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STAWAMUS RIVER
Fish Habitat, Riparian and Channel Assessments

PREPARED FOR:

Ministry of Environment, Lands and Parks
Surrey, BC

PREPARED BY:

EVS ENVIRONMENT CONSULTANTS

North Vancouver, BC

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FISH HABITAT, RIPARIAN AND CHANNEL ASSESSMENTS

FINAL

Prepared for

Ministry of Environment, Lands and Parks
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LIST OF ACRONYMS

BC	British Columbia
BC MELP	British Columbia Ministry of Environment, Lands and Parks
BEC	Biogeoclimatic Ecosystem Classification
BS	Bank Stability
CAP	Channel Assessment Procedure
CIV	Channel Impact Value
CS	Channel Stability
CWAP	Coastal Watershed Assessment Procedure
DBH	Diameter at Breast Height
DFO	Department of Fisheries and Oceans
DO	Dissolved Oxygen
EVS	EVS Environment Consultants
FHAP	Fish Habitat Assessment Procedure
FRBC	Forest Renewal British Columbia
IWMP	Integrated Watershed Management Plan
LWD	Large Woody Debris
MOF	Ministry of Forests
PNB	Present Natural Boundary
PSd	Pole Sapling deciduous (dominant vegetation)
RAP	Riparian Assessment Procedure
RMA	Riparian Management Area
ROW	Right-of-Way
RVT	Riparian Vegetation Types
SB	Sub-Basin
SHd	Shrub Herb deciduous (dominant vegetation)
SOD	Small Organic Debris
SEDS	Salmon Escapement Database System
SRP	Soluble Reactive Phosphorus
SSF	Surface Sediment Filtering
SWD	Small Woody Debris
TSS	Total Suspended Solids
WRP	Watershed Restoration Program
WRTC	Watershed Restoration Technical Circular

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EXECUTIVE SUMMARY

This report describes results of a *Level I Fish Habitat Assessment* (FHAP), a *Riparian Habitat Assessment*, and a *Channel Conditions and Prescriptions Assessment* for the Stawamus River, BC. These assessments were carried out by EVS Environment Consultants, Enviro-Pacific Consulting, and LaCas Consultants Inc. respectively, on behalf of the Ministry of Environment, Lands, and Parks, Surrey, BC.

The Stawamus River is located near the community of Squamish on Howe Sound and has a total length of 21.3 km with a drainage area of approximately 4,920 ha. The Stawamus River is a Community Watershed. An intake weir was constructed across the stream in 1972, 5.3 km upstream of the mouth of the river. Water is withdrawn from the stream for drinking water purposes by the community of Squamish. A falls at 4.8 km prevents upstream movement by fish, including anadromous salmonids.

Fish Habitat Assessment

The Stawamus River was divided into 32 reaches based on Channel Assessment criteria. Eight reaches were located downstream of the community watershed intake weir, and 24 were located upstream of the weir. Based on results of a previously completed Overview Fish Habitat Assessment, only reaches identified as *high* priority for Level I Assessment were examined as part of this study. Reaches 3 to 8 located below the weir were the only reaches having *high* priority. In addition, Little Stawamus Creek was surveyed because of its known importance as rearing habitat for juvenile coho salmon.

The Stawamus River watershed contains several species of anadromous salmonids including chum (*Oncorhynchus keta*), chinook (*O. tshawytscha*), coho (*O. kisutch*), pink (*O. gorbusha*) salmon, and steelhead trout (*O. mykiss*). Above the weir the stream also contains resident populations of Dolly Varden char (*Salvelinus malma*), cutthroat trout (*Oncorhynchus clarki clarki*), and rainbow trout (*O. mykiss*).

Restoration options for the Stawamus River and Little Stawamus Creek were prioritized according to a set of criteria based on: whether fish habitat was limited; whether access to debilitated habitat was possible; whether it can be rehabilitated; and the relative cost/benefit of the rehabilitation. All restoration options were judged to have high, low, or nil priority based on a ranking system. We concluded that 11 and 8 sites were ranked as having a high and low priority respectively for restoration on the Stawamus River. Four sites with potential restoration were ranked as nil priority. A further 9 sites were identified as high and 7 sites as low priority for restoration in Little Stawamus Creek. Due to poor access or high cost/low benefit, no sites within Reaches 7 or 8 were recommended for restoration. We also identified 9 high and 4 low priority habitat features as deficient according to criteria proposed by Johnston and Slaney (1996). The majority of sites requiring restoration were situated in Reach 6 and in Little Stawamus Creek.

Riparian Assessment

An Overview Riparian Assessment was conducted on the Stawamus River from Reach 1 to Reach 33 in the upper watershed, and on the Little Stawamus. A Level I Assessment was conducted on impaired polygons identified in the overview assessment. This assessment attempted to address concerns raised by the Coastal Watershed Assessment Procedure, to identify impaired openings in riparian vegetation resulting from logging and to determine enhancement prescriptions. A total of 367 polygons delineating unique Riparian Vegetation Types (RVTs) was identified and mapped. Information provided for each polygon included stand structure, stream class, harvesting and restocking history, other disturbances, and priority for assessment.

Logging of the Stawamus River was most intense in the lower reaches between 1947 and 1952, and was conducted on both sides of the River. In 1955, logging was conducted on the right bank between reaches 12 and 18. With the exception of the hydroline corridor, old forest habitats remain on the right bank of the river from Reach 19 to midway through Reach 25. Reaches 10 and 18 were logged on the left side of the river in 1951 and 1955. The remainder of the watershed (i.e., up to Reach 24) was logged between 1963 and 1972. Other disturbances include a CentraGas pipeline, a BC Hydro right-of-way, and residential development and diking in the lower reaches.

The overview riparian assessment concluded that only Polygon 90 be recommended for Level I assessment. The Level I survey of Polygon 90 determined that a Level II assessment is required. Other riparian habitats which have some impaired riparian functions are considered to have an acceptable level of functioning. The most significant problems with respect to riparian habitat were due to several slides. These slides require Level II assessment to develop stabilization prescriptions. Observations on the dominant flora and a list of wildlife observed (birds, mammals) were also presented.

Channel Assessment

A Channel Assessment of the Stawamus River mainstem was completed to identify significant changes to the hydrology of the watershed which have occurred as a result of past anthropogenic activities, and to recommend restoration prescriptions if appropriate. This assessment was conducted only above the weir, that is, from reaches 9 to 28 inclusive. The CAP consisted of a field reconnaissance to identify key features of the watershed including: acquisition of channel and channel geomorphology data; identify field indicators of disturbance; review airphotos; identify sediment input locations; and verify channel geomorphological features.

Based on these data, parameters such as relative roughness (D/d), power index (WbdS), hill slope valley connection, average valley width and upstream disturbance were determined for each reach. In addition, analysis of channel reaches, General Assessment of Channel Morphology, General Assessment of Channel Impact Values and Main Channel Impact Value were completed.

Several major sediment sources were identified within the mainstem and were associated with several tributary streams, especially an active connected debris flow within Reach 16 and Ray Creek. Ray Creek may introduce sediment to the Stawamus River on a chronic, long-term basis, which may impair efforts to improve the stream if left untreated. Other sources of sediment include bank erosion, minor slides and slope instability associated with the gas pipeline. The cumulative impacts of anthropogenic activities for the entire Stawamus River mainstem have a Channel Impact Value (CIV) of 0.9. In summary, there is strong evidence to suggest that anthropogenic activities (e.g., forest harvesting, forestry roads, gas pipeline, and BC Hydro right-of-way) have had a high impact on channel characteristics in the main stem of the Stawamus River.

Integrated Assessment

The Fish Habitat, Riparian, and Channel assessments were conducted concurrently and presented as separate sections (Sections 2, 3, and 4) in this document. Section 5 integrates results from each assessment and recommends habitat restoration prescriptions derived during a workshop attended by all three consulting firms, BC MELP, and DFO.

Based on decisions made during the integrated asssessment workshop, we identified seven sites with high priority for restoration in the Stawamus River and eight in Little Stawamus Creek. It was decided not to puruse low priority prescriptions at this time.

Several of the sites originally identified as high priority were dropped to low, and several low priority sites were raised to high. These decisions were based on detailed information provided at the workshop by each of the participants with respect to feasibility, difficulty, cost, engineering, and practicality. Consensus was reached by the group on all issues. Detailed restoration prescriptions for all high priority sites should be developed as part of a Level II Assessment. Four of eight high priority restoration prescriptions identified for the Little Stawamus fall outside the purview of FRBC. These are related to impaired stream crossings at foot paths, culverts and bridges. Also, the Centra Gas pipeline and the Ray Creek slide should be pursued independently by DFO and MELP with the responsible organization.

1. PROJECT OVERVIEW

1.1 GENERAL INTRODUCTION

This report describes results of a *Level I Fish Habitat Assessment* (FHAP), a *Riparian Habitat Assessment*, and a *Channel Conditions and Prescriptions Assessment* for the Stawamus River, BC. These assessments have been conducted in accordance with BC Watershed Restoration Technical Circular (WRTC) #8 (Fish Habitat Assessment), #6 (Riparian Assessment), and #7 (Channel Assessment) respectively.

The Stawamus River watershed contains several species of anadromous salmonids in the lowest 4.8 km of the stream. These species include chum (*Oncorhynchus keta*), chinook (*O. tshawytscha*), coho (*O. kisutch*), and pink (*O. gorbusha*) salmon, as well as steelhead trout (*O. mykiss*). Falls prevent further upstream movement by anadromous fish. Above the community water intake weir the stream also contains resident populations of Dolly Varden char (*Salvelinus malma*), cutthroat trout (O. *clarki clarki*), and rainbow trout (*O. mykiss*).

This watershed has been significantly affected by a variety of development activities, in addition to its use as a supply of drinking water to the community of Squamish. Activities include timber harvesting, mineral exploration, residential development, recreation, a BC Hydro transmission line corridor, and a BC Gas pipeline corridor. Each of these uses have resulted in a decline in the amount and productive capacity of fish habitat in the watershed (EVS, 1998).

EVS Environment Consultants was contracted to conduct the Fish Habitat Assessment, with the assistance of Enviro-Pacific Consulting who performed the Riparian Assessment and LaCas Consultants Inc., who performed the Channel Assessment. This project was conducted as part of the Watershed Restoration Program (WRP), which is a provincial initiative of Forest Renewal BC (FRBC) to restore the productive capacity of fisheries, forest, and aquatic resources that have been adversely affected by past forest harvest practices. The WRP hastens the recovery of degraded biological resources in logged watersheds by identifying the need for and designing and implementing projects to restore or recover habitat.

Each of these tasks were conducted concurrently and although they are published as a single report, there was no attempt to integrate results from each component here. Rather, this report provides the technical background for an integrated synthesis report (EVS, Enviro-Pacific, and LaCas, 1998) which was prepared following a workshop which included all three consulting firms, the BC Ministry of Environment, Lands and Parks

(BC MELP) and the Department of Fisheries and Oceans (DFO). The integrated synthesis report was the result of the combined assessment of the fisheries, riparian and channel components of the watershed with the aim of providing an assessment the activities that should be undertaken to increase productive capacity of the Stawamus River watershed.

1.2 STUDY AREA

The Stawamus River is located near the community of Squamish on Howe Sound. The Stawamus River has a total length of 21.3 km with a drainage area of approximately 4,920 ha. The headwaters are located at an elevation of approximately 1,400 m. Most of the watershed is located between Mt. Baldwin and Mt. Milligan to the east and Sky Pilot Mountain and Mt. Habrich to the west (Figure 1). Glacial activity in the upper reaches has formed a deeply incised V shaped valley, thus the slopes are very steep causing 47% of the terrain to be classified as highly sensitive to erosion (Baumann, 1994). The remaining unconsolidated materials are a major factor in determining terrain stability. The river mainstem merges into a wider U shaped valley near the mouth which is constricted on the southern side by Stawamus Chief Mountain. Along the northern bank of the lower reaches the river is constrained by a dike which protects the town of Squamish from flooding. Here the channel becomes braided downstream to the mouth, flowing over glaciolacustrine and glaciofluvial deposits. Natural hazards include debris flows and slides, rock falls, slumps, blowdown and snow avalanches (Baumann, 1994).

The Stawamus River Watershed contains the following sub-basins (tributaries) above the water intake at Reach 8 as per the Coastal Watershed Assessment Procedure (CWAP) (BC MELP, 1998a): SB-1- Sheer Mountain; SB-2-Skypilot; SB-3-Copilot; SB-4-Ray Creek, SB-5- Hydroline; SB-6- Red Mountain; and a residual area. Below the intake weir, the Little Stawamus River is known to be an important rearing area for juvenile anadromous salmon (EVS, 1998). Its confluence is located approximately 1.0 km upstream from the mouth of the Stawamus River at Reach 4. This stream is approximately 3.7 km long and follows a course through the town of Squamish (Figure 1).

Five biogeoclimatic zones occur within the Stawamus River watershed: a) Coastal Western Hemlock Dry Maritime (CWHdm); b) Coastal Western Hemlock Submontane Very Wet Maritime (CWHvm1); c) Coastal Western Hemlock Montane Very Wet Maritime (CWHvm2); d) Mountain Hemlock Windward Moist Maritime (MHmm1); and Alpine Tundra (ATc). The watershed receives an average of 200 cm of precipitation annually. Soils consist primarily of well drained gravely sandy loams with some occurrences of glaciofluvial deposits (Baumann, 1994).

2. LEVEL I FISH HABITAT ASSESSMENT

2.1 INTRODUCTION AND BACKGROUND

An Overview Fish Habitat Assessment for the Stawamus River watershed was conducted in 1998 by EVS Environment Consultants (EVS, 1998) according to procedures outlined in WRP Technical Circular #8 (Johnston and Slaney, 1996). The purpose of the overview assessment was to assist in identifying those factors that potentially limit fish production in the watershed by (1) identifying fish species at risk, (2) evaluating fish habitat conditions, and (3) identifying opportunities for fish habitat enhancement or rehabilitation (Johnston and Slaney, 1996). In particular, the assessment procedure attempts to quantify the impacts of forest development practices (e.g., road construction, timber removal) on aquatic resources.

A secondary objective of the Overview Assessment was to focus on the community watershed issue and the impacts of water withdrawal on habitat suitability for anadromous salmonids downstream of the intake weir. Discharge of the stream is quite variable both annually and inter-annually because of its steep gradient and lack of storage. According to the 1998 Integrated Watershed Management Plan (IWMP) (BC MELP, 1998b), the projected daily low flow of the Stawamus River for a 20-year return is 0.20 m^3/sec and the highest instantaneous peak flow over a 20-year period is 110 m^3/sec. Low flow conditions on the river are exacerbated during dry years by the amount of water withdrawn by the District of Squamish for drinking water purposes. The district is authorized to withdraw a volume up to 0.13 m^3/sec regardless of remaining flow. In the past, this volume has been exceeded (up to 0.20 m^3/sec) most commonly in the summer months. This issue is currently being addressed by a Water Use Sub-Committee and alternative water sources for the community are being investigated.

2.1.1 Historic Abundance of Fish

Historically, the Stawamus River and Little Stawamus Creek have provided spawning and rearing habitat for most species of anadromous salmon, as well as several non-anadromous salmonids. According to the Salmon Escapement Database System (SEDS), between 1947 and 1995 there has been a steady decline in the number of spawning anadromous coho, pink, and chum salmon in the lower Stawamus River. Coho salmon were relatively abundant in the Stawamus River during the late 1940's and the 1950's and in the 1970's. The highest number of adult fish (900) were counted in 1970. Numbers of adult coho have averaged 79 individuals through the 1980's. Pink salmon displayed a odd year migration into the Stawamus River in the late 1940's and the 1950's, however, by

1965 they have disappeared from the river with the exception of a few individuals enumerated in 1991. Chum salmon were relatively abundant in the Stawamus between 1947 and 1955, averaging 300 spawners per year. Since 1969, none or very few chum salmon were enumerated with the exception of 1984-86 (50 to 200 fish). Among the 49 years of data available, chinook salmon were only observed and enumerated (10) in 1991. Steelhead were enumerated from 1947 to 1952 in the Stawamus River and averaged 150 individuals (DFO, 1998).

Currently, coho, pink, and chum salmon, and steelhead are distributed from the mouth of the Stawamus River to a large set of falls located 4.8 km upstream, at Reach 7 break. The community water intake weir constructed in 1972 is an impassable barrier to all fish. Stream resident cutthroat trout, Dolly Varden and rainbow trout have been documented in the Stawamus mainstem above and below the weir (BC MELP, 1998b). Rainbow trout and coho salmon fry were recently captured in abundance in the Little Stawamus River by TERA Planning Ltd. (TERA, 1997) while coho salmon, steelhead, cutthroat trout, Dolly Varden char, and rainbow trout have also reported to be present in the Little Stawamus (DFO, 1998; FISS maps). However, it is clear that the number of spawning salmonids using the Stawamus River has declined significantly.

2.1.2 Stream Reach Delineation

The Stawamus River watershed was divided into 32 reaches based on Channel Assessment criteria (see Section 4.0). Eight reaches were located below the community watershed intake weir, and 24 were located above the weir. In terms of channel type, the Stawamus River mainstem is quite uniform, with only two reaches (9 and 10) defined as canyon type, whereas nearly all remaining reaches consisted of boulder-cascade-pool channel type.

To identify stream reaches for detailed field assessment as part of this Level I Assessment we prioritized each reach according to the following criteria, in order of importance: 1) the current and historical presence of anadromous salmonids; 2) the presence of important fish habitat and channel type; and 3) the relative abundance of unstable terrain area (EVS, 1998). We considered the significant decline in the number of anadromous fish in the watershed to be of concern. Therefore, stream reaches that historically contained abundant numbers of fish and presently have low numbers were awarded a habitat value of *high* priority for further assessment. With respect to the relative abundance of unstable terrain area the "Terrain Stability Map" (Recreation Features and Access Management Plan 1998-2002) and the IWMP report (BC MELP, 1998b) were consulted to interpret the relative abundance of unstable terrain adjacent to each reach. Reaches at greatest risk to landslides or disturbance were given the highest ranking. Reaches with no unstable terrain were given a low ranking.

