

**Reconnaissance (1:20,000)
Fish and Fish Habitat Inventory
Re-sampling of
the lower Buck Creek sub-basin
downstream of Klo Creek
Upper Bulkley River Watershed Group**

Watershed Code: 460-636000

Prepared for

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EXECUTIVE SUMMARY

Reconnaissance level fish and fish habitat inventory of streams in the lower Buck Creek watershed, downstream of Klo Creek, was initiated in 2001. Re-sampling of streams in the watershed in 2005 has concluded a broad scale fish inventory for the study area, based on TRIM (Terrain Resource Information Management) map data. While stream classification of some sampled reaches remains uncertain, fish distribution in most systems is well understood. Future fish inventory efforts can therefore focus on isolated cases where fish distribution remains unclear, and on operational needs. This report summarizes past fish inventory efforts and results in context with data collected during re-sampling to present a comprehensive picture of fish distribution in the lower Buck Creek drainage.

The lower Buck Creek watershed is a fifth order system that drains into the Bulkley River at Houston, BC, upstream of the Morice/Bulkley confluence. The study area included the mainstem reaches of Buck Creek and tributaries from the Bulkley River upstream to Klo Creek. The upper Buck Creek watershed, including Klo Creek, was inventoried in 1999 by Triton Environmental Consultants Ltd.

Fish and fish habitat inventory in 2005 was conducted to fulfill resampling requirements identified during initial reconnaissance level fish and fish habitat inventories conducted in 2001. Fish and fish habitat inventory since 2001 has resulted in sampling of 65 reaches (21.1% of reaches in the study area). A total of 13 sites representing 11 reaches (35.5% of sampled reaches) in 10 streams were re-sampled in June 2005. The only fish species captured during resampling was cutthroat trout (*Oncorhynchus clarki*); and coho (*O. kisutch*) and rainbow trout (*Oncorhynchus mykiss*) were the only species captured initial reconnaissance level sampling conducted in 2001. Buck falls is located in reach 6 of Buck Creek, and is a barrier to fish passage, and a cascade in reach 3 is a barrier to some species. The following species, including ones captured in 2001 and 2005, have been documented in the lower Buck Creek watershed:

- Pink salmon (*Oncorhynchus gorbusha*) (downstream of cascade)
- Chinook salmon (*Oncorhynchus tshawytscha*) (downstream of Buck Falls)
- Coho salmon (*Oncorhynchus kisutch*) (downstream of Buck Falls)
- Steelhead (*Oncorhynchus mykiss*) (downstream of Buck Falls)
- Cutthroat trout (*Oncorhynchus clarki*) (downstream of Buck Falls)
- Bull trout (*Salvelinus malma*) (downstream of Buck Falls)
- Dolly Varden (*Salvelinus confluentus*) (downstream of Buck Falls)
- Mountain whitefish (*Prosopium williamsoni*) (downstream of Buck Falls)
- Largescale suckers (*Catostomus macrocheilus*) (downstream of Buck Falls)
- Peamouth chub (*Couesius plumbeus*) (downstream of Buck Falls)
- Pacific lamprey (*Lampetra tridentate*) (downstream of Buck Falls)
- River lamprey (*Lampetra ayersi*) (downstream of Buck Falls)
- Rainbow trout (*Oncorhynchus mykiss*)
- Longnose suckers (*Catostomus catostomus*)
- White suckers (*Catostomus commersoni*)
- Redside shiners (*Richardsonius balteatus*)

Rainbow trout was the most widespread species captured in the Buck Creek watershed, and is the only salmonid documented upstream of Buck Falls. The population of rainbow trout upstream of Buck Falls and the population of rainbow trout upstream of a waterfall in Dungate Creek are genetically isolated from rainbow trout below these falls. Rainbow trout were captured in 11 of 32 reaches sampled for fish in the lower Buck Creek watershed. Coho were captured at two of the 32 reaches sampled during the initial inventory effort in the Buck Creek watershed (reach 6 of Buck Creek downstream of Buck falls, and reach 1 of Dungate Creek, a fourth order tributary to Buck Creek). Cutthroat trout were not captured during initial sampling, but have been documented at the bridge about 26 km downstream of Buck Falls, and were captured in reach 2 of Bob Creek (a third order tributary to Buck Creek). Due to the lack of large lakes, and the low number of small and moderate sized lakes, rainbow trout and cutthroat trout are speculated to have a fluvial life history. Coho appear to utilize fluvial habitat in the lower Buck for spawning, and juvenile rearing prior to smoltifying.

Results of this re-sampling project were combined with historical fish information to provide an overview of fish distribution based on stream size, gradient and elevation. The proportion of 3rd, 4th, and 5th order reaches found to be fish bearing, or suspected to be fish bearing, were notably higher than the proportion of 1st and 2nd order reaches. This is speculated to be due to low summer flows and lack of overwintering habitat in 1st and 2nd order reaches. Several of the lower order reaches (1st and 2nd order) were found to be ephemeral (10.0%), or to lack a defined channel (14.0%) in lower gradient and lower elevation zones. Interestingly, all fish bearing reaches where fish have been captured in the project area are below 1169 metres in elevation, had gradients less than 7%, and had mean channel widths greater than 1.9 m. Fish distribution appears to be strongly tied to the proximity of to the mainstem Buck Creek, larger order tributaries (e.g. Dungate Creek, Bob Creek), stream gradient, elevation and stream order.

PROJECT SUMMARY SHEET

PROJECT REFERENCE INFORMATION

MSR Project #:	HFP-SKR-002-2005
FDIS Project #:	946 Resampling
MSR Region:	Prince Rupert Region (06)
MSR District:	not applicable
FW Management Unit:	06-09
Fisheries Planning Unit:	not applicable
DFO Subdistrict:	Prince George (1)
Forest Region:	Prince Rupert
Forest District:	Morice Forest District
Forest Licensee & Tenure #:	Houston Forest Products, FLA – 16827 Canadian Forest Products, Morice TSA 20
First Nations Claim Area:	Wet'suwet'en Nation, Broman Lake Band, Skin Tyee Band

WATERSHED INFORMATION

Watershed Group	BULK
Watershed Name	Bulkley River
Watershed Code	460-636000
UTM at Mouth	9.667968.6006858
Watershed Area	288.36 km ² (study area only)
Total of all stream lengths	424.43 km
Stream Order	5
NTS Maps (1:50,000)	93L/1, 93L/2, 93L/7, 93L/8 (study areas only)
TRIM Maps	093L.018, 093L.027, 093L.028, 093L.037, 093L.038
BEC Zone	SBSmc, SBSdk, ESSFmc
Air Photos	30BCB 91180 No. 50-55 (study area only) 30BCB 91180 No. 104-106, No. 190-196 (study area only) 30BCB 91181 No. 8-13, No. 93-95 (study areas only) 30BCB 91181 No. 138-140 (study areas only) 30BCB 91179 No. 182-188 (study area only) 30BCC 96049 No. 202-209 (study area only) 30BCC 96050 No. 5-11 (study area only) 30BCC 96050 No. 128-133 (study area only)

SAMPLING DESIGN

Total # of Reaches	503 (in study area)
Initial Sample Sites (2001)	52
Re-sampling Sites	22 (25 proposed)
Added Value Sites	11 (8 proposed)
Total Sample Sites	33 (33 proposed)
Field Sampling Dates (2005)	June 26-29, July 16, 22, 27, Aug 1, 6, 22
Fish Species in Watershed	PK, CO, CH, ST, RB, DV, BT, RSC, WSU, LNC, CSU, LSU, MW, PL, RL

CONTRACTOR INFORMATION

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DISCLAIMER

This product has been accepted as being in accordance with the approved standards within the limits of the Ministry quality assurance procedures.

ACKNOWLEDGEMENTS

Funding for this project was provided by Forest Investment Account (FIA) and Houston Forest Products Co. (HFP), Houston, B.C. The contract was administered and monitored by Jaret van der Giessen for HFP. Helicopter services were provided by Highland Helicopters, and the help and effort of Ryan Buchanan is greatly appreciated. Editorial comments on drafts of this report were provided by Jaret van der Giessen (HFP), and Ron Saimoto (SKR Consultants Ltd.).

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LIST OF ATTACHMENTS AVAILABLE AT MSR OFFICE

Digital Project Overview Map
Digital Fisheries Project and Interpretive Maps
ArcView shape files for sites, reach gradient, reach features, and historical information
Photograph CD's (2 sets)
Digital reports
Digital FDIS database

1.0 INTRODUCTION

The lower portion of the Buck Creek Watershed, downstream of Klo Creek, were inventoried in August - September 2001 and in June – August 2005 to assess fish habitat characteristics and to investigate the diversity, population characteristics, and distribution of fish in the study area. SKR Consultants Ltd. was retained by Houston Forest Products Co. (Houston, B.C.) to conduct these surveys. The initial sampling project was jointly funded by Forest Renewal B.C. (FRBC) and Houston Forest Products Co. (HFP), and re-sampling in 2005 was funded by the Forest Investment Account (FIA) and HFP.

The Buck Creek watershed was divided into 2 sub-basins by Triton Environmental Consultants (2000). These sub-basins are:

- **Sub-Basin I: Lower Buck Creek (Buck Creek and tributaries downstream of Klo Creek), and**
- *Sub-Basin II: Upper Buck Creek (Buck Creek and tributaries upstream and including Klo Creek).*

Sub-basin II was inventoried by Triton Environmental Consultants in 1999 (Triton 2000) (indicated in italics above). Sub-basin I was inventoried in 2001 and re-sampled in 2005 (indicated in bold above). This report summarizes the initial and follow up reconnaissance level stream inventory project that was conducted in the lower Buck Creek sub-basin (sub-basin I) of the Buck Creek watershed.

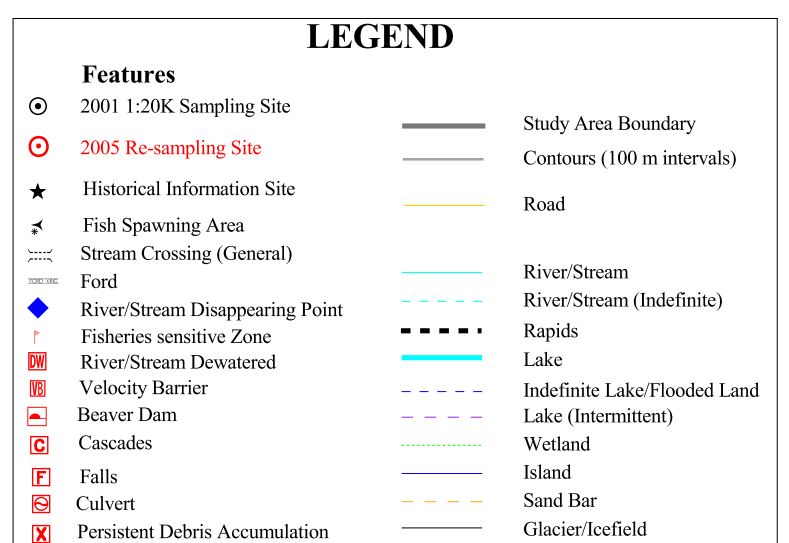
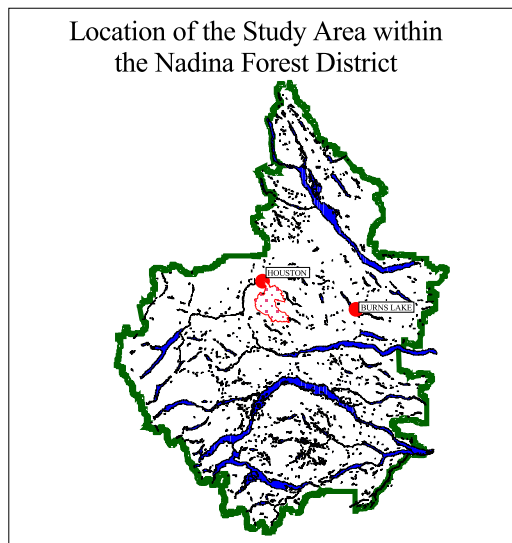
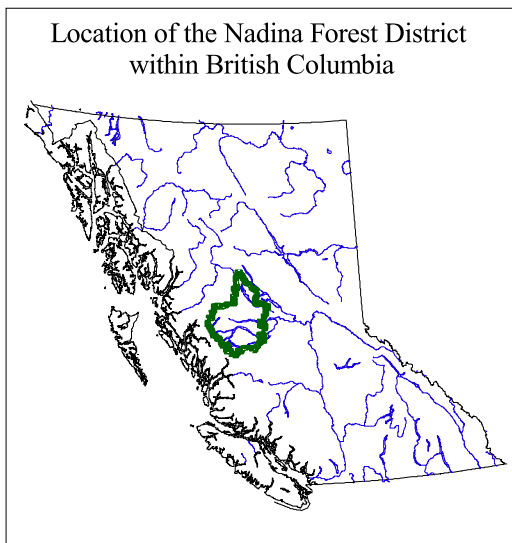
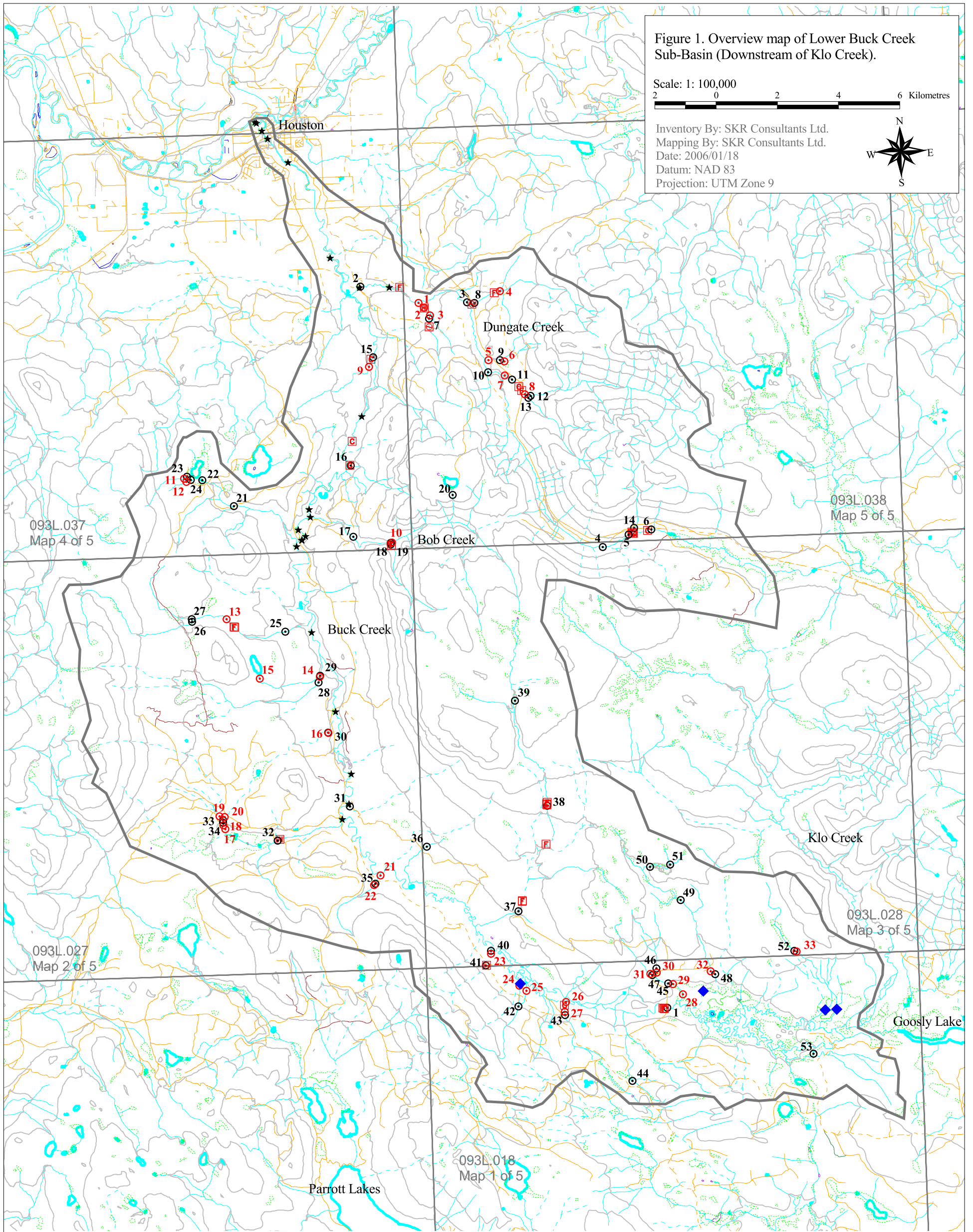
1.1 OBJECTIVES

The main objectives of the 1:20,000 fish and fish habitat reconnaissance level stream inventory project in lower Buck Creek watershed were:

- to review and summarize historical fisheries information for the study area,
- to describe fish distribution and diversity by conducting a 1:20,000 fish inventory,
- to document barriers to fish passage,
- to document fish habitat characteristics,
- to identify further sampling requirements, and
- to classify reaches sampled according to the B.C. Forest Practices Code Fish – Stream Identification guidebook (FPC 1998).

