

**Reconnaissance (1:20,000) Fish and Fish Habitat
Inventory
of
Steamboat Mountain Watersheds
WSC: 300-00000**

Prepared for:
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PROJECT REFERENCE INFORMATION

MELP Project Number	KBM98203
FRBC Project Number	18982.18988
FDIS Project Number	04-COLR-300000001-1999
FDIS Project Number	04-COLR-300000058-1999
FDIS Project Number	04-COLR-300001075-1999
FRBC Region	Kootenay/Boundary
MELP Region	Kootenay
MELP District	Invermere
FW Management Unit	4-34
Fisheries Planning Unit	N/A
DFO Sub-District	N/A
Forest Region	Nelson
Forest District	Invermere
Forest Licensee and Tenure #	Slocan Forest Products Ltd., TSA #: FL A18979
First Nations Claim Area	N/A

WATERSHED INFORMATION

Watershed Group	Steamboat Mountain
Watershed Name	Forster Creek
Watershed Code	300-9684
UTM at Mouth	11.562877.5608896
Watershed Area	7892.9 ha
Total of All Stream Lengths	105.3 km
Stream Order	6
NTS Map	82K/9
TRIM Map	82K.69; 82K.60; 82K.69; 82K.70
BEC Zone	IDF, MS
Air Photos	Line 2, BCC 868 158-186 Line 3, BCC 872 90-110 Line 4, BCC 914 9-37

Watershed Group	Steamboat Mountain
Watershed Name	Frances Creek
Watershed Code	300-9684-256
UTM at Mouth	11.557689.5607785
Watershed Area	27,490.6 ha
Total of All Stream Lengths	659.5 km
Stream Order	6
NTS Map	82K/15; 82K/16; 82K/9; 82K/10
TRIM Map	82K.067; 82K.068; 82K.069; 82K.078; 82K.079
BEC Zone	IDF, MS, ESSF, AT
Air Photos	Line 2, BCC 868 158-186 Line 3, BCC 872 90-110 Line 4, BCC 914 9-37 Line 5, BCC 914 60-90 Line 6, BCC 914 115-147 Line 7, BCC 175-199 Line 8, BCC 915 20-38 Line 9, BCC 915 64-84

Watershed Group Steamboat Mountain
Watershed Name Akenside Creek
Watershed Code 300-968400-25600-29400
UTM at Mouth 11.547057.5619430
Watershed Area 2703.3
Total of All Stream Lengths 83.0
Stream Order 5
NTS Map 82K/9
TRIM Map 82K.068, 82K.079, 82K.078, 82K.069
BEC Zone IDF, MS, ESSF, AT
Air Photos Line 5, BCC 914 60-90
Line 6, BCC 914 115-147
Line 7, BCC 914 175-199

Watershed Group Steamboat Mountain
Watershed Name Templeton River
Watershed Code 300-94900-
UTM at Mouth 11.547892.5632338
Watershed Area 7094 ha
Total of All Stream Lengths 162.2 km
Stream Order 5
NTS Map 82K/15; 82K/16
TRIM Map 82K.078; 82K.088; 82K.089;
BEC Zone IDF, MS, ESSF, AT
Air Photos Line 10, BCC 915 112-131
Line 11, BCC 915 160-170
Line 12, BCC 915 204-215
Line 13, BCC 916 20-26

Watershed Group Steamboat Mountain
Watershed Name Dunbar Creek
Watershed Code 300-968400-11900
UTM at Mouth 11.547862.5631471
Watershed Area 8989.9 ha
Total of All Stream Lengths 211.7 km
Stream Order 4
NTS Map 82K/15; 82K/16
TRIM Map 82K.078; 82K.079; 82K.088;
82K.089
BEC Zone IDF, MS, ESSF, AT
Air Photos Line 8, BCC 915 20-38
Line 9, BCC 915 64-84
Line 10, BCC 915 112-131

Watershed Group	Steamboat Mountain
Watershed Name	Horsethief Tributaries
Watershed Code	300-971300-
UTM at Mouth	11.566620.5603121
Watershed Area	2028.8 ha
Total of All Stream Lengths	36 km
Stream Order	1 to 2
NTS Map	82K/9
TRIM Map	82K.059; 82K.060
BEC Zone	IDF
Air Photos	Line 0, BCC 872 10-17

Watershed Group	Steamboat Mountain
Watershed Name	Bugaboo Creek Tributaries
Watershed Code	300-948100-
UTM at Mouth	11.545300.5636727
Watershed Area	1229.5
Total of All Stream Lengths	22
Stream Order	1 to 3
NTS Map	82K/16
TRIM Map	82K.088; 82K.089
BEC Zone	IDF
Air Photos	Line 13 BCC 18-27

Watershed Group	Steamboat Mountain
Watershed Name	Columbia River Tributaries
Watershed Code	300-948103- to 300-966400-
UTM at Mouth	na
Watershed Area	10529.8
Total of All Stream Lengths	136.4
Stream Order	1 to 3
NTS Map	82K/9; 82K/16
TRIM Map	82K.070; 82K.079; 82K.080; 82K.088; 82K.089
BEC Zone	IDF, MS, ESSF
Air Photos	Line 0, BCC 872 10-17 Line 1, BCC 872 38-64 Line 2, BCC 868 158-186 Line 3, BCC 872 90-110 Line 4, BCC 914 9-37 Line 5, BCC 914 60-90 Line 6, BCC 914 115-147 Line 7, BCC 914 175-199 Line 8, BCC 915 20-38 Line 9, BCC 915 64-84 Line 10, BCC 915 112-131 Line 11, BCC 915 160-170 Line 12, BCC 915 204-215 Line 13, BCC 916 20-26

SAMPLING DESIGN SUMMARY

Total Number of Reaches	2,463
Random Sampling Sites	61
Discretionary Sample Sites	40
Total Sample Sites	101
Field Sampling Dates	Aug.30-Sept.10, 1998

CONTRACTOR INFORMATION

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analysis by: Name:
 Address:
 Phone:

Voucher Species
ID by: Name:
 Address:
 Phone:

DISCLAIMER

This product has been accepted as being in accordance with approved standards within the limits of Ministry quality assurance procedures. Users are cautioned that interpreted information on this product developed for the purposes of the Forest Practices Code Act and Regulations, for example stream classifications, is subject to review by a statutory decision maker for the purposes of determining whether or not to approve an operational plan.

ACKNOWLEDGMENTS

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Triton Environmental Consultants Ltd. would also like to thank Ms Vivian Jablanczy of Slocan Forest Products Limited who assisted with the technical co-ordination and project co-ordination/administration. The principal contract and quality assurance monitor was Mr. Albert Chirico, Ministry of Environment, Lands and Parks, Nelson.

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Attachment II

- i) Summary of field and lab identification of preserved voucher specimens and DNA samples

Attachment III

- i) Photocopies of Photologs

Attachment IV

- i) Photo Summary Report
- ii) Photocopies of Reference Sheets included with the CD's
- iii) Photo CD's

Attachment V

- i) FISS Update Forms
- ii) FISS Update Maps

Attachment VI

- I) Digital Data

1. INTRODUCTION

1.1 Project Scope and Objectives

Slocan Forest Products, Radium Division retained Triton Environmental Consultants Ltd. (Triton) to conduct a 1:20,000 Reconnaissance Fish and Fish Habitat Inventory for drainage areas lying within the Steamboat Mountain area: Frances Creek, Akenside Creek, Templeton River, and Dunbar Creek (Figure 1). Included in the study area are the tributaries to the lower reaches of Horsethief and Bugaboo Creeks, Forster Creek up to reach 7 and its tributaries, and tributaries to the Columbia between Bugaboo and Horsethief Creeks. A lake survey was not conducted but a lake sampling plan was proposed for future sampling.

The Reconnaissance 1:20,000 Fish and Fish Habitat Inventory was conducted to provide fisheries information for Slocan Forest Products and for the Ministry of Environment, Lands and Parks. The objectives are to obtain information regarding; fish species presence and distribution and stream reach biophysical data, for use in watershed specific development plans.

Secondarily, information required to plan forestry prescriptions under the Forest Practices Code may be obtained from Fish and Fish Habitat Inventories. Inventory information collected during the Steamboat Mountain project may be used by Slocan Forest Products for ongoing resource management planning.

1.2 Location

The Steamboat Mountain project area is situated to the west of the Columbia River near Radium Hot Springs, British Columbia and drains part of the Purcell Range, including several glaciers. The project area is made up of eight subdrainage areas:

- Frances Creek,
- Akenside Creek,
- Templeton River,
- Dunbar Creek,
- the tributaries draining into the lower reaches of Horsethief Creek,
- the tributaries draining into the lower reaches of Bugaboo Creek,
- the lower reaches of Forster Creek and its tributaries, and
- tributaries to the Columbia between Bugaboo and Horsethief Creeks.