Therefore, reaches identified as *high* priority or for Level I Assessment were reaches that combined the following: are, or were, used by anadromous salmonids; are known to contain important or critical habitat; and are vulnerable to disturbance from natural or anthropogenic (e.g., forestry development, roads) sediment sources. Reaches that did not contain anadromous salmonids, yet contained important habitat for non-anadromous salmonids and are well connected to logging impaired upslope areas had a *moderate* priority for Level I Assessment. Reaches that did not contain important fish habitat and were not well connected to disturbed upslope areas had a *low* priority.

Using these criteria, only seven reaches (Reaches 2 to 8) were ranked as having a *high* priority for a Level I Assessment. One sub-Reach, Little Stawamus River, was also ranked as *high* priority. Reach 1, Reaches 9 to 17, and Reaches 25 to 27 were ranked as having a *moderate* priority. All other reaches were ranked as *low* priority for Level I Assessment. We concluded that only *high* priority reaches should be surveyed as part of a Level I Assessment and that habitat restoration below the weir was most likely to result in increased productivity of fish with a minimum of difficulty and cost. No remediation above the weir was recommended because of difficult or no access, and large cost/effort with little or no quantifiable return.

2.1.3 Objectives

The objectives for a Level I Assessment are four-fold (Johnston and Slaney, 1996): 1) confirm or revise the identification of the nature, location, extent, and severity of forest harvest impacts on fish habitat; 2) provide sufficient information to identify and prioritize restoration options, and identify initial project objectives and scope; 3) identify the need for any Level II assessments; and 4) prepare initial budgets and schedules for restoration projects.

The Level I Assessment is based on opportunities for fish habitat restoration identified in the Overview Assessment (EVS, 1998). Only high priority reaches were targeted for this Level I Assessment, and all are located downstream of the community intake weir (Reaches 2 to 8). The assessment provides field data and quantitative information on the current habitat conditions, which is critical for designing and carrying out stream restoration projects. Features used to describe fish habitat in the Stawamus River were compared to expected value to rank the quality of each reach as poor, fair, or good. The features included adult holding pools, spawning gravel quality and quantity, pool area and frequency, cover in pools and riffles, LWD frequency and distribution, stream bed substrate characteristics, and off-channel habitat.

2.2 METHODS

2.2.1 Habitat Assessment

Selection of stream reaches for Level I Assessment was based on criteria developed in the Overview Assessment (EVS, 1998). All *high* priority reaches existed below the Squamish community water supply intake weir. Reaches 1 and 2 were not assessed because they fell within the tidal influence of Howe Sound. Therefore, habitat assessment was conducted only within reaches 3 to 8 of the Stawamus River and within Little Stawamus Creek. Large sections within Little Stawamus Creek were dry at the time of survey. Methods employed in this Level I Assessment followed procedures outlined by Johnston and Slaney (1996). Stream reaches were divided into strata consisting of repetitive sequences of naturally-distinguishable habitat types, hereby referred to as habitat units.

To assess the average fish habitat condition in each reach, habitat units were sub-sampled in proportion ranging from 1:2 to 1:10, depending on the frequency of occurrence of each habitat type. A modified *systematic random sampling* strategy was followed where all habitat units were sampled at the same frequency on a reach specific basis (see Johnson and Slaney, 1996, for further information on *systematic random sampling*). The more homogeneous the reach with respect to habitat types and habitat type frequency, the higher the sampling frequency.

The sub-sampling ratios of each reach are given in the comments section of Form 4 (WRPDES) (Appendix A) on the first line entry for that reach. The sub-sampling ratio given in the header of Form 4 is the average sub-sampling ratio for all reaches surveyed (including the Little Stawamus).

The habitat units distinguished in the Level I Assessment are pools, glides, riffles, and cascades. Habitat features collected from each habitat unit surveyed included: length (m), gradient (%), mean bankfull depth (m), mean bankfull width (m), mean wetted depth (m), mean wetted width (m), maximum pool depth (m), pool type, dominant and subdominant substrate type, spawning gravel type and compaction, abundance of large woody debris (LWD), LWD size distribution, percent of the dominant cover type (e.g., pools, cutbanks, LWD), off-channel habitat (type, access, and length), disturbance indicators, riparian vegetation (type, structure, and canopy closure), and barriers.

Linear measurements and depths were measured quantitatively using a hip chain (sub-unit length), a fiberglass tape measure (bankfull width, wetted width), a meter stick (pool depth, wetted depth), and a Suunto clinometer to measure gradient. Water temperature was measured with an alcohol thermometer. Dissolved oxygen (DO) was measured using a YSI Model 55 temperature/oxygen meter. Aerial photographs (1:5000) and 1:20,000 topographic maps were used to navigate and identify and map stream features. Stream discharge was estimated using the "floating chip" method (Johnston and Slaney, 1996). Photographs of significant habitat features were taken to support recommendations for habitat restoration.

2.2.2 Habitat Diagnostics

Survey habitat data were summarized by reach to generate averages for diagnosing habitat impairment. Some of the diagnostics include counts per bankfull channel width. They are determined by first calculating the number of bankfull channel widths in each reach, then dividing the total number of features in the reach by the number of mean bankfull channel widths in the reach. For example for LWD:

$$\text{LWD per } W_b = \text{LWD tally for reach} / (\text{reach length} / W_b)$$

where W_b = bankfull channel width.

The percent pool area was calculated by dividing the total pool area by the total reach area and multiplying by 100.

Once the data were summarized per reach for each habitat parameter, the data were compared to "generic" descriptors of habitat quality to identify damaged or poor habitat conditions (Johnston and Slaney, 1996).

2.2.3 Fish Survey

A Smith-Root Model 12-B backpack electrofisher was used to sample representative stream sections within reaches of the Stawamus River. Voltage was minimized in an attempt to reduce potential adverse effects on fish. Because of the non-quantitative nature of the survey, noting presence/absence of species was sufficient w'thout administering enough voltage to capture fish in many cases. Fish were also captured with dipnets in isolated pools. Where fish were acquired, they were identified to species and their age estimated based on fish size. All fish were released unharmed back into the stream from where they were captured.

Electrofishing was conducted in the Little Stawamus Creek from its mouth to as far upstream as the stream contained flowing water. The stream was sampled by electrofishing in pools, beneath logs, in riffles, and along cutbanks to determine the presence of anadromous salmonids. The summer of 1998 was dry (e.g., only 120 mm of rainfall between June and August, compared to long-term average of 191 mm - Environment Canada Climate Services [pers, comm.]) and much of the Little Stawamus was dry or consisted of isolated pools of water within the stream channel. Discharge in the Little Stawamus was low and persisted for a distance of only 400 m upstream from its confluence with the Stawamus River. Upstream of this point the stream consisted of isolated pools that were fed either by groundwater, or by sub-surface water that flowed through the gravel within the stream bed. Approximately 700 m upstream from the mouth, the stream bed was nearly dry with the exception of a few isolated, stagnant pools. However, the stream was flowing from approximately 2 km up to 3 km from the mouth.

Small sections of reaches 4, 5, 7, and 8 of the Stawamus River were electrofished to determine the presence/absence and upstream limits of anadromous salmonid distribution. Electrofishing was conducted in pools and riffles in 50 m sections of each reach. At least 10 individuals were observed or captured to determine relative species composition.

2.2.4 Water Quality

According to the terms of reference for this contract pH, conductivity, non-filterable residue, turbidity, total Kjeldahl nitrogen, nitrate/nitrite, dissolved and total phosphorus, and metals data were required. However, it was subsequently agreed during discussions with BC MELP that only the inorganic nutrients, nitrate nitrogen (NO_3-N) and soluble reactive phosphorus (SRP) should be measured from four locations during mid-summer low flows. On August 6, water samples were collected in pre-cleaned 250 ml bottles from the following locations: just below the community intake weir (Reach 8), the mainstem just above the confluence with the Little Stawamus River (Reach 5), the mouth of the Little Stawamus River, and in the mainstem of the Stawamus below the highway bridge (Reach 3). In addition, dissolved oxygen (mg/L) and temperature (°C) were measured using a YSI Model 55 DO meter. Water samples were stored in a cooler on ice packs and transported to ASL Analytical Service Laboratories Ltd., Vancouver for analysis within 24 hr.

2.3 Fish Distribution Results

Fish species composition and distribution was determined in selected reaches and locations in the Stawamus River and in Little Stawamus Creek during August 1998. The objective of this survey was to verify fish presence in high priority stream reaches below the community watershed intake weir on the Stawamus River. This work was conducted under terms of the Department of Fisheries and Oceans fish collection permit number 98.198 and BC MELP fish collection permit #FC98-90. The methods used were electrofishing, pole seining and dipnetting. The results of the fish survey were entered in Form 5 from Johnston and Slaney (1996) and are presented in Appendix B.

2.3.1 Electrofishing

Stawamus River — Reach 4 of the Stawamus River was electrofished just upstream of the old highway bridge. At this point, the stream is wide with shallow riffles. Both juvenile coho salmon and sculpin (*Cottus spp.*) were captured in this area. Reach 5 was electrofished near the beginning of the dike that parallels the Stawamus River. The stream consists of many riffle/pool sequences created by log jams and large woody debris. Juvenile coho were captured in Reach 5. Reach 6 was electrofished below the first logging road bridge at the upstream end of the dike that parallels the Stawamus River. The stream at this point consisted of cascade/pool sequences. A small number of juvenile coho were captured in the stream and juvenile salmonids and sculpins were observed. In Reach 7, below the impassable falls which determine the Reach 7 / 8 break no fish were captured yet juvenile salmonids were observed. Reach 8 was electrofished just downstream of the intake weir and upstream of impassable falls. Again this reach consisted of a series of steep cascades, chutes and pools. Juvenile rainbow trout were captured in the stream just below the weir.

Little Stawamus Creek — Juvenile coho salmon were abundant in Little Stawamus Creek. They were captured in all of the surveyed sections from the mouth to the Guilford Road crossing. The fish were dominantly located in pools, shallow riffles, and under cutbanks. Coastrange sculpin (*Cottus aleuticus*) and lamprey (*Lampetra* sp.) were also abundant. Juvenile coho were abundant in isolated pools (formed as the creek dried up during the summer) located approximately 700 m upstream of the mouth. The majority of the pools were well shaded and had some flow through the gravel. Upstream of this point, there was very little if any flow and some of the pools contained dead fish. A few pools had completely dried up and contained many dead juvenile coho. Juvenile rainbow trout (*O. mykiss*) were also found in the isolated pools. These ranged in length from approximately 8 to 14 cm.

Approximately 360 m upstream of the mouth of the Little Stawamus there is a marshy pond that has formed just upstream of a log crossing at the southern-most edge of the residential area. This pond contained large amounts of detritus and was cloudy in appearance, suggesting poor water quality. Salmonids were observed in this pond, although none were captured. Just upstream of the pond, juvenile cutthroat trout (*Oncorhynchus clarki clarki*) approximately 15 cm in length, juvenile coho and rainbow trout were captured. Beyond this point the mainstem became a series of increasingly isolated ponds containing large numbers of juvenile coho salmon and rainbow trout. A raccoon (*Procyon lotor*) was observed feeding on the stranded fish.

2.3.2 Pole Seining/Dipnetting

Stawamus River — In Reach 3, coho fry measuring 35-50 mm were captured by pole seining and dipnetting. These fry were stranded in a pool that had formed at the base of the railway bridge support. The pool was isolated from the river as a result of low flow summer conditions.

In Reach 4, coho fry measuring 35 - 50 mm were captured in a side channel immediately upstream of the highway bridge and under a powerline right-of-way.

Coho fry measuring 35-50 mm were captured in isolated pools within a side channel off the left bank of Reach 5. At the time of the survey, these pools were isolated as there was no flow through the side channel. Again, the fish were stranded from the mainstem until high flow resumed or the pools dried up completely.

In Reach 6, coho measuring 35-50 mm were located in a deep pool formed by a log jam, with both small and large woody debris cover. In Reach 6, many other fry were observed in pools, side pools and near logjams. A 1^+ trout was also observed in a deep pool.

In Reach 8, captured rainbow trout (25-35 mm) were located in a deep pool immediately upstream of the large falls at reach break seven.

Little Stawamus Creek — Throughout the Little Stawamus, both coho and rainbow trout fry were captured consistently from the confluence up to the Guildford Road crossing using dipnets in isolated pools.

2.3.3 Summary

Fish were captured at all locations fished in the lower reaches of the Stawamus River, suggesting that salmonids were widespread and distributed throughout the mainstem. Juvenile coho salmon were distributed from the river mouth at least as far upstream as Reach 6. Juvenile rainbow trout were dominantly found from Reach 6 upstream to the weir at Reach 8. Both species were found primarily in pools within the mainstem, in isolated pools of dried up side channels, and were strongly associated with cover in areas along cutbanks, behind boulders and under large woody debris.

In Little Stawamus Creek, juvenile coho salmon and rainbow trout were consistently found in pools, riffles and covered areas. Juvenile cutthroat trout were also noted yet were not as abundant as the other two salmonid species.

All of the fish that were captured by electrofishing, pole seining and dipnetting were juveniles. A 2^+ salmonid was observed (believed to be a rainbow trout) in the Little Stawamus and another 1^+ salmonid was observed in a large pool in Reach 5 of the Stawamus. Sculpins and lamprey were also present in both of the watercourses. For specific habitat unit information and location where fish were observed during the *non-collection habitat survey*, refer to the comments section in Appendix A.

2.4 HABITAT ASSESSMENT RESULTS

The following section describes the habitat within each reach surveyed. Mean physical habitat characteristics for each reach surveyed are summarized in Table 1. This table was compiled from data presented in Appendix A (Form 4).

2.4.1 Reaches 1 and 2

Fish habitat assessment was not conducted in Reaches 1 and 2 because they were located within the intertidal zone of Howe Sound.

2.4.2 Reach 3

Reach 3 is 181 m in length and extends from the railway bridge west of Highway 99 to the Highway 99 bridge. This was the first reach above the intertidal zone. The reach has a gradient of 2% and a bankfull width of 22 m. The reach has extensive pool habitat (50% of the total reach area) partly due to presence of a large pool (Photo 1) which is used for recreational swimming. The rest of the reach was composed of equal areas of riffles and glides. Cover for fish made up 13% of the total reach area where half is represented by deep pool habitat (49%) and 30% by large woody debris (LWD). Boulders, small woody debris (SWD), and overhanging vegetation were equal to 10% or less of cover. The riparian zone consisted of a young deciduous forest with a mean canopy closure of approximately 40%. Substrate was composed of a mixture of cobble and gravel. Isolated pockets of spawning gravel suitable for anadromous salmon were present within the reach.

2.4.3 Reach 4

Reach 4 is located between the Highway 99 bridge and the confluence with the Little Stawamus Creek. It measures 481 m and has a low gradient (1%). The reach was composed primarily of riffles (48%) with the rest being equal amounts of pools and glides. Approximately 16% of the habitat available provided fish cover made up primarily by deep pools (61%) and LWD (18%). Overhanging vegetation, SWD, and undercut banks made up the rest of the cover. Cobble was the most abundant substrate and gravel was mainly sub-dominant. The substrate was moderately compacted with isolated pockets of spawning gravel suitable for anadromous salmon. The riparian zone was established by a young deciduous forest with a mean canopy closure of approximately 20%.

2.4.4 Reach 5

Reach 5 extends from the confluence with the Little Stawamus up to 200 m south of the western most extent of the dike. It measures 312 m and has a low gradient of 1%. The total area of the reach was composed of mainly pools (39%) and riffles (35%) with some cascades and glides. Twenty-one percent of the stream habitat was cover habitat, comprised of deep pools (67%) and woody debris (28%). The section was composed of multiple braided channels. As in reaches 3 and 4, the riparian zone consisted of a young deciduous forest with a canopy closure of approximately 20%. Some sections within the reach were composed of mixed deciduous and coniferous trees. The dominant substrate was cobble and there were some isolated areas of spawning gravel for anadromous salmonids.

2.4.5 Reach 6

Reach 6 extends from 200 m south of the western most extent of the dike up to the first logging road bridge. A portion of the river in this area has been channelized for flood protection purposes along the Valleycliffe subdivision. This reach was highly dominated by riffle habitat which made up 51% of the total surface area. Most of the riffles were located at the western end of the dike where the channel is entrained. The reach was deficient in pool habitat (11%) being dominated glides (20%) and cascades (19%). Gradient was low (2%). The reach was dominated by cobble, with boulders being sub-dominant. Fish cover was very diverse within this reach, amounting to 19% of available habitat, comprised of 38% SWD, 23% boulders, 21% LWD, and 14% overhanging vegetation. A low percentage of deep pools and undercut banks was also present. The riparian habitat was composed of a combination of young deciduous forest and mature mixed deciduous-coniferous forest. Riparian vegetation was absent from large sections of the right bank along the dike. Some riparian vegetation has established in several small patches, generally where exposed ground exists at the base of the dike system. Approximately 20% of the surface area of the stream was covered by the projecting riparian canopy.

2.4.6 Reach 7

Reach 7 extends from the first logging road crossing up to the large falls, 4.8 km from the mouth. This reach has the highest gradient (8%) of all reaches sampled and measures 685 m. Due to its steepness a major portion was cascade habitat (32%) and 40% was pool habitat. The rest was comprised of glide (7%) and riffle (21%) habitat. The reach provided 32% of cover for fish, dominated by boulder (97%) habitat. As expected, boulders were also the dominant substrate in high gradient reaches although there were isolated pockets of spawning gravel for anadromous salmonids. The dominant vegetation type in the riparian area was a mixed deciduous-coniferous mature forest. The extent of the canopy closure over the stream averaged 40%, which was markedly higher than the three preceding reaches. An impassable set of falls separates Reach 7 from Reach 8 (Photo 2) 4.8 km upstream from the mouth.

2.4.7 Reach 8

Reach 8 extends from the large falls at 4.8 km upstream of the mouth to the community weir (Photo 3). The reach is 473 m long and has a moderate gradient of 4%. Stream habitat was composed of riffles (57%), cascades (22%) and pools (21%). Boulders were the dominant substrate and cobble was sub-dominant. There were small areas of spawning gravel for resident salmonids. This reach had the highest percent of cover available for fish. Cover represented 40% of the stream habitat and was predominantly boulder (83%) with deep pools (17%). A mixed deciduous-coniferous forest was dominant in the riparian zone. The structural stage of the dominant vegetation was a mature forest with well-developed understory. The canopy closure was fairly low, representing 20% of the surface area of the stream.