1.2 LOCATION

Buck Creek is located in the Morice Forest District within the Prince Rupert Region (Ministry of Forests, Ministry of Sustainable Resources). The Buck Creek watershed is the largest tributary to the Upper Bulkley River (upstream of the Morice River), and drains into Bulkley River at Houston, B.C. The lower Buck Creek sub-basin in the Buck Creek watershed was inventoried in August and September 2001. The sub-basin inventoried in 2001 and re-sampled in 2005 includes mainstem and tributary reaches to Buck Creek downstream of Klo Creek



1.2.1 ACCESS

The study area was accessed by vehicle and helicopter. To access the area by vehicle, proceed west from the Houston town center along Highway 16 for approximately 3 km. Turn left onto the Buck Flats Road. The study area can be accessed from the Buck Flats Road, and by a network of logging roads, and the Equity Silver Mine road, which branch off the Buck Flats Road. Some of the reaches sampled in this study could only be accessed by a helicopter, which was based out of Houston, B.C..

1.3 HISTORICAL INFORMATION

Buck Creek is thought to potentially be one of the most productive salmonid nursery streams in the upper Bulkley System (BCCF 1997). Anadromous species, including pink salmon (*Oncorhynchus gorbusha*), chinook salmon (*O. tsawytscha*), coho salmon (*O. kisutch*), pacific lamprey (*Lampetra tridentate*), and steelhead (*O. mykiss*) are known to utilize the lower reaches of Buck Creek, but upstream migration of anadromous fish is blocked by a waterfall located about 35.7 km upstream of the Bulkley River (BCCF 1997). In addition, a cascade in reach 3 of Buck Creek likely blocks fish passage for some species (e.g. pink salmon), and most species may be prevented from navigating past the cascade at some flows (BCCF 1997, 1998). Non-anadromous species documented present in Buck Creek and/or its tributaries include bull trout (*Salvelinus confluentus*), Dolly Varden (*S. malma*), rainbow trout (*O. mykiss*), mountain whitefish (*Prosopium williamsoni*), longnose dace (*Rhinichthys cataractae*), largescale suckers (*Catostomus macrocheilus*), white suckers (*C. commersoni*), and longnose suckers (*C. catostomus*) (BCCF 1997, 1998). River lamprey were captured in a rotary screw trap operated in 1999 (MacKay 1999), one cutthroat trout (*O. clarki*) was reported present during operation of a rotary screw trap in 2000 (SKR 2000), and a peamouth chub (*Couesius plumbeus*) was reported captured in a rotary screw trap operated in 2001 (SKR 2001), but the identification of these species has not been verified.

In addition to the 1:20,000 Reconnaissance Fish and Fish Habitat inventory project conducted on the upper Buck Creek sub-basin by Triton (2000), an overview and detailed fish habitat, riparian and channel assessment have been conducted on Buck Creek through funding supplied by the Watershed Restoration Program (BCCF 1997, 1998). Buck Creek coho stocks have been enhanced in 1999, 2000 and 2001 by releases of juvenile coho (fry and smolts) into the system (McKay 1999, SKR 2000, Tamblyn 2000, SKR 2001). Buck Creek chinook stocks have been enhanced through juvenile chinook releases prior to 2000 (O'Neil personal communications).

2.0 RESOURCE USE

The Buck Creek watershed consists of public and private land, and as such is utilized by several resource sectors.

1. First Nations issues and interests in the study area:
 - The Wet'suwet'en Nation, Broman Lake Band and Skin Tyee Band have claimed a portion of the Buck Creek watershed as part of their traditional territories (Triton 2000). The Wet'suwet'en Nation is in Stage 4 of the treaty process (B.C. Treaty Commission 2005).
2. Development and land use: forestry, mining, recreation:
 - The Buck Creek watershed falls into forest license FLA-16827 (HFP), and Morice TSA 20, and harvesting and road building is in varying stages of planning and or development. Harvesting in the area is proposed to 2007 (HFP 2001, Canadian Forest Products 2001). The Small Business Forest Enterprise Program (SBFEP) also operates in the Buck Creek watershed, and three woodlots are located in the drainage (Buirs personal communications). The Swiss Fire burned approximately 8% of the Buck Creek watershed in 1983 (Wilford 1984).
 - The Morice Mountain Ski Trail, partly within the Houston Community Forest lies within the Buck Creek watershed, and is accessible via the Buck Flats Road (MoF 1992). A community snowmobile cabin is located near Klo Creek (Triton 2000).
 - Mining in the Buck Creek watershed include placer mining on Bob Creek, and open pit mining at the Equity Silver Mines. Both mines are currently inactive (BCCF 1998). Historically, a concrete factory operated at the mouth of Dungate Creek (BCCF 1998).
 - The guide outfitter territories in the Buck Creek watershed are 609G005 and 609G003 and the trapline territories are 609T064, 609T005, 609T006 and 609T052. Range Units RANM07480, RANM01188 and RAN070256 also exist within the study area (Buirs personal communications). There are six commercial cattle ranches and several hobby farms in the Buck Creek watershed, with a combined estimated 338 Aus (Remington 2000).
 - The lower reach of Buck Creek is located within the Municipality of Houston, and private land extends along the lower 25.4 km of the mainstem of Buck Creek.
3. Impacts and uses by wildlife:
 - A comprehensive inventory of wildlife species does not exist for the Morice Forest District. However, several rare and endangered wildlife species are known or suspected to utilize habitat in the Buck Creek watershed, including Grizzly bear (*Ursus arctos*), wolverine (*Gulo gulo luscus*), fisher (*Martes pennanti*), Swainson's hawk (*Buteo swainsoni*) (in localized areas in the Bulkley Basin), American Peregrine Falcon (*Falco peregrinus anatum*) (observed in the Old-Man Lake/China Nose Area), and short-eared owl (*Asio flammeus*) (Horn and Tamblyn 2000). Other wildlife species of interest include mountain goats, moose, whitetail deer, mule deer and elk, which have recently expanded their range into this area.
4. Other developments, concerns or points of interest:
 - No Protected Areas Strategy (PAS) study sites are known to exist within the Buck Creek watershed. An LRMP background report for the Morice Forest District was prepared in 2000 (Horn and Tamblyn 2000).

- The Buck Creek watershed was designated a community watershed on June 15, 1995. It is currently the only community watershed in the Morice Forest District (MSR 2001).
 - Ten water licences have been identified in the Buck Creek watershed. Nine of these are domestic water licences, and one water licence (C113686) has been granted to the Department of Fisheries and Oceans for Conservation purposes (MSR 2001).
5. Existing water quality data:
- Water quality sampling in the Buck Creek watershed was conducted by Remington (2001). In addition, Buck Creek was included as one of the systems sampled during an “Index of Biological Integrity” Study (IBI) (Dyken and Rysavy 1998).
 - Several water quality stations exist in the Buck Creek watershed. Within the lower Buck Creek sub-basin, an EMS station is located on Bob Creek (E238623), and 6 are located on the mainstem Buck Creek (E207066, E207067, E219804, E238622, E238624 and E238625). Other stations exist on the upper portion of Buck Creek, Klo Creek and Bessemer Creek (Odense personal communications).
6. Previous presence of fish in systems of interest:
- Fish presence previously documented in the study area is summarized in Table 1.

Table 1. Summary of fish species in the Buck Creek Watershed.

Fish Species	Location	Reference ¹
Pink (<i>Oncorhynchus gorbusha</i>)	Below cascade	1, 2
Chinook (<i>O. tsawytscha</i>)	Below falls	1, 2, 3
Coho (<i>O. kisutch</i>)	Below falls	1, 2, 3
Steelhead (<i>O. mykiss</i>)	Below falls	1, 2, 3
Rainbow trout (<i>O. mykiss</i>)	Below and above falls	1, 2, 3, 4, 5, 6, 7
Bull trout (<i>Salvelinus confluentus</i>)	Below falls	3
Dolly Varden (<i>S. malma</i>)	Below falls	3
mountain whitefish (<i>Prosopium williamsoni</i>)	Below falls	3
longnose suckers (<i>Catostomus catostomus</i>)	Above falls	3
Largescale suckers (<i>C. macrocheilus</i>)	Below falls	3
White suckers (<i>C. commersoni</i>)	Below and above falls	1, 2, 3, 4, 5, 7
longnose dace (<i>Rhinichthys cataractae</i>)	Below and above falls	1, 2, 3, 4, 5, 6, 7
Peamouth chub (<i>Couesius plumbeus</i>)	At first bridge (26 km below falls)	6
Redside shiners (<i>Richardsonius balteatus</i>)	Upstream of falls	7
Pacific Lamprey (<i>Lampetra tridentate</i>)	Below falls	1, 2, 3
River Lamprey (<i>Lampetra ayersi</i>)	At first bridge (26 km below of falls)	4
Cutthroat trout (<i>O. clarki</i>)	At first bridge (26 km below of falls)	5

¹References are: 1 = FISS, 2 = BCCF 1997, 3 = BCCF 1998, 4 = MacKay 1999, 5 = SKR 2000, 6 = SKR 2001, 7 = Triton 2000

3.0 METHODS

This project closely followed all applicable RIC standards (2001a) and the Forest Practice Code fish-stream identification guidebook (1998). Details on methodologies and value added attributes of sampling site selection, field assessments, and digital mapping are provided in the following sub-sections.

3.1 SAMPLE SITE SELECTION

Sample sites were selected during a detailed review of recommendations for additional sampling that were provided in the initial 1:20,000 reconnaissance fish and fish habitat inventory project (SKR 2002).

3.2 STREAM ASSESSMENT

All stream assessments were conducted in June, July and August 2005. Stream sites were accessed by four-wheel drive vehicle, on foot and helicopter. Stream sections of interest were assessed to determine fish distribution and habitat values. Fish Data Information System (FDIS) site cards and fish collection cards were completed at sample sites, following Resource Inventory Committee Standards (RIC 2001a), and data were entered into the FDIS database using the FDIS data entry tool.

All fish that were captured during this study were identified to species in the field or small subsamples were preserved for confirmation using a dissecting microscope. Identification keys in McPhail and Carveth (1994) and Scott and Crossman (1973) were consulted for species identification. Fork lengths were recorded for fish captured, and fish were released. A list of sampling equipment used during this 1:20,000 reconnaissance level fish and fish habitat inventory project is presented in table 2.

Table 2. List of sampling equipment for stream reaches used during the 1:20,000 reconnaissance fish and fish habitat inventory project in the Buck Creek watershed, June to August 2005.

Parameter	Sampling Intensity	Method
date and time	each site	wrist watch
water temperature	each site	alcohol thermometer
PH	each site	Oaktron pHTestr2
Conductivity	each site	Oaktron TDSTestr 3
water clarity	each site	Visual
fish presence	as required to determine fish presence	Smith Root Model 12B
Photography	each site	Sony Cybershot DSC-S85
GPS	where available	Garmen eTrex Legend GPS
Gradient	each site	Enduro abney level or Suunto clinometer





3.3 STATISTICAL ANALYSIS

Site and reach data were compared between various fish bearing, gradient, and stream order categories to evaluate if these factors are useful in identifying potential for fish presence for the entire watershed. Because of low sample size, and non-normal distribution of data, statistics that do not rely on normality were used for comparisons. To compare mean values (e.g. channel width) between categories, a Kruskal-Wallis and Kolmogorov-Smirnov tests were used (Zar 1984, Sokal and Rohlf 1995). Frequencies between various categories were compared using a log-likelihood χ^2 tests. All analysis were conducted using the Systat 9 statistical package, and descriptive statistics were calculated in Excel.

3.4 MAPPING

Mapping during phases I, II and III of the project were completed by SKR Consultants Ltd. using the Fish Inventory Mapping System extension for Arcview GIS software (Fish Map 1.2 Geosense Consulting Ltd. 2002), following applicable Resource Inventory Committee standards (RIC 2001b). Data presented on the maps included sub-basin boundaries, sample site locations, significant features, and historical information within the study area. In addition, SKR identified reaches with known fish presence, suspected fish presence, suspected fish absence, and known fish absence for presentation of fish distribution on the interpretive maps. The criteria used by SKR for determining fish presence and absence are presented in table 3.

Table 3. Criteria used to evaluate fish distribution for colour coded presentation on the Fisheries Project/Interpretive Hardcopy Maps (Appendix 5) of this study area.

Fish Present 	<ul style="list-style-type: none"> Stream reaches where fish have been captured or can be classified as fish bearing based on fish captured upstream. NOTE: fish distribution may not always extend to the upper limit of all reaches symbolized as fish bearing
Fish Suspected Present 	<ul style="list-style-type: none"> Stream reaches with gradients less than 21% and with any potential for fish presence, excluding first order streams less than 1 km in length on 1:20000 TRIM map
Fish Suspected Absent 	<ul style="list-style-type: none"> First order streams less than 1 km in total length on 1:20000 TRIM map Streams visited with limited potential for fish presence, but no definable barriers to fish passage following RIC standards, thus still requiring resampling
Fish Absent 	<ul style="list-style-type: none"> Reaches with no fish captured in two seasons upstream of natural obstructions to fish migration Reaches upstream of identified natural barriers to fish migration following intensive sampling in one season 1st and small 2nd order streams flowing into non fish bearing reaches Reaches with gradients exceeding 20% (Note: the location of lower reach break is not defined until field sampling is conducted)

3.5 DATA COMPILATION

Since re-sampling in 2005 included re-sampling in the lower Buck Creek watershed downstream of Klo Creek, this report and accompanying final deliverables were designed to summarize re-sampling data and data collected during previous inventory projects. Historical information on the fisheries project/interpretive maps is coded to facilitate cross-referencing with data sources captured during the literature review. FDIS database tables for the re-sampling database (fdisdat.mdb) were populated so as to facilitate merging of the re-sampling database with the FDIS database produced for the initial sampling project (SKR 2002).

3.6 QUALITY ASSURANCE

While the Ministry of Sustainable Resource Management (MSRM), and previously the Ministry of Environment (MoE) conducted independent, third party quality assurance evaluations (QA) on 1:20,000 fish and fish habitat inventory (SKR 2002), third party QA was not mandatory for projects conducted in the 2005 field season. Similarly, while the Forest Ecosystem Specialist reviewed the non-fish bearing tables produced as a result of fish and fish habitat inventory in 2001 (SKR 2002), no government representative was available to review the non-fish bearing tables produced as a result of the 2005 re-sampling project. To assure that the re-sampling data, report, data base and map continued to be of high quality, SKR conducted internal QA evaluations using guidelines and standards as detailed in the reconnaissance (1:20,000) fish and fish habitat inventory quality assurance procedures (RIC 2000).