Forster Creek, Horsethief Creek, Templeton River, and Bugaboo Creek flow directly into Columbia River. Dunbar Creek drains into Templeton River approximately 3 km upstream of the Templeton River/Columbia River confluence. Akenside Creek watershed is a fifth order watershed draining into Frances Creek, which in turn drains into Forster Creek.

fig.1

The 1:20,000 TRIM maps that cover the study area are: 82K059, 82K060, 82K067, 82K068, 82K069, 82K070, 82K077, 82K078, 82K079, 82K080, 82K088, and 82K089. The project area covered the downstream reaches of Horsethief and Bugaboo creeks but did not include their mainstems. Likewise, the tributaries flowing directly into the Columbia River were identified in the project area but the Columbia mainstem was excluded.

The Steamboat Mountain drainages of Frances Creek, Forster Creek, Templeton River, and Dunbar Creek are fed by glaciers and alpine lakes. The terrain in the headwaters of these subdrainages is steep and rugged. Many of the high elevation low order tributaries are ephemeral, and others are avalanche or talus slopes. The plateau west of Steamboat Mountain contains many lakes and wetlands, some of which are seasonal. Others are fed by year round creeks or groundwater. The tributaries flowing into Bugaboo, Horsethief, and directly into the Columbia River drain lower elevation run off from lakes, groundwater, and wetlands. In late summer, flow is either reduced to a trickle or it is extinguished.

The biogeoclimatic zones represented in the watershed include Interior Douglas Fir (IDF) along the lower half of Frances Creek, Alpine Tundra (AT) in the higher elevations, Englemann Spruce and Sub-alpine Fir (ESSF) along the Steamboat Mountain ridge, and Montane Spruce (MS) in the valleys.

1.2.1 Access

Access to the Steamboat Mountain watersheds is possible via two routes across the Columbia River: 2.6 km west from the highway at Radium Hot Springs and the crossing at Brisco approximately 30 km north of Radium Hot Springs. The road system is well developed within the project area, with the exception of Dunbar Creek where the upper reaches are not accessible by road or helicopter. There are two main roads: The Redrock Road runs parallel to the Columbia River along the east slope of Steamboat Mountain and the Westside Main Road runs north-west parallel with Frances Creek. Access to Frances and Akenside creek watersheds is via the Westside Main Road, to the Columbia River tributaries via the Redrock Road, to the Dunbar Creek and Templeton River watersheds via the Brisco crossing. All main roads are in good condition and have many adjoining tertiary roads in various condition. The tertiary road system is complex and up-to-date forest cover maps are required.

To reach the Horsethief Creek, Forster Creek, Frances Creek and Akenside Creek sites from Radium Hot Springs:

- Driving south along the Highway 95 turn right at the intersection with the flashing red light at Radium Hot Springs.
- Continue west 1.4 km and turn left before the Slocan Forest Products sawmill onto Forster Main.

At 2.8 km is the intersection with Redrock Road.

- Keep left along Forster Main.
- At 8.9 from start of Forster Main is a four-way intersection. This intersection is a point of reference from which the following distances were measured for the sites listed below.

Horsethief Creek Sites

- From the four-way intersection turn left.
- Continue 5.7 km until a bridge over the Horsethief Creek mainstem is reached.
- Two sites are on the north side upstream of the bridge.
- To reach other sites, return to the four-way intersection and turn south.
- Cross Forster Creek at 1.7 km.
- An intersection between Forster Main and Horsethief Road is at 3.2 km.
- To reach the Horsethief Creek sites on the north side of the road, turn left onto the Horsethief Road.

Forster Creek Sites

- At the intersection between Forster Main and Horsethief Road, keep right on Forster Main.
- At 0.4 km, turn left (west).
- This road circles around the lower Forster Creek and eventually leads to Westside Main.

Frances Creek Sites

- At the four-way intersection turn right onto Westside Main.
- Stay on well-maintained logging road for 5.1 km and turn left.
- This road crosses Frances Creek at 0.2 km.
- At 0.4 km, keep to the right.
- The road to the right is Dogsled Lake Road and it circles the lower Forster Creek.
- This road provides access to sites on the lower tributaries of Francis on the south-west side through a maze of tertiary logging roads.
- Starting back at the point where Westside Main crosses Frances Creek, drive north-west on Westside Main for 9.2 km.
- Turn left and cross Frances Creek at 0.2 km.

At this point there are two choices:

- Keep right at 0.2 km. From this road and its adjoining tertiary logging roads, sites on the south and west side of Frances Creek can be reached.
- Continue straight and the sites to the north and east of Frances Creek are reached by adjoining tertiary logging roads.

Akenside Creek Sites

- Turn right onto Westside Main at the four-way intersection (point of reference).
- Continue for 14.4 km.
- Turn left and cross bridge at Frances Creek.
- From the bridge drive 5.3 km and turn left.
- From this point, drive 1.7 km until the road splits.
- Keep to the right to reach the sites on Akenside Creek and to the left to reach sites on Hurst and North Hurst creeks.

Columbia River Tributaries

- From the point of reference intersection, travel east along Forster Main and travel 8.9 km to intersection with Redrock Road.
- To reach the Columbia River tributaries, turn left onto Redrock Road and continue in a northwest direction.
- Sites can be reached from Redrock Road.

Dunbar Creek Sites

- From Radium Hot Springs, drive 28.4 km north on Highway 95 to the community of Brisco.
- Turn left at the sign indicating the direction to Bugaboo Mountain ski area.
- Drive 0.5 km and turn right.
- Drive 1.4 km and keep to the left at a fork in the road.
- Make a second left after another 0.2 km.
- Zero the odometer and follow the signed direction to Bugaboo Ski Resort.
- Drive 1.9 km and turn left to access sites on Dunbar Creek.

Templeton River Sites

- Follow the same directions for Dunbar Creek sites except instead of turning left after 1.9 km on road to the Bugaboo Ski Resort, continue straight from the Dunbar Creek access point another 7.2 km.
- Turn left to access several sites on foot from a washed out bridge on the Templeton River mainstem.
- Other Templeton River sites are through a network of tertiary logging roads reached by keeping to the right at the 7.2 km fork.

Bugaboo Creek Site

For access to the Bugaboo Creek site, instead of turning left at the turnoff to the Templeton River sites, keep to the right.

2. RESOURCE INFORMATION

2.1 Resource Use

Slocan Forest Products has the timber forest license for this area and is currently constructing roads, building bridges and planning prescriptions for timber harvest in the area. The five year plan in effect from 1997-2002 shows considerable logging activity (see forest development plans Slocan (1998)). In addition to the forestry activity, the area is in high demand for recreation use, including hunting, angling, camping, backpacking, hiking, rock climbing, and other outdoor activities. Although there are no parks within the project area boundaries, Bugaboo Provincial Park is immediately to the northwest. This nearby recreational feature along with numerous Forest Service Recreation sites make the area attractive to recreational users.

The area on the plateau is used for agriculture and ranching. Concerns to fisheries are diversions for stock watering and a particular problem that was noted during the field sampling was free-ranging cattle with unimpeded access to creeks. The degradation of creek beds and creek integrity from this activity was widespread. The draw down of water through diversions into ponds for livestock in the summer may put an additional limit on fish production.

Federal and provincial wildlife management areas have been established in the Columbia River watershed. The Columbia Wetlands Wildlife Management area, extends from Athelmere to Donald, and is provincially regulated. This management area contains 3 smaller federal wildlife reserves, including the Wilmer Wildlife Refuge, which falls under the jurisdiction of C.W.S (Canadian Wildlife Service). The Columbia Basin Fish and Wildlife Compensation Program carries out waterfowl enhancement activities in the Columbia floodplain wetlands, which are home to deer (*Odocoileus sp*), moose (*Alces*

alces), elk (*Cervus canadensis*), grizzly bear (*Ursus horribilis*), and black bear (*Ursus americanus*).

Historical fisheries information for the project area exists for Frances Creek, Forster Creek, Horsethief Creek, Templeton River, and Dunbar Creek. Eleven reports were listed in the FISS database (<http://www.elp.gov.bc.ca/fish/ids/dman/>). Most of the reports have focused on fish in stocked lakes and adjacent stream reaches. The species in each system are: rainbow trout (*Oncorhynchus mykiss*), westslope cutthroat trout (*O. clarki lewisi*), bull trout (*Salvelinus confluentus*), eastern brook trout (*S. fontinalis*), and kokanee (*O. nerka*). Sampling in the Templeton River subdrainage from 1989 to 1992 has shown rainbow trout and eastern brook trout occupy reaches adjacent to stocked lakes in the plateau area (Hagen 1993). Upstream in the Templeton lakes, westslope cutthroat trout were caught in the inlet/outlet streams (Griffith, 1994). The only sportfish caught in the Dunbar Creek system in the reaches near Twin and Botts lakes, was westslope cutthroat trout (Hagen 1993), although lakes in the subdrainage are stocked with westslope cutthroat trout, rainbow trout and eastern brook trout. Westslope cutthroat trout were caught in sampling efforts along Frances Creek (Hagen 1993). Hagen (1993) commented on the relative small size of the fish in the Dunbar, Templeton and Frances streams, speculating that the stream habitat type (shallow and low discharge, or high glacial sedimentation) may not be suitable for large trout.