2.4.8 Little Stawamus Creek

Little Stawamus Creek extends from the confluence with the Stawamus River at Reach 4 up to its headwaters, approximately 3.6 km upstream. At the time of the survey (August/September, 1998), the Stawamus River was braided at the confluence with Little Stawamus Creek and the creek flowed into the Stawamus in the right channel which was dry. The flow continued downstream approximately 40 m before joining the main channel of the Stawamus River. Only the first 360 m (starting at the right channel) of the Little Stawamus were surveyed for habitat assessment because large sections upstream within the reach were dry. The area sampled ended with a large pond which accounts for the abundance of pool habitat (48% by area). The rest of the section was made up of riffles (31%) and glides (21%). Mean wetted width throughout the section was 4 m with a shallow mean depth of 15 cm. Most of the substrate within this reach was sand with some cobble. There were isolated areas of spawning gravel available for anadromous salmonids in the 360 m sampled. Fish cover within this section was as high as 24%, and was primarily made up of small woody debris (45%) and overhanging vegetation (41%). The rest was LWD (14%). Canopy cover was extremely high within this reach, as high as 100% in some areas but on average 80%. Pole-sapling stage of deciduous trees made up approximately half of the riparian habitat of the section sampled and young deciduous forest made up the other half. All substrate downstream of the pond was coated with an orange substance which appeared to be organic.

For the next 430m upstream of the pond, the substrate was mainly composed of gravel and cobble providing spawning substrate for anadromous salmonids. However, at the time of the survey, the creek was dry. There was ample overhanging vegetation cover in this section.

Above the Gilford road crossing, the channel consisted of a mixture of meandering sections and some sections were constrained along residential development. Flow was intermittent throughout the creek. There was ample overhanging vegetation in some sections and spawning gravel was abundant in various areas. The riparian habitat consisted of mature forest. At the end of the creek the channel was dry with moss build-up on the substrate.

2.4.9 Fish Habitat Evaluation

The principal objective of the habitat evaluation was to identify habitat conditions that may limit production of anadromous salmonids. Fish habitat was evaluated where there was potential physical habitat limitations to salmonid production. The parameters were compared against "generic" descriptors of habitat quality (Table 5 in Johnston and Slaney, 1996) and are presented in Appendix C. Table 2 summarizes restoration prescriptions on a reach basis, whereas, Table 3 is a summary of habitat features identified as poor according to criteria from Table 5 in Johnston and Slaney (1996).

2.4.9.1 Reach 3

There were no off-channel habitats within this reach which may be a limiting factor for some species. However, there was abundant pool habitat (Photo 1) which provided excellent rearing habitat for juvenile salmonids. Overall, cover was rated as poor due to the limited availability of boulders, overhanging vegetation, and wood cover. Juvenile coho salmon were observed trapped in a small pool under the railway bridge (Photo 4).

2.4.9.2 Reach 4

There was a large amount of off-channel habitat within this reach that is suitable for salmonid rearing habitat and where salmonids were observed. At approximately 65 m upstream of the highway bridge, two small off-channel areas (Photo 5) located on the left bank were utilized by juvenile coho salmon.

Just upstream of the new highway bridge, the old bridge acts as a sediment source to the river. Pool habitat is fairly poor within this reach and the reach is dominated by riffles. Although fish cover was rated as poor due to the limited availability of boulders, overhanging vegetation, and wood cover, LWD pieces were rated as good (Photo 6).

2.4.9.3 Reach 5

Pool habitat was fairly poor within this reach, however, there was a large man-made pool created by damming with boulders that was being used as a swimming hole by children (Photo 7). Just upstream of the pool, the right bank is unstable and is contributing sediment to the river (Photo 8). There were multiple isolated ponds with stranded juvenile salmonids in a left channel dried-up at the upstream limit of the reach just before the reach break. There were significant accumulations of LWD along the reach providing cover and rearing areas for juvenile salmonids. Aside from the LWD pile-ups, fish cover was reported to be low. There were very low quantities of spawning gravel within the reach.

2.4.9.4 Reach 6

There was a large dry channel starting at the end of reach 5 and continuing for approximately 200 m into Reach 6 (Photo 9) with some isolated puddles. Reach 6 was poor in pool habitat, due to presence of extended riffles. The habitat was also very poor in cover, but LWD were fairly abundant in the lower portion of the reach before the stream reached the dike. Approximately 150 m downstream of where the channel diverges south of the dike, many fish were observed. This habitat appears to have abundant rearing habitat due to the presence of a large pool with plenty of LWD. Certain areas along the dike lack riparian vegetation (Photo 10). Large areas of eroding banks were located in the upstream portion of the reach on the left bank (Photo 11) and smaller areas are located at the downstream end of the reach. There were a few abandoned channels which could be excavated to re-create off-channel habitat at approximately 2 km from the mouth of the river (lower part of the reach). Several areas within the channel along the dike were dammed for swimming purposes.

Construction of the dike and training of the river has caused significant alterations in the course of the stream, forcing the stream to find new channels. The stream has moved away from the dike in an easterly direction, closer to the Stawamus Chief (Photos 12 and 13). The Stawamus River is actively eroding a new channel through forested land. Many roots are exposed as the channel deepens, banks are actively eroding, and woody debris is being contributed to the stream. It may be many years before the watershed finds a more natural course and the banks and riparian zones have stabilized. It may be very difficult to undertake restoration activities in this area due to the very active and dynamic nature of the stream.

2.4.9.5 Reach 7

Large, deep adult holding pools were present throughout Reach 7 (Photo 14). A few steep cascade units may prevent passage of fish at low flow (Photo 15). Pool habitat was adequate due to the high frequency of cascade-pool sequences. There was also abundant boulder habitat which provided cover for fish in the stream, but abundance of LWD was low. There were no off-channel habitats due to steepness of the reach.

2.4.9.6 Reach 8

Reach 8 is located above the large falls which marks the downstream end of the reach break. Therefore, only resident fish are present within this reach since the falls are impassable to anadromous fish. An old bridge or the old weir may also be a potential barrier for resident fish at low flow (Photo 16). There was a large landslide (Photo 17) approximately 200 m upstream of the falls that is a significant source of sediment to the stream and the boulders may block access by fish. The slide is located on the left bank and is inaccessible to machinery. Pool habitat was poor within this reach. The amount of LWD was also low. There was extensive cover with the large amount of boulders and there were no off-channel habitats due to steepness of the reach.

2.4.9.7 Little Stawamus Creek

There were many side-channels with no flow connection to the mainstem in the section surveyed for habitat assessment. Linking these channels to the mainstem would provide rearing habitat for juvenile salmonids. Log and debris jams were present at numerous locations within the creek which results in partial barriers to migration by fish (i.e. Photo 18). Some of the partial jams were located at 10m, 202m, 215m, 846m, 1,019m, 1,226m, and 1,281m upstream from the mouth of the creek.

A deteriorated log bridge (Photo 19) located at 291m upstream of the confluence with the Stawamus River is a significant sediment source to the creek. The bridge may have contributed to the formation of a large pond (Photo 20). The blockage is resulting in stagnant water with high organic material decomposition. It also created a stagnant pool with highly turbid water and no flow downstream of the foot bridge. A pedestrian crossing through the creek located at approximately 450m could be a potential sediment source. Another deteriorated log bridge located at 1,181m (Photo 21) is acting as a sediment source.

There were a series of eroded banks within the stream. For example, eroded banks are present along McNaughton Park (at 1,361 m) and at approximately 1.8 km from the mouth. There was a large accumulation of a sediment along an eroded bank at 1075 m.

The culverted road coming at Gilford Road presents a barrier to fish movements during low flow and possibly during high flow (Photo 22). Consideration should be given to reconstruct this crossing, such that the invert elevation of the culverts are below the stream bed.

Spawning habitat was poor in the section surveyed, but was abundant in the upstream section of the creek for both resident and anadromous salmonids. Especially at approximately 2.2 km upstream of the mouth and it was also plentiful for resident trout further upstream. Pool frequency was low within the section surveyed. Therefore, creation of pool habitat in this section would provide rearing habitat for juvenile salmonids. In addition it would also provide holding pools for migrating anadromous salmon, since there were none in the section surveyed. There was abundant LWD due to the numerous log jams. No further LWD is required.

The channel was trained in most areas where there was no flow, upstream of the Gilford road crossing. Flow was present in the stream where the channel was meandering. There was ample overhanging vegetation cover in the meandering channel.

2.4.10 Water Quality

Inorganic nutrient concentrations in the Stawamus and Little Stawamus were relatively high (Table 4). In the Stawamus River water temperature was 14.4 °C below the weir (Reach 8), and increased to 17.4 °C at Reach 1 on August 6, 1998. As expected, oxygen concentrations were high, ranging from 9.1 to 10.7 mg/L. Water chemistry data collected from the Stawamus River in October 1996 (EVS, unpublished) had lower nutrient concentrations (NO_3-N of 0.02-0.05 mg/L), low conductivity (30 µS/cm), and high oxygen saturation. Total suspended solids (TSS) concentration was very low (<1 mg/L). These data suggest that the Stawamus River has water chemistry characteristics that are typical of a nutrient-poor mountain watershed. Although there are few TSS data, the sediment sources identified do not appear to be contributing significant amounts of suspended solids.

2.5 Fish Habitat Restoration Plan

2.5.1 Land Tenure

Prior to planning rehabilitation efforts to improve fish habitat in the Stawamus River watershed, the issue of land tenure must first be reconciled. Level I fish habitat prescriptions can only be implemented on Crown property and not on privately owned (e.g., federal, municipal, individual) property. Property owned by the Crown includes all land that is not privately owned as well as all foreshore habitat. For the purposes of this document, foreshore habitat is defined as all lands that occur within the present natural boundary (PNB) of the stream.

The legal definition of a natural boundary is found in Section 1 of the Provincial Land Act. For practical purposes the PNB may be defined as the location along a body of water where: 1) soil type changes - i.e., the area below the PNB may consist of washed sand, rocks and boulders whereas the soil above the PNB may contain small mineral soils and organics; and/or 2) vegetation changes - the area above the PNB may contain plant species which cannot survive prolonged inundation by water, for example grasses, moss, lichens, willows, alders and coniferous trees while plants below the PNB are highly water tolerant and may include bull rushes, skunk cabbage and other plants which require prolonged inundation. In simple terms, the stream boundary includes all land adjacent to the stream that is frequently wet, or is within the floodplain of the stream. Upland is therefore defined as all lands that occur at elevations above the PNB. Foreshore land is technically Crown land, therefore recommendations for restoration within these areas can be implemented without possible conflict with privately held land.

The legality of both accessing and working within the stream channel in areas that have been prescribed for fish habitat restoration must be resolved prior to the initiation of any work. The primary access related issues relate to upland and foreshore tenure.

Where a parcel of land has a natural boundary as one of its boundaries, such as the PNB, the limit or edge of that private parcel then moves as the PNB moves. For example, as a river slowly erodes the bank and over time, moves, the edge of the private parcel therefore migrates. Land parcels commonly lose land by erosion and gain land by accretion. The PNB always defines the limit of the property and therefore supersedes the boundaries depicted in the lot plan if the watercourse migrates since the lot plan was determined.

Maps and legal survey plans provide a snap-shot of the extent of parcels of land and/or the location of a water body for a particular time. As PNBs are ambulatory in nature, the extent of a parcel or the location of a water body as shown on an older map or a plan may be incorrect when interpreting the present situation. If it is found that the PNB shown on maps and plans differs considerably from the current situation, then an application may be made to the BC MELP Planning office for assistance.

There are seven lots bordering the Stawamus River in the reaches surveyed for this study (Table 5). Six of these lots are privately owned (e.g., federal, municipal, individual) and the seventh is a woodlot owned by the Crown. The lots span west to east from the beginning of Reach 3 (the border between the tidal and freshwater zones) up to the community intake at Reach 8. This section of the channel is influenced by the presence of a dike constructed in the early 1970s (District of Squamish, pers. comm.) and is therefore trained and braided. Thus, there is a high probability that the PNB has migrated since the original lot boundaries were derived (three of the six privately owned lots were purchased from the Crown in the late 1800's). When initiating fish habitat restoration for this section of the Stawamus the following issues should be considered with respect to land tenure:

- Access to perform work if crossing private property would require permission from all lot owners with the exception of the woodlot which would require notification to the appropriate BC MELP personnel (contract monitor and land inspector).
- Work performed below the PNB (i.e., stabilizing the lower bank, removing debris and dredging of side channels which are located below the PNB) would be possible and only require notification to the appropriate BC MELP personnel (contract monitor and land inspector).
- Work performed above the PNB (i.e., stabilizing the upper bank, dredging abandoned side channels which are located beyond the PNB, improving access to bridges, etc.) would require consent from the private lot owner and the appropriate BC MELP staff, again with the exception of the woodlot, which would require notification to the appropriate BC MELP personnel (contract monitor and land inspector).

In summary, the land tenure issue is not easily resolved and must be considered in the early stages of both planning restoration measures and determining access. The next issue regarding land tenure is to determine private lot ownership. The exact geographic location of the prescribed sites must first be identified by surveying during a Level II FHAP. The next step is to determine the legal plan/block/lot descriptors of these sites by consulting a detailed cadastral map (available from the District of Squamish). The final step is to submit these legal descriptors of the sites to the Land Titles office (New Westminster) to reveal ownership. To obtain this information relating to Stawamus Watershed land tenure, the following should be contacted: Jeff Beddoes, Land Surveyor, BC MELP - Surveyor Generals Branch, (Victoria), (250) 952-5324; Gord Dixon, Land Examiner, BC Assets and Land Corporation, (Surrey), (604) 582-5351; George Shishkov, Land Inspector, BC Assets and Land Corporation, (Surrey), (604) 582-5201; Attorney General/Land Titles Office, (New Westminster), fax (604) 660-4064; and Norbert Greinicker, Planner, MoF (Squamish), (604) 898-2145.

2.5.2 Site Access

In the majority of restoration projects, access to the stream by heavy equipment is usually required. To accomplish this, access by road to the immediate vicinity of the stream is required. Furthermore, access by the equipment from the road into the stream is necessary, without risk to the operator or risk of damaging riparian habitat. Based on an examination of Figure 2, a logging road parallels the Stawamus River along the left bank from Reach 2 to a stream crossing at Reach 6. On the right bank, the community of Squamish contains many paved roads in close proximity to the stream from reaches 1 through 6. Upstream of Reach 6 the logging road parallels the stream along the right bank, however, in Reaches 7 and 8, the Stawamus River flows within a steep sided, deep ravine. Therefore, despite access road proximity, it would not be possible for heavy equipment to access these reaches. But there is a road which allows access to the base of the community intake weir at Reach Break 8.

The logging road does cross the stream again at Reach 9, however, there are no meaningful stream rehabilitation options identified for the upper portions of Reach 8. Given that the weir is just upstream of impassable falls, instream works would be of little benefit.

2.5.3 Identification of Restoration Options

We have prioritized restoration options for the Stawamus River and Little Stawamus Creek based on a series of criteria. One of the key objectives of the Level I Assessment is to "provide sufficient information to identify and prioritize restoration options, and to identify initial project objectives and scope" (Johnston and Slaney, 1996). Accordingly, the Level I Assessment examines all high priority reaches and focuses on all significant impacts. Of course, it is not possible to rehabilitate all impacted sites either for technical (e.g., access) or practical reasons (e.g., high cost, low benefit). In identifying specific sites as requiring remediation, we applied five central tenets toward making decisions for priority of treatment. These were:

- Are the observed conditions likely to significantly limit fish production?
- Can the site be accessed?
- Can the habitat be rehabilitated to its original condition?
- How much of the observed conditions are due to natural versus anthropogenic factors?
- What is the relative benefit to the habitat versus the cost and difficulty associated with this effort?

In making these decisions, we first attempted to compare "unimpacted" habitats with "impacted habitats" from within the Stawamus River, as well as from the generic guidelines described in Table 5 of Johnston and Slaney (1996). However, the upper part of the watershed of the Stawamus River differs considerably from the lower part of the watershed. The upper watershed has been logged, contains a hydro right-of-way and a gas pipeline and is remote. The lower part of the watershed is: affected by drinking water withdrawals; the community of Squamish has developed beside the river, resulting in a suite of urban related impacts; and a dike has been constructed to train the stream, which has significantly altered its course (see Photos 12 and 13). Therefore, it was not possible to simply compare habitat that has been logged against habitat that has not been logged.

Because the Level I Assessment has focussed only on the lower reaches, it was not possible to make equitable comparisons to upper reaches. Therefore, our assessment of priority of habitat rehabilitation has been based on the above criteria, with general guidance from the criteria presented in Table 5 from Johnston and Slaney (1996). The following flowchart illustrates the decision tree developed to determine priority ranking.