4.0 RESULTS AND DISCUSSION

Thirty-one stream reaches (33 sample sites) of the 503 stream reaches identified in the lower Buck Creek sub-basin were re-sampled in June, July and August 2005 to provide a more detailed assessment of fish presence or absence in accordance with the Fish/Stream Identification Guidebook (FPC 1998). Sites were selected for re-sampling based on recommendations in the initial stream inventory conducted in 2001 (SKR 2002). Re-sampling in 2005 resulted in the conclusive classification of 93 reaches for which fish-bearing status was previously unclear (table 4).

Table 4. Summary of reaches with previously unknown fish distribution that could be conclusively classified following re-sampling in the Peter-Aleck watershed.

Sub-basin	Re-sampling intensity						# reaches conclusively classified following re-sampling	
	Re-sampling Dates (2005)	Total # of sites	# rec'd sites*	# extra sites	# reaches	# streams	Fish-bearing	Non-fish bearing
Buck	June – August	33	22	11	31	21	1	92

*Sites recommended for re-sampling during previous inventories (see SKR 2002)

4.1 LOGISTICS

Re-sampling was timed to coincide with late spring/early summer conditions at most sites to determine the seasonal utilization of fish habitat in the study area, and in order to determine the passability of obstructions which were identified during low discharge periods during initial sampling, however, the re-sampling project was not initiated until the end of June, and did not capture peak spring discharge periods. Of the 33 sites sampled, no visible channel was identified in three sites, leaving 30 sample sites with relevant water quality and flow stage data. Flow stage at most of the site sampled (24 of 30; 80.0%) exhibited moderate flow stage, and three sites (10.0%) exhibited low flow stage. Spring sampling did not encompass the peak flow event, characterized by low water temperature, and low conductivity due to the delayed start of the project. Sampling during periods of peak flow generally coincides with lower water temperatures and conductivity (Dunne and Leopold 1978), all of which may affect sampling efficiency (Reynolds 1996). Water quality encountered during spring re-sampling is summarized in table 5, and was within guidelines suggested for sampling with an electrofisher (RIC 2001a). Water was reported as clear at all sites sampled.

Table 5. Summary of water quality data collected during re-sampling of streams within the study area in 2005. The total number of sites sampled and the number of sites with water quality criteria under critical levels as identified in FDIS are also listed.

Stream Order	# sites with water quality data	Temperature (°C)			Conductivity (µS/cm)	
		range	# sites <4 °C	# sites <3 °C	Range	# sites < 30µS/cm
1	10	9-12	0	0	60-90	0
2	12	9-12	0	0	50-100	0
3	4	8	0	0	50-80	0
4	1	7	0	0	50	0

A combination of vehicle, foot (for sites > 200 m from the nearest road), and helicopter were used to access sites in the study area. Seventeen of the 33 sites (51.5%) were accessed by four-wheel drive vehicle, nine (27.3%) were accessed on foot, six (18.2%) were accessed by two-wheel drive vehicle and one site (3.0%) was accessed by helicopter. This is similar to access methods during initial sampling in 2001, where 57.7% of reaches were accessed by four-wheel drive, 38.5% on foot, and 3.8% by helicopter.

4.2 SUMMARY OF BIOPHYSICAL INFORMATION

Buck Creek is a 5th order stream, which drains an area of approximately 580 km² over a distance of 55.6 km. The Buck Creek watershed is characterized by a lack of glacial influence, a predominance of low gradient reaches, and a low proportion of the lakes. The headwaters of this system are found at an elevation of 1500 meters, and the confluence of Buck Creek and the Bulkley River is found at an elevation of 594 meters. The topography consists primarily of low gradient valley flat areas along the mainstem Buck Creek, with steeper terrain along some of the Buck Creek tributaries located in the north east quadrant of the watershed (e.g. Bob Creek, Dungate Creek). The Buck Creek watershed falls within the Humid Continental Highlands Ecodivision of the Humid Temperate Ecodomain. Within the Central Interior Ecoprovince, the entire area is within the Fraser Plateau Ecoregion (Meidinger and Pojar 1991, MoF 2001). Table 6 provides a summary of watershed information for the two sub-basins within the Buck Creek watershed, but only the lower Buck Creek sub-basin was sampled in August and September 2001, and re-sampled in June to August 2005.

This Lower Buck sub-unit encompasses the lower six reaches of Buck Creek, downstream of Klo Creek, and all tributaries that drain into Buck Creek downstream of Klo Creek. There are a total of 8 lakes in this sub-basin, with lake surface areas ranging between 10.4 ha to less than 1 ha. The majority of the watershed area is characterized by valley flats adjacent to the Buck Creek mainstem, and rolling hills. Steeper gradient areas are found in upper elevation areas, in Dungate (ILP 80004) and Bob (ILP 80127) creeks and tributaries, and in tributaries draining into the east side of reach 3 of Buck Creek (between Dungate and Bob creeks). The entire sub-basin is within the Bulkley Basin Ecoregion, and the majority of reaches are found in the Moist Cold Subzone of Sub-Boreal Spruce Biogeoclimatic Zone. The mainstem Buck Creek reaches to Klo Creek are found within a narrow band of the Dry-Cold Sub-zone of the Sub-Boreal Spruce Biogeoclimatic Zone, while the upper elevation areas of tributaries are located within moist-cold sub-zone of the Englemann Spruce – Subalpine Fir Biogeoclimatic Zone (Meidinger and Pojar 1991, MoF 2001).

Table 6. Summary of watershed information for the two sub-basins distinguished between in the Buck Creek watershed. The sub-basin inventoried in 2001 and 2005 is indicated in bold.

Sub-basin	Name	Watershed Code	Watershed Area (km ²)	Stream Length (km)	Stream Order ¹	NTS map	BEC Zone	Wetland areas (km ²)	Year of Inventory
Sub-basin I	Lower Buck Creek UTM: 9.667968.6006858	460-636000	288.36	424	5	93L/01 93L/02 93L/07 93L/08	SBSmc SBSdk ESSFmc	5.08	2001¹ 2005
Sub-basin II	Upper Buck Creek UTM: 9.667968.6006858	460-636000	274.98	411	5	93L/08 93L/01	SBSmc ESSFmc		1999 ²

¹ SKR 2002, ² Triton 2000.

4.2.1 WATER QUALITY

Water quality measurements were taken at 27 of the 33 sample sites. No visible channel was identified at the three of the remaining, one site was a secondary fish sampling site in the same reach as a second site (sites 7 and 8), and two sites were dry. Temperature ranged from 7 °C to 12 °C (mean = 9.9, SE = 0.27), pH ranged between 7.6 and 8.5 (mean = 8.06 SE = 0.037), and conductivity ranged between 50 and 90 $\mu\text{S}/\text{cm}$ (mean = 71.2 $\mu\text{S}/\text{cm}$, SE = 2.67). The predominance of neutral to alkaline pH values is consistent with pH values recorded during initial sampling (mean = 7.7, SE = 0.053) where only 5.4% of the 37 sites sampled had pH values below 7.0 (SKR 2002). Water was clear at all locations, reflecting a lack of glacial influence, and a potentially stable condition of the watershed.

4.3 FISH HABITAT CHARACTERISTICS

A number of factors can influence the capability of a stream to provide suitable habitat for fish. Several studies in recent years have shown that information easily obtained from TRIM maps and airphotos, or easily obtained field measurements, can provide good indicators of the likelihood of fish presence (e.g. Porter et al. 2000b, Latterell et al 2003, Triton 2003, SKR 2004a, 2004b). Average channel width is one such characteristic which influences fish presence (Rosenfeld et al. 2000, Triton 2003, SKR 2004a, 2004b). Stream gradient is another good indicator of the habitat value of streams for fish (FPC 1998). Using methods for estimating and categorizing streams by channel width (e.g. stream order) and gradient classes have been used to help develop a simpler indication of habitat value and fish distribution based on TRIM map interpretations (e.g. Witt and Giroux 1999).

Findings from a combination of initial sampling (SKR 2002) and resampling (2005) of streams in the lower Buck Creek watershed are used to describe fish habitat preferences based on channel width, stream order, and gradient classes. The following sections describe the characteristics of stream order and gradient classes that might be useful for estimating habitat value and the likelihood of fish presence based on future map interpretation or stream data modeling for this drainage.

4.3.1 CHANNEL WIDTHS AND GRADIENTS

Channel width and gradient have been shown to be correlated with the potential for fish presence in previous studies (SKR 2004a, 2004b). Channel width is a factor that directly affects habitat quantity, and in many cases, larger streams provide more and higher quality habitat than smaller streams. Gradients effects both, habitat quality, and habitat accessibility. Steeper streams offer less valuable rearing and spawning habitat due to larger (Hunter 1991), and fish expend more energy moving or holding in higher gradient systems. Channel width and site gradients were summarized for fish bearing, non-fish bearing, suspected fish bearing and suspected non-fish bearing reaches (table 7). Since topographic barriers limit fish distribution regardless of upstream site characteristics, sites upstream of known barriers to fish passage (e.g. falls and cascades) were omitted from the summary. No fish were captured at sites where the channel width was less than 1.9 meters. There was significant overlap in the range of site gradients between the four fish bearing categories, however, no fish were captured at sites with gradients greater than 7.5%, and all sites sampled with gradients greater than 9% were classified as non-fish bearing (table 7). The results from this study support previous findings from other fish and fish habitat inventory projects (e.g. SKR 2004a, 2004b) that fish are unlikely to use streams with average channel widths less than approximately 1metre (table 7). This indicates that fish presence at sites with gradients greater than 9% in the Buck Creek watershed is unlikely, which is supported by findings from other inventory project in the interior of BC that have documented that fish use of small streams is unlikely where gradients are greater than 12% in the central interior of British Columbia. Interestingly, there is also a high likelihood of natural barriers to fish migration (i.e. chutes, cascades or water falls) in streams with gradients more than 12%.

Table 7. Average channel widths and gradients (standard error) and range of channel widths and gradients for fish bearing, non-fish bearing, suspected fish bearing, and suspected non-fish bearing reaches in the study area. Non-classified drainages, and reaches upstream of known barriers to fish migration have been omitted from the analysis.

Fish Bearing Status	# sites in analysis	Site Gradient (%)		Channel width (m)	
		Mean (SE)	Range	Mean (SE)	Range
Fish Present	9	2.8 (0.68)	0-7.5	5.21 (0.988)	1.92-11.15
Suspect Fish Present	10	3.6 (0.99)	0.5-8.5	2.53 (0.454)	0.77-5.33
Fish Absent	14	5.7 (1.09)	1.0-18.5	1.15 (0.095)	0.37-1.88
Suspect Fish Absent	6	4.3 (0.96)	1.0-7.0	1.77 (0.244)	1.03-2.60

4.3.1.1 Relationship of Channel Widths to Stream Order

Stream order can easily be determined from map interpretation, while channel width requires field measurements. Stream order based on 1:20,000 scale TRIM streams has a relationship to drainage basin area and is commonly used to categorize streams as an indicator of stream size. Streams with small drainage basins (e.g. 1st and 2nd order streams; see Glossary for a definition of stream order) carry a relatively low volume of water and are subject to seasonal changes in water levels that cause them to be intermittent and/or ephemeral (Ross 1997). In fact, all seven sample sites where the reach was determined to be a non-classified drainage (NCD) were 1st and 2nd order reaches sampled (table 8). Stream order and channel width have also been shown to be one of the factors influencing the likelihood of fish presence (Rosenfeld et al. 2000, Triton 2003). Topographic or anthropogenic barriers will restrict or prevent fish passage to reaches upstream regardless of channel width or order, but for systems where no topographic or anthropogenic barriers are documented, channel width categories (e.g. stream order) may be useful indicators of the potential for fish presence.

Results from this study support that channel width is related to stream order. Channel widths were compared between sites representing different stream orders using a Kruskal-Wallis (H) test. Average channel widths for sampled reaches differ significantly with stream order ($H = 19.072$, $p = 0.000$). Channel width differs significantly between 1st and 2nd order reaches (Kolmogorov Smirnov (KS) statistic = 0.562, $p = 0.002$), but not between 2nd and 3rd order reaches (KS = 0.385, $p = 0.191$). Many of the first order reaches sampled in the lower Buck Creek watershed drained relatively large basins ($> 1 \text{ km}^2$) when compared to most first order streams in the study area. Overall, there is a significant relationship between stream order and channel size, though this relationship is less well defined between 2nd and 3rd order reaches sampled in the study area, likely as a result of sample site selection, and sample size. We speculate that the relationship between channel width and basin size would be stronger than the relationship between stream order and channel width. Stream order appears to be a rough indicator for stream size in the lower Buck Creek watershed, and because stream order is easily determined for all reaches in the watershed, stream order was used for comparisons of fish bearing status between reaches in the study area.

Table 8. Number of reaches sampled, average channel widths, and number of non-classified drainages broken down by stream order. Non-classified drainages are included when calculating mean channel widths, or ranges in channel widths. Historical information was included, except for re-sampled sites where the most current information was used in calculating channel widths.

Stream Order	Number sampled	Channel Width (m)		NCD's (%)
		Range	Mean (SE)	
1	23	0-4.62	1.24 (0.210)	4 (17.4)
2	28	0-4.05	2.07 (0.185)	3 (10.7)
3	11	1.05-6.25	3.33 (0.510)	0 (0.0)
4	4	3.97-7.15	6.03 (1.032)	0 (0.0)
5	1	11.15	11.15	0 (0.0)

4.3.1.2 Relationship of Stream Gradient to Stream Order

Stream gradient is a main determinant of fish distribution because gradient affects habitat types and quantity, as well as accessibility to fish (Ross 1997, FPC 1998). Reaches with low to moderate gradient are more likely to be fish bearing than reaches with higher gradients. The Fish Stream Identification Guidebook (1998) provides gradient ranges suitable for various salmonid species, and identifies a reach gradients of 20-25% as the limit to fish distribution depending on species and stream morphology. Steeper reaches are generally found in higher elevations within a watershed (Hunter 1991, Ross 1997) and figure 2 graphically illustrates that the average reach gradient decreases considerably and consistently as stream order increases. There is more variability in stream gradient among 1st and 2nd order reaches, and less variability for 3rd, 4th and 5th order reaches because all of these higher order reaches are located in, and surrounded by, valley flat areas along the mainstem, while many 1st and 2nd order reaches are located in the steeper and mountainous headwaters. For example, gradients of 1st order reaches range between 0% and 63.3%, while gradient of 4th and 5th order reaches range between 0% and 5.4%. Overall, higher order reaches, which are generally found in the valley flat area associated with the mainstem of Buck Creek, Dungate Creek or Bob Creek are on average less steep than lower order reaches, which exhibit a much wider range in gradient (ranging from low gradients in the valley flat areas and mountain plateaus to high gradients in the steep lands surrounding Dungate Creek, and Bob Creek).