Horsethief Creek supports mountain whitefish (*Prosopium williamsoni*), kokanee, bull trout, and rainbow trout in the first two reaches within the current project area (Fieldan et al. 1983). It may be expected that tributaries to Horsethief Creek would be used by these species as well, however, prior to this project nothing was known about fish utilization patterns in the tributaries.

AGRA 1997, completed an overview fisheries habitat assessment of Forster and Frances creeks, which included reach by reach descriptions of fish habitat, fish species believed to be present, and fisheries potential. Although no sampling was conducted, the authors reported that kokanee, bulltrout, eastern brook trout, rainbow trout, and westslope cutthroat trout are known or suspected in all reaches of Frances and Forster creeks.

3. METHODS

The pre-field planning component of the project was divided into the following three phases:

1. existing data review;
2. map and air photo analysis;
3. sampling design and project plan.

The pre-field planning phases of the project were conducted according to those described in Schedule A of Contract 98 RI FISH 01 - Steamboat, and *Reconnaissance (1:20,000)*

Fish and Fish Habitat Inventory: Standards and Procedures (Ministry of Fisheries, April 1998). The pre-field planning report (Triton, 1998) and all attachments are available at Ministry of Environment, Lands and Parks (Nelson). The following sections 3.1 to 3.3 summarise the methods used to conduct the pre-field planning phases but greater detail of the methods can be found in Triton (1998).

3.1 Existing Data Review (Phase 1)

3.1.1 Information Review

Contact was made with individuals who may have knowledge about fisheries or fisheries related work that either was conducted in the area or is being planned. Individuals were asked if they knew of fisheries related work that had been conducted or was being planned for the study area. The list of suggested contacts provided in the Ministry of Fisheries (1998) standards was used as a guide.

One of the first tasks in the pre-field planning was to collect existing information on fish distribution within the watershed. Databases from provincial (FISS) government sources were searched (<http://www.elp.gov.bc.ca/fsh/ids/dman/>).

All historical information was assigned numerical identifier numbers (NID's). The stream coverage shown on the Forest Cover Maps (Slocan 1998) were checked against the TRIM coverage, but no disparity was discovered in the coverage of the two maps. The road network shown on the 1:20,000 Forest Cover Maps was transcribed onto the interim maps. The proposed cutblocks and roads were drawn onto the interim maps from 1:40,000 Forest Development Maps (Slocan 1998).

3.1.2 Waterbody Identification

The entire project area boundary was delineated on the TRIM maps. All streams and lakes were identified on the TRIM maps with watershed codes, waterbody identifiers or newly assigned interim locator points (ILPs). The ILPs and watershed codes were assigned using GIS.

Lakes and wetlands smaller than 0.25 ha, in the IDF biogeoclimatic zone, were not included in the lake table. Typically lakes less than 0.5 ha in the other biogeoclimatic zones, were also excluded from the lake table. Six exceptions were made however, including ILP 6569 and WBID 00299COLR in the AT zone and ILPs 6029, 6031, 6032 and 20,000 in the MS zone.

3.2 Map and Air Photo Analysis (Phase 2)

Boundaries of all watersheds third order or greater were classified by basin type and drawn on the TRIMs. Additionally, all first or second order streams flowing into fourth order or greater were classified. Where more than one tributary flowed into a lake, the

order was calculated by drawing an imaginary line through the length of the lake and connecting the tributaries to it.

A set of 1:15,000 air photos from 1991 were used in the analysis of reaches and lakes. Streams were divided into reaches using the criteria and guidelines in Ministry of Fisheries (April 1998). Numerical identifiers (NID's) were assigned to all features found on the FISS maps as well as those identified by air photo analysis, and all reach breaks, were identified on the maps with NID's. The blocks of NID numbers were assigned to the following categories:

- Reaches: 1-4999
- Sample Features: 6000-6999
- Field Sites: 7000-7199
- Field Features: 7500-7999
- FISS/Historical Features: 9000-9999

Lakes were characterized as outlined in the above referenced Standards and Procedures (Ministry of Fisheries 1998).

All data were recorded on the appropriate FDIS v. 6.5 databases (hardcopy and digital) as required. Reaches were determined through the random selection process of FDIS based on categories of basin class, gradient, pattern, and size. Selected sites were then located on the TRIM maps. The reach card was completed for those reaches scheduled for sampling. Discretionary sites were added to address potential impacts to fisheries by harvesting and road development and to ensure field sampling would provide suitable information about fish distribution within the study area.

3.3 Sampling Design and Project Plan (Phase 3)

3.3.1 Stream Sampling Design

The random sampling selection procedure in FDIS was used to select the reach sites. This procedure bases the selection on gradient, size, terrain and basin type. Initially, 137 sites were selected by FDIS. Of these, 35 sites were eliminated due to inaccessibility, previous sampling, or clumped distribution of sites. Twenty-four sites adjacent to cutblocks were added. Discussions were held on August 28, 1998 with the Ministry Contract Monitor and the Licencee Representative to review the compiled data and the proposed sampling plan. After this meeting, further sites were eliminated due to inaccessibility (helicopter, road, or ATV) or clumped distribution of sites. Others were added. It was agreed that the sample plan would be revised after the completion of a helicopter overflight.

A concern was that streams, as indicated on the TRIM maps, may not exist on the ground. In the past, some streams shown on the maps have turned out to be mapping anomalies

(Albert Chirico, pers. comm.). In an attempt to minimize the number of non-existent streams in the sampling plan, a helicopter overflight was taken on August 28 and 29 to assess the visibility of the channels at proposed sites. If a channel was not visible from the helicopter, the site was eliminated from the plan.

Sixty-one of the original FDIS sites remained once sites were eliminated. Thirty-one discretionary sites adjacent to cutblocks were added for stream classification and an additional nine sites were added as discretionary sites for the purpose of collecting information on fish distribution. The total number of sites planned for sampling was 101. These sites were identified on the interim maps.

The finalized sampling strategy was to conduct the field collection phase during the MELP fish sampling window (August 15 to September 15) corresponding to the summer low flow period. The field crew consisted of 4 persons forming 2 sampling crews. Electrofishing was the primary sampling method at each site with either minnow traps or angling being used as the secondary method where appropriate. Voucher specimens (one specimen/species in each identified watershed) and DNA samples (fin rays) were to be collected and sent to the Ministry Contract Monitor. No scale or otolith samples and no water quality samples were required.

3.3.2 Lake Sampling Design

In total, 166 lakes and wetlands were recorded in the lake table. Lakes were grouped if they were connected. Each lake in a group was assigned the two-letter sequence unique to the group, thus indicating which lakes were in the same group. The total number of primary lakes was 72, while the number of secondary lakes was 83.

Some lakes were excluded from the sampling plan if they had been previously surveyed later than 1980, were upstream of a barrier, were small and isolated, or if they were high altitude, glacial lakes that had not been stocked according to FISS fish stocking records. The sub-sampling of the secondary lakes left 19% of secondary lakes for sampling. These considerations resulted in a lake sampling plan that consisted of 35 primary lakes and 16 secondary lakes. The lake sampling has been deferred.

3.4 Field Data Collection (Phase 4)

Sampling procedures from the Reconnaissance (1:20,000) Fish and Fish Habitat Inventory: Standards and Procedures (Ministry of Fisheries, April 1998) were followed. The Site Card and physical measurement methodologies were utilized along with the Fish Collection Form and associated collection requirements. The equipment used for field data collected is listed in Table 1.

The fish and fish habitat inventory was conducted on the selected streams in the Steamboat Mountain watersheds from August 30 to September 10, 1998. The sampling period coincided with the summer low flow period for the system. Three fish sampling methods were utilized, electrofishing, minnow traps and angling. A model 15A battery

Table 1. Equipment used in field data collection, Steamboat Mountain Project, 1998.

Habitat Sampling	Fish Sampling	Water Quality Sampling
Positioning: Garmin 45XL Gradient: Abney level Water depth: meter stick Channel width: meter stick; 50m Eslon tape Lengths: 50m Eslon tape, hip chain Photography: Cannon Sureshot A1, 32mm	Electrofishing: Smith-Root model 12B and Smith-Root model 15A Fish sampling: G-Traps and Rod and Reel DNA sampling: MELP DNA sampling kit	Conductivity: Hanna TDS #3 pH: Oakton pH Tester #2 Temperature: alcohol thermometer Turbidity: visual observations

powered Smith-Root electroshocker and a model 12B gas powered Smith-Root were used to test for fish presence at every site except the dry channel sites, where the stream of water was too small to accommodate an electroshocker anode, or where high water velocities posed a safety concern. Electrofishing was conducted in an upstream direction, and wherever possible, the full channel width was sampled. When no fish were found in sites containing prime fish habitat, extra electrofishing effort was conducted or gee (minnow) traps were placed in sites with road accessibility. Low water conditions in some tributaries and the possibility of losing the trap in high flows restricted minnow trap placement. The minnow traps were baited with canned sardines or dry cat food, and allowed to fish overnight. Angling was employed in fast, deep sites on Forster, Frances and Dunbar creeks. A single bladed spinner which was tipped with a night crawler on a single, barbless hook was the preferred gear type.