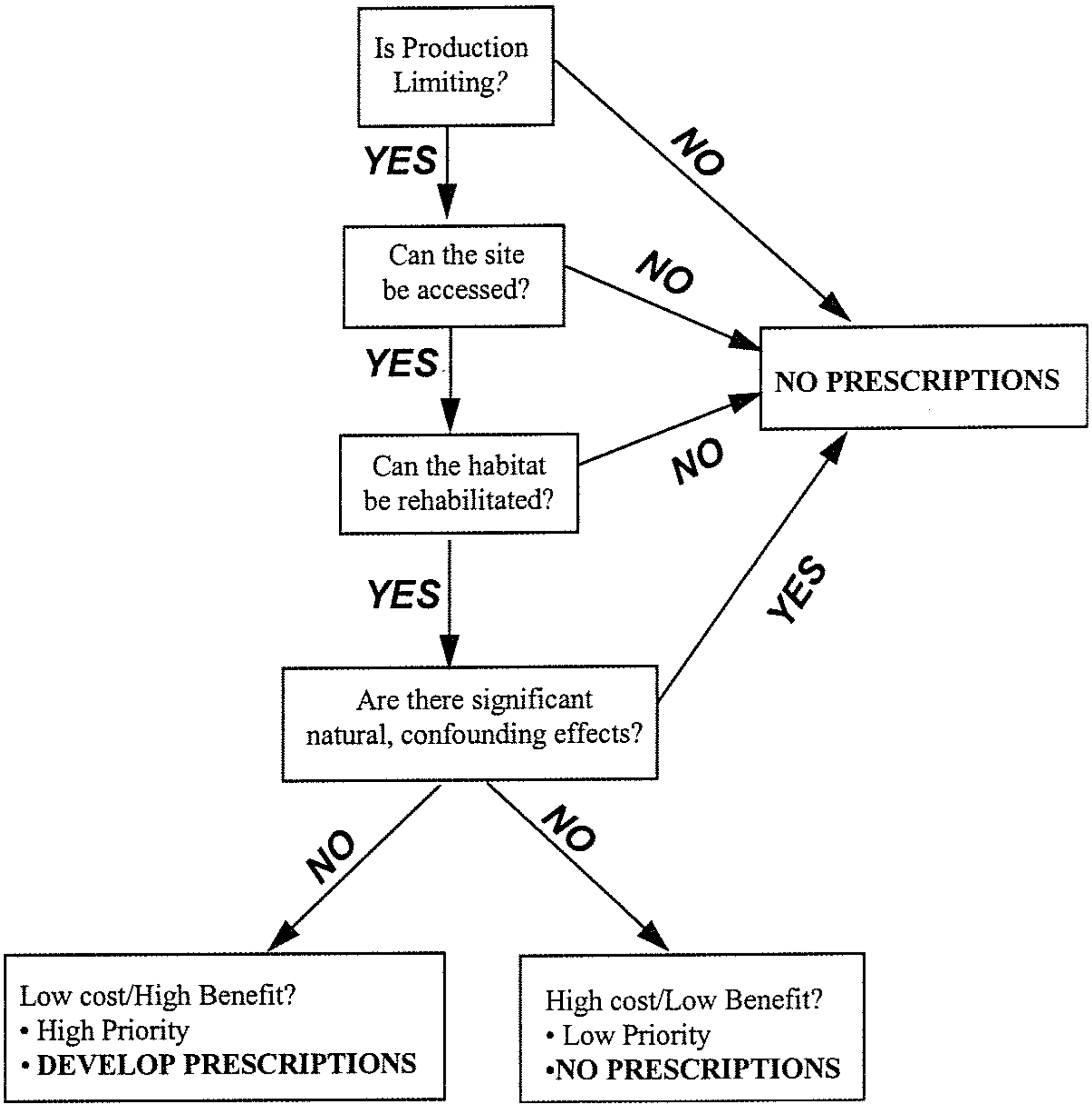
To begin, we assume that fish production is limited by in-river factors, regardless if a problem exists or not. If fish habitat is not limiting, there is little point to undertaking remediate measures (Do nothing). Answering "yes" to all categories (in the absence of natural, confounding factors) automatically places *high* priority on the site. Confounding factors include high gradient, dynamic flow and unstable terrain which may undermine attempts to remediate the stream if implemented. If there is some uncertainty as to whether or not the habitat can be rehabilitated or if there is a poor or questionable benefit relative to cost, the site receives *low* priority. In addition, if the site cannot be accessed, we have placed *nil* priority on rehabilitation, regardless of whether remediative actions should be undertaken or not. That is, technical considerations preclude any attempt at remediation.

This decision matrix has been applied to all habitat parameters (e.g., abundance of pools, spawning gravel abundance, cover, etc.) identified as being deficient (i.e., poor) for each reach as presented in Form 6 (Appendix C). All habitat features identified as poor were ranked for restoration prescriptions (Table 3). For example, where pool habitat is deficient in Reach 7, this may limit fish production. Although it can be rehabilitated with significant benefit, the priority has been ranked as nil because of lack of access. In Reach 6 where abundance and frequency of pool habitat is lacking, this was ranked as high priority because this limited habitat can be enhanced relatively easily with little cost and there are no difficulties with access.

We also applied this protocol to site specific areas within reaches during our field assessment (Table 2). For example, in Reach 5, there were several areas where there are opportunities to create off-channel nursery habitat, since these habitats are currently limiting. It will provide immediate benefit, it is technically feasible, easily accessible and these sites are not confounded by natural limitations, such as steep gradient. Thus, they have been ranked as *high* priority.

It may be that not all remediation prescriptions identified as *high* priority, get acted upon. In November, 1998, a workshop integrating results of the Fish, Riparian and Channel assessments will be held to examine, from a watershed perspective, the best options for the stream. Concurrent to this assessment was an independent assessment of the Stawamus River by the DFO. At the time this report was written, we were not aware of the specific details of the restoration activities being considered by DFO. Our recommendations and those of the DFO will be rationalized during this workshop to avoid duplication and to develop a common set of prescriptions.

Decision matrix for determining priority of rehabilitation prescriptions for the Stawamus River and Little Stawamus Creek.



As stated in the overview Fish Habitat Assessment (EVS, 1998), there has been an ongoing concern by DFO and BC MELP that seasonal low flows coupled with withdrawals by the District of Squamish for drinking water have exacerbated degradation or elimination of fish habitat. This was evident this summer as many areas along Reaches 4, 5 and 6 were dry at the time of surveying and isolated puddles were formed which left fish stranded. The District of Squamish anticipates that a groundwater source may replace the current withdrawals from the Stawamus and be activated by 1999, following an environmental review (M. Afsar, per. comm. 1998). It is highly recommended that issues concerning the source and/or the volume of this community intake be addressed.

2.5.4 Project Scope for Restoration Options

Habitat restoration opportunities identified during our field reconnaissance are summarized in Table 2 on a reach-by-reach basis. Deficiencies in stream habitat parameters in the lower Stawamus River watershed were determined by comparing observed characteristics with what would be considered "ideal" characteristics, based on standards presented in Table 5 of Johnston and Slaney (1996). Thus we pooled all habitat parameters that received a "poor" rating and summarized them in Table 3. Then, all of the habitat restoration prescriptions (Table 2) and habitat deficiencies (Table 3) identified in the study were subjected to scrutiny using the Decision Flow Chart (see Page 21) to determine whether restoration of a particular habitat feature (e.g., unstable banks) or characteristic (e.g., deficient amount of pool habitat) was warranted and deemed to be of high priority, of low priority, or of nil priority. Nil priority parameters should not be considered further because: access to the stream is not possible; there are significant natural disturbances (e.g., steep gradient, depositional areas, natural barriers, large unstable slopes/slides) that would, over time, negate efforts made to improve the habitat; and/or deficiencies of this kind of habitat are not considered limiting to production of anadromous salmonids.

High priority restoration prescriptions are those that were considered to be: limiting fish production; accessible; free from significant, confounding natural disturbances; technically feasible; and cost effective, relative to the effort invested. Low priority restoration prescriptions also met each of these criteria, except that the benefit was deemed to be low, relative to the high cost or difficulty associated with the restoration effort.

To facilitate interpretation and distribution of impaired sites, these have been mapped (Figure 2). Different symbols have been used to depict particular restoration prescriptions. Three different colours are used to distinguish the levels of priority: red for *high*, orange for *low* and green for *nil*.

The following sections describe, on a reach-by-reach basis, our assessment of the need and of the priority of each restoration prescription identified during field assessment (Table 2) and from Technical Circular #8 (Table 3).

2.5.4.1 Reaches 1 and 2

Reaches 1 and 2 fall within the intertidal zone of Howe Sound, therefore no restoration efforts were proposed.

2.5.4.2 Reach 3

Only one low priority option was identified for Reach 3. Removal of the old railway bridge piles (Photo 4) may eliminate the problem of trapping of fish in scour holes during summer low flow (Table 2). This is a low priority prescription because of low benefit relative to cost.

Cover, substrate and off-channel habitat was rated as poor. Of these, we have identified creation of cover and off-channel habitat as high priority prescriptive options because of the lack of rearing habitat in this reach. Placement of root-wad structures and LWD should be considered to improve cover.

2.5.4.3 Reach 4

Two restoration options are of high priority in Reach 4 (Figure 2). Enlargement of off-channel habitat (Photo 5) on the left bank, 65 m upstream of the highway bridge may assist in maintaining flow within the channel during low flow periods and provide a larger area for juvenile salmonids rearing habitat. Removal of LWD at the confluence with Little Stawamus Creek would eliminate a potential barrier for fish migration (Photo 11).

Percent pool habitat and cover were rated as poor. However, we have ranked these deficiencies as low priority because if off-channel habitat is created, this would satisfy these deficiencies. Creation of pool habitat is possible, however the benefits of this are uncertain.

2.5.4.4 Reach 5

Within Reach 5, two high priority sites within close proximity were identified and are associated with creating and stabilizing off-channel rearing habitat (Photo 9) which appears to be limiting in the stream (Table 2). Stabilization of an eroded bank just upstream of the large man-made pool (Photo 8) is of high priority. Connection of a small, off-channel pool to the mainstem is of low priority because of uncertain benefits.

There is a lack of pool habitat, cover, and spawning substrate in Reach 5. Given that the majority of spawning by anadromous salmonids likely occurs in reaches 5 and 6, we ranked this as a high priority deficiency. Consideration should be given to creating pools and pool/riffle sequences which may facilitate spawning and increase productivity of rearing habitat in this reach.

2.5.4.5 Reach 6

Reach 6 is by far the longest reach and contains the greatest number of rehabilitation options (Figure 2). Seven high priority prescriptions were identified and were primarily associated with creation, excavation, and re-connection of an old stream channel (Photo 23) which is believed to have contained abundant rearing habitat. We suspect that dike construction and training of the river has resulted in alteration of the stream course away from this dry channel, rendering it useless. Also, several areas of the river adjacent to the dike were exposed and had little cover. We identified lack of cover as a significant deficiency and therefore of high priority for restoration. This is also confirmed in Table 3, where cover, pool frequency and amount were regarded as poor. Thus we rated these deficiencies as high priority for restoration. Several areas have close proximity (Figure 2), therefore, it would be cost-effective to focus restoration efforts within this small area.

Several restoration efforts were rated as having low or nil priority. Low priority sites were subject to the confounding effects of the dike, which renders the stream open and exposed with little cover or riparian vegetation. We recommend that effort would be better spent in the abandoned stream reach, rather than trying to improve habitat that may be too difficult to rehabilitate. Other low priority sites were small in area and were not considered to be cost effective nor limiting in terms of productivity.

2.5.4.6 Reach 7

We identified several sites within Reach 7 that could be potential upstream barriers (velocity, barrier) to fish (Table 2, Figure 2). These are primarily velocity barriers due to steep gradient and drops caused by large boulders within the stream channel. However, access to this reach would be very difficult, if not impossible for large machinery because the majority of this reach lies within a deep ravine. Therefore, restoration opportunities within this reach are very limited and have nil priority.

According to Johnston and Slaney (1996), this reach is also deficient in LWD, off-channel habitat, and access to spawning areas. Notwithstanding difficulties associated with access, we do not believe that this reach is currently limiting fish production in the river. Therefore, we do not recommend that restoration prescriptions be developed for this reach.

2.5.4.7 Reach 8

We identified a single landslide on the left bank at 4,920 m, above the impassable falls (Table 2, Photo 17). Table 3 identifies poor percent pool frequency, LWD, off-channel habitat and spawning access. As discussed for Reach 7, there are several potential velocity barriers within Reach 8, notwithstanding the impassable falls at 4.8 km. This reach is also located within a deep, incised ravine, preventing access by large equipment. Flow within the reach is fast and access to pool habitat by juvenile salmonids would be difficult. Given these difficulties and the low probable success of any enhancement activities, we do not recommend that restoration prescriptions be designed for Reach 8.

2.5.4.8 Little Stawamus Creek

Nine locations within Little Stawamus Creek have been identified as having high priority for habitat restoration (Figure 2). Little Stawamus Creek contains abundant numbers of juvenile coho salmon and is obviously important rearing habitat. There are four groups of restoration prescriptions within Little Stawamus Creek that can be easily implemented. These are: remove parts of log jams; excavate existing side-channels; stabilize eroded banks; and fix log bridges and culverts (Table 2). Each of these prescriptions have the potential to significantly improve rearing habitat and offer a high benefit relative to cost and technical difficulty. Access to the stream is easy throughout its length.

Specific restoration prescriptions should include removal of parts of log jams throughout the creek to facilitate fish access. Locations of these are listed in Table 2. Several side-channels within the lower end of the Little Stawamus Creek become isolated from the creek during low flow periods. Excavation to connect side-channels with the creek mainstem will provide either access by fish, or escape by fish to prevent stranding in isolated pools.

There are three side-channels that should be excavated. The first and largest is a side-channel which is approximately 50 m long and is located 105 m upstream of the creek mouth. The two remaining side-channels are located at 202 m and 291 m upstream of the mouth. Eroding banks that contribute sediment to the Little Stawamus on a chronic basis are located at 1,361m across from McNaughton Park and at 1,856 m. Access to these areas by heavy machinery is easy, as there are nearby roads and the stream channel is not steeply incised. Rip rap should be placed along the stream banks to prevent further erosion.

An existing log bridge 291 m upstream of the stream mouth (Photo 19) has fallen into the stream and caused ponding upstream, which has resulted in bank erosion. Replacement of the bridge to facilitate pedestrian crossing over the stream is recommended. Another bridge located at 1,181 m (Photo 21) would also require replacement. Culverts at the

Gilford Road crossing should be reconstructed to allow fish passage at (Photo 22). The invert elevation of the culverts should be below stream bottom elevation to facilitate fish passage at all flows. Currently, fish passage at all but high flows is doubtful.

According to Table 5 in Johnston and Slaney (1996), Little Stawamus Creek has poor quality or abundance of pool frequency, substrate, spawning gravel, spawning access and holding pools. Part of the reason for these deficiencies, is that at the time of our field survey, the stream was virtually dry and only the lower parts had water. In the upper parts of the watershed which were not subjected to a proper fish habitat assessment because the stream was dry, we do not feel that productivity of the stream is limited by a lack of spawning access, gravel or substrate. Therefore, these parameters received low priority. However, we did distinguish a lack of pool habitat and recommend that pool habitat be created within the Little Stawamus as part of a Level II Assessment.

2.5.5 Recommendations for Level II Assessment

2.5.5.1 Integrated Assessment

We have identified twenty high priority locations on the Stawamus River (mainly in reaches 5 and 6) and Little Stawamus Creek for which restoration prescriptions should be developed (Tables 2 and 3). Some of these range from spatially small, simple restorative measures such as rip rapping of eroded stream banks, to reasonably large scale efforts, such as manipulation of stream flow within the existing and old stream channels to reconnect stream beds and capture sub-surface flow. These complex prescriptions require detailed hydraulic and engineering assessments to assess their feasibility, difficulty and cost. Furthermore, these prescriptions to improve fish habitat have not been fully integrated with the Riparian and Channel Assessments for the watershed as a whole. Therefore, it would not be efficient to attempt to scope out preliminary time and cost estimates for all recommended high priority prescriptions at this time.

Results from the Integrated Synthesis workshop (Section 5) attempt to identify all reasonable remediation efforts to improve fish habitat in the Stawamus River watershed. Some of the high priority prescriptions are recommended, in addition to others, which reflect integration of riparian and channel assessment perspectives. Thus, detailed planning of restoration prescriptions, as part of a Level II Fish Habitat Assessment for the Stawamus River should focus only on those high priority prescriptions developed via consensus with all parties involved including the consulting firms, BC MELP, and DFO.

2.5.5.2 Augmentation of Stream Flow

There are several factors that contribute to the issue of low flow in the Stawamus River. The major factor is withdrawal of water for domestic uses by the community of Squamish. Contributing factors are hydraulic changes to the watershed resulting from logging and loss of riparian habitat (especially between 1949-1952), the BC Hydro right-of-way corridor, and dike construction in the early 1970's, which resulted in stream bed channelization. These activities have resulted in higher peak flows and an increase in annual deposition in the bedload accumulation zones. There are large depositional areas in the lower regions of the diked area and within Reach 5, which have been partly responsible for sections of the stream drying up during low flow events in summer. The suitability of these areas as rearing habitat for juvenile salmonids has been negatively affected.

One approach that we have suggested is to increase flow around depositional areas by creating side-channels where minimum summer flows, both surface and sub-surface, would be intercepted and collected (Wood, 1997). This approach has also been proposed for High Falls Creek (upper Squamish River), and has been shown to be beneficial in the east Kootenays (Wood, 1997). An existing side-channel adjacent to the Fording River was excavated increasing base flow by 50% with a total cost in the order of $200,000, of which $40,000 was applicable to increasing the base flow.

The use of existing side-channels is highly recommended. Excavating an existing channel would increase the groundwater component and intercept subsurface flows. In the Stawamus River there are several side-channels which have minimal flow. The specific locations where this technique can be employed have been identified in Table 2.

In conclusion, the issue of domestic drinking water withdrawal from the Stawamus River should be resolved. Many of the remediation prescriptions recommended for the Stawamus are aimed at reducing the detrimental effects of low water on summer rearing habitat, which are exacerbated by domestic water consumption. We understand that a working group has been formed to address this concern, and, if possible, locate another source of drinking water for the community. It is recommended that the District of Squamish utilize a suitable groundwater source for the community intake or they develop a plan to address and mitigate the effects on fish habitat in the Stawamus resulting from seasonal low flows. While the community intake source/volume issues are being addressed, the other restoration measures for both the Stawamus and Little Stawamus as outlined in Section 5 and Tables 12 and 13 should be implemented.

3. RIPARIAN ASSESSMENT

3.1 INTRODUCTION

3.1.1 Overview of the Importance of Riparian Areas

Riparian zones can be defined as ecosystems (e.g., floodplains, fans and lakeshore communities) that are periodically flooded both above and below ground (MacKenzie and Banner, 1995).

Riparian habitats are generally characterized by high plant species diversity, high structural heterogeneity and high productivity. Specific habitat elements such as large trees, snags, downed wood and a large variety of deciduous and coniferous trees, shrubs and herbs are evident. These habitats support a disproportionately greater diversity and abundance of wildlife than most other North American habitats because of the high number of niches available.