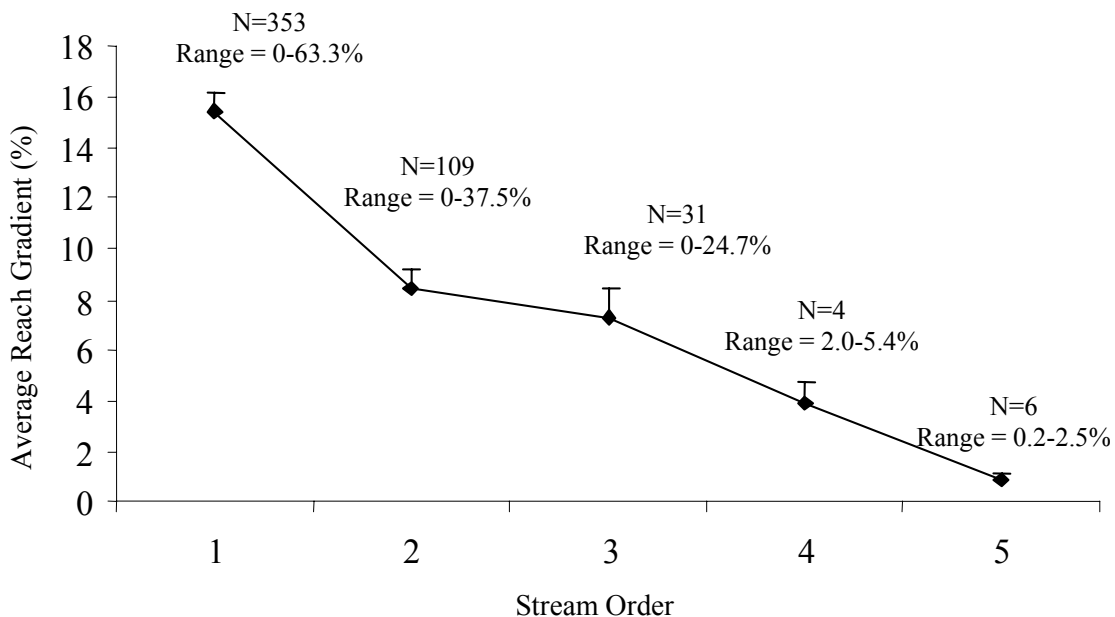


Figure 2. Average reach gradient of streams with varying stream order. Error bars indicate standard error.

4.3.2 RELATIONSHIP OF STREAM ORDER TO FISH PRESENCE

Stream order and fish bearing status of reaches sampled in the Peter-Aleck watershed are summarized in table 9. Stream order differs significantly between fish bearing, non-fish bearing, suspected fish bearing and suspected non-fish bearing reaches (log likelihood $\chi^2 = 32.876$, $p = 0.001$). No fish were captured in first order reaches, and only two of the 17 second order sites (11.8%) were found to be fish bearing (table 9). Mean channel width differed significantly ($H = 9.397$, $p = 0.024$) between reaches of different fish bearing status (fish bearing, non-fish bearing, suspected fish bearing, suspected non-fish bearing) (table 7). In general, fish bearing and suspected fish bearing reaches tend to be wider and generally have higher stream order than non-fish bearing and suspected non-fish bearing reaches in the study area.

Information on fish presence and limits to fish distribution (i.e. barriers to fish migration) was used to help classify all reaches in the watershed as fish bearing, suspected fish bearing, suspected non-fish bearing or non-fish bearing (figure 3). All 5th order reaches in the study area have been conclusively classified as fish bearing because fish were either captured in these reaches, or upstream. The proportion of reaches classified as fish bearing declines for 4th order reaches (75%), 3rd order reaches (26%) and 2nd order reaches (21%). None of the 1st order reaches are known to be fish bearing. Conversely, the proportion of non-fish bearing reaches increases from 56% of second order reaches in the study area to 65% of first order reaches in the study area. The large proportion of known non-fish bearing first order reaches have high gradients (43% of non-fish bearing 1st order reaches had gradients greater than 20%), and were therefore classified as non-fish bearing by default.

Table 9. Summary of the number (percent) of sampled reaches of different stream order that were determined to be fish bearing, non-fish bearing, suspected fish bearing, and suspected non-fish bearing.

Stream order	Fish Present	Suspected Fish Present	Fish Absent	Suspected Fish Absent	Total
1	0 (0.0)	2 (4.3)	15 (31.9)	2 (40.4)	19
2	2 (4.3)	5 (10.6)	7 (14.9)	3 (6.4)	17
3	4 (8.5)	2 (4.3)	0 (0.0)	0 (0.0)	3
4	2 (4.3)	1 (2.1)	0 (0.0)	0 (0.0)	3
5	1 (2.1)	0 (0.0)	0 (0.0)	0 (0.0)	1

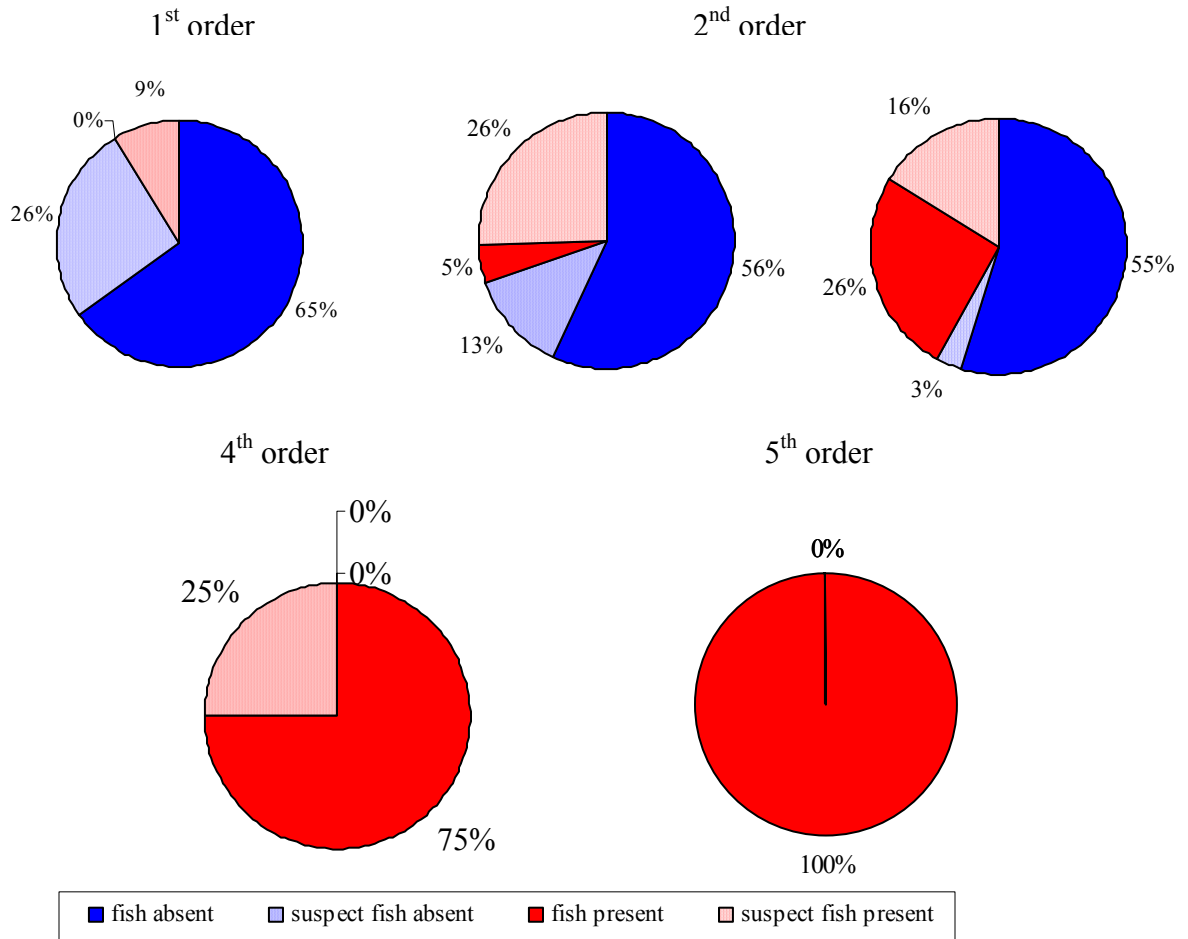


Figure 3. Percent fish bearing, suspected fish bearing, suspected non-fish bearing and non-fish bearing reaches with varying stream order.

4.3.3 RELATIONSHIP OF STREAM ORDER AND GRADIENT TO FISH PRESENCE

Easily determined reach characteristics including gradient and channel width, are interrelated, and appear to influence the likelihood of fish presence. Both gradient and channel width are related to stream order (table 8, figure 2). First and second order streams are more likely to have smaller channel width or be NCD (tables 8), and have higher average gradient (figure 2). Fish presence appears to be less likely in reaches with smaller channel widths (table 7), and steeper reaches (figure 4). Streams with lower stream order generally have smaller basin size, and basin size is strongly correlated with channel size. Thus stream order may be a suitable indicator of the likelihood of fish presence of reaches within the study area since it is an easily obtained measure that relates both these factors. However, the relationship between stream order and channel width is likely weaker than the relationship between basin size and channel width, particularly for lower order reaches. Basin size is likely a better indicator of fish presence than stream order. Not surprisingly, the proportion of fish bearing reaches in the study area increases with stream order and a significant reduction in the proportion of fish bearing reaches is noted in 1st and 2nd order reaches.

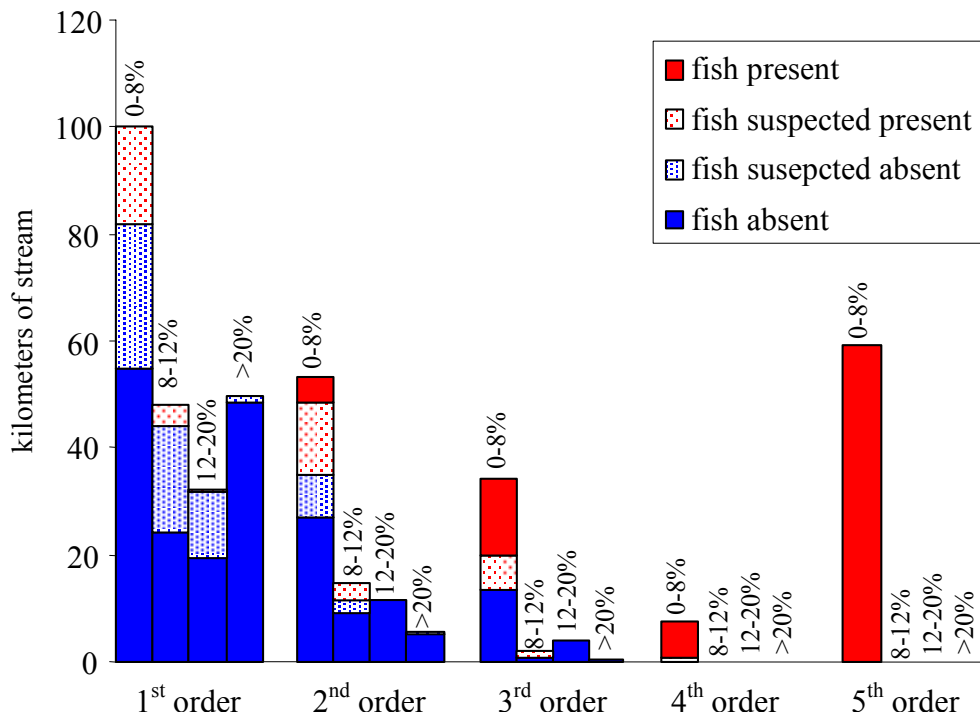


Figure 4. Distribution of fish presence and absence in different order and gradient classes of stream reaches in the study area as determined from 1: 20,000 TRIM maps. Data labels indicate gradient classes within each stream order.

Fish bearing status of reaches with various stream orders was graphed by common gradient ranges provided for fish species distribution in the Fish-Stream Identification Guidebook (FPC 1998). Figure 4 illustrates that fish presence is strongly related to gradient, and stream order. Interestingly, no fish were captured in reaches with gradients greater than 7 % during any sampling event in the study area. In addition, all suspected fish bearing reaches in the study area have a gradient less than 13.3%. No fish were captured in any reach above 1169 meter elevation, and no fish are suspected present in any reach above 1260 meter elevation. Gradient limits for known fish bearing reaches is higher in other watersheds in the central interior when compared to the lower Buck Creek watershed (e.g. 13.5% in the Whitesail (SKR 2003a), 11% in Tahtsa Reach inlets (SKR 2004a) and 17% in the Nadina (SKR 2004b)). Elevation limits identified in the lower Buck Creek watershed for fish bearing reaches are somewhat lower than that identified for the Whitesail (1300 m), Tahtsa Reach (1225 m) and Nadina (1411 m) watersheds. However, the tendency of higher elevation reaches to be non-fish bearing is likely more related to the predominance of higher gradient in these reaches, or downstream, which limits fish distribution, as well as smaller drainage size in the headwaters found at higher elevations.

4.3.4 WATERSHED RELATIONSHIP SUMMARY

Reach characteristics and sample site distribution in the study area was summarized by elevation, gradient, and stream order categories since these factors have been identified as influences on the potential for fish presence in previous studies (e.g. Witt and Giroux 1999). The number of reaches sampled across the entire study area and fish presence associated with those reaches is presented in table 10. Sample site distribution is divided into: elevation zones, as suggested by Witt and Giroux (1999); gradient classes, as identified in the Fish Stream Identification Guidebook (FPC 1998); and stream order. Reaches were not separated by channel pattern since most of the reaches (99.2%) in the project area were straight, sinuous or irregular (Appendix 3). Witt and Giroux (1999) suggest using gradient, channel pattern, and stream order classes generated by the FDIS database to create a watershed relationship table. The results of this grouping are presented in Appendix 3. Table 10 illustrates that the proportion of sampled reaches found to be fish bearing is lower for reaches at higher elevation, and with higher gradients, while a greater proportion of sites were found to be fish bearing at sites with higher stream order.

Table 10. Watershed relationship summary table for the Buck watershed.

	Elevation Zone ¹					Gradient					Stream Order				
	1	2	3	4	5	0-8%	8-12%	12-16%	16-20%	≥20%	1 st	2 nd	3 rd	4 th	5 th
Total No. Reaches	21	168	84	109	59	226	80	55	29	113	353	218	93	4	6
No. Randomly selected reaches	1	8	3	3	1	13	2	1	0	0	3	9	1	2	1
No. Biases Selected Reaches	4	29	15	0	1	32	12	5	0	0	20	18	10	1	0
Total No. Sampled	5	37	18	3	2	45	14	6	0	0	23	27	11	3	1
% reaches sampled	23.8	22.0	21.4	2.8	3.4	19.9	17.5	10.9	0	0	6.5	12.4	11.8	75	16.7
No. with Fish (% of sampled reaches)	1 (20.0)	5 (13.5)	2 (11.1)	1 (33.3)	0 (0.0)	9 (20.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (7.4)	4 (36.7)	2 (66.7)	1 (100.0)
No. with suspected fish (% of sampled reaches)	2 (40.0)	7 (18.9)	1 (5.6)	0 (0.0)	0 (0.0)	9 (20.0)	1 (7.1)	0 (0.0)	0 (0.0)	0 (0.0)	2 (8.7)	5 (18.5)	2 (18.2)	1 (33.3)	0 (0.0)
No. with no fish (% of sampled reaches)	2 (40.0)	19 (51.4)	14 (77.8)	2 (66.7)	2 (100)	23 (51.1)	11 (78.6)	5 (83.3)	0 (0.0)	0 (0.0)	19 (82.6)	16 (59.3)	4 (36.7)	0 (0.0)	0 (0.0)
No. with suspected no fish (% of sampled reaches)	0 (0.0)	6 (16.2)	1 (5.6)	0 (0.0)	0 (0.0)	4 (8.9)	2 (14.3)	1 (16.7)	0 (0.0)	0 (0.0)	2 (8.7)	4 (14.8)	1 (9.1)	0 (0.0)	0 (0.0)

¹Elevation zones are: Zone 1 = 594–777m, Zone 2 = 778-960m, Zone 3 = 961-1143m, Zone 4 = 1144–1326m, Zone 5 = 1327-1512m for upstream reach elevations (see Witt and Giroux 1999)

4.3.5 FISH HABITAT

Fish and fish habitat inventory data collected in the lower Buck Creek watershed in this and in previous studies illustrates that lower order streams are less likely to be fish bearing, and that reaches above 1260 meters elevation or reaches with gradients greater than 14% are not fish bearing and not suspected to be fish bearing. These factors are interrelated, however, and should not be viewed in isolation. For example, the lack of fish presence in reaches with gradients greater than 14% may be due to the fact that there were no 4th or 5th order reaches in the study area that had gradients greater than 5.5%. The relationships between elevation, stream order, and especially gradient and channel width in the lower Buck Creek watershed can guide future inventory efforts in refining limits of fish distribution, and in focusing re-sampling efforts where fish distribution limits are less clearly defined. However, the general lack of fish in reaches with relatively steep gradients and at high elevation, as well as in lower order reaches (of which a high proportion exhibit higher gradient and elevation) does not imply that these reaches are unimportant in maintaining the physical and biological attributes of stream habitat in the lower Buck Creek watershed. The potential detrimental effect of forestry activities on stream habitat has been well documented (e.g. Murphy and Meehan 1991). These include changes in stream hydrology (increased peak flows, lower low flows), reduction of stream bank stability (results in degrading and aggrading of stream channels), increased sedimentation, reduced organic input (e.g. leaf litter, terrestrial insects), reduced shading resulting in changes in temperature regime, loss of recruitable large woody debris for channel complexity and stabilization, reduced cover, and obstructions to fish passage (e.g. improperly placed and/or installed culverts). While some fish species are less susceptible to these impacts than others, several of the species in the study area, including Dolly Varden and rainbow trout, are highly sensitive to forestry related impacts (Porter et al. 2000). Land-use, including forestry and road building in smaller, headwater systems can have downstream and cumulative impacts on fish habitat, thus the cumulative impact of riparian and upslope management over the entire watershed should be considered when planning land-use activities.