Each fish that was caught was identified to species (McPhail and Carveth, 1992). Additional information recorded for each fish was fork length (FL) in mm, and life history stage, fry, juvenile, or adult.

One specimen of each species from each subdrainage was collected and preserved in 70% formalin. Pelvic fin clips were collected for DNA analysis in accordance with Ministry sampling guidelines for DNA from the voucher specimens caught in each watershed.

Although twelve sites were eliminated in the overflight because no visible channel could be seen, in many other cases, that information could not easily be seen from the helicopter. Thus non-visible channels were often encountered during sampling. In such a case the area around where the site was expected to be had to be ground-truthed to be certain the channel, if it existed, were not diverted or intermittent. In other cases, the channel was dry and fish habitat measurements were taken, but obviously no fish sampling was conducted. Some of these channels draining the mountains likely carry meltwater and flow only during freshet.

In some instances it was necessary to deviate from the required site length as stated in the Reconnaissance (1:20,000) Fish and Fish Habitat Inventory: Standards and Procedures (Ministry of Fisheries, April 1998). Sampling at one site on Forster Creek failed to meet the required length of 10 times the channel bankfull width because the whole reach length was entrenched in a canyon of fast running, cascading water which limited the amount of accessible site area. In this case, the sampling area was confined to one river margin. The minimum required fish sampling length of 100 m could not be accomplished for some of the tributary sites because the reaches being sampled were intermittent and had less than 100 m of continuous wetted channel. Sometimes creek channels contained very low flow, dewatered conditions or extensive steep fast flowing step pools resulting in limited useable fish habitat and reducing the fish sample area within the site (such sites were visually assessed). Habitat measurements including pool depth, channel width, and wetted width were occasionally missing the minimum required number of measurements. The reasons for these included lack of pools to measure or where hazardous conditions prevented channel crossing. In each case where extenuating circumstances caused deviation from the standards, the explanation was given on the cards and was entered into FDIS.

Another apparent deviation from the standards is that some of the identified features, i.e., logjams, were not measured or photographed. The reason for this is that these so-called features were identified in the field as disturbance indicators, but not necessarily as fish barriers or features. The FDIS database requires that a disturbance indicator with a code of D3 be identified as a feature. These 'features' were added to the database in response to this FDIS requirement.

4. RESULTS AND DISCUSSION

4.1 Logistics

The efficiency of the field study to produce the desired results was compromised by difficulty in accessing certain parts of the project area and by the low flow conditions.

4.1.1 Access

Some watershed areas were not sampled because of inaccessibility. For example, the upper Dunbar Creek system was deleted from the sampling plan due to lack of roads entering the system. However, fish are present in the upper reaches due to the stocking of Climax Lake with westslope cutthroat trout. Furthermore, the inlet and outlet streams have been sampled previously (Griffith, 1983). In addition to the Dunbar Creek subdrainage, the upper elevation sites in the Frances and Templeton systems were not sampled because of inaccessibility. Given the seasonal or avalanche slope nature of the terrain in these areas, very little information on fish habitat was probably lost because most of the sites would likely have been dry or non-visible channels. However, some creeks draining high altitude lakes or glaciers do have potential fish habitat at high elevation and these sample sites were missed. The sites that were sampled were largely

concentrated on the plateau, west of Steamboat Mountain and the Frances Creek valley area.

4.1.2 Water Level

Water levels were low at the time of year when sampling was conducted. In some areas, most of the creeks were dry. For example, the tributaries of Akenside, Forster, Bugaboo and Horsethief creeks were dry, as were most of the Columbia River tributaries. Although many were first and second order tributaries, others were third order or greater. Little fisheries information could be collected for these areas. Some of these tributaries, especially the reaches adjacent to fish-bearing mainstems, may provide important spring habitat. Lack of fisheries information regarding these dry sites may require that some of the sites be re-sampled during higher flows.

4.2 Summary of Sub-Basin Biophysical Information

For sampling purposes, the project area was divided into eight sub-basins (Table 2). Four of these were entire watersheds, Frances Creek, Akenside Creek, Dunbar Creek, and Templeton River. The other four were partial watersheds, areas draining into a small section of a larger mainstem, i.e., Columbia River tributaries, Horsethief River tributaries, Bugaboo Creek tributaries, and Forster Creek tributaries. The Frances and Forster subdrainages are the largest in this inventory and are both 6th order streams. Frances Creek is fed by Akenside Creek, a 5th order stream. The Templeton River is a 5th order subdrainage and is fed by Dunbar Creek, a 4th order stream. The unnamed tributaries to the Columbia, Horsethief and Bugaboo drainages range in size from 1st to 3rd order streams. The Forster, Frances, and Templeton subdrainages contain large wetland areas, ranging in size from 473.1 ha to 103.1 ha. The Frances and Dunbar subdrainages also contain fish bearing lakes. The Frances subdrainage includes the Halgrave Lakes, which contain westslope cutthroat trout. The Dunbar system includes Climax Lake, in which westslope cutthroat trout are historically present.

4.3 Habitat and Fish Distribution

4.3.1 General Characteristics of Fish Habitat

Fish and fish habitat information collected during the project was summarised and is presented on the Project Map (Appendix II - Fisheries Project Map). The sites were located in eight subdrainages, four biogeoclimatic zones and thus, represented considerable differences in habitats from steep glacial-fed run-off to meandering creeks in lowlands. Fish were usually observed in reaches attached to lakes in lowlands, in low-gradient, downstream reaches of tributaries to fish-bearing mainstems, and in mainstems. This was true in the four subdrainages where fish were found. In general, the further the distance from these reaches, the more likely they were to run dry by late summer, or become impassable because of steep gradient.

Table 2. Summary of watershed information for the subdrainages in the Steamboat Mountain Watershed Group.

Gazetted Name	WSC	UTM at mouth	Watershed Area (ha)	Stream length (km)	Stream order	NTC maps	BEC zone	Lake names	Wetlands
Forster Creek	300-968400-00000	11.562877.5608895	7892.9	105.3	6	82K/9	IDF MS	Dogsled	34 473.1 ha
Frances Creek	300-968400-25600-	11.557690.5607786	27490.6	659.5	6	82K/15, 82K/16, 82K/9, 82K/10	IDF, MS, ESSF, AT	Sam's Folly, McLean, Lower & Upper Halgrave, Hall Lakes, Steamboat, Halfway, Leadqueen, Whary	94 103.1 ha
Akenside Creek	300-968400-25600-29400	11.547057.5619430	2703.3	83.0	5	82K/9	IDF, MS, ESSF, AT	NA	2 29.7 ha
Templeton River	300-949900-00000	11.547892.5632338	7094	162.2	5	82K/15, 82K/16	IDF, MS, ESSF, AT	Topaz, Lang, Templeton	55 125.8 ha
Dunbar Creek	300-949900-11900	11.547863.5631472	8989.9	211.7	4	82K/15, 82K/16	IDF, MS, ESSF, AT	Climax, Horeb, Cartwright, Big Fish, Twin Lakes, Botts	23 16.5 ha
Horsethief Creek tribs	300-	11.566620.5603122	2028.8	36	1 to 2	82K/9	IDF	NA	3 3.8 ha
Bugaboo Creek tribs	300-948100	11.545300.5636728	1229.5	22	1 to 3	82K/16	IDF	NA	17 18.1 ha
Columbia River tribs	300-		10529.8	136.4	1 to 3	82K/9, 82K/16	IDF MS, ESSF	NA	64 508.8 ha

The reaches in which fish were captured or visually observed (n=22) were diverse in all fish habitat characteristics (Table 3). In general, they were low to moderately sloped, between 0 and 14% gradient. Stream morphology varied, from the most common being riffle-pool (15/22), large morphology (5/22) and cascade-pool (2/22). The dominant bed material was cobble (7/22) or fines (8/22), gravel (5/22) or rarely boulder (2/22). Almost all of the fish bearing sites were either abundant in stream cover (14/22) or moderate (7/22). The most common instream cover component was LWD, dominant in 11/22 sites. Water temperature did not seem to be an indicator of fish habitat as fish were found in reaches with temperatures from 7 C° to 19 C °. Many of the sites exhibited signs of site disturbance and the most frequent disturbance indicators being eroding banks, SWD and LWD.

The plateau between Steamboat Mountain and the Purcell Range was rich in fish habitat (Appendix 2 - Project Fisheries Maps). The plateau collects the water drained from spring run-off from these mountains and provides habitat when most other areas are dry. Several lakes in the plateau are stocked with sportfish, i.e., rainbow trout, westslope cutthroat trout, or eastern brook trout. These lakes lie within the Frances, Dunbar and Templeton subdrainages and provide important rearing habitat.