Riparian vegetation plays an integral part of the ecology of a stream, serving a number of interconnected functions including:

- Soil formation
- Stream bank retention and stability
- Sources of large woody debris (LWD) to streams (fish habitat)
- Sources of small organic debris (SOD) to streams (in-stream nutrients)
- Surface sediment and subsoil nutrient filtering
- Invertebrate production for fish consumption
- Snags for wildlife perch and nest sites
- Snow interception
- Breeding, foraging and resting opportunities for wildlife
- Traditional foods

The condition of a riparian zone is a result of complex biogeochemical processes with linkages to both aquatic and terrestrial communities. These biogeochemical processes affect water quality and the ecology of terrestrial and aquatic ecosystems.

Under the Forest Practices Code of British Columbia, Riparian Management Areas (RMAs) must be established along all streams and rivers in order to protect the important ecological functions that streamside habitats provide. Vegetation that is found within a RMA does not necessarily only include riparian or wetland vegetation. Almost all ecosystems from the driest rock outcrop to saturated wetlands may occur in the administratively defined RMA (Oikos and Johnson 1996).

3.1.2 Review of Coastal Watershed Assessment

A Coastal Watershed Assessment Procedure (CWAP) was recently completed for the Stawamus River Community Watershed (BC MELP and MOF, 1997). The CWAP is an assessment of the cumulative impacts that past forestry development has had on the water and associated resources. Of seven sub-basins in the Stawamus River watershed, the CWAP identified four sub-basins with riparian zones that had experienced moderate to high deleterious effects from streamside logging. The current assessment attempts to address concerns raised by the CWAP, identify all openings in riparian vegetation, and prescribe riparian enhancement options, where applicable. A CWAP was not conducted on Little Stawamus Creek.

The CWAP determined that old growth forests accounted for 54% of the forested area. Trees between the ages of 21 and 40 years accounted for 27%. Approximately 90% of the past 705 ha of logging has been centred mostly within the broad middle reach of the mainstem and the lower elevation reaches adjacent to the community water intake. An additional 50 ha of land has been cleared for BC Hydro and natural gas pipeline ROWs that run the length of the watershed.

The Watershed Report Card in the CWAP gave Sub-Basins 2 (Skypilot), 3 (Copilot), and 5 (Hydroline) and Residual (i.e., remaining area within the watershed not defined within one of the seven sub-basins) a moderate to high hazard rating due to the deleterious effects of streamside logging. The increased numbers of landslides in Sub-Basins 3 (Copilot) and 5 (Hydroline) were responsible for moderate hazard levels. Sub-Basin 4 (Ray Creek) and Residual were assessed high mass wasting hazard levels as a result of a high number of landslides hitting the main stem. The landslides originated from roads and cut blocks, and approximately 75% of them reached the main stem.

The CWAP also stated that the Riparian Assessment must evaluate the current potential of the riparian areas to supply LWD to the river, as well as to protect stream banks against erosion. Riparian areas that consist of predominantly deciduous stands and which have the potential to be converted to coniferous stands should also be identified by the Riparian Assessment in order to assist with rehabilitation of impacted reaches of the Stawamus River.

3.1.3 Rationale for Riparian Assessment and Prescription

The primary purpose of riparian assessment and prescription is to determine how and what functions of the riparian ecosystem have been altered by resource utilization (e.g., logging) and to determine how these important functions can be restored. Riparian Assessment addresses the Watershed Restoration Program (WRP) goal of restoring, protecting and maintaining fish, aquatic, wildlife, and forest resources.

The current assessment attempts to address concerns raised by the CWAP, to identify all impaired openings in riparian vegetation resulting from logging activities (i.e., Overview assessment), to determine which of the impaired openings require riparian restoration (i.e., Level I assessment), and to provide preliminary riparian enhancement prescriptions for these openings.

3.2 METHODS

3.2.1 Riparian Assessment and Prescription Procedures

Riparian assessment and prescription is a key component of the Watershed Restoration Program. A recently released draft 'Riparian Assessment and Prescriptions Procedures' guidebook (BC MELP and MOF, 1998) addresses the WRP goal of maintaining healthy riparian ecosystems. The methodology utilized in the current study reflects methodology outlined by the guidebook.

The general methodology outlined in the guidebook involves three distinct stages of assessment, with each stage having a progressively more intensive data collection component. The first stage, an "Overview" assessment, is office-based and relies primarily on existing information such as air photos, forest cover maps, and opening file information. The second stage, the "Level I" field-based assessment involves a field reconnaissance. The third stage, a "Level II" field-based assessment, is the most detailed and results in development of prescriptions for restoring impaired riparian habitats.

This document describes results from an Overview and Level I assessment of riparian habitats along the mainstem of the Stawamus River and Little Stawamus Creek. Level II assessment is beyond the scope of the current contract, as is riparian assessment of tributaries to the Stawamus River (e.g., Ray Creek).

3.2.1.1 Overview Assessment

The primary objectives of the riparian overview assessment were to: a) identify areas with known or suspected impaired function in previously logged riparian areas along the mainstem of the Stawamus River and Little Stawamus Creek; and b) to identify sites for

Level I assessment. The specific steps taken in the current study to complete the overview assessment were:

1. Assemble and review materials such as air photos, topographic maps, forest cover maps and opening files.

2. Utilize 1996 air photos of the Stawamus River and other materials to identify the impacts of harvested areas on the RMA of the Stawamus River.

3. Delineate distinct riparian vegetation types (RVTs) within the RMA (i.e., polygons) on acetate overlays. A stereoscope was used to identify unique polygons. Polygons were unique to reach, biogeoclimatic subzone and right or left side (i.e., when looking downstream) of the river. Since most of the RMA along the Stawamus River has been logged, both harvested and unharvested areas were delineated.

4. Define RVTs based on structural stage and tree type. Structural stages, as described in the guidebook included: a) initial succession; b) shrub-herb; c) pole sapling; d) young forest; e) mature forest; and f) old forest. Tree types were either: a) deciduous dominated; b) coniferous dominated; or c) mixed deciduous and coniferous.

5. Determine RVTs for all polygons delineated along the Stawamus River. Each polygon was given a unique number, starting from '1' at the mouth of the river. Each of the unique RVTs (i.e., 35) were designated a tentative RVT number. Similar RVTs in each of the three BEC subzones were given unique RVT numbers.

6. Identify stream class (following FPC guidelines).

7. Determine known harvesting history for each polygon based on sources such as forest cover maps and MOF opening files.

8. Note other disturbances impacting polygons.

9. Select sites for Level I field assessment based on air photo observations, proper functioning condition, harvest history and other information sources.

3.2.1.2 Level I Field Assessment

The objectives of the Level I assessment are to: a) confirm or revise the nature, location, and extent of forest harvest impacts on riparian habitat; b) provide field data for use in prescription development; c) provide a preliminary list of restoration options for sites with impaired riparian functions; and d) provide sufficient information to identify and prioritize impaired sites for Level II assessments and prescriptions. Level I field assessments were conducted on impaired polygons identified in the Overview assessment.

Level I field assessment involved collection of quantitative and qualitative information on impaired polygons (15 July 1998), and evaluating the riparian "level of functioning". Determining level of functioning was based on the ability of a site to provide riparian functions including LWS, SOD, stream shading, stream bank and channel stability, and wildlife and general biodiversity attributes.

3.2.2 Ground and Helicopter Reconnaissance

A ground reconnaissance of the Stawamus River was conducted on July 30 and September 9, 1997. Ground reconnaissance of Little Stawamus Creek was conducted on September 28 1998. Representative habitats were viewed and plant communities identified. The main logging road was driven from Highway 99 to the Stawamus River and Indian River watershed boundary. The initial site visits permitted a preliminary assessment of riparian conditions along the mainstem of the Stawamus River.

A helicopter reconnaissance of the entire mainstem of the Stawamus River was conducted on September 9, 1997. All openings identified from air photo analysis were viewed from the air to determine whether Level I assessment was warranted. Sources of mass slope failure on several tributaries were also investigated.

3.2.3 Wildlife Observations

Dedicated surveys of wildlife presence and habitat utilization were not conducted. Incidental wildlife sightings during the field visits and comments on potential regionally important wildlife species impacted by impaired riparian areas are provided.

3.3 Results and Discussion

The total length of the Stawamus River is approximately 21 km from its source in the subalpine habitats around Stawamus Lake to its mouth near the head of Howe Sound. Much of the lower reaches of the river run in braided channels through a well established riparian forest. A portion of the river in this area has been channelized for flood protection purposes along the Valleycliffe subdivision. The upper reaches of the river have limited riparian habitats. In some sections, the river is deeply incised. Riparian habitat of Little Stawamus Creek was also described because of its known importance as nursery habitat for anadromous fish.

3.3.1 Overview Assessment

3.3.1.1 Riparian Vegetation Type

A total of 367 polygons delineating unique RVTs was identified. All polygons are indicated on acetate overlays on air photos, and information unique to each polygon is provided in Form 1, Appendix D. For each polygon, Form 1 describes reach number, polygon number, stand structure, tentative RVT number, stream class, harvesting and restocking history, other disturbances, and priority for Level I and Level II assessment. Polygons were unique to reach, biogeoclimatic subzone, and right or left side of the river. Polygons were also only delineated within 50 m (i.e., the RMA for S2 streams) of the Stawamus River. Polygon numbers corresponding to each of the 33 reaches are provided in Table 6. A total of 44 polygons delineating unique RVTs was identified in Little Stawamus Creek. Polygons were only delineated within 50 m of the Little Stawamus River.

Five biogeoclimatic zones occur within the Stawamus River watershed: a) Coastal Western Hemlock Dry Maritime (CWHdm); b) Coastal Western Hemlock Submontane Very Wet Maritime (CWHvm1); c) Coastal Western Hemlock Montane Very Wet Maritime (CWHvm2); d) Mountain Hemlock Windward Moist Maritime (MHmm1); and Alpine Tundra (ATc). The riparian assessment investigated impacts of logging, which only occurred within the three CWH subzones. Polygon numbers corresponding to each of the CWH subzones are: a) CWHdm (1-131); b) CWHvm1 (132-199); and c) CWHvm2 (200-367).

A total of 13 structural stage/tree type combinations was identified along the Stawamus River. Since unique RVT numbers were designated for each of the three CWH subzones, a total of 35 RVTs was defined (Table 7).

3.3.1.2 Ground and Helicopter Reconnaissance

On the 30 July 1997 site visit, several major landslides were noted, some of which likely contributed significant quantities of sediment to the Stawamus River. Several of the slides were observed to have disrupted streamside riparian vegetation. Areas that were clearcut between the 1950s and 1970s appear to be regenerating well. Cover appears to be well distributed with few openings. Old logging roads have completely grown in with alder and other deciduous shrub species making access extremely difficult in some areas. Several small slides were noted which appear to be related to old logging roads and active stream gullies.

The September 9, 1997 helicopter reconnaissance of the Stawamus River involved flying and videotaping the entire length of the mainstem. All openings resulting from previous logging activity appeared to be regenerating well, and riparian enhancement work was considered not to be warranted. Habitats below the hydroline were also well vegetated.

However, cutting of trees occurs regularly as part of BC the Hydro right-of-way maintenance program. Openings caused by landslides were determined to be having the most severe impact on the river. Riparian buffer areas have been disrupted in many cases. However, it was determined that riparian restoration efforts will likely not be effective until landslide areas and dynamic drainage systems have been stabilized by other means. A transcription of field notes from the July 30 and September 9, 1997 field visits is included in Appendix E.

On the 28 September 1998 site visit to Little Stawamus Creek, habitat characteristics were described for three general areas: a) creek confluence with the Stawamus River to Guilford Road; b) Guilford Road to Plateau Crescent; and c) Plateau Road to the hydroline. Most riparian habitats were characterized by mid-aged mixed coniferous and deciduous forest stands with a well established shrub understorey. Although detailed descriptions of riparian habitats are generally not provided in an Overview and Level I Riparian Assessment, the importance of the Little Stawamus River to anadromous fish populations warranted a more detailed description.

Stawamus River to Guilford Road — Riparian habitats were dominated by an overstorey of deciduous trees including red alder (see Appendix E for botanical names), bigleaf maple and black cottonwood. Several scattered Sitka spruce and western hemlock were also present. The understorey was characterized by a dense, diverse shrub layer including dominant species such as salmonberry, red elderberry and vine maple. Shrub species occurring to a lesser extent included thimbleberry, willow, stink currant, and hardhack. Young Sitka spruce and western red cedar were also present in the understorey. Representative herbaceous species included piggy-back plant, lady fern, swordfern, spiny wood fern, and false lily-of-the-valley. Small sections of the creek ran through a large pond and hydroline corridor. Vegetation along the pond edge was characterized by red alder, Sitka spruce, vine maple, and western hemlock. Water inundation has resulted in creation of several red alder snags, important to woodpeckers and cavity nesters. Willow, hardhack and other shrub species were present along the creek within the hydroline corridor. Appendix E provides a list of plant species observed between Stawamus River and Guilford Road.

Guilford Road to Plateau Crescent — Little Stawamus Creek runs through a band of riparian vegetation retained along the north side of the Valley Cliffe subdivision. Red alder was the dominant tree species, but bigleaf maple, black cottonwood, western hemlock and western red cedar also occurred. Immature western red cedar and western hemlock were prevalent in the understorey. The shrub layer was particularly dense on the south side of the creek where clearing of adjacent forests for subdivision development has resulted in increased light penetration. Dominant shrub species include salmonberry, red elderberry, trailing blackberry and thimbleberry. The herbaceous layer was generally poorly established because of the thick shrub layer. Herb species include wall lettuce, Pacific bleeding heart, lady fern and swordfern. Appendix E provides a list of plant species observed between Guilford Road and Plateau Crescent.

Plateau Road to Hydroline — Riparian vegetation, dominated by deciduous tree species, was particularly evident on the south side of the creek where the ground is low-lying. Mature, coniferous dominated forests occur on steeper slopes north of the creek. Most low lying habitats were identified as site series '07' (Western Red Cedar - Foamflower). Drier habitats on steep slopes were determined to be site series '01' (Western Hemlock - Flat Moss) or '05' (Western Red Cedar - Swordfern). Common coniferous tree species included Douglas-fir (to 75 cm DBH), western red cedar, and western hemlock. Red alder (to 60 cm DBH), black cottonwood, and bigleaf maple dominate low-lying areas along the creek. Many red alder were decadent providing excellent foraging and cavity-nesting opportunities for woodpeckers, chickadees, nuthatches, and small owls. Immature Douglas-fir, Sitka spruce, western red cedar, and western hemlock saplings were well established in the deciduous tree understorey. Prevalent shrub species included vine maple, trailing blackberry, and salmonberry. Common herbaceous species included foamflower, lady fern, spiny wood fern, and swordfern. Skunk cabbage was observed in wet areas along the creek. Douglas-fir stumps and western red cedar stumps with springboard cuts were also noted. Appendix E provides a list of plant species observed between Plateau Road and the hydroline.

3.3.1.3 Harvesting History

Harvesting history for each of the polygons, if applicable, is provided in Appendix D (i.e., Form 1). Generally, riparian habitats in the lower reaches (i.e., 3-6) were harvested between 1949 and 1952. A review of historical air photos determined that the riparian zone was logged to the river's edge in these reaches. The historical air photo review also determined that between Reaches 7 and 11, the right bank of the Stawamus River was logged prior to 1947. The left bank between reaches 7 and 9 was not logged, and therefore contains some of the last remaining old forest habitats along the lower Stawamus River.

In 1955, logging was conducted on the right bank of the river, between reaches 12 and 18. With the exception of the hydroline corridor, old forest habitats remain on the right bank of the river, between reaches 19 and midway through reach 25. Forests between reaches 10 and 18 on the left side of the river were logged in 1951 and 1955. Some remnant patches of old forest were retained on the left bank of the river. More expansive old forest habitats remain on the left side of the river between reaches 22 and midway through reach 24. The remainder of the watershed (i.e., up to reach 24 was logged between 1963 and 1972, with most of the logging activity occurring in the 1960s).

Most of the logging in the 1940s and 1950s involved yarding timber across the river. Therefore, few leave-strips were retained. Although logging in the upper watershed in the

1960s and early 1970s was conducted up to the river bank leaving few or narrow leave-strips, timber apparently was not yarded across the river. Yarding across rivers results in soil degradation and damage to existing riparian shrub vegetation.

Riparian habitats in the Little Stawamus Creek appeared to be harvested between the early 1900s and early 1950s. A review of historical air photos determined that the riparian zone was logged to the river's edge.

3.3.1.4 Other Disturbances

A number of other disturbances have impacted the riparian management zone along the Stawamus River. Overall, these other disturbance sources appear to be having a more detrimental affect on the RMA than logging activities. Two major linear developments have impacted the RMA. A transmission line corridor developed in the late 1960s was constructed across the Stawamus River between reaches 17 and 22. Maintenance of vegetation at a shrub stage of forest succession has impaired some of the riparian functions (i.e., stream shading and LWD production).

A CentraGas pipeline corridor constructed in the 1980s has resulted in several major land slides which are contributing sediment to the Stawamus River. Impacts of these slides are greatest in reaches 10, 15, 16 and 17.

Other disturbances include industrial and residential development in the lower reaches of the river. Many residential lot boundaries are within the 50 m RMA of Little Stawamus Creek. Of particular note is the diking of the right bank of the Stawamus in Reach 6 for flood protection of the Valleycliffe subdivision. Dike construction and maintenance has resulted in an absence of riparian vegetation in this section of the river. The western end of this dike is within a few metres of Little Stawamus Creek and may have resulted in alteration of the historical channel. Several roads serving the Valleycliffe and other subdivisions intersect the river. Occasional flooding in the lower reaches has also impacted forested riparian habitats.

3.3.1.5 Priority for Level I Assessment

Polygons which were determined to have impaired riparian function and which may require further assessment are indicated in Appendix D (i.e., Form 1). Many of the polygons with impaired riparian function are slides. A summary of field notes on impaired polygons, taken during the Overview assessment, is provided in Section 3.3.1.6 below.

When determining whether a polygon was impaired and required further assessment, level of functioning of six riparian functions was considered. Riparian functions included LWD, shade, Small Organic Debris (SOD), surface sediment filtering (SSF), channel stability (CS) and bank stability (BS). Level of functioning for each of the six functions was rated as either Low (0), Moderate (1) or High (2). For polygons with slides, ratings only apply to slide portions of the polygon. Further assessment was considered for all polygons with a total score of 5 or less.

