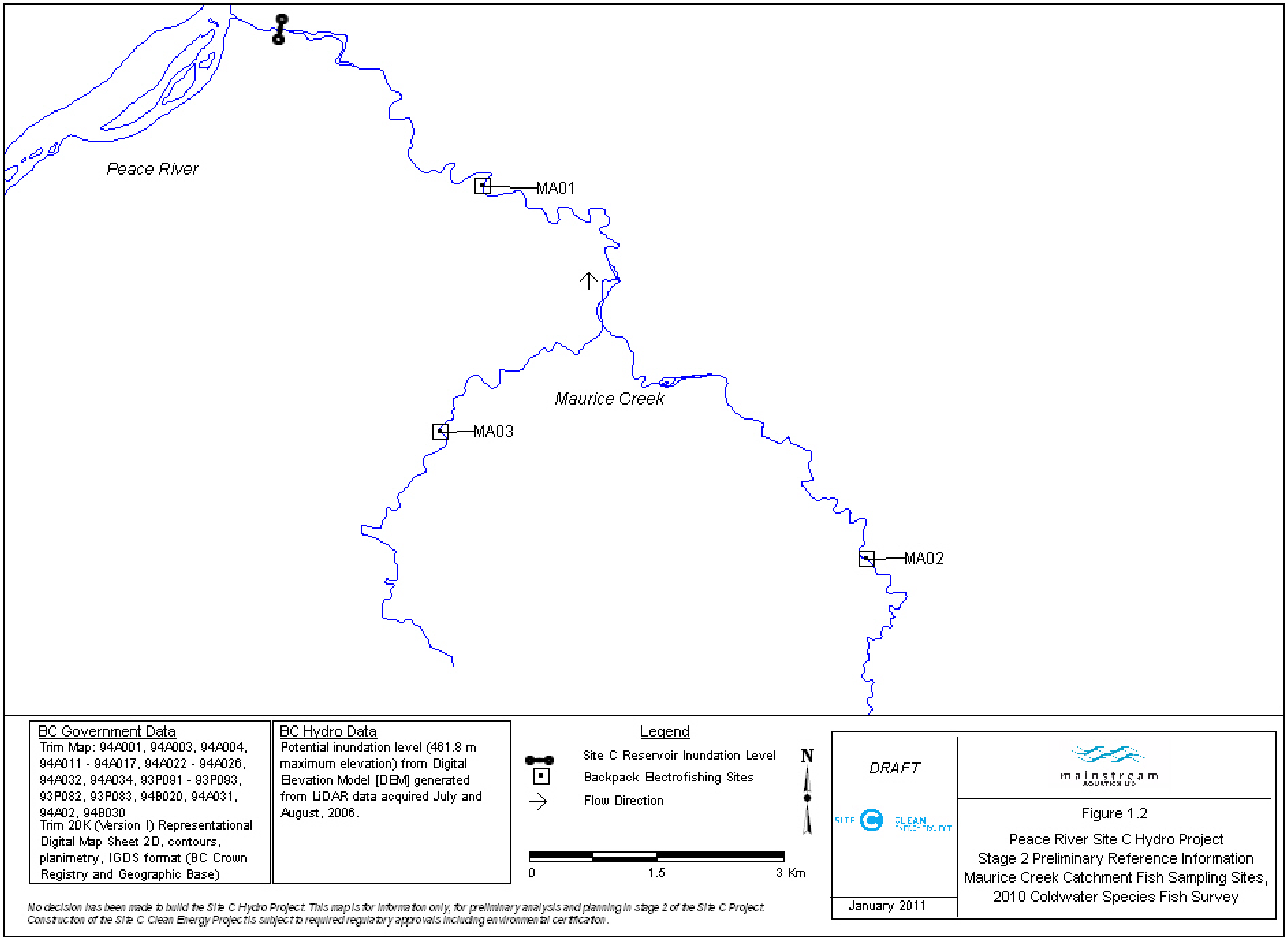
The study area included Maurice Creek, Lynx Creek, and Farrell Creek (Figure 1.1 and Table 1.1; Appendix A). A total of 13 sites were surveyed including three in the Maurice Creek catchment (two on Maurice Creek and one on an unnamed tributary to Maurice Creek, Figure 1.2), four in the Lynx Creek catchment (including two on Lynx Creek and two on Brenot Creek, Figure 1.3), and six on Farrell Creek (Figure 1.4).

All study sites were located upstream of previously sampled locations in order to collect new information. The number of sites in each system depended on stream length to be investigated and catchment characteristics. Where possible, the location of each site was chosen to include a range of habitats, several riffle-pool sequences and to be representative of the creek section. Site selection was also based on ease and safety of access. The fish survey was completed during a three-day period from 14 to 16 September, 2010 (Table 1.1). The survey occurred during this period in order to maximize sample effectiveness (i.e., low discharge and high water clarity) and to facilitate capture of Age 0 coldwater sportfish.

Table 1.1 Site locations and survey dates, 2010 Site C coldwater species fish survey.

Catchment	Site Name	Creek	UTM			Distance Surveyed (m)	River Location (km)	Date Surveyed (2010)
			Zone	Easting (m)	Northing (m)			
Maurice	MA01	Maurice Cr.	10U	571079	6207162	500	5.3	September 14
	MA02	Maurice Cr.	10U	575601	6202776	510	15.5	September 14
	MA03	Unnamed Trib.	10U	570579	6204261	500	12.7	September 16
Lynx	LX01	Lynx Creek	10U	564345	6221483	500	17.9	September 14
	LX03	Lynx Creek	10U	558729	6224420	500	29.5	September 14
	LX04	Brenot Cr.	10U	565097	6216686	125	10.2	September 16
	LX05	Brenot Cr.	10U	565092	6216539	125	10.1	September 16
Farrell	FA01	Farrell Cr.	10U	581360	6228457	370	14.7	September 16
	FA02	Farrell Cr.	10U	581448	6233356	300	26.3	September 16
	FA03	Farrell Cr.	10U	572499	6240091	500	55.3	September 15
	FA04	Farrell Cr.	10U	565925	6235072	500	76.1	September 16
	FA05	Farrell Cr.	10U	561011	6238185	300	85.4	September 15
	FA06	Farrell Cr.	10U	552083	6234386	500	97.8	September 16


Halfway River
Red Creek
Hwy 29
Fort St.John
Hwy 97
FA03
FA05
FA06
FA04
Farrell Creek
FA02
FA01
Cache Creek
LX03
LX01
Lynx Creek
Brenot Creek
LX04
LX05
Peace River
Proposed Site C Location
Taylor
Pine River
Moberly River
Hudson's Hope
Peace Canyon Dam
MA01
Maurice Creek
MA03
MA02
BC Government Data
Trim Map: 94A001, 94A003, 94A004, 94A011 - 94A017, 94A022 - 94A026, 94A032, 94A034, 93P091 - 93P093, 93P082, 93P083, 94B020, 94A031, 94A02, 94B030
Trim 20K (Version I) Representational Digital Map Sheet 2D, contours, planimetry, IGDS format (BC Crown Registry and Geographic Base)
BC Hydro Data
Potential inundation level (461.8 m maximum elevation) from Digital Elevation Model [DEM] generated from LiDAR data acquired July and August, 2006.
Legend
Flow Direction
Waterbody
Road
Town
Dam
2010 Survey Site
0
10
20 km
N
DRAFT
January 2011
mainstream
Figure 1.1
Peace River Site C Hydro Project
Stage 2 Preliminary Reference Information
Peace River Study Area,
2010 Coldwater Species Fish Survey
No decision has been made to build the Site C Hydro Project. This map is for information only, for preliminary analysis and planning in stage 2 of the Site C Project. Construction of the Site C Clean Energy Project is subject to required regulatory approvals including environmental certification.


Peace River
MA01
MA03
MA02
Maurice Creek
BC Government Data
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Trim 20K (Version I) Representational Digital Map Sheet 2D, contours, planimetry, IGDS format (BC Crown Registry and Geographic Base)
BC Hydro Data
Potential inundation level (461.8 m maximum elevation) from Digital Elevation Model [DEM] generated from LiDAR data acquired July and August, 2006.
Legend
Site C Reservoir Inundation Level
Backpack Electrofishing Sites
Flow Direction
0
1.5
3 Km
N
DRAFT
January 2011
Figure 1.2
Peace River Site C Hydro Project
Stage 2 Preliminary Reference Information
Maurice Creek Catchment Fish Sampling Sites,
2010 Coldwater Species Fish Survey
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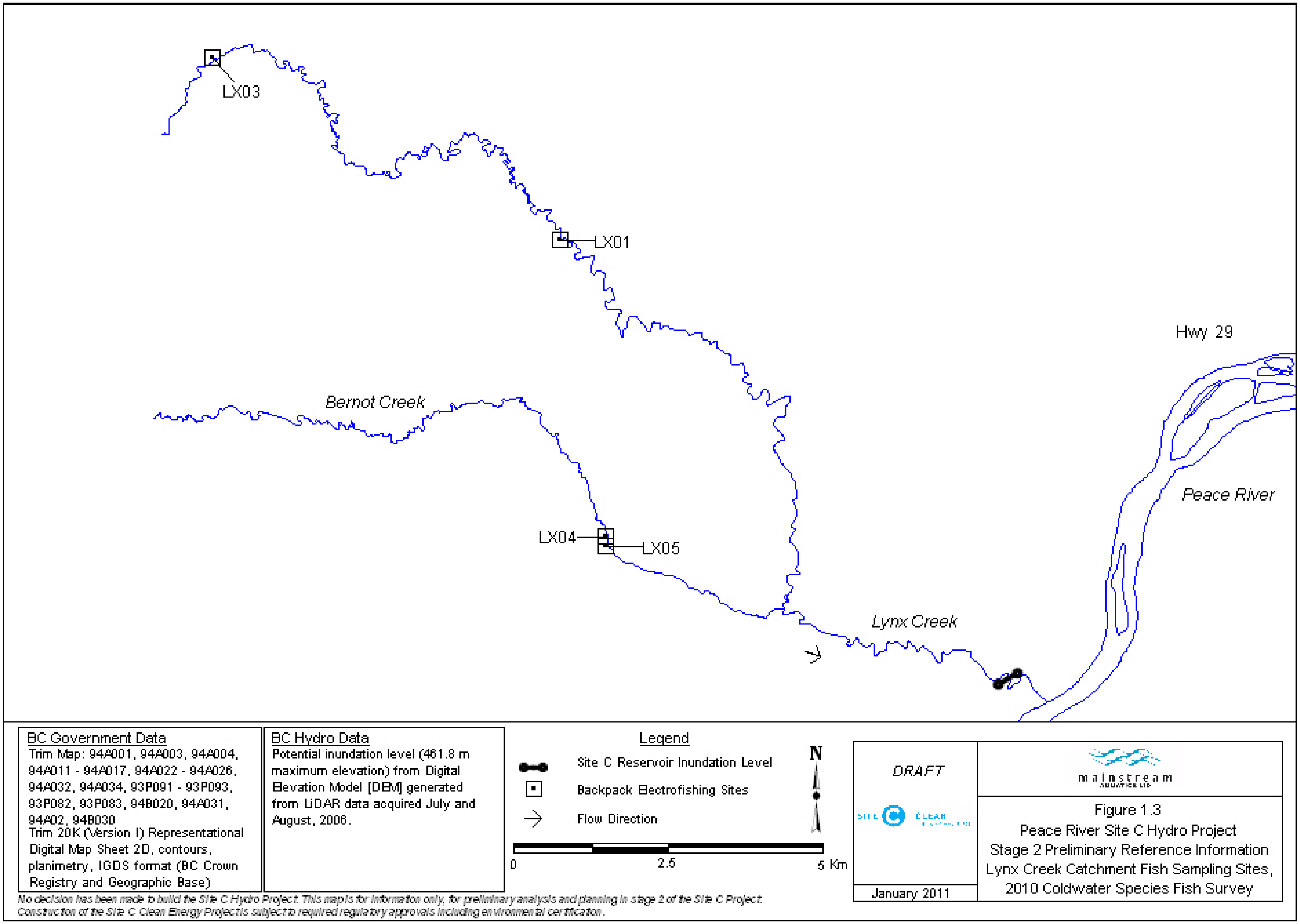
LX03
LX01
Hwy 29
Bernot Creek
Peace River
LX04
LX05
Lynx Creek
BC Government Data
Trim Map: 94A001, 94A003, 94A004, 94A011 - 94A017, 94A022 - 94A026, 94A032, 94A034, 93P091 - 93P093, 93P082, 93P083, 94B020, 94A031, 94A02, 94B030
Trim 20K (Version I) Representational Digital Map Sheet 2D, contours, planimetry, IGDS format (BC Crown Registry and Geographic Base)
BC Hydro Data
Potential inundation level (461.8 m maximum elevation) from Digital Elevation Model [DEM] generated from LiDAR data acquired July and August, 2006.
Legend
Site C Reservoir Inundation Level
Backpack Electrofishing Sites
Flow Direction
N
0
2.5
5 Km
DRAFT
January 2011
mainstream
Figure 1.3
Peace River Site C Hydro Project
Stage 2 Preliminary Reference Information
Lynx Creek Catchment Fish Sampling Sites,
2010 Coldwater Species Fish Survey
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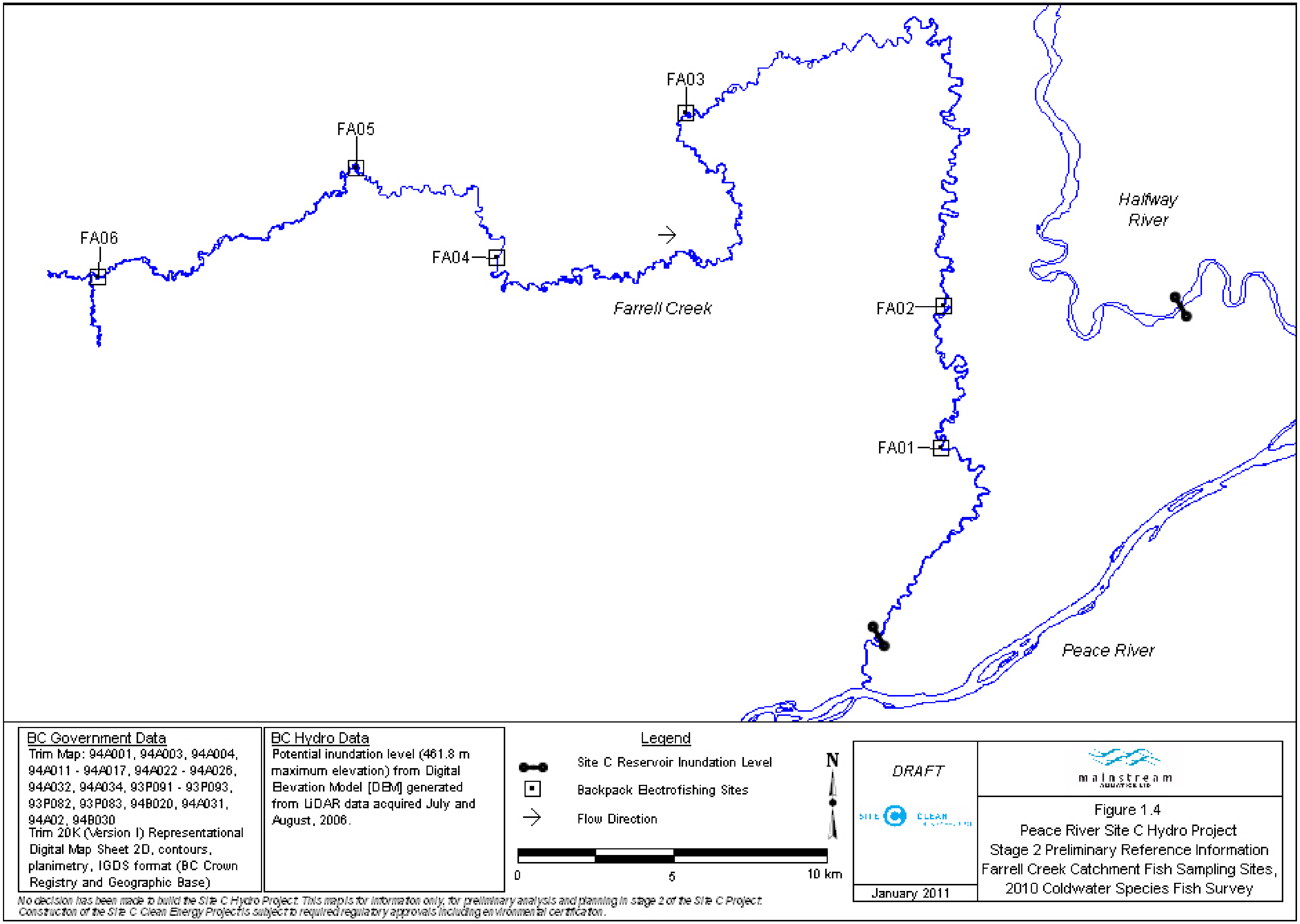
FA06
FA05
FA04
FA03
FA02
FA01
Farrell Creek
Halfway River
Peace River
BC Government Data
Trim Map: 94A001, 94A003, 94A004, 94A011 - 94A017, 94A022 - 94A026, 94A032, 94A034, 93P091 - 93P093, 93P082, 93P083, 94B020, 94A031, 94A02, 94B030
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BC Hydro Data
Potential inundation level (461.8 m maximum elevation) from Digital Elevation Model [DEM] generated from LiDAR data acquired July and August, 2006.
Legend
Site C Reservoir Inundation Level
Backpack Electrofishing Sites
Flow Direction
N
0
5
10 km
DRAFT
January 2011
mainstream
Figure 1.4
Peace River Site C Hydro Project
Stage 2 Preliminary Reference Information
Farrell Creek Catchment Fish Sampling Sites,
2010 Coldwater Species Fish Survey
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2.0 METHODS