4.4 FISH DISTRIBUTION

The lower Buck Creek watershed, from the Bulkley River upstream to Klo Creek, is characterized by a predominance of valley flat areas, with some steeper gradient terrain in the north east quadrant of the drainage, around Dungate Creek and Bob Creek. The lower Buck and its tributaries are not influenced by glaciers, though small glaciers feed the headwaters of the upper Buck Creek and Bessemer Creek upstream of Gossly Lake. No large or moderate sized lakes are found in this portion of lower Buck Creek watershed. The entire mainstem, and a good proportion of tributaries are accessible to fish, as a result of generally gentle terrain.

Fish were confirmed present in approximately 84 km (14.3%) of all stream lengths in the lower Buck watershed. In total, no first order reaches, 4.3 km of second order reaches, 14.16 km of third order reaches, 6.49 km of fourth order reaches and 59.36 km of fifth order reaches were found to be fish bearing (figure 3). First order reaches directly connected to higher order systems may provide refuge habitat during periods of high discharge, and are important in maintaining fish habitat and water quality downstream. In addition, 22.71 km of first order reaches, 17.4 km of second order reaches, 8.1 km of third order reaches, and 0.9 km of fourth order reaches are suspected to be fish bearing. Fish are suspected or confirmed to be absent from 207.5 km of first order reaches, 63.5 km of second order reaches and 18.9 km of third order reaches. Table 11 summarizes the relative amounts of fish habitat found within each stream order category.

Fish were confirmed to be present in approximately 87.26 kilometres of stream in the study area, which has approximately 424.02 kilometres of first, second, third, fourth and fifth order streams shown on the 1:20,000 TRIM maps. No fish were captured in any of the first order reaches sampled, and of the 23 first order reaches sampled, five (21.7%) were ephemeral and four (17.4%) were NCD. Habitat quality in most of the first order reaches sampled was poor or absent (figure 3). Habitat quality tended to improve in higher order reaches, and most third, fourth and fifth order reaches were identified to be fish bearing. Fish distribution in higher order reaches, particularly in the Dungate Creek and Bob Creek systems, was generally limited by the natural topographic barriers (i.e. falls, cascades, etc. (table 12)), rather than limited habitat quality which tended to be the case in first order reaches.

Table 11. Percent of reaches with known fish bearing status, and kilometers of each stream classification within reaches of different stream order.

Stream Order	% of reaches with confirmed presence/absence after re-sampling	% of confirmed reaches which have fish present	Kilometers of Stream				% of reaches with fish present/suspected fish present
			Fish Present	Suspected Fish Present	Fish Absent	Suspected Fish Absent	
1	65.2%	0%	0.0	22.7	146.9	60.6	8.8%
2	61.5%	7.5%	4.3	17.4	53.3	0.4	30.3%
3	80.6%	32%	14.2	8.1	18.7	0.3	41.9%
4	75%	100%	6.5	0.93	0	0	100%
5	100%	100%	59.4	0	0	0	100%
Total	65.8%	6.6%	84.3	49.2	218.8	71.1	17.3%

A cascade located in reach 3 of Buck Creek restricts access to upstream habitat for some species (e.g. pink salmon), and series of water falls (locally known as Buck Falls) is a barrier to fish passage in reach 6 of Buck Creek (ILP 80001), about 35.7 km upstream of the Bulkley River (Table 10). Suitable rearing, spawning and overwintering habitat upstream of Buck Falls is utilized by freshwater resident species, including rainbow trout, longnose suckers, white suckers and redbreasted shiners.

The two major tributaries sampled (Dungate Creek and Bob Creek) during this inventory project are characterized by steep gradient sections, low valley to channel ratios, and the presence of topographical barriers to fish migration. Fish were captured upstream of a 7 m falls in reach 2 of Dungate Creek (ILP 80004), but no fish were captured upstream of a series of cascades in reach 5 (Table 11). The lower reaches of some tributaries to Dungate Creek are accessible to the resident fish populations in the system, but gradient in the mid and upper reaches of most tributaries limit the accessibility and suitability of fish habitat in this fourth order tributary to Buck Creek. Similarly, access and suitability of fish habitat in Bob Creek (ILP 80110), a 3rd order tributary to Buck Creek, is limited to the mainstem, since tributary reaches rise steeply out of the narrow valley in which Bob Creek is located.

Fish distribution in the lower Buck Creek sub-basin extended from lower elevation reaches to mid elevation reaches and included the Buck Creek mainstem, Dungate Creek (to reach 5) and is suspected to encompass the majority of the Bob Creek mainstem. Fish were generally absent in higher elevation reaches of the western, and southern portion of the study area due to the presence of topographic barriers in Dungate Creek, tributaries to Bob Creek, and inlet streams to reaches 3 and 5 of Buck Creek (e.g. ILP 80167). Systems draining the eastern portion of the northern half of the study area are characterized by gentler sloping terrain, and fish distribution extends to near the headwaters of some of the systems sampled (e.g. ILP 80130 (a third order system)). Among the reaches sampled, the best quality accessible fish habitat was found in higher order reaches below topographic barriers

Table 12. Summary of historic and new barriers and obstructions to fish migration found in the Lower Buck Creek sub-basin of the Buck Creek Watershed (sorted by ILP and reach number).

ILP	TRIM map #	Reach	Barrier			
			Type	Height (m)	Verified in field	Description
80001	093L.047	3	C		Y	Barrier to some species (e.g. pink salmon) (BCCF 1997)
80001	093L.047	6	F	2	Y	Collectively known as Buck Falls; these falls are barriers to fish passage, but rainbow trout and Dolly Varden have been captured upstream (SKR 2002)
80001	093L.047	6	F	3.4	Y	
80001	093L.047	6	F	4.1	Y	
80004	093L.037	2	F	7	Y	(BCCF 1998)
80004	093L.037	5	C	6	Y	(SKR 2002)
80004	093L.037	5	C	3	Y	(SKR 2002)
80004	093L.037	5	C	5	Y	(SKR 2002)
80005	093L.038	1.2	XW	1	Y	One of several sediment wedges
80005	093L.038	2	CV	1	Y	1.0 m perched culvert with an 80 m long 40% gradient cascade below (SKR 2002)
80008	093L.038	1	CV		Y	Outfalls onto high gradient rip-rap (SKR 2002)
80008	093L.038	1	F	6	Y	About 750 meters upstream of Dungate Creek
80016	093L.038	1	C	22	Y	22% gradient cascade (ranges between 21 and 25%), located 30 meters upstream of confluence
80023	093L.038	1	F	1	Y	Rock controlled falls with 0.5 m plunge pool (SKR 2002)
80023	093L.038	1	C	15	Y	18% gradient cascade with 15 m at 28% about 170 m downstream of road
80081	093L.038	1	C	4	Y	At bottom of reach (SKR 2002)
80094	093L.037	1	C	22	Y	100 m long 22-24 percent gradient cascade about 80 m upstream from confluence
80101	093L.037	1	C	10	Y	22% gradient cascade section (SKR 2002)
80112	093L.037	1	F	1	Y	1.0 m fall with no plunge pool (SKR 2002)
80130	093L.037	7	FD		Y	No culvert at road crossing (SKR 2002)
80142	093L.027	2	F	3	Y	A series of two 3 m falls about 2600 m upstream of Buck Creek
80156	093L.027	2	FLD		Y	Dewatered section on downstream side of wooden box culvert (SKR 2002)
80167	093L.028	2	F	3	Y	(SKR 2002)
80167	093L.028	2	F	3	Y	(SKR 2002)
80167	093L.028	3	C	2	Y	(SKR 2002)
80167	093L.028	3	F	12	Y	(SKR 2002)
80167	093L.028	3	F	2.5	Y	(SKR 2002)
80167	093L.028	3	F	2	Y	(SKR 2002)
80180	093L.028	2	CV	0.8	Y	Residual pool depth was 0.5 m (SKR 2002)
80185	093L.018	1	FSB		Y	seepage and dispersed flow with no defined channel in lower 50 m
80193	093L.018	1	C	22	Y	100 m long, 22 % cascade about 100 m upstream of confluence
80211	093L.018	1	FSB		Y	no visible flow or channel in open wetland
80228	093L.018	1	FSB		Y	no defined channel downstream of heavy braiding in this large wetland

¹ FLD = underground seepage, F = falls, C = cascade, FD = ford, CV = culvert, XW = sediment wedge

4.5 FISH AGE, SIZE AND LIFE HISTORY

Species previously documented in the lower Buck Creek watershed include eight species of salmonids (coho, Chinook, pink, steelhead/rainbow trout, cutthroat trout, Dolly Varden, bull trout, mountain whitefish), three species of catostomids (largescale suckers, longnose suckers, white suckers), three species of cyprinids (longnose dace, peamouth chub, redside shiners) and two species of lampreys (river lamprey, pacific lamprey) (FISS, BCCF 1997, 1998, MacKay 1999, SKR 2000, Triton 2000, SKR 2001, 2002). Rainbow trout and coho were the only two species captured in the lower Buck Creek sub-basins in August and September 2001, and a cutthroat trout was captured at one of the 20 sites sampled for fish during re-sampling in 2005. The following sub-sections describe the distribution and life history of each of the salmonids captured during initial sampling in 2001 (SKR 2002) and during resampling in 2005.

4.5.1 RAINBOW TROUT

Rainbow trout was the most common and wide spread species captured within reaches sampled in the lower Buck Creek sub-basin in August and September 2001, but this species was not captured in 2005. The distribution and life history interpretations are based on data collected in 2001 (SKR 2002). Of the 32 stream reaches sampled for fish in August and September 2001, rainbow trout were captured in 11 reaches. Rainbow trout were also captured in the upper Buck Creek sub-basin during a previous inventory (Triton 2000). Rainbow trout appears to be the most widespread and abundant species in the reaches sampled in the Buck Creek watershed in the summer of 2001.

Forty-nine scale samples (57.6%) were collected from the 85 rainbow trout captured. Twelve of these scale samples were not suitable for age determination, and ages were determined for the remaining 37 of the 85 rainbow trout captured. Scale samples were not collected randomly. No scale samples were collected from rainbow trout measuring less than 60 mm, thus resulting in an under-representation of age structures from age 0 rainbow trout. Length at age data for the 37 rainbow trout aged by scale sample analysis are summarized in table 13. Length frequency histograms for rainbow trout captured in the four sub-basins sampled are illustrated in figure 5. Size ranges of the different age classes present in the sample of rainbow trout captured in the three sub-basins, as estimated from aged rainbow trout and length frequency distribution are also shown in figure 5. Rainbow trout captured in the lower Buck Creek sub-basin of the Buck Creek watershed sampled in 2001 represented five distinct age classes, ranging from young of the year (age 0) to age 4 mature rainbow trout. Age at sexual maturity was 3 for the sample of rainbow trout captured. Scott and Crossman (1973) indicate that rainbow trout generally mature between ages 3-5 with males often maturing one year earlier than females, which corresponds to the age at maturity found during our study.

Table 13. Length at age for eleven rainbow trout aged from scales in August and September 2001 (SKR 2002). No rainbow trout were captured during resampling in 2005.

Age	N	Fork Length (mm)			
		min.	max.	mean	SE
0	4	60	65	62.5	1.041
1	9	68	82	73.11	1.679
2	16	78	105	94.69	1.964
3	7	131	148	137.71	2.427
4	1	151	151	151	---

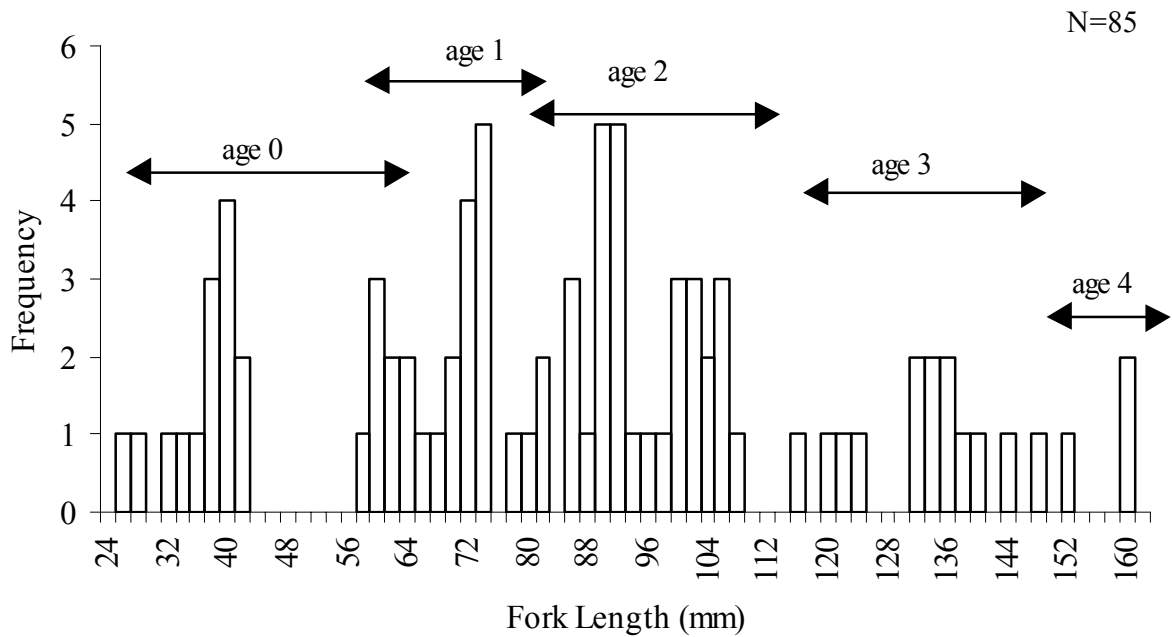


Figure 5. Length frequency histogram of rainbow trout captured in streams sampled in the lower Buck Creek sub-basin in 2001 (SKR 2002). Arrows refer to estimated age categories.