Table 8 provides a summary of level of functioning ratings for all impaired polygons, as well as an indication whether Level I assessment is required. Level II assessment in Table 9 refers to polygons with slides which require a detailed prescription for restoration, but where Level I assessment is not applicable because of an absence of vegetation.

For polygons 64 and 71, the total rating is artificially high because of rip rap which provides channel and bank stability. Although riparian functions are severely impaired in Polygon 71, dike maintenance issues prevent any enhancement activities on the dike itself.

Opportunities to enhance riparian growth along Little Stawamus Creek are limited. Riparian vegetation is well developed in most areas, with the exception of residential lots. Although some areas dominated by deciduous vegetation would appear to require underplanting with conifers, good growth of young conifers was noted in many of these areas during the site reconnaissance.

3.3.1.6 Initial Field Notes of Impaired Polygons

The following descriptions of impaired polygons are based on notes taking during an initial site reconnaissance of the Stawamus River, as part of the Overview assessment. Level I assessment is recommended where the riparian functions are significantly impaired (see Table 9). Level II assessment (i.e., for developing detailed prescriptions) is only recommended for slides where a Level I assessment is not applicable because of the absence of vegetation. Level II assessment, in this context, does not refer to assessment of existing riparian habitats, but to assessment of soils, stability, and other factors required to develop detailed prescriptions for restoration utilizing bioengineering techniques.

Polygon 64, Reach 6 — The area of impaired riparian function in polygon 64 is found where the Mamquam River mainline logging road is located in close proximity to a side channel of the Stawamus River. Large rip rap has been used to stabilize the road and prevent erosion. Some plant growth was evident on the steep slope between the road and the channel. Species included thimbleberry (*Rubus parviflorus*), salmonberry (*Rubus spectabilis*), red alder (*Alnus rubra*), willow (*Salix* spp.), red elderberry (*Sambucus racemosa*), hardhack (*Spiraea douglasii*), bigleaf maple (*Acer macrophyllum*), Douglas-fir (*Pseudotsuga menziesii*), western hemlock (*Tsuga heterophylla*), western red cedar (*Thuja plicata*) and black raspberry (*Rubus leucodermis*). Because slopes are stable and riparian vegetation is regenerating rapidly, there does not appear to be a need for riparian restoration. ***Level I assessment not required.***

Polygon 71, Reach 6 — Riparian vegetation is absent from large sections of the right bank of the Stawamus River. Diking (i.e., rock rip rap) for flood protection of the Valleycliffe Subdivision prevents riparian vegetation from becoming established in most areas. Some riparian vegetation is established in several small patches, generally where exposed ground exists at the base of the dike system. Red alder in these areas is established to a width of 5-7 m. Although deciduous shrub and tree vegetation is rapidly colonizing the top of the dike, frequent cutting (i.e., dike maintenance) limits the opportunity to permanently establish riparian vegetation.

Tree species observed colonizing the base and the crest of the dike system included bigleaf maple, black cottonwood (*Populus balsamifera*), Douglas-fir, paper birch (*Betula papyrifera*), red alder, western hemlock and western redcedar. Shrub species diversity was high and included black raspberry, hardhack, red elderberry, Scotch broom (*Cytisus scoparius*), salmonberry, Sitka mountain-ash (*Sorbus sitchensis*), thimbleberry and willow. Pearly everlasting (*Anaphalis margaritacea*) and swordfern (*Polystichum munitum*) were some of the herb species identified. ***Level I assessment not recommended because of dike maintenance policies.***

Because of the importance of the lower reaches of the Stawamus River to anadromous salmonids, innovative bioengineering techniques to increase stream shading and development of pool habitats should be considered. Crib walls with willow and cottonwood plantings which jut out into the river could be established at the base of the dike in various locations and should be considered as an enhancement option. This enhancement option would avoid any conflict with dike maintenance policies but would improve riparian level of functioning considerably. ***Level II assessment required.***

Polygon 90, Reach 6 — The left bank of the Stawamus River opposite the Valleycliffe subdivision is dominated by a dense shrub-stage stand of red alder, thus having a low capability for future LWD production. Opportunities to increase conifer stocking by planting Sitka spruce (*Picea sitchensis*), and possibly western red cedar, in clusters may exist. Impaired riparian function includes presence of large wood, structural diversity, and floodplain and bank stability. A Level I assessment is necessary to determine existing conifer stocking in the understorey. ***Level I assessment required.***

Polygons 121 and 122, Reach 9 — Two small slides initiating from the logging road on the right side of the river may require stabilization by bioengineering techniques. A field visit is required to confirm whether stabilization is necessary. ***Level I assessment not applicable. Level II assessment may be required.***

Polygon 127, Reach 10 — A rock slide appears to have originated from a pipeline right-of-way located on the right side of the Stawamus River. A narrow band of riparian vegetation is present between the rock slide and the river. Tree species present in the riparian band include bigleaf maple, Douglas-fir, red alder and western hemlock. Some regrowth of shrubs including black raspberry, red alder and thimbleberry is occurring on the slide itself. Rock material in the slide is reasonably large. Sediment inputs to the river are expected to be minimal because of the size of the slide material and because the riparian buffer acts as a sediment filter. ***Level I assessment not applicable. Level II assessment not required.***

Polygon 139, Reach 10 — A significant slope failure has occurred in polygon 139, on the right side of the Stawamus River. Again, the cause appears to be the pipeline right-of-way. However, the slide does not continue all the way to the Stawamus River. A moderate riparian buffer, consisting of western hemlock, bigleaf maple and Douglas-fir exists between the toe of the slide and the river. Several patches of red alder are established in the centre of the slide area. Very little shrub vegetation has recolonized the slide suggesting that the failure occurred recently and/or slide activity or soil erosion is active and ongoing. Slide materials consist of both large rocks and fine sediments. It is expected that the riparian zone does not filter all fine material washed down the slide surface. Efforts to stabilize the slide area (e.g., bioengineering, pull back etc.) are warranted. ***Level I assessment not applicable. Level II assessment is required.***

Polygon 141, Reach 10 — A slide is present at the mouth of the Ray Creek tributary, designated as Sub-Basin 5 by the 1997 CWAP. Ray Creek is an unstable tributary which contributes large amounts of sediment to the Stawamus River. Upstream sediment sources appear to be primarily natural although logging on some slopes may also be a sediment source. Bioengineering or other methods may be warranted to stabilize the slide. A field visit is necessary to confirm whether stabilization is required. ***Level I assessment not applicable. Level II assessment may be required.***

Polygon 230 and 231, Reaches 16 and 17 — Continued erosional and mass movement concerns are expected to continue with this ephemeral tributary entering the right side of the Stawamus River. The source of the material is a steep canyon above the hydroline corridor. Because there does not appear to be any way of stabilizing this dynamic system, riparian restoration of the streamside area is not recommended. Some natural regeneration of willow, Douglas-fir and thimbleberry is occurring on the exposed gravels. Vegetation adjacent to the slide area includes willow, Sitka alder (*Alnus crispa*), red alder, Douglas-fir and Amabalis fir (*Abies amabalis*). ***Level I assessment not applicable. Level II assessment not recommended.***

Polygon 234, Reach 17 — A small slide on the right side of the river may require stabilization by bioengineering techniques. A field visit is required to confirm whether stabilization is necessary. ***Level I assessment not applicable. Level II assessment may be required.***

Polygon 289, Reach 25 —A narrow band of coniferous trees is established along the length of this opening on the right bank of the Stawamus River. Coniferous trees are not regenerating evenly in more upslope areas. However, all areas are covered by dense shrub vegetation providing adequate soil stability and filtering functions. Given the riparian vegetation already present and the inaccessibility of the site, riparian restoration is not recommended. ***Level I assessment not recommended.***

Polygon 291, Reach 25 — Copilot Creek, a tributary to the Stawamus River, runs through polygon 291, on the left side of the river. Both deciduous and coniferous vegetation appears to be well established in most areas of the polygon. The RMA in some areas is somewhat poorly stocked with conifers, however, restoration options such as conifer planting, would be difficult because of extremely poor access. Because of previous logging activity in upstream reaches of Copilot Creek, some sediment is entering the Stawamus River. ***Level I assessment not recommended.***

Polygon 313, Reach 27 —Polygon 313, along the middle reaches of the Stawamus River (left side) is part of forest cover opening #45. Coniferous tree regeneration is proceeding slowly. However, a dense cover of huckleberries, blueberries and other shrub species is present in small openings between established conifers. Vegetation is well established along the river banks providing bank stability and sediment and nutrient filtering functions. Because vegetation in polygon 313 is expected to progress well and access is extremely poor, riparian restoration efforts are not warranted. ***Level I assessment not recommended.***

Polygons 320 and 325, Reaches 28 and 29 — Polygon 320 and 325, on the right side of the Stawamus River is a small opening in forest cover opening #42 with limited conifer cover. Because a dense layer of shrub vegetation is established along the creek, no riparian restoration is required. Because of the small size of the opening and extremely difficult access, planting of conifers to increase stocking and to meet biodiversity objectives, is not suggested. ***Level I assessment not recommended.***

Polygon 330, Reach 29 — Polygon 330 represents a small slide originating from an old logging road on the left side of the Stawamus River. The slide may require stabilization by bioengineering techniques. A field visit is necessary to determine stabilization options and to collect detailed information for prescription development. ***Level I assessment not applicable. Level II assessment required.***

Polygon 339 and 343, Reaches 29 and 30 —Two small slides initiating from an old logging road on the left side of the river may require stabilization by bioengineering techniques. The slides appear to be the result of poor drainage (i.e., channeling run-off) and are likely contributing a significant amount of sediment to the river. A field visit is necessary to determine stabilization options and collect detailed information for prescription development, however, access is only by helicopter. ***Level I assessment not applicable. Level II assessment required.***

3.3.2 Recommended Sites for Level I Field Data Collection

Only Polygon 90 is recommended for Level I assessment. Other riparian habitats which have some impaired riparian functions are considered to have acceptable level of functioning of riparian functions.

Several sites (i.e., slides) require a Level II assessment to develop bioengineering or other prescriptions for stabilizing eroding slopes. Level II assessment is beyond the scope of this project.

3.3.3 Level I Field Assessment

In the Stawamus Overview Assessment only one polygon (Polygon 90) was determined to require Level I field assessment. Several additional polygons which contain slides require further assessment (i.e., Level II) in order to develop bioengineering or other prescriptions for stabilizing eroding slopes. Level I assessment is not applicable in slide areas.

Level I field assessment was conducted on Polygon 90. Two plots, which collect detailed information on stand overstorey and understorey conditions, soil characteristics and riparian level of functioning, were completed. Whereas the overview assessment identified the RVT of polygon 90 as being Shrub deciduous (SHd), the Level I field assessment determined that both Pole Sapling deciduous (PSd) and SHd RVTs occur in the polygon. Field Form 2 was completed for both plots (see Appendix F). A summary of information collected on the Level I assessment is provided below. Form 3 data are provided in Appendix G.

3.3.3.1 Polygon 90, Reach 6

Plot 1 — Plot 1 was located approximately 10 m from the river bank and approximately 500 m west of the Mamquam Road bridge. A portion of the plot appeared to be that of an old logging road. Dominant overstorey vegetation was red alder with some black cottonwood. Height did not exceed 10 m. Western hemlock was particularly abundant below the red alder upper layer. Several Douglas-fir were also present. Stocking densities of conifers in the 0.1 to 7.4 cm layer were estimated at 4,000 stems/ha. Numerous western hemlock seedlings with height below 1.3 m were also present. Total stocking densities of conifers in all layers was estimated at 11,600 stems/ha.

Understorey vegetation was relatively sparse, but dominated by thimbleberry and salmonberry. Herbaceous species included Pacific bleeding heart (*Dicentra formosa*) and baneberry (*Actaea rubra*). The moss layer was absent. Overall level of functioning of the plot was considered to be moderate. Because of the young age of the stand, LWD, shade, channel stability and bank stability were rated as low. Small organic debris was rated as high because of the large amounts of leaf litter and other organic debris entering the river system. Surface sediment filtering was rated as moderate.

The soil analysis indicated that the area appeared to have been flooded in recent years. The 'Ae' horizon (i.e., surface mineral layer indicating strong leaching of organic matter and nutrients from upper mineral soil) was very reduced.

Plot 2 — Plot 2 was located approximately 20 m from the river bank and approximately 350 m west of the Mamquam Road bridge. Dominant overstorey vegetation was red alder with some bigleaf maple. Height did not exceed 20 m. Western hemlock was particularly abundant below the red alder upper layer. Several western red cedar were also present. Stocking densities of conifers (i.e., primarily western hemlock) in the <1.3 m height category were estimated at 10,800 stems/ha. Stems/ha of the dominant deciduous layer (i.e., 1a and 1b) was 1,200.

Understorey vegetation, particularly the shrub layer, was well developed, and dominated by red elderberry and salmonberry. Herbaceous species included one-leafed foamflower (*Tiarella unifoliata*), swordfern and spiny wood fern (*Dryopteris expansa*). Approximately 30% of the plot was covered by moss. Overall level of functioning of the plot was considered to be moderate. Because of the young age of the stand, LWD, channel stability and bank stability were rated as low. Small organic debris was rated as high because of the large amounts of leaf litter and other organic debris entering the river system. Surface sediment filtering and shading were rated as moderate. The soil analysis indicated a very well developed 'H' and 'Ah' layer, suggesting a rich site.

Other Plant Species Noted — Other shrub species observed in Polygon 90 during the Level I assessment included black gooseberry (*Ribes lacustre*), Douglas maple (*Acer glabrum*), hardhack, mountain-ash, oceanspray (*Holodiscus discolor*), saskatoon (*Amelanchier alnifolia*), trailing blackberry (*Rubus ursinus*) and vine maple (*Acer circinatum*). Additional herbaceous species included bedstraw (*Galium* spp.), brachen (*Pteridium aquilinum*), broad-leaved starflower (*Trientalis latifolia*), clasping twisted stalk (*Streptopus amplexifolius*), grasses (Graminae spp.), goat's beard (*Aruncus dioicus*), herb-Robert (*Geranium robertianum*), lady fern (*Athyrium felix-femina*), miner's lettuce (*Claytonia* spp.), rosy twisted stalk (*Streptopus roseus*), sedge (*Carex* spp.), wall lettuce (*Lactuca muralis*) and wild ginger (*Asarum caudatum*).

Restoration Options — Both Plots 1 and 2 indicated a high stocking of western hemlock. Western red cedar and Douglas-fir were also present but at lower densities. One restoration option is to directionally fall deciduous canopy trees to release understorey western hemlock and speed development of LWD. Because of the high densities of western hemlock, some thinning of conifers may also be desirable. However, an overall assessment of conditions on the site indicate that restoration may not be appropriate because: a) the polygon may be subject to periodic flooding; b) restoration would result in short-term impairment of SOD, biodiversity and stream shading; and c) the site will likely move naturally quite quickly to a conifer-dominated stand. Following a field visit on November 17, 1998, ***a Level II assessment of Polygon 90 is recommended.***

3.4 WILDLIFE OBSERVATIONS

Twenty bird species were observed on the three days of field reconnaissance in the Stawamus River watershed. They included American robin (*Turdus migratorius*), barn swallow (*Hirundo rustica*), cedar waxwing (*Bombycilla cedrorum*), common raven (*Corvus caurinus*), dark-eyed junco (*Junco hyemalis*), hairy woodpecker (*Picoides villosus*), MacGillivray's warbler (*Oporornis tolmiei*), northern flicker (*Colaptes auratus*), northwestern crow (*Corvus caurinus*), pine siskin (*Carduelis pinus*), red crossbill (*Loxia curvirostra*), red-breasted sapsucker (*Sphyrapicus ruber*), Steller's jay (*Cyanocitta stelleri*), Swainson's thrush (*Catharus ustulatus*), Vaux's swift (*Chaetura vauxi*), warbling vireo (*Vireo gilvus*), violet-green swallow (*Tachycineta thalassina*), white-crowned sparrow (*Zonotrichia leucophrys*), winter wren (*Troglodytes troglodytes*) and yellow-rumped warbler (*Dendroica coronata*).

Bird species observed during site reconnaissance of the Little Stawamus which were not seen in the Stawamus River included American dipper (*Cinclus mexicanus*), black-capped chickadee (*Parus atricapillus*), brown creeper (*Certhia americana*), chestnut-backed chickadee (*Parus rufescens*), evening grosbeak (*Coccothraustes vespertinus*), golden-crowned kinglet (*Regulus satrapa*), song sparrow (*Melospiza melodia*), spotted towhee (*Pipilo maculatus*), and varied thrush (*Ixoreus naevius*).

Abundant signs of Douglas squirrel (*Tamiasciurus douglasii*), black bear (*Ursus americanus*) and black-tailed deer (*Odocoileus hemionus columbianus*) were observed throughout the watershed. During fish sampling in the Little Stawamus Creek, a raccoon (*Procyon lotor*) was observed feeding on stranded fish.

The fish sampling crew also found tailed frogs (*Ascaphus truei*) in several Stawamus River tributaries while minnow trapping and electrofishing. Tailed frogs are blue-listed by BC MELP (1997) and are considered to be sensitive and vulnerable to habitat disturbance.

Many wildlife species which have a close association to stream and riparian habitats are known or expected to occur along the Stawamus River. The riparian habitat requirements of species that are of local or regional significance (e.g., blue or red-listed, game species) are briefly described below.

3.4.1 Black Bear - Large Game Species

Black bears utilize a wide range of habitats. Riparian habitats are particularly important because they provide an abundance of herbaceous vegetation in the spring and berries in the summer and fall. Riparian habitats are also utilized as corridors for movement, dispersal and altitudinal migration.

3.4.1.1 Black-tailed Deer - Large Game Species

Black-tailed deer forage on a wide variety of herbaceous plant species and young shoots of a variety of shrubs including red huckleberry (*Vaccinium parvifolium*) and salal (*Gaultheria shallon*). These plants are often most abundant in productive and moist riparian habitats. Deer also undergo altitudinal movements, migrating to mountain tops and high valleys during the summer and back to lower elevations in winter. Riparian habitats act as important movement corridors. Mature coniferous dominated forest stands and their ability to intercept snow are important wintering areas for deer.