2.1 FIELD

2.1.1 General Water Quality

Water clarity was measured to the nearest centimetre at each site with a secchi rod. At each site, a Hanna HI98311 EC/TDS meter was used to measure pH (± 0.01), conductivity (± 2% full scale), and water temperature (± 0.1^{o}C).

2.1.2 Fish Habitat

Habitat types at each site (Table 1.1) were classified according to O'Neil and Hildebrand (1986), which closely follow fish habitat assessment procedures (MOE 1995). The primary difference was separation of glide habitat into run or flat habitat based on observed differences in water velocity. Physical characteristics were measured at each site using fish habitat assessment procedures described in MOE (1995).

Parameters measured (definitions presented in Appendix B) at each site were as follows:

- Date and time
- Geodetic location
- Habitat type
- Channel width (m)
- Water depth (m)
- Water velocity (m/s)
- Substrate composition (%)
- D90 (cm)
- Substrate embeddedness (low, moderate, high)
- Substrate compaction (low, moderate, high)
- Large organic debris (presence)
- Photograph

Water depth (± 0.1 m) and water velocity (± 0.01 m/s) were measured at ¼, ½, and ¾ wetted channel width with a Swoffer Model 2100 velocity meter and staff rod using standard procedures described by Bain and Stevenson (1999). Percent substrate composition was visually estimated using a classification system based on the modified Wentworth Scale (Cummins 1962). A 2 m wide band situated perpendicular to each transect was used to visually assess substrate characteristics. D90 represented the average size of substrate particle that was in the 90th percentile and followed procedures outlined in MOE (1995). Embeddedness is the amount of fine particles (sand, silt, and clay) present within the substrate. Compaction evaluates the density or looseness of the substrate within the channel. Compaction and embeddedness were evaluated as low, moderate, or high. The presence or absence of large organic debris (LOD; woody debris), defined as having a diameter greater than 10 cm and a length greater than 1 m, also was recorded. Finally, digital photographs were taken of representative habitat types at each site.

2.1.3 Fish Capture

At each site, a backpack electrofisher was used to capture fish during the study. Standard sections containing multiple habitat units were sampled in wadeable tributaries. A Smith-Root Type XII high output backpack electrofisher with settings maintained at an output of 200-400 VDC, 6 ms and a frequency of 60 Hz was used. The backpack electrofisher operator waded upstream along the channel margin and sampled suspected fish holding areas. The netter, who was positioned in close proximity to the electrofisher operator, collected immobilized fish and placed them in a holding bucket. A single pass was used at each site; sampled length ranged from 125 m to 510 m (Table 1.1). At each site, effort was recorded as time (s), distance (m), and width (m) sampled.

Parameters measured at each fish sample site were as follows:

- Date and time
- Geodetic location
- Sample method settings
- Sample effort (seconds/meters/width)
- Biological characteristics
    - species
    - fork length (mm)

<u>Biological Characteristics</u>

Data recorded for most captured fish included species and fork length (to the nearest mm). Total lengths were measured for fish less than 20 mm, and sculpin species. When the catch exceeded 10 individuals per species a sub-sample was measured. The first 10 individuals of each species were measured, while the remaining fish were identified and enumerated prior to release.

The common name, scientific name, and label of all fish species mentioned in this report are presented in Table 2.1.

Smaller young-of-the-year suckers could not be identified to species in the field. For these fish, the percent composition of identified species in the sample was calculated. The calculated percentage for each species was then applied to the sample of unidentified fish. For example, if 50% of a sample was identified as longnose sucker, 10 of 20 unidentified suckers in that sample were designated as longnose sucker. This approach was used for 28 suckers from Farrell Creek.

Table 2.1 Fish species discussed in this report and recorded during the 2010 Site C coldwater species fish survey.

Group	Common Name	Scientific Name	Species Label
Sportfish	Arctic grayling	*Thymallus arcticus*	GR
	Bull trout	*Salvelinus confluentus*	BT
	Burbot	*Lota lota*	BB
	Kokanee	*Oncorhynchus nerka*	KO
	Lake whitefish	*Coregonus clupeaformis*	LW
	Mountain whitefish	*Prosopium williamsoni*	MW
	Northern pike	*Esox lucius*	NP
	Rainbow trout	*Oncorhynchus mykiss*	RB
Sucker	Largescale sucker	*Catostomus macrocheilus*	CSU
	Longnose sucker	*Catostomus catostomus*	LSU
	White sucker	*Catostomus commersoni*	WSU
Minnow/Trout-perch	Flathead chub	*Platygobio gracilis*	FHC
	Lake chub	*Couesius plumbeus*	LKC
	Longnose dace	*Rhinichthys cataractae*	LNC
	Northern pikeminnow	*Ptychocheilus oregonensis*	NSC
	Northern redbelly dace	*Phoxinus eos*	RDC
	Peamouth	*Mylocheilus caurinus*	PCC
	Redside shiner	*Richardsonius balteatus*	RCS
	Trout-perch	*Percopsis omiscomaycus*	TP
Sculpin	Prickly sculpin	*Cottus asper*	CAS
	Slimy sculpin	*Cottus cognatus*	CCG
	Spoonhead sculpin	*Cottus ricei*	CRI

2.2 OFFICE

Data collected in the field were recorded on standardized forms, which were checked for errors or omissions. Data were entered into standardized data entry spreadsheets using Microsoft Excel™. The data was visually compared to the field forms for errors and subjected to several summary analyses including graphical examination to identify errors and outliers. The checked fish and habitat data were then imported into a single Microsoft Access™ data file for management and storage.

Mapping

Geodetic location information (UTM coordinates) were tabulated and plotted onto geo-referenced base maps (BC TRIM, scale 1:20,000) using MapInfo Professional™. River locations are the distance upstream from the confluence with the Peace River (i.e., km 0 = confluence with the Peace River). River locations were calculated using MapInfo Professional™.

Catch Rate

Relative catch rate, or catch-per-unit-effort (CPUE), of fish was calculated for each site by dividing the number of fish captured by sampling effort. CPUE was expressed as number of fish/100 m.

Fish Biological Characteristics

Age-group designations were assigned based on modal peaks illustrated by length frequency distributions. Age-groups of interest were Age 0 (young-of-the year), Age 1, and older than Age 1.

3.0 RESULTS

3.1 MAURICE CREEK

3.1.1 General Water Quality

During the coldwater species fish survey in the Maurice Creek catchment, average pH was 8.8, average conductivity was 419 µS/cm and average water temperature was 7.6°C (Table 3.1; Appendix C). The pH was similar between sites; however conductivity and water temperature were lower in the unnamed tributary to Maurice Creek (site MA03) than in Maurice Creek (sites MA01 and MA02; Appendix C). Water clarity of Maurice Creek was high.

Table 3.1 General water quality of study tributaries, 2010 Site C coldwater species fish survey.

Catchment	*n*	pH		Conductivity (µS/cm)		Water Temperature (°C)		Water Clarity (m)	
		Average	Range	Average	Range	Average	Range	Average	Range
Maurice Cr.	3	8.8	8.68 – 8.89	419	322 – 504	7.6	4.9 – 10.0	TCB[a]	
Lynx Cr.	4	9.0	8.21 – 9.34	710	661 – 752	9.1	6.8 – 12.5	TCB	TCB – 0.08
Farrell Cr.	6	8.8	8.26 – 9.27	476	289 – 546	8.7	6.3 – 10.9	TCB	

[a] To channel bed.

3.1.2 Fish Habitat

The major habitat types recorded at each site in Maurice Creek were pools, riffles, and runs (Plate 1; Appendix D). Other habitats recorded included flats and falls (Plate 2). The first set of major falls approximately 2.5 m – 30 m high, located 3.0 km upstream of the Peace River, were a permanent barrier to upstream fish passage. Beaver impoundments were prevalent upstream of site MA02 in Maurice Creek.

Water depth was generally less than 0.25 m, and water velocities were generally less than 0.24 m/s (Figure 3.1, Appendix D). Pool habitats exhibited greater water depths (0.50 m). D90 exceeded 45 cm in all habitats, which indicated substantial stream power at high flows. At site MA01, overhead and rock provided cover for aquatic fauna. More cover was available upstream at sites MA02 and MA03, with overhead, rock, LOD, and vegetation cover present.

Cobbles generally dominated the bed materials at most sites. There was also a high proportion of coarser material (i.e., boulder and bedrock) at site MA01 and a high proportion of finer material (i.e., silt, sand, and gravel) at sites MA02 and MA03, which are located upstream of site MA01. Bed material embeddedness and compaction was moderate to high at each site.

Overall, the riffle-pool-run complexes, moderate velocity, and coarse substrate provided moderate quality spawning, rearing, and feeding habitat for coldwater fish species at the sites surveyed in the Maurice Creek catchment (Plate 1). Of the upstream sites, the unnamed tributary (site MA03) had better quality habitat than upper Maurice Creek (site MA02).Wintering habitats at all sites was limited at the time of the survey due to the absence of deep water areas.

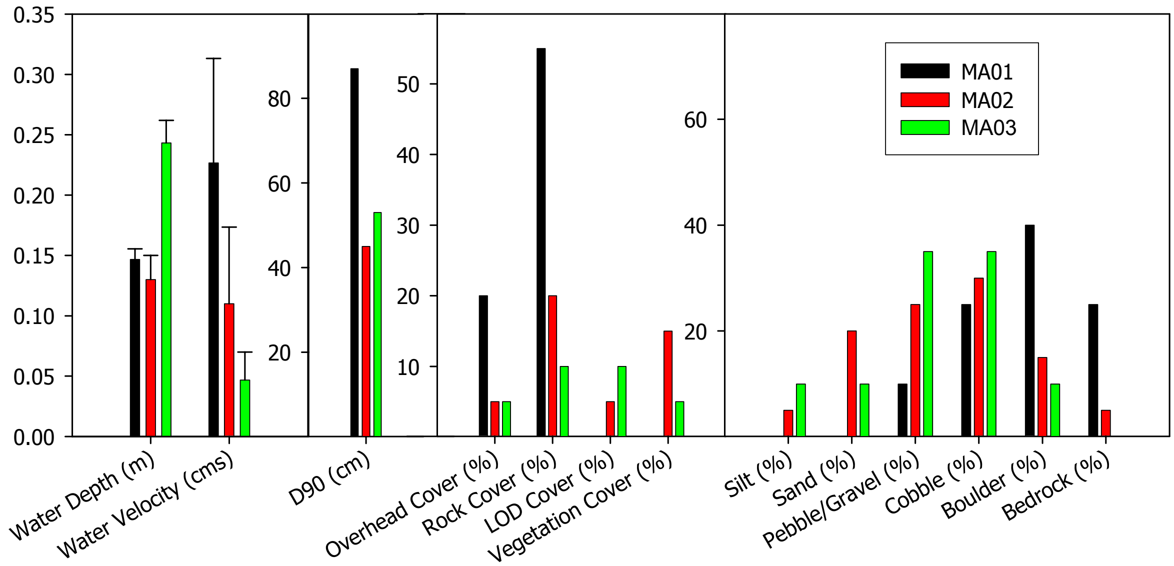

Figure 3.1 Physical and bed material characteristics (mean m, cms, cm, or % ± SE) of Maurice Creek (sites MA01 and MA02) and an unnamed tributary to Maurice Creek (site MA03), 2010 Site C coldwater species fish survey.