Many of the streams identified on the 1:20, 000 TRIM projection, were not visible in the field because of mapping error or because they may have been part of a seasonal run-off path that was not sufficient to cause channel scouring. In the latter case there was usually some evidence of water flow, either some intermittent standing water or muddiness. But whether these habitats provide rearing habitat available for fry in high flows depends on the distance from a known fish-bearing reach and the habitat quality or presence of barriers in between. For example in the Forster Creek subdrainage, some upper reaches of tributaries were swampy, but the distance and the number of road crossings and culverts between them and Forster Creek makes it highly unlikely that fish would ever be found at any time of the year. Tributaries or drainage paths coming off Steamboat Mountain fell into this category as well.

4.3.1.1 Forster/Frances/Horsethief subdrainages

The mainstem reaches of Forster Creek occurring within the study area had few tributaries (Appendix 2 - Project Fisheries Maps). The surrounding land draining the creek has little water flowing in the summer and there was no visible channel at a number of sites. Moving north into the Frances Creek drainage, the same pattern emerges until the plateau region lakes are reached, i.e., reach two. Many of these lakes have been stocked with rainbow trout, eastern brook trout, or westslope cutthroat trout and these resident populations may migrate downstream into the main creek.

Fisheries sensitive zones, off channel ponds or side channels that flood during high flows have been identified along the third reach of Frances Creek (AGRA 1997). These areas provide good rearing, spawning, or staging areas for all life history stages. The area to

tab.3

the east of Frances Creek contains some good quality fish habitat, in particular, the Hall Lakes and Halgrave Lakes. These were two productive complexes of lake, wetland, and stream. Weirs were built on the lakes of both systems to enhance the fish habitat. The Halgrave Lakes had good fish rearing and spawning habitat in the inlet and outlet streams. The sites had abundant instream cover and spawning gravel. Steamboat Lake is a stocked lake with a year round outflow to Frances Creek. The outlet reach was not sampled, the quality of fish habitat is unknown, but the downstream reach contained excellent pool-riffle habitat for juveniles and fry. The upper reach tributaries draining Steamboat Mountain were dry at the time of this survey. Low lying areas with some standing water were occasionally visible.

The land on the west side of Frances Creek in reach 3 is drained by Castor, Ogelston, Hurst, Akenside and North Hurst creeks. These creeks were dry in the upper reaches, except for Akenside Creek which drains a series of alpine lakes in the headwaters. Although there is year round flow in the upper reaches of Akenside Creek, the subdrainage is of little value as fish habitat as the system becomes intermittent, apparently dewatering above site 7038 on the North Hurst/Akenside Creek system. Although water flowed in two sites upstream of site 7038 on the Akenside/North Hurst system, no water was present at site 7038. Further downstream the dry channel runs through a grassy field. According to the TRIM map it was expected to cross Westside Road and drain into reach 2 of Frances Creek. However, the crossing could not be located. The creek may have been diverted. The value of the habitat in the Akenside subdrainage would depend on the integrity of the downstream connection with Frances Creek.

Reaches 4 to 6 of Frances Creek is where the creek turns from its north-south aspect to run east-west. In this section a large area of the plateau with wetlands and stocked lakes such as Halfway, Whary, Leadqueen lakes, drain into the mainstem. Continuing upstream, Frances Creek enters mountainous terrain at reach 7. From reach 7, through to the headwaters, the Frances mainstem is fed year round by glaciers and alpine lakes. Where there was neither glacier nor lake at the headwaters, the channels were dry. The channels draining the mountain slopes are steep and typically only the first few hundred meters of the lower reaches are accessible to fish. The first reach in these tributaries may be particularly important as fish refuge in freshet and warrant further study.

4.3.1.2 Templeton River and Dunbar Creek Subdrainages

Templeton River and Dunbar Creek subdrainages were physically similar. They originate in the Purcell Mountains fed by steep tributaries coming off alpine lakes or small glaciers. Once the mainstems come out of the Purcell Mountain valleys they enter the plateau and meander through a series of wetlands and lakes. The lakes and adjoining creek/wetland habitats within these subdrainages provided excellent fish habitat. Many of the lakes were stocked with sport fish and the adjacent streams and wetlands provided good rearing habitat. One feature lacking in the streams was deep pools for larger adults. This deficiency was noted by Hagen (1993) and confirmed in the sites that were sampled as part of the current study. From the plateau, the creeks pass through the Steamboat

Mountain ridge where they merge and flow to the Columbia River. Dunbar Creek passes through a narrow canyon before merging with Templeton River. The Dunbar Creek subdrainage was identified as having fisheries sensitive zones in four sites, including high quality rearing and spawning habitat and fisheries sensitive wetlands. Excellent spawning gravel for kokanee for observed by survey crews in reach 1 of the Dunbar mainstem.

4.3.2 General Pattern of Fish Distribution

The Forster, Frances, Dunbar and Templeton mainstems were fish bearing. Two species of fish were caught in both Forster Creek and Frances Creek, westslope cutthroat trout, and eastern brook trout. In addition, rainbow trout were found in Frances Creek. In the Templeton and Dunbar subdrainages, rainbow trout and eastern brook trout were common to both systems. Westslope cutthroat trout were found at reach 3 in the Dunbar Creek mainstem but not in any of the four Templeton River subdrainage sites. The most significant fish populations occurred in the plateau area in the streams associated with wetlands and lakes. Habitat partitioning by the different species was not noted in this inventory. The fish distribution in many cases depended on barriers to fish migration (Table 4a - e).

Fish migration from the Columbia River to Frances Creek and reaches 4 and above of the Forster mainstem, is prevented by a cascade and a 3 m falls in reach 3 of Forster Creek (Table 4a - Project Maps - 82K.060). Below the impassable falls, kokanee, bull trout, westslope cutthroat trout, rainbow trout, and eastern brook trout are present (AGRA 1997). Given the presence of these impassable barriers, all of the fish caught in the sites above the falls are resident fish. Eastern brook and westslope cutthroat trout were caught in reach 6 of Forster Creek, located upstream of confluence with the Dogsled Lake outlet. Dogsled Lake is stocked with eastern brook trout and rainbow trout and some of these fish may migrate downstream to Forster Creek. Forster Creek was also sampled in reach 8 at site 7000. The water was fast and wading conditions hazardous in this reach and no fish were caught by electrofishing at the sample site. The lack of suitable habitat probably limits the use of this reach by fish to migration. Fish distribution is expected through the upper reaches of Forster Creek beyond the project area, where steep gradient limits further distribution (AGRA 1997). The numerous landslides along Forster Creek reported in AGRA (1997) were not verified in the present study.

Rainbow trout, eastern brook trout, and westslope cutthroat trout were observed in various sites in the Frances Creek subdrainage prior to reach 10. The most significant fish populations in Frances Creek subdrainage were in reach 2 of the mainstem and in streams associated with stocked lakes: Upper and Lower Halgrave Lakes, Steamboat Lake, and Leadqueen Lake. The Halgrave Lakes, on the east side of Frances Creek, are stocked with westslope cutthroat trout. Steamboat Lake, stocked with rainbow trout, is connected to Frances Creek by a year round flowing tributary. Rainbow trout were caught in reach 1 of the tributary. Leadqueen Lake has been stocked with westslope cutthroat trout. In a reach upstream of the lake both rainbow and westslope cutthroat trout were caught.

tab.4a

tab.4b

tab.4b

tab.4b

tab.4c

tab.4d

tab.4e

Landslides were a prominent feature in the upper reaches of Frances Creek, which flows through a mountainous area (Table 4b). Their affect on fish distribution is likely only temporary as diversions were observed bypassing the landslides. Many logjams, passable and temporary, were also noticed in the lower reaches of Frances Creek. The only observed barrier believed to be impassable to fish on the Frances mainstem was a set of three cascades in reach 10. The barriers found on tributaries to Frances Creek included cascades, usually in the first reach of the tributary, logjams, subsurface flow and problematic road crossings (Table 4b). Several logjams have been identified in the third reach of Frances Creek (AGRA 1997), but whether they are permanent barriers to fish is unknown - they were not confirmed in the field this year. Given the size of the mainstem (average channel width = 14 m; max. flows in June - July: 8-14 m³/s (Environment Canada, WSC surveys), it is unlikely that any of them were permanent or that they blocked fish passage.

An upstream limit for Frances Creek was tentatively established in reach 10, by sampling and catching no fish above a set of three cascades, which combined exceed 3 m in height and 20 m in length. Further downstream in Frances Creek, eastern brook trout were found in reach 7 but no fish were found in reach 8, located above a log jam and downstream of a recent slide area. Poor sampling conditions were present at the time of survey. The flow was quick and turbid and little refuge or resting habitat was noted.