3.4.2 Harlequin Duck - Species of Regional Concern

Harlequin ducks (*Histrionicus histrionicus*) are dependent on creeks and rivers and associated riparian habitats in the breeding season. A study in the U.S. Rocky Mountains region (Cassirer and Groves 1990) identified second order or larger streams containing reaches with average gradient of 1% to 7%, riffle habitat, clear water, gravel to boulder-sized substrate, and forested bank vegetation as being important for harlequin ducks. Additional site characteristics included overhanging bank vegetation, woody debris, loafing sites, absence of human activity and inaccessibility. Nest sites are most often located in dense streamside vegetation, overturned rootwads, log jams, on rocks and sometimes tree cavities (Cassirer 1993). Harlequin ducks feed primarily on aquatic invertebrates. Overhanging stream vegetation is important in providing an invertebrate food source, and escape and security cover.

3.4.3 Marbled Murrelet - Red-listed, Identified Wildlife

Marbled murrelets (*Brachyramphus marmoratus*) have a unique preference for nesting on large limbs of conifers in old-growth and mature forests and do not necessarily have a specific requirement for riparian habitats. However, because of high productivity in riparian habitats, these areas can produce, more rapidly than adjacent areas, trees that are suitable for nesting.

3.4.4 Vaux's Swift - Species of Regional Concern

Vaux's swifts nest in tree cavities, particularly in large, decadent black cottonwood, bigleaf maple and large western red cedar (Summers and Gebauer 1995). Since suitable nesting cavities are often associated with riparian habitats, these areas are of particular importance.

3.4.5 Tailed Frog - Blue-listed

The tailed frog is dependent on cold, clear, unsilted mountain streams. These streams are often small, fast-flowing and darkly shaded. Degradation and sedimentation of these habitats by logging and other activities can severely impact tailed frog populations. When tailed frogs are found in logged streams, it is usually because unlogged areas remain immediately upstream (Bury and Corn 1988, as cited in Bunnell and Dupuis 1993). Although streams and creeks are the key habitat requirement, adjacent forested areas are also utilized, especially during winter rains.

3.5 SUMMARY

The riparian overview assessment identified 19 polygons with impaired riparian functions related to logging or other land-use activities. Of the 19 polygons, only one was recommended for Level I assessment. Two plots were conducted in Polygon 90 to determine specific site conditions and to determine the level of impairment of riparian functions. Coniferous regeneration was determined to be excellent with heavy stocking of western hemlock. Riparian restoration works include thinning of red alder and spacing of western hemlock. Table 9 summarizes condition, level of assessment required and potential restoration options for each of the impaired polygons.

Riparian vegetation was well established along most areas of Little Stawamus Creek Residential lots, hydroline right-of-ways and roads have impacted some areas. Further riparian assessment work is not recommended. Riparian restoration activities may be required in conjunction with channel or fish habitat restoration works.

The most significant problems in riparian habitats along the Stawamus River were associated with several slides. Most of these slides require Level II assessment to develop prescriptions for stabilization. Stabilization techniques are expected to require a variety of bioengineering structures. Because portions of most slides are outside the RMA, jurisdictional issues exist between Ministry of Environment, Lands and Parks, and Ministry of Forests. These issues need to be addressed prior to proceeding with Level II prescriptions for slides.

4. CHANNEL ASSESSMENT

4.1 INTRODUCTION

4.1.1 Background

This stream Channel Assessment Procedure (CAP) builds on and forms the Level II analysis of a Coastal Watershed Assessment Procedure (CWAP), which was recently completed for the Stawamus River on behalf of BC MELP and MOF (BC MELP, 1998a). The CWAP is performed to assess the extent of cumulative impacts on surface waters related to forestry development and to guide future developments to minimize impacts. The CWAP is also used to assist forest managers to understand water related problems in a watershed and to recognize the implications of forest development activities on stream hydrology (BC MELP, 1998a).

The completed Level I CWAP indicated that sub-basins, 2 (SB-Skypilot), 3 (SB-Copilot), 4 (SB-Ray), 5 (SB-Hydraulic) and the residual sub-basin (SB-Residual) have hazard indices equal to or exceeding 0.5 (medium impact), thereby triggering the need for a Channel Assessment procedure analysis. The Surface Erosion hazard index is medium (0.6) for sub-basin 4 and high (0.8) for the residual sub-basin. The Riparian Buffer hazard index is medium (0.6) for sub-basin 2 and high (0.8) for sub-basin 3. The Mass Wasting hazard index is medium (0.6) for sub-basin 5. Finally, the Headwaters hazard index is medium for sub-basin 2 and high (0.8) for the residual sub-basin.

According to the Level I CWAP "an intensive road deactivation and a landslide revegetation program is underway and will address many of the concerns of this CWAP" (BC MELP, 1998a). Road culvert replacement and installation of erosion abatement works downstream of road culverts was observed in the spring of 1998. This work should mitigate the sediment inputs into the Stawamus River mainstem. The CAP discussed in this section is predicated on the Channel Assessment Procedure Guidebook, December 1996 (CAP, 1996).

The Stawamus River is a "high energy system", evidenced by an average channel slope of seven percent and characterized by significant bedload movement. The main tributaries to Stawamus River are Ray Creek, Copilot Creek, Sky Pilot Creek and Omer Creek. There are also numerous ephemeral and seasonal chute tributaries contributing to the flow in the main stem of the Stawamus River.

4.1.2 Objectives

The CAP for the Stawamus River builds on the reconnaissance level data collected by the CWAP. These data have been used to identify significant changes to the hydrology of the Stawamus River watershed which have occurred as a result of past anthropogenic activities; and to recommend, if appropriate, restoration prescriptions.

In 1996, under the auspices of the Stawamus River Watershed Committee, Squamish Nation and the Ministry of Environment, Lands and Parks, an initial Channel Assessment Procedure (CAP) was carried out on the mainstem of the Stawamus River. Due to unfortunate circumstances, all of the written CAP data were lost (by others). In an attempt to recover as much data as possible, field studies were repeated in September, 1997, to replace the missing CAP data by carrying out a CAP on the mainstem of the Stawamus River, utilizing where possible the original reach breaks marked in the field. BC MELP (1998a) stated that in addition to the mainstem, a CAP should be conducted in each of the five main sub-basins, namely SB-Res, SB-2 (Skypilot), SB-3 (Copilot), SB-4 (Ray Creek), and SB-5 (Hydroline). In discussions between BC MELP and EVS, it was determined that this was beyond the scope of reference for this project, subsequently the CAP has been limited only to the mainstem of the Stawamus River.

The Stawamus River is a community watershed with a water intake structure situated at Reach 8. For the purposes of this assessment, the original terms of reference stated that the CAP should only be conducted upstream of the weir, that is, from reaches 8 to 29. Despite the fact that the Overview Fish Habitat Assessment (EVS, 1998) targeted only fish habitat downstream of the weir for the Level I Assessment (see Section 2.0), it was decided that, in consultation with BC MELP, that the CAP should still be restricted to reaches above the weir. If instream rehabilitation works are considered for the Stawamus River below the weir, these sites will be examined later on an individual basis from an hydraulic perspective.

4.2 METHODS

Fieldwork and First Nations (Squamish Nation) channel assessment training was carried out on September 27, 1997. The field program consisted of two components: a helicopter overview and videotaping (September 9, 1997); and an on the ground assessment. The helicopter flight provided a bird's eye view of the entire watershed to identify the spatial extent and magnitude of potential mainstem channel disturbances.

The main component of the CAP consisted of a field reconnaissance of the Stawamus River beginning at a point 300 m downstream of the intake works (within Reach 8) to an upstream boundary just above the confluence of Skypilot Creek (Reach 29). Individual tasks included; videotaping and still photography of key features; acquisition of channel and channel geomorphology data; and identification of field indicators of disturbance. Historical and recent airphotos were reviewed to locate reach breaks, to identify sediment input locations and to verify channel geomorphological features.

The Stawamus River CAP crew carried out between one and four standard stream cross section surveys within each reach. At each roughly evenly spaced cross section (a measuring point at right angles to the flow in the channel), a number of parameters were measured including: bankfull width; bankfull depth; channel slope; largest fluvial stone; gravel bar width; valley flat width; left and right bank slope; large woody debris presence; and upstream logging presence. Bankfull width was measured with a hip chain as the width of the stream that just fills the channel without flowing onto the floodplain. Channel depth was measured using a tape measure as the maximum depth from the thalweg to the height of the bankfull depth. Channel slope was measured as the average channel slope using two clinometers held by two different observers of roughly the same height (same eye level). Both observers recorded their observations and compared results. Any major differences required a repeat of the exercise. The largest fluvial stone was measured as the average size of the largest stone moved by flowing water. These stones had evidence of movement by flowing water during the past decade. Once identified, the b-axis (intermediate length) diameter of the largest stone was identified. Valley flat width was measured with a hip chain from the left bank (looking downstream) to the nearest break in slope (high ground) demarcating the floodplain boundary. This was repeated for the right bank. The total length was added to determine the valley flat width for the section. In the case of a canyon, by definition, the valley flat width was zero. For wide floodplains greater than 100 m the valley flat width was noted as greater than 100 m.

The presence of upstream logging was noted if no or very sparse buffer strips were evident. The aforementioned channel morphological data were also recorded at each cross section including the distance upstream from the reach break boundary. Averages of the channel morphological parameters were taken within each reach and these averages were used in the calculation of relative roughness and stream power morphological indices.

The relative roughness, the ratio of the average largest fluvial stone (D) to the average bankfull depth (d) was calculated for each reach, which provides a relative measure of the channel depth and the morphology for each reach. The average stream power, the product of the average bankfull width (Wb), the average bankfull depth (d) and the average slope was calculated for each reach to determine the relative hydraulic power of each reach.

4.3 RESULTS

4.3.1 Stream Reach Breaks

The stream reaches used in this study were derived from the original CAP performed in 1996 (by others) and later re-visited to acquire the information presented here. Because these reaches were previously determined, it was decided not to conduct a separate reach break exercise based on criteria for overview assessments as described in Johnston and Slaney (1996) (D. Macqueen, BC MELP, pers. comm.).

The Stawamus River was divided into reach breaks according to the guidelines specified in the Channel Assessment Procedure Guidebook (BC MELP, 1996), and were based on the following criteria; changes in stream channel form (e.g., from a straight to sinuous channel or a single-thread to a multiple-branched channel); changes in sediment supply (e.g., large point sources of sediment, such as an actively eroding landslide scar or deposit); changes in riparian vegetation (e.g., from grassland to forest); changes in stream bed or stream bank materials (e.g., cohesive to non-cohesive banks); changes in stream channel confinement (e.g., from a wide floodplain to a confined canyon); changes in the relative coupling among the hill slope, valley flat, and stream channel; a tributary confluence (at least second order streams on the aerial photographs); and changes in stream gradient (at least 2%). Two additional criteria were added, including changes in land use (e.g., forest clear-cut) and changes in channel constriction, such as a bridge.

Table 10 summarizes available physical data for the watershed acquired during the channel assessment procedure in accordance with the CAP Guidebook (BC MELP, 1996) and includes average gradient, bankfull width, average depth, average rock diameter, relative roughness, Power Index, sensitivity rating, channel type and the channel condition.

Average gradient of reaches was relatively low, being less than 9% in all reaches. Mean bankfull width of the stream ranged from 12 to 27 m in all reaches except for Reach 26 which measured 2.5 m. Average water depth was shallow and relatively uniform, ranging from 0.8 to 2.1 m. In terms of channel type, Reaches 9 and 10 were defined as "canyon", whereas the remainder of the reaches were very uniform in their classification, consisting of boulder-cascade-pool channels (Johnston and Slaney, 1996). Only two reaches (13 and 25) were classified as boulder-step-pool channel type.

4.3.2 CAP Field Data

Field Data Entry Forms have been completed for each reach break (Reach 8 through 29) which are found in Appendix H.

4.3.3 Fluvial Geomorphological Assessment

To more efficiently describe the specific nature of channel impacts and the fluvial geomorphologic assessment of the Stawamus River, the stream was divided into "macro-reaches". These macro-reaches combine several reaches together, based on common geomorphic and fluvial characteristics. Four macro-reaches have been defined and are discussed below.

4.3.3.1 Reaches 8 to 10

This macro-reach (8 through 10) has high fluvial energy reaches that is laterally constrained by steep mountain banks forming a canyon. The single channel canyon planform exhibits step pool and cascade pool morphology. In-channel anthropogenic modifications include the potable water intake works and weir at the bottom of the macro-reach. Other anthropogenic structures include two bridge crossings and a gas pipeline corridor.

The bankfull width varies through the canyon from 6 m to 30 m with the slope hydraulically steep varying from 4% to 6%. The streambed is interspersed with bedrock outcrops smoothed by fluvial processes. This macro-reach is characterized by numerous colluvial inputs of sediment and large organic debris caused by slide failures in ephemeral and seasonal chute streams. Large colluvial boulders (lag boulders 1.5 to 3 m) are found in the channel bottom, which indicated coupling with adjacent slide areas. Many of the lag boulders were moss covered indicating a low frequency of this size of bedload movement during recent times.

The concrete weir at the potable water intake works acts as bedload stabilization bar extending across the entire width of the Stawamus River. There was evidence of channel aggradation immediately upstream of the weir and bank erosion immediately downstream of the weir.

Within Reach 10, a large amount of sediment and organic debris is carried into the main stem of the Stawamus River by Ray Creek. Large slides on the right bank of Ray Creek in the vicinity of the confluence were evident. Significant bank erosion causing large woody debris entering the creek due to undermining was also evident near the confluence.

4.3.3.2 Reaches 11 to 16

This macro-reach (11 through 16) has high fluvial energy that exhibits an irregular meandering single channel planform with cascade pool morphology. Bankfull width varies through this macro-reach from 14 m to 30 m with the slope hydraulically steep varying from 4% to 10%. The streambed is interspersed with bedrock outcrops smoothed by fluvial processes.

Another structural element, very large colluvium (1.5 m to 3 m diameter lag boulders) are strewn throughout the stream bed. This colluvium has moved down the steep valley walls slopes and is now resting in the channel. Most of the colluvium within the channel and the channel periphery was moss covered indicating an infrequency of fluvial movement. There is considerable infilling behind the lag boulders by fluvial boulder sized rock indicating an aggrading channel. Furthermore, stone lines are not typically intact within these reaches.

This macro-reach is characterized by numerous emphermerally wetted chute channels on both the right and left banks. These steep channels provide episodic pulses of sediment and water into the main channel of the Stawamus. Two small recently active bank slope failures were observed on both right and left banks within Reach 16. In addition, a connected debris flow run-out-zone was observed within Reach 16.

Large woody debris was observed but was not functional and appeared to be a result of undermining and windfall. It is typical to see large woody debris buried in medial bars however one significant mid-channel logjam was observed near the bottom of Reach 16 which was probably due to the aforementioned sediment inputs.

4.3.3.3 Reaches 17 through 23

This macro-reach (17 through 23) exhibits medium fluvial energy with an irregular meandering channel planform with alternating cascade pool and boulder riffle pool morphology. A wide floodplain within these reaches is indicative of high channel avulsion potential. Anthropogenic modifications include an abandoned logging road bridge and a BC Hydro right-of-way within the floodplain of the Stawamus River. Bankfull width varies through the macro-reach from 14 m to 30 m with the slope varying from 2% to 5%.

The riparian vegetation within this macro-reach appears to have widened to its full extent providing shade, but due to the hydro right-of-way clearing and brush vegetation characteristic of floodplain areas, large woody debris recruitment was limited. Limited vegetation of medial and point bars was observed. There was evidence of alluvial deposition in point bars indicating high channel aggradation.

Within Reach 17 large woody debris has hung up in an abandoned bridge crossing. In addition, a small slope failure on the left bank was a connected sediment source. Within Reach 20, large organic debris was found in the creek bed due to windfall and undermining.

4.3.3.4 Reaches 24 through 29

This macro-reach (24 through 29) has high fluvial energy reaches that exhibits cascade pool and step pool morphology with a laterally constricting rock canyon within reaches

25 and 26. Bankfull width varied through the macro-reach from 12 m to 20 m with the slope varying from 4% to 7%. Large woody debris was evident on point bars downstream of the canyon, however no logjams were evident within this macro-reach.

A tributary called Copilot Creek has its confluence with the mainstem of the Stawamus River within Reach 25. This tributary has the potential for sediment inputs into the system.

4.3.4 Data Analysis

Analysis of the channel assessment procedure includes the calculation of relative roughness (D/d), power index (WbdS), hill slope valley connection, average valley width and upstream disturbance for each reach. These values have been calculated for each Field Data Entry Form for each reach assessed (Appendix H).

In addition, analysis of the entire mainstem of the Stawamus River includes the classification of channel reaches (Appendix I), General Assessment of Channel Morphology (Appendix J), General Assessment of Channel Impact Values (Appendix K) and Main Channel Impact Value (Appendix L). Appendix I illustrates the Sub-basin, Reach Number, Reach Length (m), Drainage Network Class and whether a CAP is applicable for the designated reach. The common drainage network class is CB1bii which designates an entrenched non-erodible stream channel under 8 percent gradient with a width greater than 20 m. Appendix J illustrates the channel lengths of non-erodible channels, erodible and visible channels and altered channel morphology. Appendix K illustrates the channel impact value (CIV) for the total watershed and Appendix L illustrates a high CIV of 0.9 for the main channel of the Stawamus River.

4.4 Conclusions and Recommendations

The Stawamus River is a high-energy mountain stream with several significant sedimentation sources, translating into significant bedload movement and channel aggradation. Sediment sources are numerous, however, the two major sources include an active connected debris flow within Reach 16 and the major tributary of Ray Creek within Reach 10. Ray Creek may introduce sediment to the Stawamus River on a chronic, long-term basis, which may impair efforts to improve the stream, if left untreated. Other sources of sediment include; bank erosion and minor slides, possibly exacerbated by an increase in peak flows due to forestry activities in the watershed. The gas pipeline corridor has attendant slope instabilities, which should be addressed. The hydro right-of-way clearing and towers within the floodplain of the Stawamus River also have an impact. The cumulative impacts of anthropogenic activities for the entire Stawamus River mainstem have a Channel Impact Value (CIV) of 0.9.