Plate 1: Riffle–run complex on Maurice Creek at site MA01, 14 September 2010.

Plate 2: Falls on Maurice Creek located 3.0 km upstream from the confluence with the Peace River, 14 September 2010.

3.1.3 Fish Composition, Distribution, and Catch Rate

No coldwater species were recorded in the Maurice Creek catchment survey area (Appendix E). In total, two fish were recorded during the coldwater fish survey, both were northern pike. All fish were recorded at site MA01; no fish were recorded at sites MA02 and MA03.

3.1.4 Fish Biological Characteristics

The length characteristics of sampled fish from Maurice Creek indicated that the northern pike were older juveniles or adult fish; the median length was 435 mm (range 426 – 441 mm).

3.2 LYNX CREEK

3.2.1 General Water Quality

During the coldwater fish survey in the Lynx Creek catchment (i.e., Lynx Creek and Brenot Creek), average pH was 9.0, average conductivity was 710 μS/cm, and average water temperature was 9.1^{o}C (Table 3.1; Appendix C). Conductivity was similar between sites; however, pH was higher in Brenot Creek (9.3) than in Lynx Creek (8.2 – 9.0) and water temperature was lower in Brenot Creek (6.8^{o}C – 7.1^{o}C) than in Lynx Creek (10.1^{o}C – 12.5^{o}C) (Appendix C). Water clarity at sites on Lynx Creek and at site LX04 upstream of a landslide on Brenot Creek was high (i.e., to channel bed). Water clarity of Brenot Creek at site LX05 located downstream of the landslide was very low (0.08 m).

3.2.2 Fish Habitat

The major habitat types recorded at each site on Lynx Creek were pools, riffles, and flats (Plates 3 and 4; Figure 3.2; Appendix D). The major habitat types recorded at each site on Brenot Creek were riffles, runs, and flats. Beaver impoundments were prevalent at the most upstream sites on Lynx Creek (site LX03) and Brenot Creek (site LX04; Plate 4). There is a series of falls approximately 2 m – 4 m high, located approximately 9.9 – 10.2 km on Lynx Creek upstream from the confluence with the Peace River. These falls were at least partial barriers to upstream fish passage. There were no known barriers or changes in fish habitat recorded between the sites on Lynx Creek (LX01 and LX03). The landslide, which separated sites LX04 and LX05 on Brenot Creek, had turbid runoff flowing into Brenot Creek near site LX05 (Plate 5).

Water depth was generally less than 0.25 m, and water velocities were generally less than 0.25 m/s (Figure 3.2). D90 was low on both creeks. In Lynx Creek, overhead and LOD provided cover for aquatic fauna. In Brenot Creek, overhead, rock, LOD, and vegetation provided cover for aquatic fauna.

Plate 3: Flat-run complex on Lynx Creek at site LX01, 14 September 2010.

Plate 4: Beaver impoundment on Brenot Creek at site LX05, 16 September 2010.

Plate 5: Landslide with runoff into Brenot Creek, 16 September 2010.

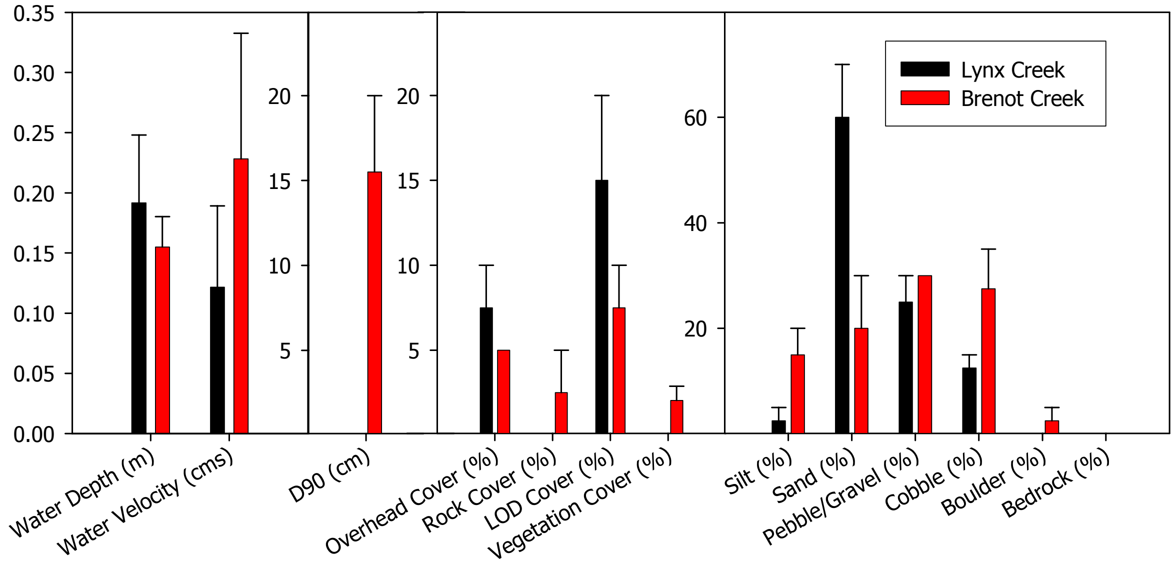

Figure 3.2 Physical and bed material characteristics (mean m, cms, cm, or % ± SE) of Lynx Creek and Brenot Creek, 2010 Site C coldwater species fish survey.

In Lynx Creek, sands dominated the bed material (Figure 3.2), whereas coarser substrate (i.e., pebbles/gravel and cobbles) dominated the bed material in Brenot Creek. Bed material generally had a high embeddedness and compaction at all sites.

The physical and bed material characteristics of the upstream and downstream sites were very similar in both Lynx Creek and Brenot Creek.

Overall, there was low quality spawning, rearing, and feeding habitat for coldwater fish species at the sites surveyed in the Lynx Creek catchment, due to an abundance of fine substrates. Wintering habitats at all sites was limited at the time of the survey due to the absence of deep water areas.

3.2.3 Fish Composition, Distribution, and Catch Rate

In total, 127 fish were recorded during the coldwater fish survey in the Lynx Creek catchment (Table 3.2; Appendix E). The sample consisted of two species, including one sportfish and one sculpin species. Rainbow trout were the dominant species recorded, accounting for 97.6% of the total sample whereas slimy sculpin accounted for 2.4% of the total.

In Lynx Creek, the majority of rainbow trout were recorded at site LX01. In Brenot Creek the majority of rainbow trout were recorded at site LX04 upstream of the landslide (Table 3.2; Figure 3.3). Slimy sculpin were only recorded upstream of the landslide on Brenot Creek (site LX04).

Table 3.2 Fish species composition in Lynx Creek and Brenot Creek, 2010 Site C coldwater species fish survey.

Group	Species	Lynx Creek				Brenot Creek				Total	
		Site LX01		Site LX03		Site LX05		Site LX04			
		No.	%	No.	%	No.	%	No.	%	No.	%
Sportfish	NP	0		0		0		0		0	
	RB	68	100.0	33	100.0	3	100.0	20	87.0	124	97.6
Suckers	CSU	0		0		0		0		0	
	LSU	0		0		0		0		0	
Minnows	LKC	0		0		0		0		0	
	LNC	0		0		0		0		0	
	NSC	0		0		0		0		0	
	RCS	0		0		0		0		0	
	TP	0		0		0		0		0	
Sculpin	CCG	0		0		0		3	13.0	3	2.4
Total		**68**	**100.0**	**33**	**100.0**	**3**	**100.0**	**23**	**100.0**	**127**	**100.0**
No. of Species		**1**		**1**		**2**		**1**		**2**	

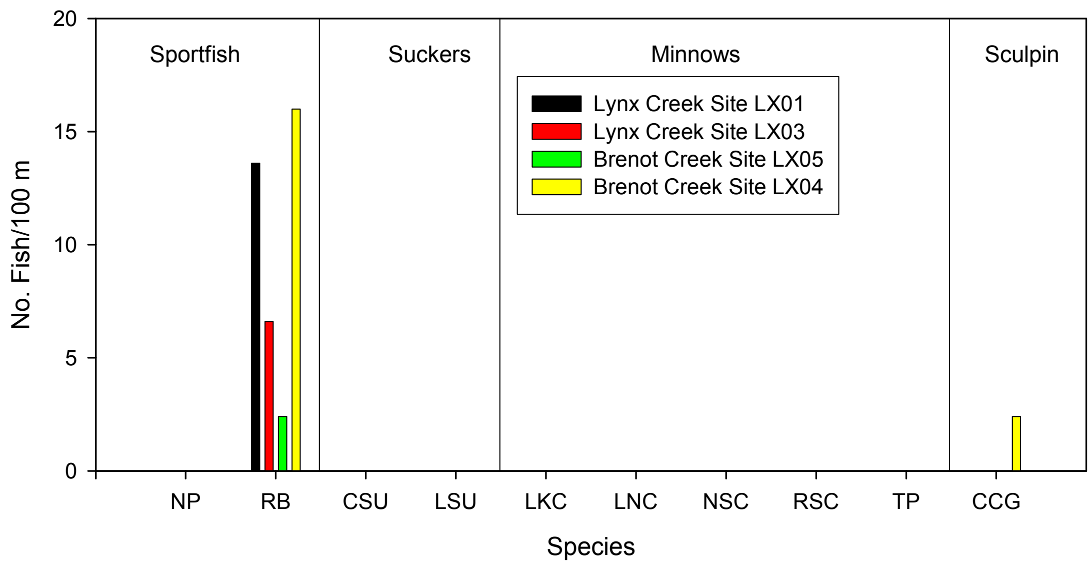

Figure 3.3 Fish relative catch rates (number of fish/100 m) in Lynx Creek and Brenot Creek, 2010 Site C coldwater species fish survey.

3.2.4 Fish Biological Characteristics

The length characteristics of sampled fish from Lynx Creek and Brenot Creek indicated that the rainbow trout sample consisted of Age 0 and older fish (Table 3.3, Table 3.4, and Figure 3.4). The majority of larger rainbow trout and Age 0 rainbow trout were recorded from site LX01 on Lynx Creek. Only larger, presumably older rainbow trout were recorded downstream of the Brenot Creek landslide (site LX05).

Table 3.3 Length characteristics of fish species sampled from Lynx Creek, 2010 Site C coldwater species fish survey.

Group	Species	Site LX01			Site LX03		
		No.	Median Length (mm)	Range	No.	Median Length (mm)	Range
Sportfish	RB	68	156.5	39 – 217	33	114	43 – 196
Sculpin	CCG	0			0		

Table 3.4 Length characteristics of fish species sampled from Brenot Creek, 2010 Site C coldwater species fish survey.

Group	Species	Site LX05			Site LX04		
		No.	Median Length (mm)	Range	No.	Median Length (mm)	Range
Sportfish	RB	3	105	101 – 130	20	129	47 – 192
Sculpin	CCG	0			3	78	77 – 82

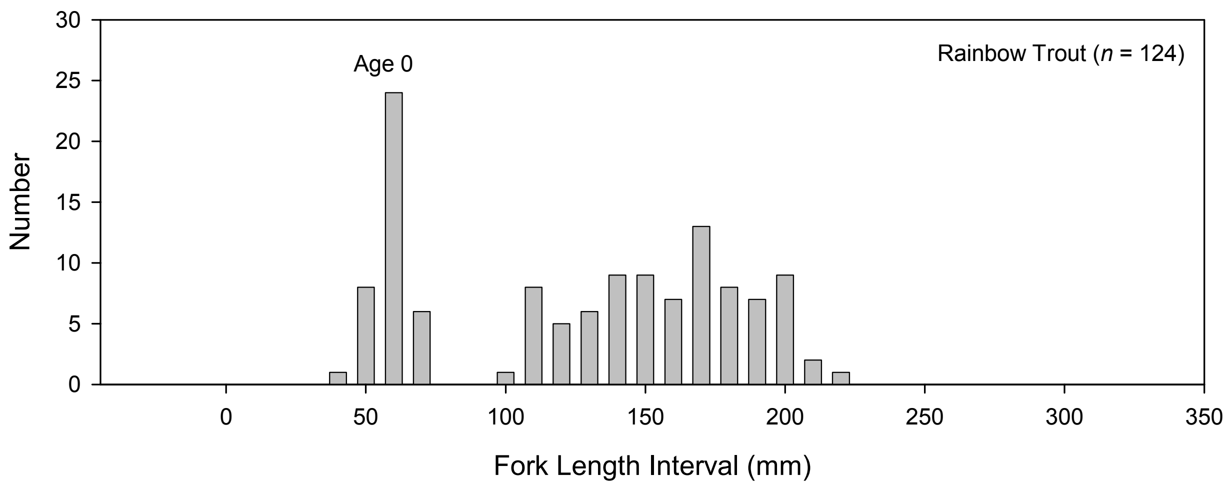

Figure 3.4 Length and suspected age distributions of rainbow trout sampled from Lynx Creek and Brenot Creek, 2010 Site C coldwater species fish survey (data from all sites combined).

3.3 FARRELL CREEK

3.3.1 General Water Quality

During the coldwater fish survey on Farrell Creek, average pH was 8.8, average conductivity was 476 µS/cm, and average water temperature was 8.7°C (Table 3.1; Appendix C). Conductivity, pH, and water temperature decreased with increasing distance upstream (Appendix C). Water clarity of Farrell Creek was high at the time of the survey (i.e., to channel bed).

3.3.2 Fish Habitat

The major habitat types recorded in Farrell Creek were pools, riffles, runs, and flats (Plates 6 and 7; Appendix D). Beaver impoundments were prevalent at the most upstream sites on Farrell Creek (sites FA05 and FA06).

Water depth was generally less than 0.30 m, and water velocities were generally less than 0.30 m/s (Figure 3.5). D90 generally exceeded 30 cm, which indicated substantial stream power at high flows. Overhead, rock, LOD, and vegetation provided cover for aquatic fauna. Overhead and LOD cover were more abundant at the most upstream site (FA06) than the other sites.

Cobble dominated the bed material throughout the creek (Figure 3.5), however, coarser substrates (i.e., boulder) were more abundant at the downstream sites (FA01, FA02, FA03, and FA04), whereas finer substrates (i.e., silt and sand) were more abundant at the upstream sites (FA05 and FA06). Bed material generally had a moderate to high embeddedness and compaction.