Length at age data for the 37 rainbow trout aged from scales were used to generate a Ford-Walford plot (figure 6) to illustrate growth trajectory for rainbow trout captured. Since the age 0 size class was under-represented in the sample of aged rainbow trout, rainbow trout smaller than 60 mm in fork length were included to obtain the mean length of this age group for the Ford Walford Plot. Mean fork length at age n was plotted against mean fork length at age n+1, assuming a linear relationship. The regression equation for rainbow trout and corresponding r^2 values for the trend line in Figure 6 are presented below:

rainbow trout:

$$(FL \text{ at age } n+1) = 0.885 (FL \text{ at age } n) + 36.072$$

sample size = 4

$$r^2 = 0.8954$$

age range = 0 to 4

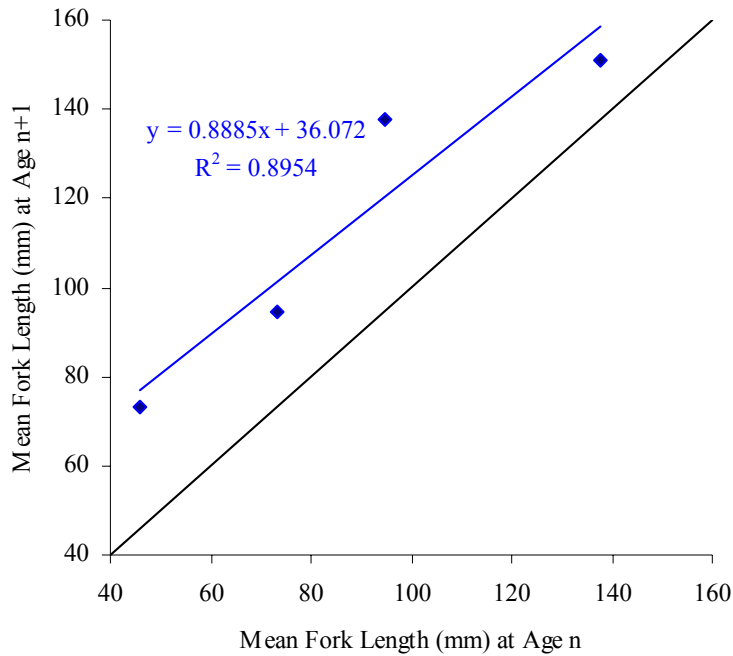


Figure 6. Ford-Walford plot for rainbow trout captured in lower Buck Creek sub-basin in 2001 (SKR 2002). The 45° line is included to illustrate a uniform absolute increase in length with age.

The Ford-Walford plot illustrates that the line generated by linear regression almost parallel to the 45° diagonal, with a slope of 0.885. The asymptotic length (L_{∞}) is therefore calculated to be 323.5 mm. The accuracy of the Ford-Walford plot and resultant asymptotic length is likely reduced by the small sample size of age 4 rainbow trout ($N=1$), which may have biased the equation. The Ford-Walford plot illustrated in Figure 6 should be viewed with consideration to this limitation and biases of the size at age data collected.

Rainbow trout were captured throughout many of the stream reaches in lower Buck Creek sub-basin sampled. These populations may exhibit an adfluvial or fluvial life history. The presence of rainbow trout in Goosly Lake (FISS) supports that at least some of the populations in the system are adfluvial. The presence of rainbow trout upstream of falls in the Buck Creek mainstem, and in Dungate Creek suggest that genetically isolated populations of rainbow trout are present in the watershed. Rainbow trout in Dungate Creek are stream resident upstream of the falls, and form a unique population.

4.5.2 CUTTHROAT TROUT

One adult cutthroat trout was captured at one of 20 sites sampled for fish during resampling in 2005 (5%), but this species was not captured at any of the 32 sites sampled for fish during initial sampling conducted in 2001 (SKR 2002). Cutthroat trout have previously been documented in the lower Buck Creek watershed below Buck Falls (SKR 2000), but the species has not been documented upstream of the falls, or in the upper Buck watershed inventoried by Triton (2000). This species is not widespread or abundant in the Buck Creek system. The cutthroat trout was caught at site 10 in reach 2 of Bob Creek (ILP 80110), and measured 220 mm in length (figure 7). The age of this fish is estimated to be greater than 2 years. No juvenile fish were captured at this site. Due to the lack of lakes in the vicinity of the capture location, we speculate that cutthroat trout exhibit a fluvial life history.



Figure 7. Cutthroat trout (fork length = 220 mm) captured at site 10, reach 2 of Bob Creek (ILP 80110) on August 22nd, 2005.

4.5.3 COHO

Coho were captured in two stream reaches sampled in 2001, all of which were located downstream of Buck Falls, and Dungate Creek (SKR 2002). Coho were captured at site 1 in reach 6 of Buck Creek (ILP 80001), and at site 2 in reach 1 of Dungate Creek (ILP 80004). While coho did not appear as wide spread as rainbow trout, this species was commonly captured in the lower Buck Creek, downstream of Buck Falls, and in the lower reaches of tributaries that drain into reaches 1 to 6 of Buck Creek. Data summaries are based on data collected in 2001 since no coho were captured during resampling in 2005.

Twenty-five scale samples (40.3%) were collected from the 62 coho captured. Two of these scale samples were not suitable for age determination, thus ages were determined for the remaining 23 of the 62 coho captured (37.1%). Length at age data for the 23 coho aged by scale sample analysis are summarized in table 14. Length frequency histograms for coho captured in the three sub-basins sampled are illustrated in figure 8. Coho captured in the lower Buck Creek sub-basin represent two distinct age classes, with the majority of coho aged as 0+. Age 1+ coho represent a proportion of coho that delay smoltification for two or more winters in freshwater, when compared to most coho, which have been documented to smolt after one winter for more southern and coastal populations (Sandercock 1991).

Table 14. Length at age for 23 coho aged from scales.

Age	N	Fork Length (mm)			
		min.	max.	mean	SE
0+	20	56	78	67.05	1.241
1+	3	77	95	88.00	5.568

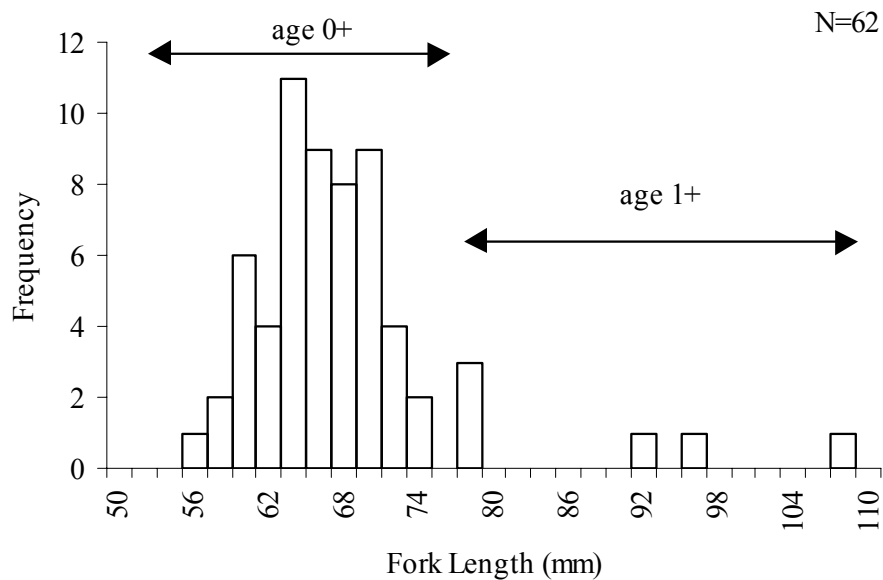


Figure 8. Length frequency histogram of coho captured in the Lower Buck sub-basin in August and September 2001. Arrows refer to estimated age categories.

4.6 SIGNIFICANT FEATURES AND FISHERIES OBSERVATIONS

Overall, the lower Buck Creek sub-basin appears to be more productive for fish than reaches sampled in upper Buck Creek sub-basin during a previous inventory (Triton 2000). A number of salmonid and non-salmonid species, including anadromous and freshwater resident populations utilize the habitat in the lower Buck Creek sub-basin. Rainbow trout were frequently captured in relatively large numbers in mainstem reaches of Buck Creek during initial sampling in 2001 (SKR 2002), and the species appears to be widespread throughout the Buck Creek watershed. Coho salmon were captured in the mainstem of Buck Creek, downstream of Buck Falls in 2001 (SKR 2002), and one cutthroat trout was captured in Bob Creek during resampling in 2005. Other anadromous and freshwater species documented in the watershed, including Chinook and pink salmon, as well as Dolly Varden and bull trout, were not captured in any of the reaches sampled in 2001 or in 2005, indicating that the distribution of these species is less widespread. The following sections describe interesting features related to fish, fish habitat, and habitat protection concerns in the study area within the lower Buck Creek watershed based on historical information and the findings from this study.

4.6.1 FISH AND FISH HABITAT

The higher order and moderate-low gradient reaches of mainstem and larger (third and fourth order) tributaries within the study area appear to offer the most suitable and abundant fish spawning, rearing and overwintering habitat. Overwintering and rearing habitat is also provided by a few of the small sized lakes and moderate sized wetlands in the systems. In addition to rainbow trout, cutthroat trout and coho salmon, captured and observed during the inventory conducted in 2001 and 2005, other species found in Buck Creek watershed (e.g. pink and chinook salmon, whitefish, Dolly Varden, bull trout, suckers, reidside shiners and dace) may use suitable habitat in higher order reaches near the Bulkley River, but only stream resident populations are present upstream of Buck Falls.

4.6.2 HABITAT PROTECTION CONCERNS

4.6.2.1 *Fisheries Sensitive Zones*

No fisheries sensitive zones were identified in the study area.

4.6.2.2 *Fish above 20% gradient*

No fish were captured in reaches with gradients greater than 20%.

4.6.2.3 *Rare and Endangered Species*

Bull trout and Dolly Varden have been documented present in Buck Creek and Dungate Creek (BCCF 1998), but these species appear to be absent from the upper Buck Creek sub-basin (Triton 2000). Both of these species are blue listed species and are considered vulnerable to human disturbances and natural catastrophes (B.C. Environment 2005).

Rainbow trout were captured upstream of waterfalls in the Buck Creek mainstem and in Dungate Creek. These populations are genetically isolated from those present in the lower 5 reaches of Buck Creek.

4.6.2.4 High Value Sport Fishing

Several species attractive for sport fishing have been documented in the Buck Creek watershed, including rainbow trout, coho, Dolly Varden and bull trout. Sport fishing opportunities exist in the mainstem of Buck Creek, and in several of the lakes in the drainage (e.g. Goosley Lake), but Buck Creek is currently closed to fishing (B.C. Fisheries 2005).

4.6.2.5 Restoration and Rehabilitation Opportunities

A significant proportion of the Buck Creek watershed, particularly downstream of Buck Falls Lake, has experienced a variety of landuse activities, including agriculture, urbanization, linear development, mining and forestry (BCCF 1997, 1998), and further harvest has been proposed. The west portion of the drainage is located in an area impacted by the Swiss Fire, which has accounted for a significant amount of timber removal either directly by the fire, or through salvage of remaining timber. Several of the reaches sampled in 2001 and 2005 were dry (21.7% of first order reaches), or did not have a defined channel (17.4% of first order reaches, and 10.7% of second order reaches). The ephemeral nature of some of the sampled reaches is partly attributable to the timing of initial sampling (late summer and fall 2001). However, the lack of wetted reaches (particularly in first order systems) appears to be relatively common, and may be partly be due to the level of harvest in the watershed, which may result in increased high flow levels that last for a shorter duration, and decreased low flow levels. Changes in hydrology of the watershed may have resulted from the harvest in this generally low gradient system, but these affects are difficult to restore.

Evidence of range activities and associated impacts were also noted in the study area, particularly in the Dungate Creek basin. Range activities can result in trampling of stream banks as cattle access water or cross streams. Some of the sites where these impacts were noted were located in non-fish bearing sections of the watershed, upstream of barriers to fish passage. While cattle activities in non-fish bearing sections of the drainage may not directly impact fish and fish habitat, indirect and cumulative impacts as a result of increased sedimentation, and decreased bank and channel stability may occur.

Broader scale impacts of landuse management are difficult to assess and restore, but some of these impacts have been identified in previous studies (BCCF 1997, 1998). In addition, some specific sites offering rehabilitation opportunities were identified during initial inventory in the lower Buck Creek sub-basin in 2001 (SKR 2002). No additional restoration or rehabilitation opportunities were identified during resampling in 2005. Restoration and rehabilitation opportunities identified during reconnaissance fish and fish habitat inventories in the lower Buck watershed are summarized in table 15.

Table 15. Summary of restoration and rehabilitation opportunities identified in reaches sampled in the lower Buck Creek sub-basin in 2001 (SKR 2002).

ILP	Reach	Site	TRIM Map	Comments
80004	5	4	093L.028	Several unraveled and washed out culverts (figure 9) were located in a section of Dungate Creek, just downstream of tributary ILP 80081; rainbow trout have been captured in this reach of the stream
80025	2	7	093L.038	A 1.0 m perched culvert draining onto an 8 m long 40% gradient boulder/cobble section at the road crossing is a barrier; marginal fish habitat upstream
80008	1	8	093L.038	A culvert draining onto a 10 m section of high gradient rip-rap at the Equity Mine road crossing was noted as a barrier to fish passage but only marginal fish habitat upstream was identified upstream
80130	7	23	093L.037	No culvert was present at the road crossing in this reach, which consisted of a series of logs laid across the stream; the reach was dry at the time of survey
80136	2	24	093L.037	The culvert at this road crossing consists of a concrete pipe, and is inadequate for the drainage required at the crossing (evidence of flooding was noted)
80156	2	32	093L.027	This reach is located in the Swiss Fire area; a dewatered section downstream of the box culvert in this reach is a seasonal barrier; fish were captured upstream; deactivation of the road is recommended
80180	2	41	093L.028	A 0.8 m perched culvert with a 0.5 m deep plunge pool was noted at the road crossing in this reach; fish passage in reach 1 may be limited seasonally by dewatered sections; moderate fish habitat is present upstream of the culvert



Figure 9. Downstream view of several unraveled and washed out culverts in Dungate Creek (ILP 80004), just downstream of tributary ILP 80017.

4.7 FISH BEARING STATUS

Fish distribution in the study area is limited by a combination of gradient barriers to fish migration, and intermittent channels. Fish bearing reaches are summarized in table 16, while proposed non-fish bearing reaches are summarized in table 17. Reaches upstream of barriers to fish migration where no fish were captured, or where no perennial fish habitat was identified, are classified as non-fish bearing based on one season of sampling. Some reaches where no fish were captured, but no definite barrier to fish migration were observed, were noted to require further sampling to conclusively establish fish presence or absence (table 18).

4.7.1 FISH BEARING REACHES

Fish bearing status was assigned to all reaches in which species listed in the Forest Practices Code Fish Stream Identification guidebook were captured (FPC 1998). In addition, reaches in which no fish were captured, but where fish presence has been documented upstream, and where no barriers to fish migration have been identified were defaulted as fish bearing. Table 16 summarizes reaches that were documented to be fish bearing during this study. Of the 31 reaches sampled in 2005, fish were captured in one stream reach (table 16). Other potential fish bearing reaches are indicated on the Fisheries Project/Interpretive Map (Appendix 5).

4.7.2 NON - FISH BEARING REACHES

Non-fish bearing status was assigned to 21 reaches sampled upstream of barriers to fish migration in which no fish were captured in one season of sampling or which did not offer perennial fish habitat (table 17). This indicates a lack of resident fish upstream of these barriers.

4.7.3 FOLLOW – UP SAMPLING REQUIRED

Fish presence or absence was not conclusively determined for 11 reaches sampled in the lower Buck watershed during the re-sampling program in June 2005 (table 18). Reaches, which could not be conclusively classified, may require re-sampling to indicate if seasonal fish use is present and to confirm fish absence as described under Forest Practices Code standards (FPC 1998).

Results and Discussion
Fish Bearing Reaches

Table 16. Summary of data from one fish bearing reach in the Buck Creek watershed sampled in 2005 (*for details see Appendix 1*).

Site #	Alias Stream name	ILP/ Watershed Code	TRIM map	Reach	Species	Channel		Proposed Riparian Class	Comments
						Width (m)	Site gradient (%)		
10	Bob Creek	80110	093L.037	3	CT	5.33	8.33	S2	One adult cutthroat trout (fork length = 220 mm) was captured in this reach. Excellent rearing habitat, some potential spawning habitat (though gravel wedges indicate this reach is somewhat unstable), and some potential overwintering habitat were noted in this reach. Several 30 to 40 cm high gravel wedges may limit fish distribution in this reach (especially for juveniles), but no definite barriers to fish passage were identified.