Fish are distributed throughout the Templeton River subdrainage from the confluence with the Columbia River to the inlet streams of Templeton River at the headwaters. However, there are two important falls - one in reach 4 preventing upstream migration from the Columbia River and the other in reach 23 at the outlet of Templeton Lake which prevented migration into Templeton Lake (Table 4c). Templeton Lake was stocked with westslope cutthroat trout. In between these two barriers, rainbow trout and eastern brook trout were caught at several sites. Previous sampling in stream sites that were not sampled in the current study, e.g., Lang Lake, have established the presence of westslope cutthroat trout as well. The most significant fish populations are in reach 9 of the mainstem and in reach 1 of Rand Creek. Ten rainbow trout and one eastern brook trout were captured in reach 9 of the Templeton River, while three rainbow trout and eight eastern brook trout were captured in reach 1 of Rand Creek.

In the Dunbar subdrainage, a falls in reach 13 was noted from air photo interpretation (Table 4d). Aside from this upstream barrier, no other barriers, including the cascade in the entrenched reach 3, are expected to prevent fish utilization. However, the falls in reach 13 is likely a barrier for upstream migration only; the downstream migration of stocked fish from Climax Lake would be presumably unimpeded. A falls in reach 4 of Templeton River presents an impassable barrier to fish migrating from the Columbia River. The falls is 200 m upstream of the confluence with Dunbar Creek and does not prevent fish migration into in the Dunbar Creek system (Hagen 1983).

The streams associated with Botts, Twin, and Big Fish lakes represent significant fish habitat in the Dunbar Creek subdrainage. They were sampled where previous sampling

was not conducted, for example, in the inlet stream of Big Fish Lake. Only three eastern brook trout were caught at that location, but some of the streams in these areas are known to contain excellent rearing and spawning habitat for westslope cutthroat trout, e.g., Outlet Creek between Big Fish Lake and reach 6 of Dunbar Creek (Hagen 1993). Of all the sample sites, the catch was greatest in reach 3 of Dunbar Creek. In total twelve fish were successfully captured by electrofishing and included three species, rainbow trout, westslope cutthroat trout, and eastern brook trout.

4.4 Fish Age, Size and Life History

The collection and ageing of scales was not part of the present study thus age data can not be presented. The distinctions between fry, juvenile and adult stages were estimated with histograms for westslope cutthroat trout caught in Forster/Frances Creek subdrainage (Figure 2), eastern brook trout caught in Forster/Frances Creek subdrainage (Figure 3), and rainbow trout caught in Templeton River subdrainage (Figure 4). No other species or subdrainage had sufficient numbers of specimens caught to make a reasonable representation of frequency of lengths. The distinctions between life stages were not always clear from the histograms, and the length distribution in one subdrainage does not necessarily reflect the length distribution in a neighboring subdrainage. However, using the present data (Table 5) and additional sources of data from the literature (Table 5A), the following breakdown was applied:

- fish 30-60 mm in length were identified as fry
- fish 61 - 200 in length were identified as juveniles (1+, 2+)
- fish >201 mm in length were identified as adults (3+ and older).

It should be noted that these guidelines are very rough estimates. Data on length are highly variable (Tables 5 and 5B) and age of maturity is variable, therefore the cut-off points may be inaccurate. For example one westslope cutthroat trout, 165 mm in length and 2 eastern brook trout, 150 mm and 200 mm in length, were classified as adults because spawning colours were observed (Table 5).

Fish were captured at sites in the Frances, Forster, Dunbar, Isaac, Rand and Templeton mainstems and in unnamed tributaries to Frances and Dunbar Creek. Because the only subdrainages that were connected were the Frances Creek and Forster Creek subdrainages, these were the only systems where data was combined and presented together. The data from Dunbar Creek and Templeton Creek subdrainages were presented separately, as the Dunbar system is isolated from the Templeton mainstem by a falls barrier in reach 4.

The length and stage data of each species are presented for the Frances and Forster Creek subdrainages in Table 5B. Length-frequency information for westslope cutthroat trout and eastern brook trout captured in these drainages is summarised in Figures 2 and 3. Westslope cutthroat trout were the most commonly caught of all the species in these two subdrainages, followed by eastern brook trout (Table 5). The capture data demonstrates

fig.2

fig.3

fig.4

tab.5

tab.5

tab.5

Table 5A. Lengths and ages of westslope cutthroat trout, rainbow trout and eastern brook trout from reports as indicated.

Westslope Cutthroat Trout					
Age of maturity: 2-6 yrs					
Author	0+	1+	2+	3+	4+
Scott & Crossman 1979		mean=46	mean=129	mean=225	mean=312
Lister & Kerr Wood Leidal 1980*	<25-58	60-105	76-170	134-217	195-255
Griffith 1993			154-208		
Ford et al. 1995		mean=55	mean=100	mean=146	mean=194

* samples of 0+ and 1+ measured in September to October, samples of 2+ to 4+ measured in July

Rainbow Trout					
Age of maturity: 1-4 yrs					
Author	0+	1+	2+	3+	4+
Scott & Crossman 1979*		mean=62	mean=125	mean=289	mean=445
Fieldan et al. 1993	43-73	91-93	144-163	240	
Hagen 1993	29-58	79-81	88-106	155	190
Ford et al. 1995*		mean=226	mean=315	mean=456	mean=598

* mean from samples in Kootenay Lake

Eastern Brook Trout				
Age of maturity: 2-3 yrs				
Author	0+	1+	2+	3+
Scott & Crossman 1979*		137	218	282
Hagen 1993			161-169	

*means from samples in Pyramid L., AB

that juvenile fish predominated, making up between 48.5% and 18.2% of the total catch. One eastern brook trout, 150 mm in length was classed as adult even though it was smaller than the 200 mm limit as it was displaying spawning coloration. Similarly, spawning colours were observed on a 168 mm westslope cutthroat trout. These fish were caught in the upper reaches of Frances Creek.

All the fish in Forster Creek, sampled by angling and electrofishing, were caught in reach 6 of the mainstem (see Project Maps - Appendix II). One juvenile eastern brook trout (149 mm) and nine juvenile westslope cutthroat trout were caught (93 mm-190 mm) (Table 5). An additional ten westslope cutthroat trout, from approximately 100 mm to 180 mm were visually observed.

The fish caught in the Frances Creek drainage, sampled by electrofishing and minnow trapping, were resident and were commonly juveniles. Juvenile rainbow trout captured in Frances Creek ranged in size from 60 mm to 130 mm.

tab.5b

tab.5b

Adult fish were captured at four sites, including reach 1 of Isaac Creek, reach 2 of Frances Creek, reach 2 of an unnamed tributary to Frances Creek (300-968400-25600-19100), and reach 6 of unnamed tributary to Frances Creek (300-968400-25600-37500) (see Project Maps - Appendix II). Both eastern brook trout and western cutthroat trout adults were captured in the Frances Creek subdrainage and ranged in size from 150 mm to 248 mm and 168 mm to 250 mm respectively (Figures 5 and 6). Spawning colours were noted on fish less <201 mm in length that were classified as adults. Two 200 mm rainbow trout were visually observed in reach 2 of Frances Creek and have been categorised as adults.

Fry were noted at six sites in the Frances Creek subdrainage, including; reaches 2 and 7 of Frances Creek, reach 1 of an unnamed tributary to Frances Creek (ILP 2278), reach 1 of an unnamed tributary to Frances Creek (300-968400-25600-35400), reach 1 of an unnamed tributary to Frances Creek (300-968400-25600-75500) and reach 6 of an unnamed tributary to Frances Creek (300-968400-25600-37500) (see Project Maps - Appendix II). Western cutthroat trout fry encountered in this watershed ranged in size from 33 mm to 58 mm, while rainbow trout fry ranged from 39 mm to 58 mm and eastern brook trout fry ranged from 47 mm to 58 mm.

In the Templeton River subdrainage, rainbow trout and eastern brook trout were caught. The 21 rainbow trout caught in reaches 5, 9 and 20 of the Templeton River mainstem were categorised as fry and juveniles (Figure 4). These specimens ranged in length from 42 mm to 181 mm and were caught by electrofishing. A single juvenile eastern brook trout, 122 mm in length was also captured in reach 9 of the Templeton River. These fish were caught upstream of the falls barrier in reach 4 of Templeton River and are resident fish.

Most of the fish sampled or observed in the Dunbar system were classified as juveniles, with the exception of one 200 mm eastern brook trout adult, five rainbow trout fry (37 mm to 58 mm) and two westslope cutthroat trout fry (42 mm to 52 mm) (Table 5). All remaining eastern brook trout were between 68 and 150 mm. One 240 mm spawning kokanee was caught by angling in reach 1 of Dunbar Creek. Because the kokanee were spawning at the time of survey, they were not sampled by electrofishing. The remaining lengths and numbers of kokanee recorded for this species are estimates derived from visual observations. Approximately 100 spawning kokanee were observed; their lengths were estimated to range from 240 to 300 mm. They were all classed as adults and the kokanee length data is not presented. Rainbow trout fry were captured by electrofishing in reaches 3 and 8 of the Dunbar mainstem and both rainbow trout and westslope cutthroat trout fry were captured by electrofishing in reach 3 of Dunbar Creek. A single 200 mm adult eastern brook trout was visually observed in reach 8 of the Dunbar mainstem.

fig.5

fig.6

4.5 Significant Features and Fisheries Observations

4.5.1 Fish and Fish Habitat

The tributaries flowing from lakes in the plateau to downstream mainstems (Frances, Dunbar or Templeton) warrant special habitat protection. These lake fed streams contain year round flow and provide important rearing habitat for fry, including refuge from mainstem high flows. These tributaries are vulnerable to impacts from the many road crossings that occur in the area servicing logging, farming, and other uses. An important staging area for fish in Forster Creek was in reach 6, where the channel widened and was split by bars. The energy level was decreased in the off channel habitats and pool habitat was created by scouring under logjams.