Overall, the riffle-pool-run complexes, moderate velocity and coarse substrate provided moderate quality spawning, rearing, and feeding habitat for coldwater fish species at the sites surveyed on Farrell Creek (Plate 6). Wintering habitats at all sites was limited at the time of the survey due to the absence of deep water areas.

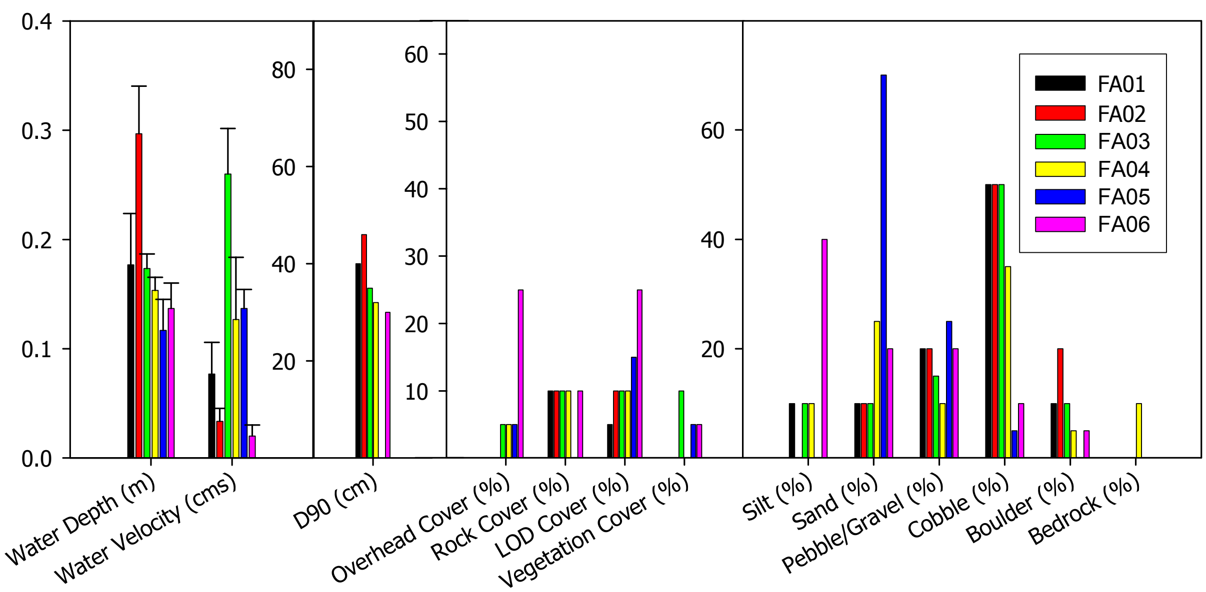

Figure 3.5 Physical and bed material characteristics (mean m, cms, cm, or % ± SE) in Farrell Creek, 2010 Site C coldwater species fish survey.

Plate 6: Typical riffle–run complex on Farrell Creek at site FA01, 16 September 2010.

Plate 7: LOD on Farrell Creek at site FA05, 15 September 2010.

3.3.3 Fish Composition, Distribution, and Catch Rate

In total, 550 fish were recorded during the coldwater fish survey on Farrell Creek (Table 3.5; Appendix E). The sample consisted of nine species, including one sportfish, two sucker, five minnow, and one sculpin species. Rainbow trout, a sportfish, accounted for 17.5% of the total sample. The sucker group accounted for 17.6% of the total sample. Longnose suckers (8.2%) and largescale suckers (9.4%) were well represented. Minnows were the numerically dominant group (40.5% of the total sample). Lake chub (9.3%), longnose dace (6.0%), and redside shiner (16.4%) were the numerically dominant species in the minnow group. Slimy sculpin was the only species encountered in the sculpin group and accounted for 24.4% of the total sample.

The species composition was generally similar between sites on Farrell Creek (Table 3.5), with eight to nine species recorded at each site. However, only six species were recorded at the farthest upstream site (FA06). Rainbow trout, longnose sucker, lake chub, longnose dace, redside shiner, and slimy sculpin were recorded at every site. Largescale sucker were recorded at every site except site FA06. Northern pikeminnow were only recorded at the downstream sites (FA01, FA02, and FA03) and trout-perch were only recorded at the middle sites (FA03, FA04, and FA05).

Table 3.5 Fish species composition in Farrell Creek, 2010 Site C coldwater species fish survey.

Group	Species	Site[a] FA01		FA02		FA03		FA04		FA05		FA06		Total	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Sportfish	NP	0		0		0		0		0		0		0	
	RB	8	17.4	18	46.2	16	14.4	11	7.0	11	10.7	32	34.4	96	17.5
Suckers	CSU	5	10.9	5	12.8	13	11.7	19	11.8	10	9.9	0		52	9.4
	LSU	2	4.3	4	10.3	8	7.2	7	4.7	12	11.5	12	12.9	45	8.2
Minnows	LKC	8	17.4	2	5.1	10	9.0	15	9.5	13	12.6	3	3.2	51	9.3
	LNC	5	10.9	1	2.6	12	10.8	5	3.2	7	6.8	3	3.2	33	6.0
	NSC	2	4.3	1	2.6	1	0.9	0		0		0		4	0.7
	RDC	12	26.1	5	12.8	28	25.2	13	8.2	31	30.1	1	1.1	90	16.4
	TP	0		0		5	4.5	32	20.3	8	7.8	0		45	8.2
Sculpin	CCG	4	8.7	3	7.7	18	16.2	56	35.4	11	10.7	42	45.2	134	24.4
Total		**46**	**100.0**	**39**	**100.0**	**111**	**100.0**	**158**	**100.0**	**103**	**100.0**	**93**	**100.0**	**550**	**100.0**
No. of Species		**8**		**8**		**9**		**8**		**8**		**6**		**9**	

[a] Sites are from downstream to upstream.

In general, fish catch rates were higher at the upstream sites than at the downstream sites (Figure 3.6). This was particularly true for the coldwater species (rainbow trout and slimy sculpin) and the suckers (largescale sucker and longnose sucker). Catch rates for lake chub, longnose dace, redside shiner, and trout-perch generally increased with increasing distance upstream; however catch rates at the most upstream site (FA06) decreased.

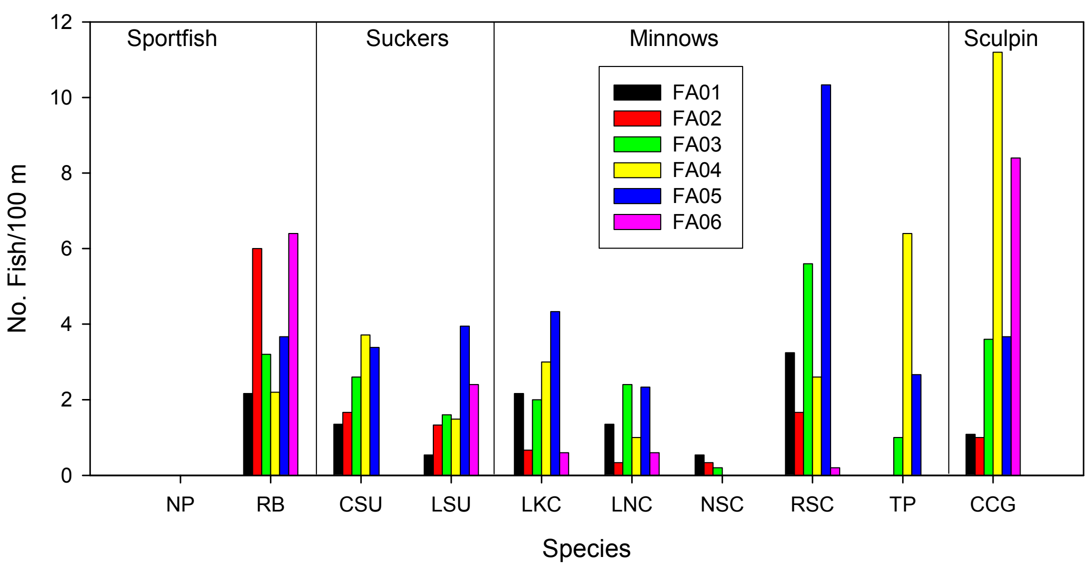

Figure 3.6 Fish catch rates (number of fish/100 m) in Farrell Creek, 2010 Site C coldwater species fish survey.

3.3.4 Fish Biological Characteristics

The length characteristics of sampled fish from Farrell Creek indicate that large-fish species (rainbow trout, longnose sucker, and largescale sucker) were dominated by Age 0 and suspected Age 1 and Age 2 fish (Figure 3.7; Appendix F).

There was a good distribution of age classes for rainbow trout in Farrell Creek. All of the suspected Age 0 rainbow trout were recorded at the most upstream site (FA06; Appendix F). Larger (> 150 mm fork length), presumably older rainbow trout were recorded throughout Farrell Creek; however, few (*n* = 2) were recorded at the most upstream site (FA06). Samples of both sucker species contained primarily suspected Age 1 fish. Larger longnose and largescale suckers were recorded at the downstream sites (FA01, FA02, and FA03) on Farrell Creek.

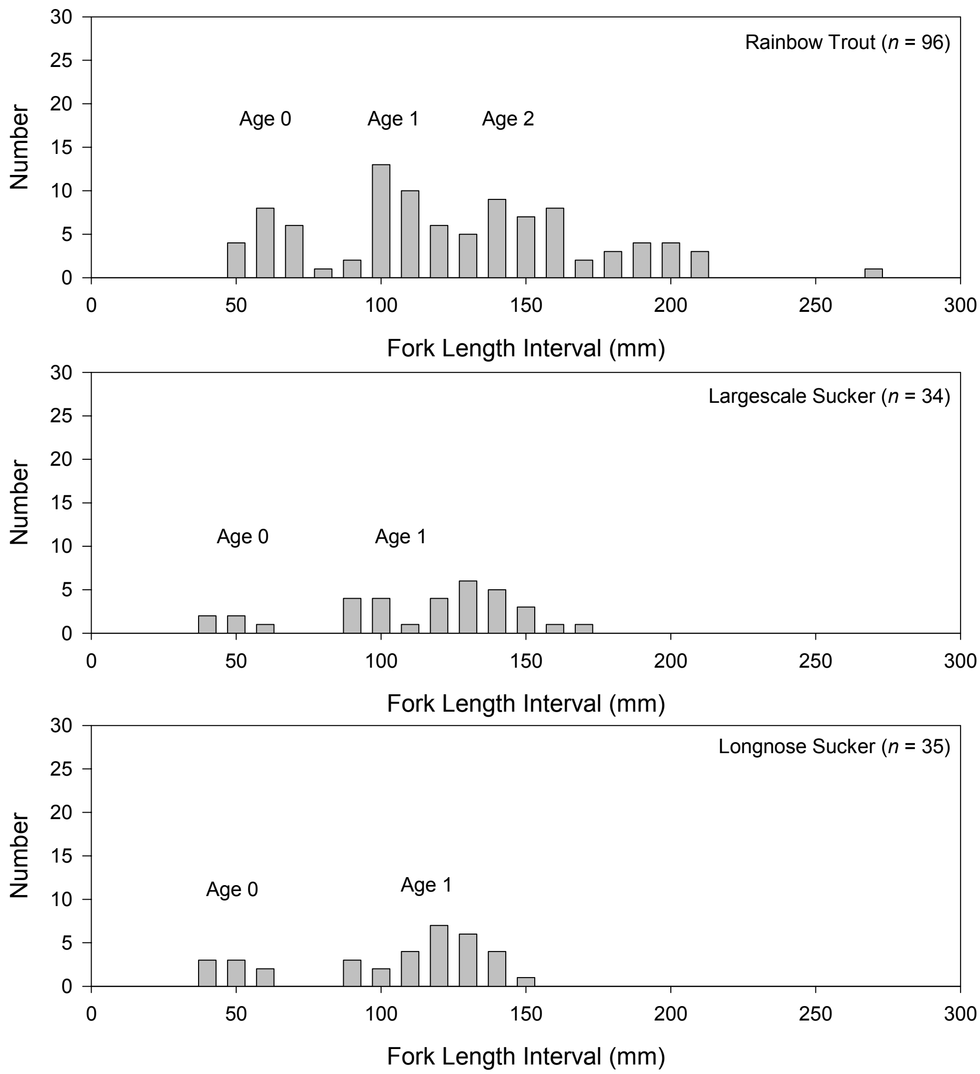

Figure 3.7 Length and suspected age distributions of rainbow trout, longnose sucker, and largescale sucker sampled from Farrell Creek, 2010 Site C coldwater species fish survey (data from all sites combined).

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4.0 DISCUSSION

4.1 GENERAL WATER QUALITY

4.1.1 Overview

Water quality parameters measured during the early fall survey (14 to 16 September 2010) were generally consistent among sites and tributaries. Water pH in all creeks ranged between 8.21 and 9.34, which indicated neutral to slightly alkaline conditions. Water conductivity values in the creeks were elevated and ranged from 289 μS/cm in the Farrell Creek catchment to 752 μS/cm in the Lynx Creek catchment. There are currently no conductivity water quality guidelines for the protection of aquatic life (CCME 2007); however, the high values likely indicated groundwater inputs. Water temperature generally decreased with increased distance upstream in each tributary and ranged from 4.9^{o}C in the Maurice Creek catchment to 12.5^{o}C in the Lynx Creek catchment.

Water clarity was generally high during the survey. However, Brenot Creek downstream of the landslide was turbid. The runoff from the landslide was contributing significant amounts of sediment to the system at the time of the survey, which may have adversely affected fish habitat (and fish) in Brenot Creek and Lynx Creek downstream of the landslide.

4.1.2 Comparisons to Other Studies

The water quality results of the 2010 program were similar to findings of previous studies (Mainstream 2009b, c). The pH in the tributaries has historically been neutral to slightly alkaline and conductivity has been moderate to high depending on stream and season (Mainstream 2009c).

In 2010, water temperatures at the most downstream sites were generally similar to findings of previous studies; however, water temperatures at the upstream sites were lower than that previously recorded. ARL (1991a, b), Pattenden *et al.* (1990), and AMEC & LGL (2006, 2007) recorded large seasonal changes in water temperature and/or discharge.