Results and Discussion
Non-Fish Bearing Reaches

Table 17. Summary of data from 21 non-fish bearing reaches (sorted by site number) in the Buck Creek watershed sampled in 2005 (for details see Appendix 1). Site data pertaining to the initial sample event are listed first, with re-sampling data listed second for all re-sampled reaches.

Site #	Alias Stream Name	ILP/ Watershed Code	Reach	TRIM map	Electrofishing specifications								Secondary Method	Date (2005)	Proposed Riparian Class	Comments
					Gradient (%)	Channel Width (m)	Dist. (m)	Time (s)	Cond. (uS)	Temp.	Stage	Turbidity				
3	Unnamed	80005	2	93L.038	5.5	1.02	---	---	---	---	dry	C	EF	29/06	S6	This reach was initially sampled on August 28, 2001. The reach was dry during initial sampling, and fish habitat was rated as poor. No fish were captured during re-sampling. Overall fish habitat during re-sampling was rated as moderate. Shallow pools provide potential rearing habitat, but no suitable overwintering habitat (no deep pools) and no spawning habitat (no suitable substrate and ephemeral) were noted in this reach. This reach can be managed as non-fish bearing due the presence of only moderate, seasonal fish habitat, the lack of fish in two seasons of sampling in this reach, and the lack of fish in better habitat in reaches 1-1 and 1-2 downstream (sites 1 and 2).
					5.5	1.25	100	375	70	9	M					

Results and Discussion
Non-Fish Bearing Reaches

Table 17. Summary of data from 21 non-fish bearing reaches (sorted by site number) in the Buck Creek watershed sampled in 2005 (for details see Appendix 1). Site data pertaining to the initial sample event are listed first, with re-sampling data listed second for all re-sampled reaches.

Site #	Alias Stream Name	ILP/Watershed Code	Reach	TRIM map	Electrofishing specifications								Secondary Method	Date (2005)	Proposed Riparian Class	Comments
					Gradient (%)	Channel Width (m)	Dist. (m)	Time (s)	Cond. (uS)	Temp.	Stage	Turbidity				
4	Unnamed	80008	1.2	93L.038	5.25	2.30	100	362	80	8	M	C		01/08	S6	This reach was sampled about 800 meters upstream of Dungate Creek. A 6 m high falls was identified as a barrier to fish passage at the lower reach break. Limited fish habitat and no suitable overwintering habitat (no deep pools) was noted upstream. No fish were captured at this site. Downstream reaches should be managed as fish bearing by default. No fish sampling was conducted downstream of the falls due to the presence of an anthropogenic barrier at the road crossing in reach 1.1.
5	Unnamed	80016	1	93L.038	9.67	1.00	---	---	60	9	M	C	---	16/07	S4/S6	A 22% gradient, 100 m long cascade was identified as a barrier to fish passage about 30 meters upstream of Dungate Creek. No perennial fish habitat is present upstream of the cascade (no deep pools for overwintering, low discharge). The lower 30 meters of the reach, downstream of the cascade should be managed as fish bearing by default, but upstream reaches can be managed as non fish bearing.

Results and Discussion
Non-Fish Bearing Reaches

Table 17. Summary of data from 21 non-fish bearing reaches (sorted by site number) in the Buck Creek watershed sampled in 2005 (for details see Appendix 1). Site data pertaining to the initial sample event are listed first, with re-sampling data listed second for all re-sampled reaches.

Site #	Alias Stream Name	ILP/ Watershed Code	Reach	TRIM map	Electrofishing specifications								Secondary Method	Date (2005)	Proposed Riparian Class	Comments	
					Gradient (%)	Channel Width (m)	Dist. (m)	Time (s)	Cond. (µS)	Temp.	Stage	Turbidity					
6	Unnamed	80016	2	93L.038	1.75 ---	0.37 ---	--- ---	--- ---	--- ---	--- ---	--- ---	Dry	-- ---	---		S6	This reach was dry during initial sampling on August 27, 2001. Re-sampling was conducted about 200 meters upstream of the reach break, and the confluence with ILP 80017. No defined channel was identified at this site. This reach can be managed as non-fish bearing due to the lack of perennial fish habitat upstream of the 6 m falls in reach 1 (see site 5).
8	Unnamed	80023	1	93L.038	3	3.97	100	3.0	50	8	M	C	---	01/08	S5	A series of cascades (70 m long with average gradient of 18%, including 15 meters with gradient of 28%) and a 1 m falls were identified as barriers to fish passage downstream of the road crossing. No fish were captured upstream of these barriers at this site during re-sampling, or at two sites sampled upstream in 2001 (SKR 2002).	

Results and Discussion
Non-Fish Bearing Reaches

Table 17. Summary of data from 21 non-fish bearing reaches (sorted by site number) in the Buck Creek watershed sampled in 2005 (for details see Appendix 1). Site data pertaining to the initial sample event are listed first, with re-sampling data listed second for all re-sampled reaches.

Site #	Alias Stream Name	ILP/ Watershed Code	Reach	TRIM map	Electrofishing specifications								Secondary Method	Date (2005)	Proposed Riparian Class	Comments
					Gradient (%)	Channel Width (m)	Dist. (m)	Time (s)	Cond. (µS)	Temp.	Stage	Turbidity				
9	Unnamed	80094	1	93L.037	13	0.55	---	---	---	---	Dry	--		28/06	S4/S6	This reach was dry during initial sampling on August 27 th , 2001 (SKR 2002). A 22% gradient, 100 m long cascades was identified as a barrier to fish passage about 80 meters upstream of Dungate Creek. No perennial fish habitat was noted upstream due to the ephemeral nature of the system, with little surface water at the time of re-sampling (June). The lower 80 meters of the system should be managed as fish bearing by default.
					5.5	0.70	---	---	---	---	M	C				
12	Unnamed	80136	2	93L.037	8.5	0.83	---	---	---	---	Dry	---		28/06	NCD	This reach was dry during initial sampling on August 14 th , 2001. This reach was re-sampled about 350 meters upstream of Beaver Pelt Lake. An unmapped drainage joins this system at the reach 1- reach 2 break. No suitable fish habitat was identified in this reach. The section of the reach upstream of the confluence with the unmapped drainage can be managed as NCD, and the channelized section downstream of the confluence should be managed as fish bearing by default.
					6.5	---	---	---	---	---	NCD	---				

Results and Discussion
Non-Fish Bearing Reaches

Table 17. Summary of data from 21 non-fish bearing reaches (sorted by site number) in the Buck Creek watershed sampled in 2005 (for details see Appendix 1). Site data pertaining to the initial sample event are listed first, with re-sampling data listed second for all re-sampled reaches.

Site #	Alias Stream Name	ILP/ Watershed Code	Reach	TRIM map	Electrofishing specifications								Secondary Method	Date (2005)	Proposed Riparian Class	Comments
					Gradient (%)	Channel Width (m)	Dist. (m)	Time (s)	Cond. (µS)	Temp.	Stage	Turbidity				
13	Unnamed	80142	2	93L.027	4.5	4.05	140	920	60	10	M	C		06/08	S3/S5	Two 3 meter high falls were noted in this reach, about 2600 meters upstream of Buck Creek. These falls are a definite barrier to fish passage. Rainbow trout were captured in this reach downstream of the falls during initial sampling (SKR 2001), but no fish were captured upstream of the falls at two sites sampled in 2001 (SKR 2002), or at site 13 sampled in 2005. This reach and upstream reaches can be managed as non-fish bearing.
14	Unnamed	80146	1	93L.027	11 8.25	0.90 1.05	100 ---	462 ---	140 ---	6 ---	L Dry	C		22/07	S6	No fish were captured at this site during initial sampling on August 23 rd , 2001, and the reach was dry during re-sampling on July 22 nd , 2005. The gradient increases to 12% about 50 meters upstream of the confluence with ILP 80145. The system was dry in reach 2 as well, and habitat quality declines further upstream. This reach can be managed as non-fish bearing based on the lack of fish in two seasons of sampling, and the very marginal, ephemeral fish habitat.

Results and Discussion
Non-Fish Bearing Reaches

Table 17. Summary of data from 21 non-fish bearing reaches (sorted by site number) in the Buck Creek watershed sampled in 2005 (for details see Appendix 1). Site data pertaining to the initial sample event are listed first, with re-sampling data listed second for all re-sampled reaches.

Site #	Alias Stream Name	ILP/ Watershed Code	Reach	TRIM map	Electrofishing specifications								Secondary Method	Date (2005)	Proposed Riparian Class	Comments
					Gradient (%)	Channel Width (m)	Dist. (m)	Time (s)	Cond. (µS)	Temp.	Stage	Turbidity				
15	Unnamed	80146	2	93L.027	1.0	1.00	---	---	---	--	Dry	---		22/07	S6	This reach was dry and provided very marginal rearing habitat, no spawning habitat (no gravels), and no suitable overwintering habitat (ephemeral, no deep pools). No fish were captured downstream during two seasons of sampling (site 14). The channel consisted of wet mud with no pools, and the channel was poorly defined in several sections.
20	Unnamed	80161	1	93L.027	5.0	1.18	---	---	90	10	L	C		27/07	S6	This reach provides only very poor fish habitat. The discharge was low at the time of sampling, and the reach is suspected to be ephemeral. No potential spawning habitat (no suitable substrate) and no potential overwintering habitat (no deep pools) were identified in this reach. Fish sampling was not conducted due the failed wood culvert present downstream, which obstructs fish passage. This reach can be managed as non-fish bearing due to the lack of fish captured in two seasons in better habitat in the mainstem downstream (reach 4-2, ILP 80156, sites 18 and 19), and due to the presence of only marginal fish habitat in this reach.

Results and Discussion
Non-Fish Bearing Reaches

Table 17. Summary of data from 21 non-fish bearing reaches (sorted by site number) in the Buck Creek watershed sampled in 2005 (for details see Appendix 1). Site data pertaining to the initial sample event are listed first, with re-sampling data listed second for all re-sampled reaches.

Site #	Alias Stream Name	ILP/ Watershed Code	Reach	TRIM map	Electrofishing specifications								Secondary Method	Date (2005)	Proposed Riparian Class	Comments
					Gradient (%)	Channel Width (m)	Dist. (m)	Time (s)	Cond. (µS)	Temp.	Stage	Turbidity				
22	Unnamed	80164	2	93L.027	6.0	1.92	--	--	--	--	Dry	--	EF	27/06	S6	This reach was dry during initial sampling on August 23 rd , 2001. Some moderate potential rearing habitat, some suitable gravel pockets for spawning, but no suitable overwintering habitat (no deep pools) were noted during re-sampling. Habitat quality is limited due to the ephemeral nature of the reach. No fish were captured during re-sampling. This reach can be managed as non-fish bearing due to the lack of perennial fish habitat, and the lack of fish captured in two seasons upstream of the 30 meter section of poorly defined channel in reach 1 (site 21) which restricts fish access to seasonal habitat in this reach.
					7.5	1.88	100	395	60	11	M	C				
24	Unnamed	80185	1	93L.018	3	1.43	120	645	60	9	M	C		27/06	S6	The lower 50 meters of this reach consist of seepage with no defined channel. This section of the reach is a barrier to fish passage. Some potential rearing habitat, but no suitable spawning habitat (ephemeral) was noted in this reach. No fish were captured in one season of sampling.

Results and Discussion
Non-Fish Bearing Reaches

Table 17. Summary of data from 21 non-fish bearing reaches (sorted by site number) in the Buck Creek watershed sampled in 2005 (for details see Appendix 1). Site data pertaining to the initial sample event are listed first, with re-sampling data listed second for all re-sampled reaches.

Site #	Alias Stream Name	ILP/ Watershed Code	Reach	TRIM map	Electrofishing specifications								Secondary Method	Date (2005)	Proposed Riparian Class	Comments
					Gradient (%)	Channel Width (m)	Dist. (m)	Time (s)	Cond. (µS)	Temp.	Stage	Turbidity				
25	Unnamed	80185	1	93L.018	11	---	---	---	---	---	---	---		27/06	NCD	This stream has two mapped distributaries on the TRIM map. This reach is the east distributary of the mainstem. No defined channel was identified in the section surveyed (about 300 meters upstream of Buck Creek). A defined gully was identified, but limited drainage was present, and no channel was found.
26	Unnamed	80193	1	93L.018	5	1.3	100	396	80	8	M	C		27/06	S4/S6	A 100 m long, 22% gradient cascade was identified as a barrier to fish passage about 100 meters upstream of Buck Creek. No fish were captured downstream of the cascade (site 26), and no fish were captured upstream of the cascade (site 27). Some potential rearing habitat (good cover) was noted downstream of the cascade, and fish may use the lower 100 meters on a seasonal basis. This reach should be managed as fish bearing downstream of the cascade, but can be managed as non-fish bearing upstream of the cascade.

Results and Discussion
Non-Fish Bearing Reaches

Table 17. Summary of data from 21 non-fish bearing reaches (sorted by site number) in the Buck Creek watershed sampled in 2005 (for details see Appendix 1). Site data pertaining to the initial sample event are listed first, with re-sampling data listed second for all re-sampled reaches.

Site #	Alias Stream Name	ILP/ Watershed Code	Reach	TRIM map	Electrofishing specifications								Secondary Method	Date (2005)	Proposed Riparian Class	Comments
					Gradient (%)	Channel Width (m)	Dist. (m)	Time (s)	Cond. (µS)	Temp.	Stage	Turbidity				
27	Unnamed	80193	2	93L.018	2.50	0.78	---	---	---	---	Dry	--		27/06	S6	This reach was dry during initial sampling on August 23 rd , 2001 (SKR 2002). No fish were captured in this reach during re-sampling, and the reach provided only relatively poor fish habitat due to the presence of extensive algal cover, and the ephemeral nature of the reach. This reach is non-fish bearing due to the lack of fish captured in two seasons of sampling, and the lack of perennial fish habitat upstream of a barrier to fish passage (cascade in reach 1, see site 26).
					4.0	1.05	100	312	80	8	M	C				
29	Unnamed	80207	2	93L.018	1.0	1.15	100	374	150	10	M	C		27/06	S6	No fish were captured in this reach during initial sampling on August 24 th , 2001, and no fish were captured during resampling. This reach provides some potential rearing habitat (limited by low flow), but no suitable spawning habitat was identified (substrate is mostly fines, discharge is low). This reach is non-fish bearing due to the lack of fish captured in two seasons of sampling, and the lack of perennial fish habitat upstream of a barrier in reach 1 (heavily braided and poorly defined channel in the upper 300 m of reach 1; see site 28).
					1.5	1.05	110	411	80	11	M	C				

Results and Discussion
Non-Fish Bearing Reaches

Table 17. Summary of data from 21 non-fish bearing reaches (sorted by site number) in the Buck Creek watershed sampled in 2005 (for details see Appendix 1). Site data pertaining to the initial sample event are listed first, with re-sampling data listed second for all re-sampled reaches.

Site #	Alias Stream Name	ILP/ Watershed Code	Reach	TRIM map	Electrofishing specifications								Secondary Method	Date (2005)	Proposed Riparian Class	Comments
					Gradient (%)	Channel Width (m)	Dist. (m)	Time (s)	Cond. (µS)	Temp.	Stage	Turbidity				
30	Unnamed	80207	3	93L.018	7	0.9	---	---	---	---	Dry	--		27/06	S6	This reach was dry during initial sampling on August 24 th , 2001, and the reach was mostly dry during re-sampling. Habitat quality was limited by the presence of soft barrier steps, and the ephemeral nature of the reach. No fish were captured during re-sampling, and no fish were captured in two seasons of sampling in reach 2, both of which are located upstream of a barrier to fish passage (heavily braided and poorly defined channel in the upper 300 m of reach 1).
					7	0.83	30	292	80	10	M	C				
31	Unnamed	80208	1	93L.018	1.0	0.7	---	---	140	10	L	C		27/06	S6	The channel is poorly defined in several sections in this reach, and only marginal fish habitat was present. No suitable spawning habitat (no gravels) and no suitable overwintering habitat (no deep pools) were noted during initial sampling on August 24 th , 2001, or during re-sampling. This reach can be managed as non-fish bearing due to the lack of fish captured in two seasons of sampling in better habitat in reach 2 of the mainstem (ILP 80207) upstream of a barrier to fish passage (heavily braided and poorly defined channel in the upper 300 m of reach 1 of the mainstem ILP 80207).
					1.0	0.63	---	---	90	11	M	C				

Results and Discussion
Non-Fish Bearing Reaches

Table 17. Summary of data from 21 non-fish bearing reaches (sorted by site number) in the Buck Creek watershed sampled in 2005 (for details see Appendix 1). Site data pertaining to the initial sample event are listed first, with re-sampling data listed second for all re-sampled reaches.