Reach 1 of Dunbar Creek (site 7130) contains important kokanee spawning habitat. It has a high proportion of instream cover, resting areas behind boulders, and spawning gravel. The reach upstream of site 7142, consisting of a pond in a wetland, warrants protection because it provides rearing habitat. A spawning channel was built at site 7122 in a tributary to Dunbar Creek. Off-channel habitat containing fish was found at sites 7114 a downstream tributary to Botts Lake, 7116 downstream of Cartwright Lake, 7115 downstream of Cartwright and Jade lakes. These sites were characterised as flooded, off-channel grassy areas where fish were observed.

The sports-fishing opportunities are good in the stocked lakes of the Templeton, Dunbar and Frances creek subdrainages. As discussed in Hagen (1993) the lakes, at least in the Templeton and Dunbar creek systems, may provide the only good habitat for larger adults. The streams in these two systems suffer from a scarcity of deep pool habitat and may not meet the rearing needs of larger adults.

4.5.2 Habitat Protection Concerns

4.5.2.1 *Fisheries Sensitive Zones*

Fisheries Sensitive Zones were noted in several sites in the Dunbar Creek (sites 7114, 7115, 7116, and 7130) and Templeton River subdrainages (sites 7134, 7129 and 7144) and one (site 7100) in the Frances Creek subdrainage (Appendix 2 - Project Interpretive Maps; Table 6). At site 7100, the channel flowed through a flooded wetland 50 m to 60 m wide. Although no fish were caught, it was expected that fish might use the reach for migration to an upstream pond. The FSZ at site 7114 was part of the channel where it was dry except for standing water behind boulders along the margins of the channel. Fish were observed in these pools of water. Two sites, 7115 and 7116, in the Dunbar Creek subdrainage were identified as wetlands associated with the channel. Fish were observed at site 7115 but not 7116. A side channel at site 7130 was identified as providing excellent rearing habitat for rainbow trout.

tab6

Two sites on Templeton River at reach 20 and reach 9 both featured good side channel habitat for rainbow trout rearing. The site 7134 on Rand Creek had swamp associated with the reach that contained fish.

4.5.2.2 Fish above 20% Gradients

No fish were caught above reaches with gradient over 20% (Table 3). The average gradient at confirmed fish bearing sites, ranged from 0.85% at site 7013, (reach 6 of unnamed tributary to Frances Creek, 300-968400-25600-27600), to 9.07% at site 7014, (reach 1 of unnamed tributary to Frances Creek, 300-968400-25600-35400). The average gradient at all sites classified as fish bearing in this inventory ranged from 0.74% at site 7116, (reach 4 of unnamed tributary to Dunbar Creek, 300-949900-11900-15400-2110) to 10.67%, at site 7121 (reach 21 of the Templeton River). The average gradient at sites classified as non fish bearing S5 or S6, ranged from 0.75% at site 7123, (reach 3 of unnamed tributary to Frances Creek, ILP 2424) to 34.38%, at site 7130, (reach 1 of unnamed tributary to Templeton River, 300-949900-78200). Slope data for sites classified as non fish bearing is provided in Table 7.

4.5.2.3 Restoration and Rehabilitation Opportunities

Several opportunities for restoration were identified while sampling the sites (Table 8). In many of these sites, cattle access has degraded the creek, causing trampling of banks, discontinuity of channel, and sedimentation. Given the free-range grazing in the Frances Creek watershed, it would be a challenge to restore these habitats. Perhaps only the sites where significant fish populations were identified, such as site 7018 where adults, juveniles, and newly emerged fry were observed, may be reasonably considered as candidates for restoration. The other impacts that were observed were logging debris in the channels, logging related riparian devegetation, and road associated impacts.

A road bisected the channel at site 7012 in the Hurst Creek system. No culvert was in place. However unless resampling shows that fish use this habitat, it probably is not worthwhile to rehabilitate the channel. The culvert placed above the channel downstream of site 7042 in the tributary to Columbia River might be lowered if another sampling attempt indicated fish occupy the reach downstream of the site.

Site 7006 in reach 1 of an unnamed tributary to Frances Creek (ILP 2278) was clogged with logging debris, the channel was diverted, and cattle have damaged the stream bank. This channel provides good refuge off the mainstem of the Frances and fish were caught in small, drying pools. This site would be a good candidate for rehabilitation. Another candidate for restoration was observed at site 7014 in reach 1 of unnamed fish-bearing tributary to Frances Creek (300-968400-25600-35400). Upstream approximately 30 m, a road crossed the creek and the upstream riparian vegetation was sparse - having been cut to the bank previously. This tributary leads to Steamboat Lake and would benefit from greater vegetation in that reach.

tab.7

tab.8

A non-permanent debris jam barrier was noted at Site 7140, in reach 8 of the Dunbar mainstem (photo 16-21). No fish were caught immediately upstream of this barrier, however westslope cutthroat trout are present upstream in Climax Lake. This debris jam is naturally occurring and the presence of fish upstream precludes the need for its removal.

The other sites that would benefit from restoration are the sites in Dunbar Creek and Templeton River subdrainages, where roads cut too close to the channel. Most of the other sites where impacts were noted had either no downstream access to fish bearing streams or re-sampling would be required to confirm that the reach is used by fish.

4.6 Fish Bearing Status

The status of each creek is indicated on the Project Interpretive Maps (Appendix 2) and in Tables 9 and 10. A total of 39 confirmed stream reaches were classified as fish bearing. However, fish were caught at only 22 sample sites. Low or non-existent flows at the time of survey and the requirement of two fish sampling sessions, using two separate methods to establish non fish bearing status, have resulted in the application of inferred fish bearing status, to reaches in which no fish were caught or observed. In these cases, the unconfirmed nature of the proposed riparian class was indicated by parentheses.

4.6.1 Fish Bearing Reaches

Forster Creek

Reach 6 of Forster Creek was sampled in this inventory and classified as S2 (Table 9). Westslope cutthroat trout and eastern brook trout were present in this reach, which has a low gradient section accompanied by a widening of the channel. Accumulations of log debris from excessive riparian windfall lay in the reach. There were sections of side channel created by side bars where the water was calm, and in scour areas under log debris, deep. Reach 8 (Site 7000) flows through a narrow canyon where the water was turbulent and hazardous at the time of survey. Limited sampling was carried out in this reach and no fish were visually observed. It was classified as S2 because no barriers were present to prevent the passage of fish between reaches 6 and 8.

Frances Creek and Akenside Creek Subdrainages

Reaches 2, 7, 8 and 10 of Frances Creek were classified as S2, with westslope cutthroat trout noted in reach 2 and eastern brook trout noted in reach 7 (Table 9). Fish were not caught or visually observed in reach 8, however sampling was difficult due to fast, hazardous water. It was observed that little staging habitat for fish was available in this reach. The set of cascades below site 7109 in reach 10 is assumed to prevent fish from reaching the upstream reaches. No fish were caught by electrofishing above these cascades and minimal rearing habitat was noted at sample site 7109.

tab.9

tab.9

Re-sampling was recommended for seven reaches in the Frances subdrainage including: reaches 8 and 10 of Frances Creek, reach 2 of North Hurst Creek and reach 3 of Ogelston Creek (Table 9). Additionally, follow up sampling is recommended for reach 1 of an unnamed tributary to Akenside Creek (ILP 2241), reach 1 of an unnamed tributary to North Hurst Creek (ILP 2304) and reach 3 of an unnamed tributary to Castor Creek (300-968400-25600-19100-3480-2310). Typically, dry conditions and low flows prevented fish sampling at sites in this watershed and hence it was classified as fish bearing by default. For example, sites 7038 and 7039 in the North Hurst and Ogelston systems contain both spawning and rearing habitat, and were dry at the time of survey. The presence of suitable fish habitat in these reaches necessitates sampling at higher flow stages.

Templeton River

The Templeton River was classified as an S2 in reaches 5, 9, 20 and 21, based on the presence of fish or fish habitat in the sampling areas and a lack of observed barriers (Table 9). Eastern brook trout and rainbow trout were captured in reach 9 and rainbow trout were captured in reaches 5 and 20. The flow at site 7121 in reach 21 of the Templeton River, was fast and hazardous and no fish were caught. Re-sampling at lower flows has been recommended for this reach.