Pattenden *et al.* (1990) documented highly variable water turbidity, which tended to be low in summer, fall, and winter but very high in spring. The authors indicated that discharge had a strong influence on this water quality parameter. ARL (1991a, 1991b) also noted very low water clarity of tributaries during the early summer sampling program followed by clear water conditions during fall. The authors attributed this change to a decrease in suspended sediment concentrations caused by low water flow and the absence of sediment inputs from rainfall events. Their findings were consistent with results of other fisheries investigations completed in spring and fall 2008 (Mainstream 2009b).

Similar to this study, ARL (1991a, 1991b) documented that Brenot Creek was contributing significant amounts of sediment to the Lynx Creek catchment, which adversely affected fish habitat in Lynx Creek downstream of the confluence of these two systems.

4.2 FISH HABITAT

4.2.1 Overview

Pools, riffles, and runs were the dominant fish habitats in all three streams. These results suggested a consistent, uniform distribution of fish habitats (i.e., riffle-pool-run complexes) during low flow periods. Additionally, beaver impoundments were prevalent at the most upstream sites in each stream. These characteristics indicated that spawning, rearing, feeding, and wintering habitats were available to fish.

Water depth and water velocity in the catchments reflected low flow conditions at the time of the survey. Maximum water depths rarely exceeded 0.3 m. These characteristics limited the amount (surface area) and quality (water depth) of fish habitats in all streams.

Bed materials in most tributaries were dominated by coarser materials; however, bed material size varied within and between streams. Maurice Creek and Farrell Creek contained high percentages of cobbles at the downstream sites, whereas the upstream sites had a higher percentage of silt and sand. In the Lynx Creek catchment, Lynx Creek contained high percentages of sand and Brenot Creek contained high percentages of gravel and cobble.

Ratings for embeddedness and compaction provided an index of substrate quality, with higher index values indicating potential effects of sedimentation. All surveyed streams exhibited moderate to high ratings for embeddedness and compaction suggesting the potential for high sediment loads and sedimentation. High sediment loads and sedimentation has the potential to reduce the quality of spawning, rearing, and feeding habitats and can be harmful to young coldwater fish (Newcombe and MacDonald 1991, Anderson *et al.* 1996).

Overall, the riffle-pool-run complexes recorded in each stream provided spawning, rearing, and feeding habitats for coldwater fish species. Fish habitats in Maurice Creek and in Farrell Creek were deemed to be moderate quality. Spawning, rearing, and feeding habitat for coldwater fish species at the sites surveyed in the Lynx Creek catchment were deemed to be lower quality compared to the other surveyed streams due to an abundance of substrates. Wintering habitats in all streams was limited at the time of the survey due to the absence of deep water areas.

4.2.2 Comparisons to Other Studies

There have been few studies in the upper sections of the tributaries surveyed in this program. ARL (1991a) completed synoptic surveys of the lower and middle sections of each tributary. These surveys were generally located downstream of the sites in this study, however, there was some overlap of sites on Maurice Creek and Farrell Creek. ARL (1991b), RL&L (2001), AMEC & LGL (2006, 2007), and Mainstream (2009b, c) also completed surveys in the lower sections of the study catchments.

Similar to the sites surveyed in this study, the dominant fish habitats in the lower sections of the study streams were riffles, pools, and runs (or glides) (ARL 1991b, Mainstream 2009b). Although not quantified in this study, AMEC & LGL (2006) suggested that habitat composition varied between streams in the downstream reaches (i.e., downstream of the sites surveyed in this study). Maurice Creek and Lynx Creek were dominated by riffles with boulders, and Farrell Creek was comprised of a mix of riffles, pools, and runs.

Similar to results of the present study ARL (1991a, 1991b) noted a series of falls on each of Maurice Creek and Lynx Creek that were thought to be impassable to fish. These falls limit the amount of habitat available to Peace River fish populations upstream of the falls. On Maurice Creek, several falls (approximately 2.5 m – 30 m high) occur from 3.0 km to 8.0 km upstream from the confluence with the Peace River. On Lynx Creek, several falls (approximately 2 m – 4 m high) are located approximately 9.9 km to 10.2 km upstream from the confluence with the Peace River.

Similar to this study, in the lower sections the percentage of wetted width to bankfull width was low, suggesting that these systems were subjected to variable flows and that stream channels, at least at some locations, were laterally unstable (Mainstream 2009c, AMEC & LGL 2006). D90 values in the lower sections were greater than 20 cm at most sites, which suggested the potential for high flows (Mainstream 2009c).

Similar to this study, bed materials in the lower sections were generally dominated by coarser materials (Mainstream 2009c, AMEC & LGL 2006). However, lower Lynx Creek contained high percentages of cobbles and boulders (Mainstream 2009c), whereas upper Lynx Creek contained high percentages of silt and sand (this study). Also similar to this study, the lower sections of Maurice Creek, Lynx Creek, and Farrell Creek exhibited moderate to high ratings for embeddedness and compaction (Mainstream 2009c).

Overall, comparisons to other studies indicated that fish habitats in each study stream are spatially consistent. Comparisons to historical studies also suggest that fish habitats in each stream have not substantively changed over time.

4.3 FISH COMMUNITY

4.3.1 Overview

In total, 10 fish species were recorded in the study tributaries (Table 4.1). There was representation by sportfish (two species), suckers (two species), minnows/trout-perch (five species), and sculpins (one species). Nine species were recorded in Farrell Creek, two species were recorded in Lynx Creek, and despite the moderate habitat quality in Maurice Creek, only one species was recorded. The low number of species recorded in Maurice Creek and Lynx Creek may be due to the series of falls located on each tributary, which prevents access to fish originating from the Peace River. In Maurice Creek, the falls are absolute barriers to upstream fish passage, and in Lynx Creek the falls are likely barriers to upstream fish passage during most flows.

Table 4.1 Fish species distribution in study tributaries in this study, 2010 Site C coldwater species fish survey.

Group	Species	Maurice Creek	Lynx Creek	Farrell Creek
Sportfish	Northern pike	**X**		
	Rainbow trout		**X**	X
Suckers	Largescale sucker			X
	Longnose sucker			X
Minnows/ Trout-perch	Lake chub			X
	Longnose dace			X
	Northern pikeminnow			X
	Redside shiner			X
	Trout-perch			X
Sculpins	Slimy sculpin		X	**X**
Number of Species		**1**	**2**	**9**

[a] X denotes most numerous species in the group; **X** denotes most numerous species in the tributary.

Species distribution and abundance varied among streams. Only two species were recorded in more than one tributary. Rainbow trout and slimy sculpin were recorded in the Lynx Creek catchment and in Farrell Creek. Rainbow trout were the dominant species in Lynx Creek and they were abundant in Farrell Creek. Slimy sculpin were the dominant species in Farrell Creek; however, they were rare in the Lynx Creek catchment (n = 3). Northern pike, the only other sportfish recorded, were rare (n = 2) and were only recorded in Maurice Creek.

The remaining seven species were only recorded in Farrell Creek. In Farrell Creek, longnose suckers and largescale suckers were well represented and minnows were the numerically dominant group.

Northern pike were recorded at the most downstream site on Maurice Creek; no fish were recorded at the other sites.

In Lynx Creek, catch rate data indicated that rainbow trout were more abundant at the downstream sites in the study area. Conversely, in Farrell Creek and Brenot Creek, fish catch rates for all species were generally higher at the upstream sites than the downstream sites, which was particularly true for the coldwater species (rainbow trout and slimy sculpin) and the suckers (largescale sucker and longnose sucker). Catch rates for lake chub, longnose dace, redside shiner, and trout-perch in Farrell Creek generally increased with increasing distance upstream. This may have reflected a shift in habitat conditions such as greater abundance of fine substrates and low velocity zones.

Age 0 and older rainbow trout were present in Lynx Creek and in Farrell Creek, suggesting that both systems provide all required habitats for this species. Fewer rainbow trout and only larger, presumably older rainbow trout were recorded downstream of the landslide on Brenot Creek. It is unclear why rainbow trout are present in Lynx Creek and Brenot Creek given the lower quality habitats. It is possible that fish may be dispersing from upstream areas not sampled during the present study or that, habitat quality, although low, is sufficient to support rainbow trout.

4.3.2 Comparisons to other studies

Several investigations have inventoried fish communities in the study tributaries. Surveys completed by ARL (1991b), RL&L (2001), AMEC & LGL (2006, 2007), and Mainstream (2009b, c) all documented fish use of tributaries. These surveys cover an extended sample period (1989 to 2008); however, most focused on the lower sections of the tributaries and do not include the areas that were surveyed by this study. Of the three creeks, the lower sections of Maurice Creek supports the most diverse community, with 17 species previously recorded including six sportfish species and numerous coldwater species (i.e., Arctic grayling, rainbow trout, and sculpins) (ARL 1991b, RL&L 2001, AMEC & LGL 2006, 2007, and Mainstream 2009b, c). In the lower sections of Lynx Creek and Farrell Creek, 15 species have been previously recorded including four sportfish species (ARL 1991b, RL&L 2001, AMEC & LGL 2006, 2007, and Mainstream 2009b, c). The majority of these species likely reside in the Peace River and move into the lower sections of the tributaries at different times of the year. These findings suggest that the lower sections of Maurice Creek, Lynx Creek, and Farrell Creek support more diverse fish communities compared to the upper sections surveyed in this study. And, the lower sections are used by Peace River fishes, while the upper sections are not.

In Maurice Creek, there are no known recordings of coldwater fish species above the series of falls located approximately 3.0 – 8.0 km upstream from the confluence with the Peace River. Northern pike and northern pikeminnow are the only fish species that have been recorded above the first falls at Km 3.0 (ARL 1991a, Mainstream 2011, this study). It should be noted that it is highly unlikely that northern pikeminnow are present in the upper watershed (populations typically require access to large rivers); therefore, this species designation is likely an error (Mainstream 2011). Northern pike are piscivorous (i.e., they consume other fish), therefore it is interesting that no other species of fish have been recorded upstream of the falls at Km 3.0. It is possible that the northern pike subsist on amphibians and possibly macroinvertebrates (ARL 1999). It was hypothesized by ARL (1999) that the continued presence of northern pike in Maurice Creek is likely due to influx of northern pike from unnamed lakes located within the Maurice Creek catchment.

The absence of other sportfish in the upper sections of Maurice Creek, suggests that these sections are not accessible to coldwater sportfish species that occur downstream of the falls. Previous studies have concluded that the lower section of Maurice Creek (i.e., downstream of the Km 3.0 falls) provides spawning, rearing, and feeding habitat for several coldwater fish species including mountain whitefish, rainbow trout, prickly sculpin, slimy sculpin, and spoonhead sculpin (Mainstream 2009b, c).

In the upper sections of Lynx Creek, only rainbow trout have been recorded above the series of falls located approximately 9.9 – 10.2 km upstream from the confluence with the Peace River (ARL 1991a, this study). Similar to this study, high catch rates of rainbow trout were recorded upstream of the confluence with Brenot Creek (ARL 1991a).

Similar to this study, ARL (1991a) found that the upper sections of Farrell Creek are known to support a more diverse fish community than Maurice Creek and Lynx Creek. However, no rainbow trout were recorded in the upper sections of Farrell Creek in September 1989 (ARL 1991a), whereas this study found significant numbers of rainbow trout in the upper sections of Farrell Creek. This difference may reflect differences in sampling effort, sampling locations (the ARL 1991a study was further downstream compared to this study), annual variation in rainbow trout population dynamics, or environmental conditions at the time of sampling. One other explanation for the presence of rainbow trout during the present study, but not in 1989, is stocking in Chinaman Lake located at the headwaters of Farrell Creek. Chinaman Lake was stocked with approximately 2000–5000 rainbow trout in 1982, 1988, 1989, and 1990, and then annually since 1992 (Government of British Columbia 2010). It is possible that since the 1989 survey, the stocked fish have dispersed downstream throughout the Farrell Creek catchment. Rainbow trout have also been recorded in Ruby Creek and Beany Creek, which are tributaries to Farrell Creek (Government of British Columbia 2010).

4.3.3 Summary

Coldwater sportfish species that have the potential to use the three surveyed tributaries include rainbow trout, mountain whitefish, Arctic grayling, and bull trout. Of these species only rainbow trout were recorded by the present study.

In summer 2008, the lower sections of Maurice Creek, Farrell Creek, and Lynx Creek contained Age 0 and suspected Age 1 rainbow trout suggesting that all three creeks provided spawning, rearing, and feeding habitats for this species (Mainstream 2009c). Very high numbers of Age 0 rainbow trout in Maurice Creek provided strong evidence that the lower 1.86 km of Maurice Creek may be important to the Peace River rainbow trout population for spawning and rearing (Mainstream 2009c). However, no rainbow trout were recorded upstream of the Maurice Creek falls during this or previous studies.

Few rainbow trout were recorded in the lower sections of Lynx Creek and Farrell Creek in summer 2008 (Mainstream 2009c); however, this study indicated that rainbow trout were relatively abundant futher upstream. Higher numbers of rainbow trout in upper sections of Lynx Creek and Farrell Creek suggest better quality spawning, rearing, feeding, and wintering habitat compared to the lower sections of these tributaries.

Very few mountain whitefish (including young and old fish) have been recorded in the lower sections of the three study tributaries by previous investigations (AMEC & LGL 2006, 2007; Mainstream 2009c). No mountain whitefish were recorded in upper sections of the three study tributaries by the present study. The absence of this species indicates that none of the study three streams provides important habitats for this species.

Arctic grayling were not recorded during the present study and previous investigations (ARL 1991b, RL&L 2001, AMEC & LGL 2006, 2007, and Mainstream 2009b, c). Small numbers of Age 0 Arctic grayling have been recorded at the Farrell Creek confluence with the Peace River (RL&L 2001, Mainstream 2010). It is possible that a small population of Arctic grayling resides in the Farrell Creek catchment, but this population has not been detected.

Bull trout have been infrequently encountered in the lower sections of Maurice Creek, Lynx Creek, and Farrell Creek by previous investigations (ARL 1991b, RL&L 2001, AMEC & LGL 2006, 2007, and Mainstream 2009b, c). Bull trout were not recorded in the upper sections of the study streams during the present study. The results suggest that bull trout originating from the Peace River may enter the study streams opportunistically, but bull trout did not reside in these streams.

5.0 CONCLUSIONS

The present study described fish use and general habitat characteristics of three tributaries to the Peace River during late summer. The investigation examined environmental conditions (general water quality), measured physical characteristics of habitats, and described the fish community (composition, distribution, and abundance).