Site #	Alias Stream Name	ILP/ Watershed Code	Reach	TRIM map	Electrofishing specifications								Secondary Method	Date (2005)	Proposed Riparian Class	Comments
					Gradient (%)	Channel Width (m)	Dist. (m)	Time (s)	Cond. (µS)	Temp.	Stage	Turbidity				
32	Unnamed	80211	2	93L.018	4.5	2.25	220	1125	90	8	M	C		27/06	S6	No fish were captured in this reach during initial sampling on August 24 th , 2001, and no fish were captured during re-sampling. Excellent rearing and spawning habitat were identified in this reach. Reach 1 of this system is located in an extensive wetland, and has no defined channel. Reach 2 and upstream reaches can be managed as non-fish bearing due to the lack of fish captured in two seasons of sampling upstream of a barrier to fish passage.
					7	2.3	160	927	60	9	M	C				
33	Unnamed	80228	4-2	93L.018	5	1.12	100	782	80	6	M	C		27/06	S6	No fish were captured in this reach during initial sampling on August 24 th , 2001, and no fish were captured during re-sampling. This reach provides good rearing habitat, limited suitable spawning habitat (few pockets of suitable gravels), and no overwintering habitat (no deep pools). Reach 2 of this system is located in an extensive wetland, and lacks a clearly defined channel and is a barrier to fish passage. Reach 4-2 and upstream reaches can be managed as non-fish bearing due to the lack of perennial fish habitat, and the lack of fish captured in two seasons of sampling upstream of a barrier to fish passage.
					4.5	1.30	140	642	80	11	M	C				

Results and Discussion
Reaches Requiring Resampling

Table 18. Follow - up sampling requirements 11 reaches (sorted by Site number) in the Buck Creek watershed that were sampled in 2005 (for details see Appendix 1).

Site #	ILP/Stream name	Reach	TRIM map	Channel Width (m)	Timing	Methods	Proposed Riparian Class	Comments
1	80005	1.1	093L.038	1.67	Fall	EF	S3	This reach provides only poor potential fish habitat, due to a predominance of riffles, with very shallow pools and trace cover provided by overhanging vegetation. The lower 120 meters of this reach are in the Dungate Creek floodplain area. The reach is located on an alluvial fan, and the channel exhibits signs of instability. No fish were captured in this reach despite suitable sampling conditions. Only seasonal fish use is suspected since fish habitat quality deteriorates further upstream (reach 2 is ephemeral).
2	80005	1.2	093L.038	1.93	Fall	EF	S3	This reach was sampled about 300 meters upstream of Dungate Creek, and the entire reach was surveyed. Some potential spawning gravels, and some rearing habitat for juvenile fish as well as potential refuge habitat was identified in the lower 50 meters of the reach, but overwintering habitat was noted (no deep pools). No fish were captured despite suitable sampling conditions. Fish presence is unlikely due to the ephemeral nature of this system (reach 2 was dry during initial sampling, SKR 2002), sediment wedges in this reach, and channel instability in the alluvial fan in reach 1-1 of this system.
7	80023	1	093L.038	3.97	Spring	EF	S3	No fish were captured in the lower 250 m of this reach, downstream of a series of cascades and falls (see site 8) during initial sampling on August 27 th , 2001 (SKR 2002), or during re-sampling on August 1 st , 2005. Some suitable fish habitat, and refuge habitat was identified downstream of the cascade. Fish may be present on a seasonal or sporadic basis.

Results and Discussion
Reaches Requiring Resampling

Table 18. Follow - up sampling requirements for classification for 11 reaches (sorted by site number) in the Buck Creek watershed that were sampled in 2005 (*for details see Appendix 1*).

Site #	ILP/Stream name	Reach	TRIM map	Channel Width (m)	Timing	Methods	Proposed Riparian Class	Comments
11	80130	7	093L.037	1.03	---	---	S4	Only very poor fish habitat was noted in this reach, upstream of the road crossing. The culvert at the crossing is an anthropogenic barrier to fish passage. Fish presence is not suspected in this reach due to the presence of only marginal fish habitat, and the moderate gradient of the reach (6.5%), but the reach should be managed as fish bearing by default. Re-sampling is not recommended until the anthropogenic barrier at the crossing has been addressed.
16	80153	2	093L.027	1.27	---	---	S4	This reach was dry during initial sampling on August 23 rd , 2001. Some potential rearing habitat, but no suitable overwintering habitat (no deep pools) were noted during re-sampling on June 27 th , 2005. A landowner has constructed a watering pond in reach 1 of this system, and this impoundment is an anthropogenic barrier to fish passage. No fish sampling was conducted as this reach should be managed as fish bearing by default. Re-sampling is not recommended unless fish access to this system is re-established.
17	80156	4-1	093L.027	2.60	Fall	EF	S3	This reach was sampled to assist in establishing limits to fish distribution in this system. The reach has large channel morphology, with signs of beaver activity. Some potential rearing habitat (pools with good cover), limited overwintering habitat (minimal discharge except during spring freshet), and no suitable spawning habitat (no suitable substrate) were noted in this reach. No fish were captured on June 26 th , 2005.
18 19	80156	4-2	093L.027	1.53 1.55	---	---	S3	A collapsed wood culvert was identified in this reach on June 26 th , 2005. This culvert may obstruct fish passage. No fish were captured in this reach during initial sampling on August 23 rd , 2001, and no fish were captured during re-sampling, but no definite barriers to fish passage were identified downstream. This reach has some pockets of suitable potential spawning habitat, but overwintering habitat is limited by the low discharge.

Results and Discussion
Reaches Requiring Resampling

Table 18. Follow - up sampling requirements for classification for 11 reaches (sorted by site number) in the Buck Creek watershed that were sampled in 2005 (*for details see Appendix 1*).

Site #	ILP/Stream name	Reach	TRIM map	Channel Width (m)	Timing	Methods	Proposed Riparian Class	Comments
21	80164	1	093L.027	1.82	Fall	EF	S3	This reach was sampled about 100 meters upstream of Buck Creek. Some good potential rearing habitat was noted at the sample site on July 27 th , 2005, but no fish were captured during electrofishing despite suitable sampling conditions. The channel braids over a 30 m distance near Buck Creek, but then redefines in the lower 30 meters of the reach prior to draining into Buck Creek. The 30 m section of poorly defined and braided channel obstructs fish passage.
23	80180	1	093L.028	1.37	---	---	S4	This reach had little habitat diversity, and consisted primarily of uniform riffle habitat with cobble/gravel substrate. Eroding banks, and aggrading (by about 0.5 m) were noted in this reach. Fish habitat quality was reduced by the lack of pools, and the uniform nature of the reach. No fish were captured during initial sampling on August 27 th , 2001, and no fish were capture during re-sampling on June 27 th , 2005. No barrier to fish migration were noted downstream to Buck Creek. Upstream reaches can be classified as non-fish bearing due to the poor fish habitat upstream and due to the lack of fish captured in two seasons of sampling in this reach.
26	80193	1	093L.018	1.3	---	---	S4	A 100 m long, 22% gradient cascade was identified as a barrier to fish passage about 100 meters upstream of Buck Creek. No fish were captured downstream of the cascade (site 26), and no fish were captured upstream of the cascade (site 27). Some potential rearing habitat (good cover) was noted downstream of the cascade, and fish may use the lower 100 meters on a seasonal basis. This reach should be managed as fish bearing downstream of the cascade, but can be managed as non-fish bearing upstream of the cascade.

Results and Discussion
Reaches Requiring Resampling

Table 18. Follow - up sampling requirements for classification for 11 reaches (sorted by site number) in the Buck Creek watershed that were sampled in 2005 (*for details see Appendix 1*).

Site #	ILP/Stream name	Reach	TRIM map	Channel Width (m)	Timing	Methods	Proposed Riparian Class	Comments
28	80207	1	093L.018	2.70	Fall	EF	S3/W5	This reach is located in a wetland and exhibits large channel morphology. The reach is heavily braided through a thick willow swale in the upper 300 meters of the reach, and this section is a barrier to fish passage. No fish sampling was conducted due to the proximity of this reach to Buck Creek, the lack of barriers to fish passage, and the presence of good potential rearing habitat.

5.0 GLOSSARY OF ABBREVIATIONS AND TERMS

Adfluvial	Referring to both lake (lacustrine) and stream (fluvial) habitat
BEC Zone	Biogeoclimatic Ecosystem Classification zone. A system used by the B.C. Ministry of Forests, and others, to describe terrestrial ecosystems based on vegetation, geography, and climate (see Meidinger and Pojar 1991)
CMP	Corrugated metal pipe (culvert)
FDIS	Field Data Information System. A standardized MS Access database developed by B.C. Fisheries used to input field data collected during the reconnaissance (1:20,000) fish and fish habitat inventory
FFHI	Fish and fish habitat inventory
FIA	Forest Investment Account
FISS	Fisheries Information Summary System
FPC	Forest Practices Code of British Columbia
FSR	Forest Service Road
<i>H</i>	Kruskal-Wallis test statistic. The Kruskal Wallis test is the non-parametric analog to the one-way analysis of variance.
HFP	Houston Forest Products Co.
ILP	Interim Locational Point
KS	Kolmogorov-Smirnoff test statistic. The Kolmogorov-Smirnoff test tests whether independent samples come from the same distribution.
MSRM	B.C. Ministry of Sustainable Resource Management
NCD	Non-classified Drainage
NVC	No Visible Channel
Stream Order	Stream order is a method used to describe the relative size and topology of a stream in a network. Order is determined from TRIM map interpretation. Streams with no tributaries are 1 st order, and order increases by one unit where streams of the same order join (e.g. two 2 nd order streams make a 3 rd order stream).
TRIM	Map products produced as a result of the provincial government's Terrain Resource Information Management program
WBID	Waterbody Identifier. A unique alpha-numeric code given to each waterbody within a watershed group (e.g., 00825UNRS). Acquired from the B.C. Watershed Atlas.
WSC	Watershed Code. Obtained from the B.C. Watershed Atlas.

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Appendix 1. Sample Site Information including FDIS Site Cards, Fish Forms, and Site Photographs (sorted by site number).

SITE CARD INDEX

ILP	TRIM Map #	Reach #	Site #	Page #
80005	093L.038	1.1	1	S-1
80005	093L.038	1.2	2	S-2
80005	093L.038	2.0	3	S-3
80008	093L.038	1.0	4	S-4
80016	093L.038	1.0	5	S-5
80016	093L.038	2.0	6	S-6
80023	093L.038	1.0	8	S-7&8
80094	093L.037	1.0	9	S-9
80110	093L.037	3.0	10	S-10
80130	093L.037	7.0	11	S-11
80136	093L.037	2.0	12	S-12
80142	093L.027	2.0	13	S-13
80146	093L.027	1.0	14	S-14
80146	093L.027	2.0	15	S-15
80153	093L.027	2.0	16	S-16
80156	093L.027	4.1	17	S-17
80156	093L.027	4.2	18	S-18
80156	093L.027	4.2	19	S-19
80161	093L.027	1.0	20	S-20
80164	093L.027	1.0	21	S-21
80164	093L.027	2.0	22	S-22
80180	093L.028	1.0	23	S-23
80185	093L.018	1.0	24	S-24
80185	093L.018	1.0	25	S-25
80193	093L.018	1.0	26	S-26
80193	093L.018	2.0	27	S-27
80207	093L.018	1.0	28	S-28
80207	093L.018	2.0	29	S-29
80207	093L.018	3.0	30	S-30
80208	093L.018	1.0	31	S-31
80211	093L.018	2.0	32	S-32
80228	093L.028	4.2	33	S-33

Appendix 2. Photodocumentation Forms 1 and 2.

Photodocumentation Form 1 – Equipment Details

Survey Start Date: June 22nd, 2005 Survey End Date: August 22nd, 2005
Agency: C141
Crew: RS/RS

Camera #1:

Make and Model: Sony Cybershot DSC-S85
Lense: 35 mm
Format: JPEG files

Roll and or Batches Detail:

Roll #	CD #	Camera	Output Medium	Film Type
1	1	1	CD Rom	Digital
2	1	1	CD Rom	Digital
3	1	1	CD Rom	Digital
4	1	1	CD Rom	Digital
5	1	1	CD Rom	Digital
6	1	1	CD Rom	Digital

Appendix 3. Watershed relationship summary table for the Buck watershed, using criteria described in Witt and Giroux (1999).

	Elevation Zones ¹					Gradient (from FDIS)					Channel Pattern			Size		
	1	2	3	4	5	Class 1	Class 2	Class 3	Class 4	Class 5	ST/SI	IM/ME	AN/BR	Small	Med.	Large
Total No. Reaches	21	168	84	109	59	121	109	160	49	64	499	3	1	352	140	11
No. Randomly selected reaches	1	8	3	3	1	9	5	2	0	0	15	1	0	4	9	3
No. Biases Selected Reaches	4	29	15	0	1	10	24	15	0	0	49	0	0	19	29	1
Total No. Sampled	5	37	18	3	2	19	29	17	0	0	64	1	0	23	38	4
% reaches sampled	23.8	22.0	21.4	2.8	3.4	15.7	26.6	10.6	0	0	12.8	33.3	0	3.5	27.1	36.4
No. with Fish (% of sampled reaches)	1 (20.0)	5 (13.5)	2 (11.1)	1 (33.3)	0 (0.0)	6 (31.6)	3 (10.3)	0 (0.0)	0 (0.0)	0 (0.0)	8 (12.5)	1 (100.0)	0 (0.0)	0 (0.0)	6 (15.8)	3 (75.0)
No. with suspected fish (% of sampled reaches)	2 (40.0)	7 (18.9)	1 (5.6)	0 (0.0)	0 (0.0)	2 (10.5)	8 (27.6)	0 (0.0)	0 (0.0)	0 (0.0)	10 (15.6)	0 (0.0)	0 (0.0)	2 (8.7)	7 (18.4)	1 (25.0)
No. with no fish (% of sampled reaches)	2 (40.0)	19 (51.4)	14 (77.8)	2 (66.7)	2 (100)	8 (42.1)	17 (58.6)	14 (82.4)	0 (0.0)	0 (0.0)	39 (60.9)	0 (0.0)	0 (0.0)	19 (82.6)	20 (52.6)	0 (0.0)
No. with suspected no fish (% of sampled reaches)	0 (0.0)	6 (16.2)	1 (5.6)	0 (0.0)	0 (0.0)	3 (15.8)	1 (3.4)	3 (17.6)	0 (0.0)	0 (0.0)	7 (10.9)	0 (0.0)	0 (0.0)	2 (8.7)	5 (13.2)	0 (0.0)

¹Elevation zones are: Zone 1 = 594–777m, Zone 2 = 778-960m, Zone 3 = 961-1143m, Zone 4 = 1144 – 1326m, Zone 5 = 1327-1512m for upstream reach elevations (see Witt and Giroux 1999)

Appendix 4. QA/QC Communications

**Appendix 5. 1:20,000 Fisheries Project/Interpretive Maps for the lower Buck Creek
Sub-basin of the Buck Creek watershed.**

Fisheries Project/Interpretive Maps:

093L.018

093L.027

093L.028

093L.037

093L.038