An unnamed tributary to Templeton River, ILP 12, was classified as S3 in reach 1, based on the presence of eastern brook trout at the sample site. An unnamed tributary to Templeton River (300-949900-08000) was also classified as an S3 in reach 4, based on the presence of suitable fish habitat in the surveyed area. No fish were caught by electrofishing in this reach, which should be re-sampled at higher flows. Rainbow trout and eastern brook trout were caught by electrofishing in reach 1 of Rand Creek (300-949900-59300), which was classified as S3. Reaches 4 and 5 of Rand Creek were electrofished and classified as S3 and S4 respectively, based on the presence of suitable fish habitat in the sampled areas and a lack of observed barriers to fish migration. The survey crew walked the creek from reach 1 to reach 4 and found no barriers to fish migration

Dunbar Creek

Reaches 1, 3, and 8 of Dunbar Creek were classed as S2 (Table 9), based on the presence of fish in each reach. Two reaches of unnamed tributary to Dunbar Creek (300-949900-11900-15400-2110) were classified as S4, based on the presence of fish habitat in the surveyed areas. Reach 1 of unnamed tributary to Dunbar Creek (300-949900-11900-15400-55100) was classified as S3, in which an unidentified trout species was visually observed. Additionally, reach 2 of ILP 13, an unnamed tributary to Dunbar, was classified as fish bearing by default. This reach was at low flow and could not be sampled due to unsuitable conditions. Re-sampling at higher flows is recommended for four reaches of unnamed tributaries to the Dunbar mainstem.

Columbia River

One unnamed tributary draining into the Columbia River was surveyed and classified as S4 (Table 9). ILP 3004, site 7150, was sampled by electrofishing and no fish were caught. The habitat in this reach is marginal, however its proximity and accessibility to the Columbia River has resulted in the application of fish bearing status. Future sampling at higher flows is recommended for this reach.

4.6.2 Non-Fish Bearing Reaches

Eighteen confirmed stream reaches sampled in the project area were declared non-fish bearing, based on the absence of fish and/or habitat and the identification of downstream barriers (Appendix III, Contract No. 98, RIFISH02 - Steamboat). Non fish bearing status was applied to sample sites in the Forster, Frances and Templeton subdrainages as well as sites on unnamed tributaries to the Columbia River. Reaches classified as “No visible channel”, based on the lack of both a continuously defined channel and fluvial substrate, have been included in this category. Summary data for all non fish bearing reaches is presented in Table 10.

Reach 3 of Isaac Creek was classified as S5. This site was electrofished and no fish were caught, despite the presence of suitable fish habitat in the sampling area. Fish were present in reach 1 of Isaac Creek and it appears that channel impediments from reach 1 to reach 3 (over 1500 m distance) present a barrier to fish. The gradient along this section is > 10% and is accompanied by a series of small debris jams and cascades.

The remaining non fish bearing reaches were classified as S6 and the rationale for this status is provided (Table 10). Seven of these reaches were sampled by electrofishing, with reach 2 of unnamed tributary to Castor Creek (300-968400-25600-19100-5490) sampled both by minnow trapping and electrofishing. Many of the reaches classified as S6 in this inventory have subsurface flow and poorly defined channels. Cattle impacts were noted at two sites, 7044 and 7046, on unnamed tributaries to the Columbia River (Table 10). Reach 1 of unnamed tributary to the Columbia River (ILP 3016), site 7042, was classified as non-fish bearing because of the placement of a culvert 0.8 m above the channel in the next reach downstream.

Sites 7010, 7012, 7016 and 7048 were totally lacking in fish habitat and contained areas of sub-surface flow. Site 7011 in reach 2 of North Hurst Creek and site 7048 on ILP 3004 were lacking in fish habitat and illustrated a complete absence of instream cover. Sites 7110 and 7021, on unnamed tributaries to Frances and Forster Creeks, as well as lacking fish habitat, had ill-defined channels. Site 7026, in reach 1 of ILP 2037, an unnamed tributary to Frances Creek, contained marginal fish habitat. However, as the water trickles down the hillside, it settles into a low boggy area in pools. From this point, there is likely underground seepage into Frances Creek, but there is absolutely no indication of a channel connecting the bog and the mainstem. There is also a 2 meter drop from the bog level to Frances Creek. Site 7123, in reach 3 of ILP 2424, an unnamed

tab.10

tab.10

tributary to Frances Creek, has some rearing capabilities but was classed non-fish bearing based on conditions observed in a lower reach. Reach 1 of this stream is actually an old road and is dry. Fish would not be able to migrate through this reach. Site 7027 in reach 1 of (300-968400-25600-75600), also an unnamed tributary to Frances Creek, contains no fish habitat. Large amounts of angular substrate and deeply incised, eroded banks attest to the fact that this stream is subject to severe blow-out in spring freshet, quite possibly the only time of year that there is a significant amount of water in this stream.

4.6.3 Follow-up Sampling Required

No follow up sampling was recommended for the stream reaches that were classified as non-fish bearing. However, Table 11 provides a summary of the 19 sample sites classified as fish bearing, for which future sampling is recommended. Typically, low flows and/or dry conditions prevented fish sampling in these reaches.

tab.11

5. BIBLIOGRAPHY

Agra Earth and Environmental Ltd. 1997. Overview Fish Habitat Assessment of the Forster Creek Watershed. Report for Slocan Forest Products, Radium Division. Revelstoke, BC.

Cannings S.G and Ptolemy, J. Rare Feshwater Fish of British Columbia. BC Environment, 1998.

FISS website. <http://www.elp.gov.bc.ca/fsh/ids/dman/>

Ford, B.S., P.S. Higgins, A.F. Lewis, K.L. Cooper, T.A. Watson, C.M. Gee, G.L. Ennis, and R.L. Sweeting. 1995. Literature reviews of the life history, habitat requirements and mitigation/compensation strategies for thirteen sport fish species in the Peace, Liard and Columbia River drainages of British Columbia. Canadian Manuscript Report of Fisheries and Aquatic Sciences No. 2321.

Griffith, R.P. and Assoc. 1994. A reconnaissance survey of Templeton Lake. Report for Mica Fisheries Compensation Program, BC Hydro, and BC Environment. Nelson, BC.

Hagen, J. 1993. Sportfish habitat use in selected small streams of the Upper Columbia Watershed. Report for BC Hydro, Columbia Kootenay Fisheries Compensation Program, and BC Environment. Nelson, BC

Lister, D.B. and Associates Ltd., and Kerr Wood Leidal Associates Ltd. 1980. Fording River aquatic environment study. Report for Fording Coal Ltd.

McPhail, J. D. and R. Carveth. 1994. Field Key to the Freshwater Fishes of British Columbia. Victoria, B.C.: R.I.C.

Province of British Columbia: Resource Inventory Committee 1998. Reconnaissance (1:20,000) Fish and Fish Habitat Inventory: Standards and Procedures , Version 1.1 RIC April.

Province of British Columbia: Resource Inventory Committee 1998. Reconnaissance (1:20,000) Fish and Fish Habitat Inventory: Data Forms and User Notes, Version 1.1 RIC April..

Province of British Columbia: Resource Inventory Committee 1998. Standards for Fish and Fish Habitat Maps, RIC. May.

Province of British Columbia: Forest Practices Code 1995. Fish-stream Identification Guidebook

Province of British Columbia: Forest Practices Code 1995. Riparian Management Area Guidebook.

Slocan Forest Products Ltd. 1998. Forest Development Maps (1:40,000). Radium Hot Springs, BC.

Scott, W.B., and E.J. Crossman. 1979. Freshwater Fishes of Canada. Bulletin of the Fisheries Research Board of Canada 184, pp. 966

APPENDIX I

FDIS Site Card Report, Fish Form Report and Photographs

APPENDIX II
Hardcopy Maps

Attachment II Summary of field and lab identification of preserved voucher specimens and DNA samples from fish in the Frances Creek watershed

Site #	Local Name	Watershed Code	Reach #	Genetic Sample Number	Genetic Structure	Voucher Specimen	Species	Fish Length (mm)	Maturity	Verified ID
7007	Trib. to Frances Cr.	300-968400-25600-37500	1	1	FR	1	EB	125	U	EB
7013	Trib. to Frances Cr.	300-968400-25600-27600	6			2	WCT	100	U	WCT
7025	Frances Cr.	300-968400-25600	7	3	FR	3	EB	47	IM	EB-1*
7028	Trib. to Frances Cr.	300-968400-25600-75500	1			4	RB	58	IM	RB
7114	Dunbar Cr.	300-949900-11900	3	51	FR	5	CT	126	U	WCT
7114	Dunbar Cr.	300-949900-11900	3	52	FR	6	RB	121	U	RB-2*
7114	Dunbar Cr.	300-949900-11900	3	53	FR	7	EB	79	IM	EB
7144	Templeton R.	300-949900	9	55	FR	10	EB	122	U	EB
7129	Templeton R.	300-949900	20	54	FR	8	RB	117	U	RB

1 Sample sent to Vancouver for verification

2 Possible rainbow/cutthroat trout hybrid (a red slash was present but based on spotting, it looks like a rainbow).
Sample was sent for verification.