The physical characteristics of fish habitats in the study tributaries were influenced primarily by low flow conditions at the time of the survey and stream size. The physical characteristics of fish habitats were generally similar among and within the creeks surveyed. Habitats were dominated by riffle-pool-run complexes and bed materials were dominated by cobbles.

Ten fish species were recorded during the study, which represented four groups that included sportfish, suckers, minnows/trout-perch, and sculpins. Species assemblage varied substantially between catchments, with only one species recorded in the Maurice Creek catchment, two species recorded in the Lynx Creek catchment and nine species recorded in Farrell Creek.

Notable findings of the study were as follows:

1. The 2.5 m – 30 m falls in Maurice Creek are permanent barriers to upstream fish passage and there are no known records of coldwater fish species above the falls.
2. The 2 m – 4 m falls in the Lynx Creek catchment maybe barriers to upstream passage during most flows.
3. Sediment ladened discharge originating from a landslide located on Brenot Creek reduced the quality of downstream fish habitats in Brenot Creek and Lynx Creek downstream of the confluence with Brenot Creek.
4. The physical characteristics of fish habitats in Maurice, Lynx, and Farrell Creeks were generally similar. Habitats were dominated by riffle-pool-run complexes and bed materials were dominated by cobbles. Fish habitats in Lynx Creek were considered to be lower quality compared to the other study streams due to the abundance of fine substrates.
5. Farrell Creek supports a diverse fish community including two coldwater species: rainbow trout and slimy sculpin. Lynx Creek and Maurice Creek upstream of fish barriers do not support diverse fish communities. However, the Lynx Creek catchment (Lynx Creek and Brenot Creek) do support rainbow trout populations.

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APPENDICES

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APPENDIX A
Site Locations

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Appendix A Table A1. Sample site information (Nad 83, Zone 10), 2010 Site C Coldwater Species Fish Survey.

Waterbody Section	Method	Site	Easting	Northing	Upper Easting	Upper Northing	Lower Easting	Lower Northing
FARRELL CREEK								
	BACKPACK ELECTROFISH	FA01	581360	6228457	581360	6228457		
	BACKPACK ELECTROFISH	FA02	581448	6233356	581448	6233356		
	BACKPACK ELECTROFISH	FA03	572499	6240091	572499	6240091	572189	6239755
	BACKPACK ELECTROFISH	FA04	565925	6235072	565925	6235072	566083	6235444
	BACKPACK ELECTROFISH	FA05	561011	6238185	561011	6238185	561010	6238340
	BACKPACK ELECTROFISH	FA06	552083	6234386	552083	6234386	551770	6234428
LYNX CREEK								
	BACKPACK ELECTROFISH	LX01	564345	6221483	564345	6221483		
	BACKPACK ELECTROFISH	LX03	558729	6224420	558729	6224420		
	BACKPACK ELECTROFISH	LX04	565097	6216686	565097	6216686		
	BACKPACK ELECTROFISH	LX05	565092	6216539	565092	6216539		
MAURICE CREEK								
	BACKPACK ELECTROFISH	MA01	571079	6207162	571079	6207162	571467	6207127
	BACKPACK ELECTROFISH	MA02	575601	6202776	575601	6202776	575593	6203202
	BACKPACK ELECTROFISH	MA03	570579	6204261	570579	6204261	570379	6203983

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APPENDIX B
Definitions

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Appendix – B1A
Habitat Type Classification System

Instream Habitat (modified from RL&L Environmental Services Ltd.)

Provides a qualitative assessment of the physical characteristics of a stream and its potential as fish habitat.

Riffle - Portion of channel with increased velocity relative to Run and Pool habitat types; broken water surface due to effects of submerged or exposed bed materials; shallow (less than 25 cm). Limited value as habitat for larger juveniles and adults (i.e., feeding), but may be used extensively by young-of-the-year and small juveniles.

RF - Typical riffle habitat type; provides limited cover for all life stages.

RF/BG - Riffle habitat type with abundance of large cobble and boulder substrates. Limited cover for juveniles and adults; but, may be used extensively by young-of-the-year fish.

Rapids (RA) - Portion of channel with highest velocity relative to other habitat types. Deep (>25 cm); often formed by channel constriction. Substrate extremely coarse; dominated by large cobble and boulder substrates. Habitat provided for juveniles and adults in pocket eddies associated with substrate.

Run - Portion of channel characterized by moderate to high current velocity relative to Pool and Flat habitats; water surface largely unbroken. Potentially high habitat value for all life stages. Can be differentiated into five types based on depth and cover.

R1 - Maximum depth exceeding 1.5 m; average depth 1.0 m. High cover at all flow conditions. Highest quality habitat for larger juveniles and adults; limited value for young-of-the-year-fish.

R2/BG - Maximum depth reaching 1.0 m and generally exceeding 0.75 m; presence of large cobble or boulder substrates in channel. High cover at all flows. Moderate to high quality habitat for larger juveniles and adults.

R2 - Maximum depth reaching 1.0 m and generally exceeding 0.75 m. High cover during most flows, but not during base flows. Moderate quality habitat for juveniles and adults; limited value for young-of-the-year-fish.

R3/BG - Maximum depth of 0.75 m, but averaging <0.50 m; presence of large cobble or boulder substrates in channel. Moderate cover at all flows. Moderate quality habitat for juveniles and adults; but, the value to young-of-the-year-fish is potentially high.

R3 - Maximum depth of 0.75 m, but averaging <0.50 m. Low cover at all flows. Lowest quality habitat for juveniles and adults; but, the value to young-of-the-year-fish is potentially high.

Flat - Area of channel characterized by low current velocities (relative to RF and Run cover types); near-laminar (i.e., non-turbulent) flow. Depositional area dominated sand/silt substrates. Differentiated from Pool habitat type by high channel uniformity and lack of direct association with riffle/run complex. Potential habitat value for all life stages is moderate to high. Can be differentiated into five types based on depth and cover.

F1 - Maximum depth exceeding 1.5 m; average depth 1.0 m or greater. High cover at all flows. Highest quality habitat for larger juveniles and adults; limited value for young-of-the-year-fish.

F2/BG - Maximum depth reaching 1.0 m and generally exceeding 0.75 m; presence of large cobble or boulder substrates in channel. High cover at all flows. Moderate to high quality habitat for larger juveniles and adults.

F2 - Maximum depth exceeding 1.0 m; generally exceeding 0.75 m. High cover during most flows, but not during base flows. Moderate quality habitat for juveniles and adults; limited value for young-of-the-year-fish.

F3/BG - Maximum depth of 0.75 m, but averaging <0.50 m; presence of large cobble or boulder substrates in channel. Moderate cover at all flows. Moderate quality habitat for juveniles and adults; but, the value to young-of-the-year-fish is potentially high.

F3 - Maximum depth of 0.75 m, averaging less than 0.50 m. Low cover at all flows. Lowest quality habitat for juveniles and adults; but, the value to young-of-the-year-fish is potentially high.

Pool - Discrete portion of channel featuring increased depth and reduced velocity (downstream oriented) relative to Riffle and Run habitat types. Normally featuring Riffle/Run associations. Principal habitat value for all life stages is cover. When in close association with Riffle/Run habitats, value can be very high. Can be differentiated into three types based on depth.

P1 - Maximum depth exceeding 1.5 m; average depth 1.0 m or greater; high cover at all flow conditions. Often intergrades with deep-slow type of R1. Highest quality habitat for larger juveniles and adults; limited value for young-of-the-year-fish.

P2 - Maximum depth reaching or exceeding 1.0 m, generally exceeding 0.75 m. High cover at all but base flows. Moderate quality habitat for juveniles and adults; limited value for young-of-the-year-fish.

P3 - Maximum depth of 0.75 m, averaging <0.50 m. Low instream cover; includes small pocket eddies. Lowest quality habitat for all life stages.

Special Features - Includes the following instream features:

Ledges (LG) - Areas of bedrock intrusion into the channel; often creates Chutes and Pool habitat.

Falls (FAL) - Channel section exhibiting distinct vertical falls over boulder and bedrock. Often a barrier to fish.

Cascade (CAS) - Area of channel exhibiting distinct drop over boulder and bedrock, but, no defined falls. Often a barrier to fish.

Tributary Confluence (TC)) - Area of main river channel directly affected by tributary confluence.

Snye (SN) - Well-defined back channel not subjected to mainstem currents.

Backwater (BW) - Well-defined zone of zero or reverse flow water velocity associated with a large bank irregularity.

Bank Habitat (modified from RL&L Environmental Services Ltd.)

The zone within the immediate hydraulic influence of the bank-water interface. Typically extends from the annual high-water to low-water mark.

Armoured
Bank is stable and is composed of armoured cobble to boulder substrates that are not subjected to movement during annual floods; can be differentiated into categories based on the amount of bank roughness.
(A1 very rough, A2 moderately rough, A3 not rough)

Canyon
Bank is stable, is near vertical, and is composed of boulder to bedrock substrates; can be differentiated into categories based on the amount of bank roughness (C1 very rough, C2 moderately rough, C3 not rough).

Depositional
Bank exhibits low relief and is composed of silt to cobble substrates; characterized by high substrate mobility and low bank roughness (D1 cobble; D2 gravel; D3 sand and silts). Differentiated into tributary (TD) and mainstem (MD) depositional zones.

Erosional
Bank is dominated silt to gravel substrates that exhibit evidence of active erosion; note that large rock substrates can be present; can be differentiated into categories based on the amount of bank roughness
(E1 very rough, E2 moderately rough, E3 not rough).

Substrate Classification System

Modified Wentworth classification for substrate particle sizes
(from Cummins 1962)

Category	Particle Size Range (mm)
Bedrock	-
Boulder	>256
Cobble	32 - 256
Gravel	1 - 32
Sand	0.0625 - 0.2-1
Silt	0.0039-0.0625
Clay	<0.0039
Organics	-

Appendix – B1B
Definitions

Wetted width (m):	Width of wetted stream channel at time of survey perpendicular to the direction of flow.
Channel width (m):	Width of rooted stream channel (perennial vegetation to perennial vegetation perpendicular to the direction of flow.
Habitat type:	Classification of habitats into discrete (see Habitat Classification System).
Substrate type (%):	Material forming the bottom of the stream bed (see Substrate Classification System). Visually rated within a predetermined area of stream bed.
D90 (cm):	The diameter of stream bed material which is larger than 90% of the remaining material.
Embeddedness:	Degree that rock substrates are surrounded and/or are covered by sediment (Low, Moderate, High).
Compaction:	Looseness of substrate; ability to be moved during high flow (Low, Moderate, High).
Fish Cover (%):	Instream materials (vegetation, logs, rock) that provide protection for fish within a predetermined area.
Discharge (m^3/s):	Volume of water flows past a point.
Bankfull width:	Point at which the stream overflows its banks.

Appendix – B1C
Life History Data Abbreviations and Codes

BC Label	Alberta Label	Common Name	Scientific Name	BC Label	Alberta Label	Common Name	Scientific Name
RB	RBTR	Rainbow trout	*Oncorhynchus mykiss*	BB	BURB	Burbot	*Lota lota*
GB	BNTR	Brown trout	*Salmo trutta*	CCG	SLSC	Slimy sculpin	*Cottus cognatus*
CT	CTTR	Cutthroat trout	*Oncorhynchus clarkii*	CRI	SPSC	Spoonhead sculpin	*Cottus ricei*
BT	BLTR	Bull trout	*Salvelinus confluentus*	CAS	PRSC	Prickly sculpin	*Cottus asper*
DV	DOVR	Dolly varden	*Salvelinus malma*	CAL	CSSC	Coastrange sculpin	*Cottus aleuticus*
LT	LKTR	Lake trout	*Salvelinus namaycush*	CCN	SHSC	Shorthead sculpin	*Cottus confusus*
AC	ARCH	Arctic char	*Salvelinus alpinus*	CLA	PSSC	Pacific staghorn sculpin	*Leptocottus armatus*
EB	BKTR	Brook trout	*Salvelinus fontinalis*	CBA	MTSC	Mottled sculpin	*Cottus bairdii*
GR	ARGR	Arctic grayling	*Thymallus arcticus*	CRH	TRSC	Torrent sculpin	*Cottus rhotheus*
MW	MNWH	Mountain whitefish	*Prosopium williamsoni*	BSB	BRST	Brook stickleback	*Culaea inconstans*
RW	RNWH	Round whitefish	*Prosopium cylindraceum*	NSB	NNST	Ninespine stickleback	*Pungitius pungitius*
PW	PGWH	Pygmy whitefish	*Prosopium coulterii*	TSB	THST	Threespine stickleback	*Gasterosteus aculeatus*
LW	LKWH	Lake whitefish	*Coregonus clupeaformis*	RSC	RDSH	Redside shiner	*Richardsonius balteatus*
KO	KOKA	Kokanee	*Oncorhynchus nerka*	NSC	NPMN	Northern pikeminnow	*Ptychocheilus oregonensis*
LSU	LNSC	Longnose sucker	*Catostomus catostomus*	PDC	PRDC	Pearl dace	*Margariscus margarita*
WSU	WHSC	White sucker	*Catostomus commersonii*	PCC	PEAM	Peamouth	*Mylocheilus caurinus*
CSU	LSSC	Largescale sucker	*Catostomus macrocheilus*	FHC	FLCH	Flathead chub	*Platygobio gracilis*
BSC	BRSC	Bridgelip sucker	*Catostomus columbianus*	LKC	LKCH	Lake chub	*Couesius plumbeus*
MSC	MNSC	Mountain sucker	*Catostomus platyrhynchus*	LNC	LNDC	Longnose dace	*Rhinichthys cataractae*
CMC	CHIS	Chiselmouth	*Acrocheilus alutaceus*	FDC	FNDC	Finescale dace	*Phoxinus neogaeus*
LSG	LKST	Lake sturgeon	*Acipenser fulvescens*	RDC	NRDC	Northern redbelly dace	*Phoxinus eos*
WSG	WHST	White sturgeon	*Acipenser transmontanus*	LDC	LPDC	Leopard dace	*Rhinichthys falcatus*
GE	GOLD	Goldeye	*Hiodon alosoides*	ESC	EMSH	Emerald shiner	*Notropis atherinoides*
NP	NRPK	Northern pike	*Esox lucius*	STC	SPSH	Spottail shiner	*Notropis hudsonius*
WP	WALL	Walleye	*Sander vitreus*	FM	FTMN	Fathead minnow	*Pimephales promelas*
	SAUG	Sauger	*Sander canadensis*	TP	TRPR	Trout-perch	*Percopsis omiscomaycus*
YP	YLPR	Yellow perch	*Perca flavescens*		IWDR	Iowa darter	*Etheostoma exile*

Sex and Maturity Descriptions

M	F	Class	Description
99		Immature A	Sex indeterminable due to small gonad size.
01	11	Immature B	Small gonad size; fish has never spawned and will not spawn during the coming spawning season.
02	12		Maturing but not ready to spawn; will spawn this year
06	16	Alternate	Small gonad size associated with large size; suggests alternate year spawner.
07	17	Gravid	Sexual organs fill cavity testes white, drops of milt fall with pressure; eggs completely round, some already translucent.
08	18	Ripe	Roe or milt are extruded by slight pressure on the belly.
09	19	Spent	Spawning completed; resorbtion of residual ovarian tissue is not yet complete.
10	20	External	Sex determined by external characteristics
97		Adult	Based on fish size; sex not determined.
98		Juvenile	Based on fish size; sex not determined.

Capture Method Codes

Code	Capture Method	Code	Capture Method
SL	Set line	ES	Boat electrofisher
DN	Dip net	EF	Backpack electrofisher
GN	Gill net	AL	Angling
BS	Beach seine	GE	Gee minnow trap
HN	Hoop net	RST	Rotary screw trap
TR	Trap		

Tag Codes

Code	
Y, W, O	Color code for tag (Yellow, White, Orange)

Code	Tag Type
P	PIT (Passive Integrated Transponder)
R	Radio (Radio transmitter tags)
F	Floy

Capture Codes

Code	Capture Code
0	First capture, released
1	First capture, mortality
2	Recapture, released
3	Recapture, mortality
5	Recapture, fin clip and lost tag

Age Structure Codes

Code	Age Structure	Code	Age Structure
SC	Scales	CL	Cleithra
OT	Otoliths	CS	Cleithra and scales
SO	Scales and otoliths	SF	Scales and fin rays
FR	Fin ray		

Identified to Family

BC/Alberta Label	Family
SU/SUCK	Catostomidae
CC/SCUL	Cottidae
MINN	Cyprinidae

APPENDIX C
Water Quality Data

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Appendix C Table C1. Water quality information, 2010 Site C Coldwater Species Fish Survey.

Waterbody	Section	Site	Date	pH	Conductivity (µS/cm)	Clarity (cm)
FARRELL CREEK						
		FA01	9/16/2010	9.24	509	
		FA02	9/16/2010	9.10	473	
		FA03	9/15/2010	9.27	523	
		FA04	9/16/2010	8.72	546	
		FA05	9/15/2010	8.47	518	
		FA06	9/16/2010	8.26	289	
LYNX CREEK						
		LX01	9/14/2010	8.21	752	
		LX03	9/14/2010	8.98	661	
		LX04	9/16/2010	9.31	722	
		LX05	9/16/2010	9.34	703	8
MAURICE CREEK						
		MA01	9/14/2010	8.89	430	
		MA02	9/14/2010	8.68	504	
		MA03	9/16/2010	8.69	322	

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APPENDIX D
Habitat Data

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Appendix D Table D1. Habitat characteristics information, 2010 Site C Coldwater Species Fish Survey.

Waterbody Site	Habitat	Substrate (%) OM	Si	Sa	Gr	Co	Bo	Be	D90 (cm)	Emb.	Comp.	Cover (%) Ovh.	Rock	LOD	Subm.	Emer.	Algae	Depth (m) Near	Mid	Far	Velocity (m/s) Near	Mid	Far
FARRELL CREEK																							
FA01	RUN	0	10	10	20	50	10	0	40	M	M	0	10	5	0	0		0.12	0.14	0.27	0.03	0.13	0.07
FA02	RIFFLE	0	0	10	20	50	20	0	46	M	M	0	10	10	0	0		0.21	0.33	0.35	0.04	0.01	0.05
FA03	POOL	5	10	10	15	50	10	0	35	H	H	5	10	10	5	5		0.16	0.20	0.16	0.20	0.34	0.24
FA04	POOL	5	10	25	10	35	5	10	32	H	H	5	10	10	0	0		0.16	0.13	0.17	0.06	0.24	0.08
FA05	RIFFLE	0	0	70	25	5	0	0				5	0	15	5	0		0.06	0.15	0.14	0.13	0.17	0.11
FA06	RIFFLE	5	40	20	20	10	5	0	30	M	M	25	10	25	0	0		0.16	0.16	0.09	0.01	0.01	0.04
LYNX CREEK																							
LX01	RIFFLE	0	0	70	20	10	0	0				10	0	20	0	0		0.40	0.10	0.20	0.01	0.42	0.21
LX03	FLAT	0	5	50	30	15	0	0				5	0	10	0	0		0.31	0.07	0.07	0.00	0.02	0.07
LX04	FLAT	0	20	30	30	20	0	0	11	H	M	5	0	10	0	5		0.20	0.21	0.22	0.00	0.07	0.00
LX05	RIFFLE	0	10	10	30	35	5	0	20	H	H	5	5	5	0	0		0.08	0.10	0.12	0.33	0.65	0.32
MAURICE CREEK																							
MA01	POOL	0	0	0	10	25	40	25	87	M	M	20	55	0	0	0		0.16	0.15	0.13	0.14	0.40	0.14
MA02	POOL	0	5	20	25	30	15	5	45	M	H	5	20	5	0	5		0.11	0.17	0.11	0.00	0.11	0.22
MA03	POOL	0	10	10	35	35	10	0	53	H	M	5	10	10	0	0		0.22	0.28	0.23	0.04	0.09	0.01

See Appendix B1 for definitions

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APPENDIX E
Sampling Effort and Catch Data

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Appendix E Table E1. Backpack electrofisher effort, small fish catch (≤ 200 mm length), total catch, and catch-per-unit-effort, 2010 Site C Coldwater Species Fish Survey.

Waterbody	Site	Date	Voltage	Freq. (Hz)	Effort (m)	Effort (s)	Species	Small Fish Catch	Small Fish CPUE (Fish/100m)
FARRELL CREEK									
	FA01	9/16/2010	275	60	370	914			
							CCG	4	1.08
							CSU	5	1.35
							LKC	8	2.16
							LNC	5	1.35
							LSU	2	0.54
							NSC	2	0.54
							RB	8	2.16
							RSC	12	3.24
	FA02	9/16/2010	275	60	300	698			
							CCG	3	1.00
							CSU	5	1.67
							LKC	2	0.67
							LNC	1	0.33
							LSU	4	1.33
							NSC	1	0.33
							RB	17	5.67
							RSC	5	1.67
	FA03	9/15/2010	275	60	500	1286			
							CCG	18	3.60
							CSU	13	2.60
							LKC	10	2.00
							LNC	12	2.40
							LSU	8	1.60
							NSC	1	0.20
							RB	15	3.00
							RSC	15	5.60
							TP	5	1.00
	FA04	9/16/2010	400	60	500	782			
							CCG	11	11.20
							CSU	17	3.80
							LKC	11	3.00
							LNC	5	1.00
							LSU	5	1.40
							RB	11	2.20
							RSC	13	2.60
							TP	11	6.40
	FA05	9/15/2010	300	60	300	680			
							CCG	11	3.67
							CSU	9	3.33
							LKC	12	4.33
							LNC	7	2.33
							LSU	10	4.00
							RB	11	3.67
							RSC	15	10.33
							TP	8	2.67
	FA06	9/16/2010	400	60	500	864			
							CCG	12	8.40
							LKC	3	0.60
							LNC	3	0.60

Appendix E Table E1. Backpack electrofisher effort, small fish catch (≤ 200 mm length), total catch, and catch-per-unit-effort, 2010 Site C Coldwater Species Fish Survey.

Waterbody	Site	Date	Voltage	Freq. (Hz)	Effort (m)	Effort (s)	Species	Small Fish Catch	Small Fish CPUE (Fish/100m)
							LSU	12	2.40
							RB	31	6.20
							RSC	1	0.20
LYNX CREEK									
	LX01	9/14/2010	200	60	500	1098			
							RB	64	12.80
	LX03	9/14/2010	200	60	500	1000			
							RB	33	6.60
	LX04	9/16/2010	275	60	125	500			
							CCG	3	2.40
							RB	20	16.00
	LX05	9/16/2010	275	60	125	271			
							RB	3	2.40
MAURICE CREEK									
	MA01	9/14/2010	300	60	500	810			
							NP	0	0.00

Appendix E Table E2. Numbers of fish observed and/or captured but released with no data that were used as part of the catch rate calculations, 2010 Site C Coldwater Species Fish Survey.

				Observed			RND		
Waterbody	**Method**	**Site**	**Species**	**YOY**	**Juv**	**Adult**	**YOY**	**Juv**	**Adult**
FARRELL CREE									
	BACKPACK ELECTROFISH								
		FA03	RSC	0	13	0	0	0	0
		FA04	CCG	0	45	0	0	0	0
		FA04	CSU	0	2	0	0	0	0
		FA04	LKC	0	4	0	0	0	0
		FA04	LSU	0	2	0	0	0	0
		FA04	TP	0	21	0	0	0	0
		FA05	CSU	0	1	0	0	0	0
		FA05	LKC	0	1	0	0	0	0
		FA05	LSU	0	2	0	0	0	0
		FA05	RSC	0	16	0	0	0	0
		FA06	CCG	0	30	0	0	0	0

See Appendix B for definitions

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APPENDIX F
Fish Biological Data

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Appendix F Table F1. Biological characteristics data for sampled fish, 2010 Site C Coldwater Species Fish Survey.

Site	FishID	Species	Fork Len (mm)	Wt. (g)	Sexual Mat.	Age Struct.	Age	Tag Type	Tag No.	Capt. Code
FA01	453	CSU	133							
FA01	454	RB	191							
FA01	455	RB	160							
FA01	456	RB	130							
FA01	457	RB	117							
FA01	458	RB	156							
FA01	459	LSU	127							
FA01	460	LSU	133							
FA01	461	RB	142							
FA01	462	CSU	119							
FA01	463	CSU	126							
FA01	464	RB	102							
FA01	465	NSC	87							
FA01	466	CCG	82							
FA01	467	CSU	88							
FA01	468	LKC	89							
FA01	469	CCG	83							
FA01	470	RB	117							
FA01	471	NSC	64							
FA01	472	LKC	73							
FA01	473	LKC	74							
FA01	474	CSU	60							
FA01	475	RSC	24							
FA01	476	RSC	38							
FA01	477	RSC	23							
FA01	478	LNC	34							
FA01	479	LKC	76							
FA01	480	RSC	76							
FA01	481	RSC	68							
FA01	482	RSC	37							
FA01	483	RSC	34							
FA01	484	RSC	42							
FA01	485	RSC	81							
FA01	486	RSC	73							
FA01	487	LKC	75							
FA01	488	LKC	73							
FA01	489	RSC	34							
FA01	490	LNC	61							
FA01	491	LNC	60							
FA01	492	LNC	53							
FA01	493	LKC	78							
FA01	494	LNC	77							
FA01	495	CCG	72							
FA01	496	LKC	77							
FA01	497	CCG	72							
FA01	498	RSC	72							
FA02	499	RB	206							
FA02	500	RB	140							
FA02	501	RB	189							
FA02	502	RB	133							
FA02	503	RB	185							
FA02	504	RB	106							
FA02	505	RB	189							
FA02	506	LSU	132							
FA02	507	CSU	158							
FA02	508	RB	146							
FA02	509	RB	156							
FA02	510	RB	143							
FA02	511	RB	88							
FA02	512	RB	142							
FA02	513	CSU	121							
FA02	514	CSU	115							
FA02	515	RB	142							
FA02	516	RB	152							
FA02	517	CSU	124							
FA02	518	RSC	78							
FA02	519	RB	135							
FA02	520	LKC	93							
FA02	521	RB	99							
FA02	522	LSU	130							
FA02	523	RB	106							
FA02	524	RB	104							
FA02	525	RSC	68							
FA02	526	RSC	74							
FA02	527	RSC	68							
FA02	528	RSC	74							
FA02	529	CCG	57							
FA02	530	LSU	122							
FA02	531	LSU	130							
FA02	532	LNC	60							
FA02	533	NSC	110							
FA02	534	CCG	59							

See Appendix B for definitions

Appendix F Table F1. Biological characteristics data for sampled fish, 2010 Site C Coldwater Species Fish Survey.

Site	FishID	Species	Fork Len (mm)	Wt. (g)	Sexual Mat.	Age Struct.	Age	Tag Type	Tag No.	Capt. Code
FA02	535	CCG	62							
FA02	536	CSU	91							
FA02	537	LKC	80							
FA03	213	LSU	140							
FA03	214	CSU	142							
FA03	215	CCG	39							
FA03	216	CSU	142							
FA03	217	CSU	140							
FA03	218	CSU	103							
FA03	219	CCG	61							
FA03	220	CCG	42							
FA03	221	LSU	117							
FA03	222	RSC	72							
FA03	223	RSC	72							
FA03	224	LKC	70							
FA03	225	LKC	72							
FA03	226	LSU	124							
FA03	227	LSU	117							
FA03	228	RB	123			SCALE				
FA03	229	RB	165			SCALE				
FA03	230	RB	192			SCALE				
FA03	231	RB	167			SCALE				
FA03	232	RB	106			SCALE				
FA03	233	RB	197			SCALE				
FA03	234	RB	117			SCALE				
FA03	235	RB	136			SCALE				
FA03	236	RB	201			SCALE				
FA03	237	RB	133							
FA03	238	RB	133							
FA03	239	RB	154			SCALE				
FA03	240	RB	122			SCALE				
FA03	241	RB	102							
FA03	242	RSC	75							
FA03	243	RSC	69							
FA03	244	LSU	83							
FA03	245	LSU	119							
FA03	246	CCG	63							
FA03	247	CSU	90							
FA03	248	CSU	130							
FA03	249	CCG	66							
FA03	250	NSC	113							
FA03	251	CSU	130							
FA03	252	RSC	68							
FA03	253	LNC	37							
FA03	254	RSC	35							
FA03	255	TP	71							
FA03	256	CSU	167							
FA03	257	RSC	70							
FA03	258	CSU	120							
FA03	259	RSC	29							
FA03	260	RSC	30							
FA03	261	RSC	69							
FA03	262	TP	31							
FA03	263	CCG	42							
FA03	264	CSU	91							
FA03	265	LKC	73							
FA03	266	LSU	150							
FA03	267	LKC	82							
FA03	268	LKC	73							
FA03	269	CCG	68							
FA03	270	CSU	120							
FA03	271	RSC	70							
FA03	272	LKC	80							
FA03	273	LNC	53							
FA03	274	RSC	71							
FA03	275	RSC	71							
FA03	276	TP	33							
FA03	277	LKC	78							
FA03	278	LNC	55							
FA03	279	RB	134							
FA03	280	RSC	71							
FA03	281	LKC	38							
FA03	282	RSC	32							
FA03	283	LKC	66							
FA03	284	CCG	39							
FA03	285	LNC	62							
FA03	286	LKC	78							
FA03	287	LSU	100							
FA03	288	CCG	42							
FA03	289	CCG	38							
FA03	290	CCG	41							
FA03	291	CSU	39							
FA03	292	CCG	33							

See Appendix B for definitions

Appendix F Table F1. Biological characteristics data for sampled fish, 2010 Site C Coldwater Species Fish Survey.

Site	FishID	Species	Fork Len (mm)	Wt. (g)	Sexual Mat.	Age Struct.	Age	Tag Type	Tag No.	Capt. Code
FA03	293	RB	115							
FA03	294	LNC	35							
FA03	295	TP	84							
FA03	296	CCG	39							
FA03	297	CCG	38							
FA03	298	TP	78							
FA03	299	CCG	37							
FA03	300	CCG	43							
FA03	301	CCG	68							
FA03	302	LNC	67							
FA03	303	LNC	53							
FA03	304	LNC	53							
FA03	305	LNC	30							
FA03	306	LNC	44							
FA03	307	LNC	56							
FA03	308	LNC	22							
FA03	309	CSU	41							
FA03	310	CCG	41							
FA04	374	CSU	137							
FA04	375	CSU	97							
FA04	376	CSU	144							
FA04	377	TP	73							
FA04	378	RSC	88							
FA04	379	CCG	62							
FA04	380	TP	77							
FA04	381	RSC	77							
FA04	382	CCG	52							
FA04	383	CCG	61							
FA04	384	TP	34							
FA04	385	YSU	29							
FA04	386	TP	38							
FA04	387	TP	67							
FA04	388	RSC	32							
FA04	389	RSC	21							
FA04	390	YSU	28							
FA04	391	CCG	71							
FA04	392	LKC	84							
FA04	393	TP	35							
FA04	394	CCG	52							
FA04	395	CCG	32							
FA04	396	CCG	54							
FA04	397	CCG	35							
FA04	398	TP	37							
FA04	399	CCG	35							
FA04	400	LKC	32							
FA04	401	LKC	72							
FA04	402	CCG	34							
FA04	403	CCG	52							
FA04	404	RSC	27							
FA04	405	YSU	36							
FA04	406	TP	73							
FA04	407	TP	34							
FA04	408	TP	40							
FA04	409	LKC	75							
FA04	410	RB	134			SCALE				
FA04	411	RB	198			SCALE				
FA04	412	RSC	89							
FA04	413	RB	106			SCALE				
FA04	414	RSC	32							
FA04	415	YSU	38							
FA04	416	LSU	120							
FA04	417	YSU	26							
FA04	418	LKC	80							
FA04	419	TP	20							
FA04	420	LSU	93							
FA04	421	RB	118							
FA04	422	YSU	25							
FA04	423	LKC	32							
FA04	424	LNC	67							
FA04	425	RSC	74							
FA04	426	LKC	31							
FA04	427	RSC	22							
FA04	428	LKC	62							
FA04	429	RB	172			SCALE				
FA04	430	RSC	21							
FA04	431	YSU	32							
FA04	432	YSU	32							
FA04	433	RB	108							
FA04	434	RSC	25							
FA04	435	LKC	32							
FA04	436	YSU	33							
FA04	437	YSU	30							
FA04	438	RB	158			SCALE				

See Appendix B for definitions

Appendix F Table F1. Biological characteristics data for sampled fish, 2010 Site C Coldwater Species Fish Survey.

Site	FishID	Species	Fork Len (mm)	Wt. (g)	Sexual Mat.	Age Struct.	Age	Tag Type	Tag No.	Capt. Code
FA04	439	RB	202			SCALE				
FA04	440	RB	175							
FA04	441	LKC	38							
FA04	442	LKC	68							
FA04	443	RSC	24							
FA04	444	RB	92			SCALE				
FA04	445	LNC	25							
FA04	446	RSC	28							
FA04	447	CSU	43							
FA04	448	CSU	39							
FA04	449	RB	131							
FA04	450	LNC	52							
FA04	451	LNC	67							
FA04	452	LNC	62							
FA05	130	CSU	132							
FA05	131	RSC	23							
FA05	132	YSU	28							
FA05	133	CSU	121							
FA05	134	CSU	93							
FA05	135	CSU	85							
FA05	136	CSU	87							
FA05	137	CSU	137							
FA05	138	RSC	68							
FA05	139	RSC	70							
FA05	140	CCG	74							
FA05	141	LSU	104							
FA05	142	TP	70							
FA05	143	LSU	108							
FA05	144	TP	40							
FA05	145	TP	69							
FA05	146	CCG	67							
FA05	147	TP	48							
FA05	148	RB	183			SCALE				
FA05	149	CCG	61							
FA05	150	RB	155			SCALE				
FA05	151	RSC	68							
FA05	152	RSC	72							
FA05	153	YSU	29							
FA05	154	RB	80			SCALE				
FA05	155	RSC	73							
FA05	156	LKC	73							
FA05	157	RB	148			SCALE				
FA05	158	TP	65							
FA05	159	TP	60							
FA05	160	CCG	72							
FA05	161	TP	50							
FA05	162	RSC	22							
FA05	163	RSC	73							
FA05	164	RSC	65							
FA05	165	RSC	64							
FA05	166	YSU	30							
FA05	167	RB	92			SCALE				
FA05	168	RB	122							
FA05	169	RB	105							
FA05	170	LKC	77							
FA05	171	CCG	62							
FA05	172	RSC	69							
FA05	173	LKC	72							
FA05	174	CCG	67							
FA05	175	YSU	27							
FA05	176	RSC	20							
FA05	177	RB	95			SCALE				
FA05	178	RB	95							
FA05	179	LNC	29							
FA05	180	RSC	25							
FA05	181	CCG	32							
FA05	182	YSU	32							
FA05	183	LSU	35							
FA05	184	RSC	24							
FA05	185	TP	30							
FA05	186	LNC	28							
FA05	187	RSC	68							
FA05	188	LSU	113							
FA05	189	RB	157			SCALE				
FA05	190	LKC	83							
FA05	191	LKC	77							
FA05	192	LSU	83							
FA05	193	LKC	72							
FA05	194	LKC	84							
FA05	195	LKC	72							
FA05	196	LKC	77							
FA05	197	CCG	42							
FA05	198	LSU	33							

See Appendix B for definitions

Appendix F Table F1. Biological characteristics data for sampled fish, 2010 Site C Coldwater Species Fish Survey.

Site	FishID	Species	Fork Len (mm)	Wt. (g)	Sexual Mat.	Age Struct.	Age	Tag Type	Tag No.	Capt. Code
FA05	199	LNC	29							
FA05	200	RB	128							
FA05	201	LNC	29							
FA05	202	CCG	72							
FA05	203	CCG	41							
FA05	204	LKC	33							
FA05	205	LKC	70							
FA05	206	YSU	29							
FA05	207	LKC	36							
FA05	208	CCG	38							
FA05	209	LSU	36							
FA05	210	LNC	32							
FA05	211	LNC	31							
FA05	212	LNC	27							
FA06	311	CCG	63							
FA06	312	LKC	87							
FA06	313	RB	96			SCALE				
FA06	314	RB	63			SCALE				
FA06	315	RB	172			SCALE				
FA06	316	LSU	121							
FA06	317	LSU	90							
FA06	318	LSU	48							
FA06	319	LKC	80							
FA06	320	CCG	80							
FA06	321	RB	63							
FA06	322	RB	51			SCALE				
FA06	323	RB	65							
FA06	324	RB	97			SCALE				
FA06	325	RB	149			SCALE				
FA06	326	CCG	76							
FA06	327	RB	92							
FA06	328	LSU	135							
FA06	329	LSU	106							
FA06	330	CCG	59							
FA06	331	LSU	52							
FA06	332	CCG	55							
FA06	333	RB	48							
FA06	334	LSU	116							
FA06	335	CCG	76							
FA06	336	CCG	41							
FA06	337	RB	99							
FA06	338	CCG	61							
FA06	339	RB	111			SCALE				
FA06	340	RB	55							
FA06	341	CCG	71							
FA06	342	CCG	31							
FA06	343	RB	54							
FA06	344	CCG	62							
FA06	345	RSC	71							
FA06	346	RB	53							
FA06	347	LSU	48							
FA06	348	RB	65							
FA06	349	RB	97							
FA06	350	RB	48			SCALE				
FA06	351	RB	108							
FA06	352	LSU	46							
FA06	353	RB	89							
FA06	354	CCG	37							
FA06	355	LSU	113							
FA06	356	RB	59							
FA06	357	LNC	68							
FA06	358	RB	57							
FA06	359	RB	51							
FA06	360	RB	100							
FA06	361	RB	44							
FA06	362	RB	70							
FA06	363	RB	67							
FA06	364	LSU	102							
FA06	365	LNC	70							
FA06	366	RB	46							
FA06	367	LKC	81							
FA06	368	RB	54							
FA06	369	RB	98							
FA06	370	RB	92							
FA06	371	LSU	52							
FA06	372	LNC	53							
FA06	373	RB	270			SCALE				
LX01	3	RB	178			SCALE				
LX01	4	RB	52			SCALE				
LX01	5	RB	198			SCALE				
LX01	6	RB	194			SCALE				
LX01	7	RB	187			SCALE				
LX01	8	RB	168			SCALE				

See Appendix B for definitions

Appendix F Table F1. Biological characteristics data for sampled fish, 2010 Site C Coldwater Species Fish Survey.

Site	FishID	Species	Fork Len (mm)	Wt. (g)	Sexual Mat.	Age Struct.	Age	Tag Type	Tag No.	Capt. Code
LX01	9	RB	58			SCALE				
LX01	10	RB	63			SCALE				
LX01	11	RB	146			SCALE				
LX01	12	RB	146			SCALE				
LX01	13	RB	184							
LX01	14	RB	116							
LX01	15	RB	198							
LX01	16	RB	158							
LX01	17	RB	55							
LX01	18	RB	48							
LX01	19	RB	48							
LX01	20	RB	54							
LX01	21	RB	52							
LX01	22	RB	129							
LX01	23	RB	169							
LX01	24	RB	172							
LX01	25	RB	179							
LX01	26	RB	39							
LX01	27	RB	164							
LX01	28	RB	208							
LX01	29	RB	124							
LX01	30	RB	156							
LX01	31	RB	62							
LX01	32	RB	58							
LX01	33	RB	51							
LX01	34	RB	51							
LX01	35	RB	57							
LX01	36	RB	54							
LX01	37	RB	54							
LX01	38	RB	62							
LX01	39	RB	60							
LX01	40	RB	51							
LX01	41	RB	45							
LX01	42	RB	60							
LX01	43	RB	173			SCALE				
LX01	44	RB	164			SCALE				
LX01	45	RB	197			SCALE				
LX01	46	RB	217			SCALE				
LX01	47	RB	192			SCALE				
LX01	48	RB	207			SCALE				
LX01	49	RB	188			SCALE				
LX01	50	RB	182			SCALE				
LX01	51	RB	180			SCALE				
LX01	52	RB	173			SCALE				
LX01	53	RB	58							
LX01	54	RB	174							
LX01	55	RB	199							
LX01	56	RB	190							
LX01	57	RB	182							
LX01	58	RB	200							
LX01	59	RB	58							
LX01	60	RB	186							
LX01	61	RB	163							
LX01	62	RB	157							
LX01	63	RB	180							
LX01	64	RB	167							
LX01	65	RB	161							
LX01	66	RB	136							
LX01	67	RB	143							
LX01	68	RB	136							
LX01	69	RB	54							
LX01	70	RB	65							
LX03	71	RB	137							
LX03	72	RB	117							
LX03	73	RB	58							
LX03	74	RB	52							
LX03	75	RB	156							
LX03	76	RB	144							
LX03	77	RB	169							
LX03	78	RB	196							
LX03	79	RB	144							
LX03	80	RB	112							
LX03	81	RB	44							
LX03	82	RB	43							
LX03	83	RB	168							
LX03	84	RB	153							
LX03	85	RB	167							
LX03	86	RB	107							
LX03	87	RB	51							
LX03	88	RB	51							
LX03	89	RB	138							
LX03	90	RB	114							
LX03	91	RB	44							

See Appendix B for definitions

Appendix F Table F1. Biological characteristics data for sampled fish, 2010 Site C Coldwater Species Fish Survey.

Site	FishID	Species	Fork Len (mm)	Wt. (g)	Sexual Mat.	Age Struct.	Age	Tag Type	Tag No.	Capt. Code
LX03	92	RB	54							
LX03	93	RB	141							
LX03	94	RB	52							
LX03	95	RB	135							
LX03	96	RB	54							
LX03	97	RB	159							
LX03	98	RB	105							
LX03	99	RB	105							
LX03	100	RB	148							
LX03	101	RB	103							
LX03	102	RB	166							
LX03	103	RB	107							
LX04	104	RB	162			SCALE				
LX04	105	RB	145			SCALE				
LX04	106	RB	192			SCALE				
LX04	107	RB	150			SCALE				
LX04	108	RB	160			SCALE				
LX04	109	RB	127			SCALE				
LX04	110	RB	167			SCALE				
LX04	111	RB	108			SCALE				
LX04	112	RB	47			SCALE				
LX04	113	RB	93			SCALE				
LX04	114	RB	125							
LX04	115	RB	123							
LX04	116	RB	131							
LX04	117	RB	117							
LX04	118	RB	64			SCALE				
LX04	119	RB	67			SCALE				
LX04	120	RB	132							
LX04	121	RB	138							
LX04	122	RB	48							
LX04	123	CCG	82							
LX04	124	CCG	78							
LX04	125	RB	132							
LX04	126	CCG	77							
LX05	127	RB	101							
LX05	128	RB	105							
LX05	129	RB	130							
MA01	1	NP	426							
MA01	2	NP	441							

See Appendix B for definitions