In summary, there is strong evidence to suggest that anthropogenic activities (e.g., forest harvesting, forestry roads, gas pipeline, and BC Hydro right-of-way) have had a high impact on channel disturbances in the main stem of the Stawamus River.

A Level II CAP should be conducted in each of the five main sub-basins, namely SB-Res, SB-2 (Skypilot), SB-3 (Copilot), SB-4 (Ray Creek), and SB-5 (Hydroline). These future CAP's would provide much needed information as to the main sources of sub-basin contributed sediment. To conclude, no instream works are recommended to be installed upstream of the weir at this time until the sub-basin CAP's have been completed and a professional engineer (Geotechnical, P.Eng.) assesses the debris flow at Cross Section 16, the entire gas pipeline corridor and any areas unstable areas further identified by the sub-basin channel assessments. No further expansion of anthropogenic modifications should take place in the Stawamus River watershed until the aforementioned assessments are thoroughly reviewed.

5. STAWAMUS RIVER INTEGRATED ASSESSMENT WORKSHOP

5.1 INTRODUCTION

Assessments of fish habitat, riparian condition, and channel characteristics of the mainstem of the Stawamus River and Little Stawamus Creek are reported in Sections 2, 3, and 4 respectively. This section integrates these multidisciplinary perspectives with those of BC MELP and DFO input to yield holistic prescriptions. We involved DFO because they have been planning fish habitat restoration in the watershed and this was an opportunity to harmonize restoration prescriptions.

5.2 METHODS

On November 10, 1998 members of the study team: Randy Baker, François Landry and Julie Orban (EVS Environment Consultants), Brian LaCas (LaCas Consultants), and Martin Gebauer (Enviro-Pacific Consulting) met with Ron Henry (BC MELP), Chris Picard (BC Conservation Foundation), and Matt Foy (DFO). The objective of the workshop was to discuss results of the multidisciplinary assessments with the aim of developing restoration prescriptions for the lower Stawamus River by integrating results of the independent assessments.

The agenda of the workshop was as follows: M. Gebauer (RAP), B. LaCas (CAP), and R. Baker (FHAP) presented results of their assessments; M. Foy summarized DFO activities in the watershed; J. Orban summarized the Land Tenure issue; the Community Watershed issue and drinking water supply for Squamish was discussed by the group; and R. Baker, F. Landry (EVS), and M. Foy (DFO) presented an overview of all recommended fish habitat restoration prescriptions for the Stawamus and Little Stawamus. This was followed by a point by point discussion by the group regarding each proposed fish habitat restoration prescription according to the criteria outlined in the decision matrix (Section 2.5.3). Using these criteria and drawing from local knowledge of the watershed, the group assigned either a *high* (develop prescription), *low* (do not develop prescription) or *nil* priority for each habitat restoration option. All *high* priority prescriptions are described in more detail below and will be used to guide a Level 2 FHAP. A Level 2 FHAP is required to plan effective restoration prescriptions.

5.3 RESULTS

5.3.1 Community Watershed

Currently, the Stawamus River is used to supply the community of Squamish with drinking water. The current water license allows a water volume of 0.13 m^3/sec to be withdrawn from the river at the weir site (5.3 km upstream from the mouth). A minimum flow of 0.5 m^3/sec must be maintained in the mainstem below the weir in accordance with DFO field assessment restrictions (Macfarlane, pers. comm. 1995), although during low flow periods in summer, this is not always possible. It is our understanding that an alternate source of drinking water for the community is being sought. There is no timetable for this, therefore, we decided that prescriptions for habitat restoration should proceed, even in the absence of an agreement to abandon the Stawamus River as the drinking water source for Squamish.

5.3.2 Land Tenure

Land tenure must be considered when planning restoration work. The BC Assets and Land Corporation office confirmed that the lots bordering the Stawamus and Little Stawamus in the study area are District lots 1520, 4267, 912, 833, 515, and 7032, which are privately (Federal, municipal, individual, etc.) owned. Wood lot 28 is owned by the Crown. Permission to access and perform work above the present natural boundary of the channel must be granted from the landowner when dealing with private property. The Crown should also be consulted when accessing sites and performing restoration in areas which are located below the present natural boundary of the channel as this zone is considered to be Crown property.

5.3.3 Centra Gas Pipeline

Centra Gas owns and operates a natural gas pipeline which partially resides in the Stawamus watershed and parallels the river along the right bank from Reaches 7 to 25. This pipeline has caused faults and slips in the steep banks (Table 9), causing chronic inputs of sediment at several locations. Stabilization of the pipeline route is not within the purview of the Watershed Restoration Program, however, Centra Gas should be responsible for stabilization of the right-of-way to prevent further degradation of the upslope and sediment additions to the Stawamus River. It is recommended that this issue be raised by BC MELP and DFO directly with Centra Gas.

5.3.4 Ray Creek

Ray Creek has been identified as a large, chronic source of sediment to the Stawamus River. There is a slide situated in an upslope area of Ray Creek that appears to be highly unstable. It is recommended that studies be conducted to determine the risks, hazards, and consequences associated with this potential sediment source before drawing plans to stabilize this site. It may be that the area is too large and too unstable to justify large-scale slope stabilization engineering. It is recommended that this issue be raised by BC MELP directly with MOF.

5.3.5 Sediment Trap

Another possible means to reduce sediment inputs to the mainstem below the weir, which was raised at the Integrated Workshop, was to construct a sedimentation and gravel extraction zone within the Stawamus River channel in the vicinity of the upstream end of the existing dike (Reach Break 6). This zone would trap sediment and reduce deposition downstream. This option requires further investigation by a river engineer (P.Eng.) to determine the effectiveness and the costs/benefits in conjunction with the sediment source mitigation solutions previously identified.

5.3.6 Stawamus River Dike

The dike constructed (early 1970's) along the right bank of the Stawamus River to protect the Valleycliffe subdivision from flooding has laterally constrained the river corridor, possibly increasing deposition volumes within the adjacent reaches. The channel pathway is still dynamic and ambulatory and may not stabilize for some time, as the channel attempts to adjust to constraints of the dike. It was decided not to propose prescriptions which would involve creating or diverting flow into the abandoned / pre-dike channel path, despite the abundant off-channel habitat and riparian vegetation that it contains. As evolution of the stream channel continues we felt this would undermine our attempts to create off-channel habitat within the old stream bed. Until further assessment is carried out by a river engineer and an aquatic biologist, no further action is recommended.

5.3.7 Stawamus River Restoration Prescriptions

Initially, a total of eleven *high* and eight *low* priority sites was identified for restoration on the Stawamus River (Table 2). A further four sites were identified as requiring remediation, however, their priority was *nil* because of difficulty of access. All of these sites were re-evaluated by the integrated assessment team and new priorities were assigned. Eight sites which were originally identified as *high* or *low* priority were changed to *nil* priority based on criteria developed during the Integration Workshop as listed in Table 11.

Given fiscal constraints it was decided not to pursue *low* priority sites at this time, and to focus efforts on *high* priority sites. Table 12 presents results of the re-evaluation and identifies 7 sites with *high* priority for restoration within the Stawamus River, the majority (five) of which are situated in Reach 6. Two of these were initially given *low* priority and changed to *high* priority (3,344 m and 3,569 m upstream of the mouth) upon discussion at the workshop. One prescription was added (1,500 m) based on the recommendation of DFO, which consists of improving existing off-channel habitat.

In Reach 4, only one site was identified for restoration and is situated just upstream of the Highway 99 bridge. There is an opportunity to enlarge two existing off-channel pockets (Photo 5) on the left bank to increase rearing habitat by juvenile coho salmon. The abundance of young deciduous trees would provide cover and shade.

The DFO created an off-channel habitat (a few hundred meters long) in Reach 5 on the left bank. There are two outlets to this off-channel habitat, one of which is located near the Highway bridge just upstream of the powerline. There is an opportunity to both increase and sustain flow within this existing off-channel habitat. It was proposed that an infiltration gallery be installed within the existing abandoned channel (Photo 9) located upstream of the off-channel habitat to route surface water from the active channel to provide constant flow rate of approximately one cubic foot per second (0.028 m^3/s).

Both instream and overhanging cover are scarce within Reach 6 adjacent to the dike. We have identified three locations in Reach 6 which require installation of cover such as LWD, rootwad structures and riparian vegetation (shrubs). The specific locations are at 2,455 m, 2,662 m, and 3,569 m upstream of the mouth. The LWD and rootwad structures should be installed by anchoring these to the toe of the dike and extending them into the water. A low cost option involves simple planting of riparian vegetation at regular intervals along the dike (i.e., ecopockets). Planting of the dike will be subject to approval by the District of Squamish and Inspector of Dikes.

At approximately 3.6 km upstream of the mouth, at RAP polygon 90, consideration should also be given to enhancing existing conifer growth by thinning alder and spacing the existing conifers. There is also one location in Reach 6 which requires bank stabilization through bioengineering.

Reach 6 lacks pool habitat. There is the potential to create an alcove on the left bank where the active channel diverges south of the dike (Figure 2). Placement of an infiltration gallery extending approximately 350 m upstream, beside the mature forest at the base of the active floodplain under the bar, would collect enough ground water to supply constant flow to the alcove. It was suggested to lay a perforated pipe under the ground water table at the upstream section which would connect to a solid pipe in the downstream section. This alcove would provide pool habitat for juvenile coho salmon.

Table 3 summarized the major habitat features that the Stawamus River was considered to be deficient in, according to standards used as "generic" descriptors for habitat quality described by Johnston and Slaney (1996). The most significant deficiencies in the lower reaches were lack of pool habitat and cover (Reaches 5 and 6), spawning gravel (Reach 5), and cover and off-channel habitat in Reach 3. The restoration prescription proposed for Reach 5 (install infiltration gallery to increase and sustain water level in the off-channel habitat) should address the lack of pool and cover habitat. Five prescriptions identified in Reach 6 are designed to increase cover and the abundance of pool habitat which address the main deficiencies according to the descriptors used. The restoration prescriptions identified for the Stawamus River addresses site specific problems, as well as creates habitat which was considered lacking within particular reaches.

5.3.8 Little Stawamus Creek Restoration Prescriptions

Initially, a total of 9 *high* and 7 *low* priority sites were identified for restoration on Little Stawamus Creek (Table 2). No *nil* sites were identified. Each of the sites were re-evaluated by the integrated assessment team and new priorities were assigned. Based on our re-assessment, a total of eight sites were identified as *high* priority for restoration (Table 12 and 13). Three sites originally identified as *high* priority were subsequently changed to *low* because it was felt fish access would likely not be impeded by woody and anthropogenic debris in the stream during high flow (Table 14).

Little Stawamus Creek is the most utilized rearing area for juvenile coho salmon within the entire watershed. This creek lacks pool habitat and is deficient in spawning substrate in certain areas (Table 3). The *high* priority prescriptions that we recommend address site-specific problems as well as addressing the deficiencies identified according to diagnostics of habitat conditions provided by Johnston and Slaney, (1996).

Three of four restoration prescriptions proposed involve creation of side-channel rearing habitat for juvenile coho (at 105 m, 202 m, and 291 m upstream of the mouth), especially in the lower part of the creek. There are currently three side-channels in the lower reaches of the Little Stawamus with no direct connection to the mainstem. These side-channels should be connected to the mainstem, and deepened such that they provide refuge or pool habitat, yet do not become an active part of the mainstem. DFO is also in the process of planning the construction of 2 side-channels approximately 350 m upstream of the confluence, which will connect to the existing pond.

Between 791 m and 850 m upstream from the mouth, starting at the Gilford Road crossing, there is a section of creek which runs parallel to the residential development. This should be redeveloped to create riffle/pool sequences to increase pool habitat and possibly encourage spawning below the riffles. No other *high* priority sites were identified.

Four of the eight sites (Table 13) identified as *high* priority fall outside the scope of WRP incentives and FRBC responsibilities. If these sites are not addressed, they have the potential for constraining habitat enhancement. Most serious are the culverts installed across the stream at 791 m. As Photo 22 depicts, fish passage is likely prevented at all but moderate or high flows, as the majority of the water flows beneath the culverts. The other sites concern stream crossings (361 m, 1,181 m, and 1,361 m) which are slumped into the creek and have caused damming of the stream, and erosion and deposition of sediment.

The lack of a crossing at 1,361 m requires that people ford the stream, which has caused erosion of the banks and sediment deposition. These sites should be restored or constructed by the Squamish community.

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FIGURES

Figure 1: Watershed boundary, drainage area, stream network pattern, and major geological features of the Stawamus River watershed.

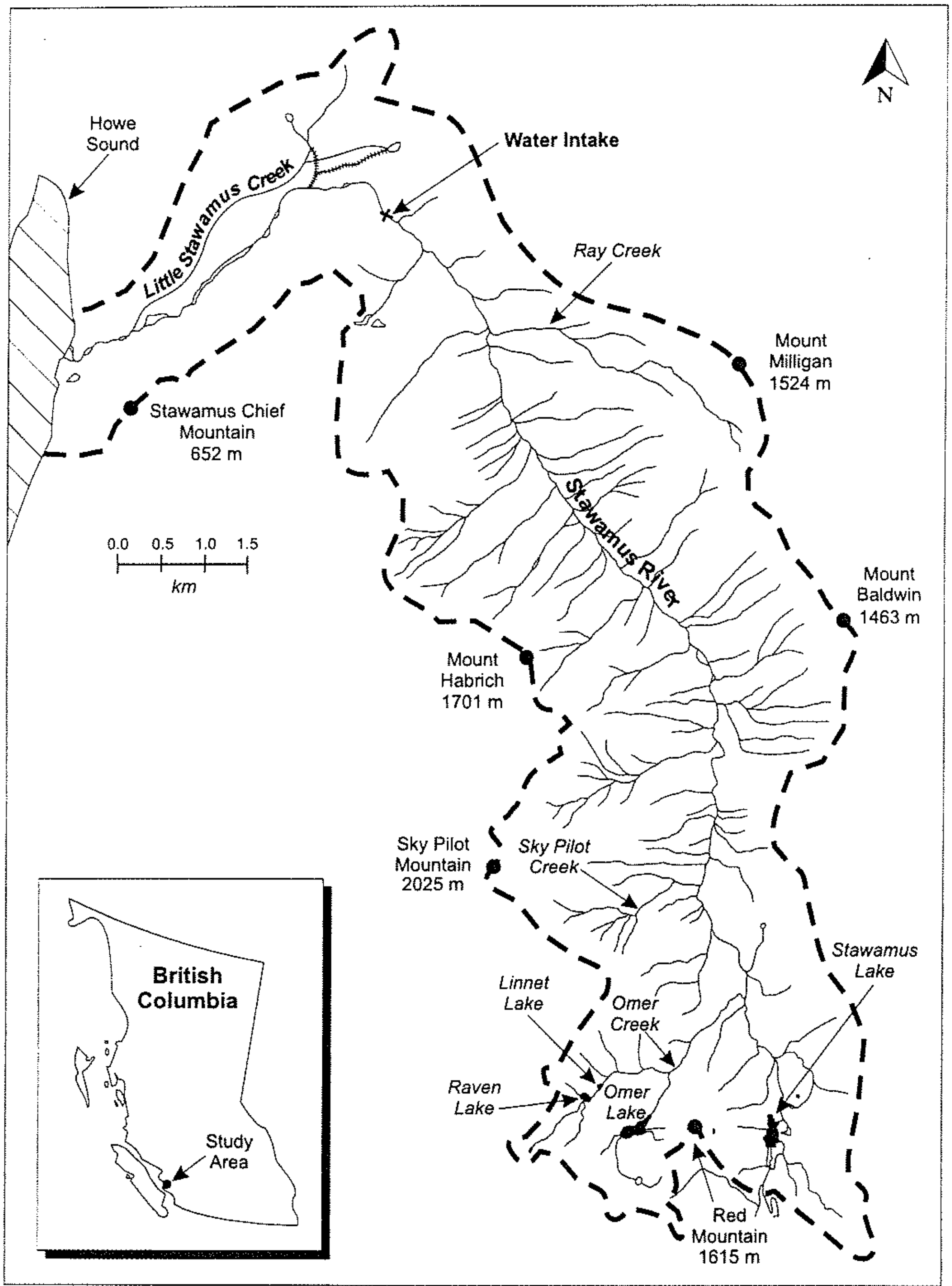


Figure 2: Summary of high and low priority habitat restoration prescriptions for the Stawamus River and the Little Stawamus Creek.

See map attached at back of report.

TABLES

Table 1: Summary of mean habitat characteristics for each reach collected during the Level I FHAP assessment.

CHARACTERISTICS	REACH 3	REACH 4	REACH 5	REACH 6	REACH 7	REACH 8	LITTLE STAWAMUS
Date	Aug-5-98	Aug-6-98	Aug-6-98	Aug-7-98	Aug-10-98	Aug-10-98	Sept-16-98
Length (m)	181	481	312	2544	685	473	361
Gradient (%)	2	1	1	2	8	4	1
% Riffle (by area)	24.5	47.6	35.2	50.9	20.5	56.9	30.6
% Glide (by area)	25.2	25.6	15.9	19.8	7.4	-	20.7
% Pool (by area)	50.2	26.8	38.5	10.7	40.1	21.2	47.5
% Cascade (by area)	-	-	10.3	18.6	32.0	21.8	1.2
Bankfull width (m)	22.3	22.9	24.9	22.0	15.6	16.8	8.2
Wettted width (m)	9.8	9.9	10.4	7.1	8.6	8.7	4.4
Bankfull depth (m)	1.30	0.80	1.30	1.50	1.40	1.40	0.35
Wetted depth (m)	0.60	0.30	0.35	0.45	0.55	0.50	0.15
Max depth pool (m)	1.45	0.90	1.55	1.10	1.00	1.65	0.50
Residual pool depth (m)	1.10	0.70	1.35	0.90	0.75	1.50	0.45
Pool type	Dammed	Unknown	Dammed	Dammed	Unknown	Unknown	Dammed
Dominant substrate	Cobbles	Cobbles	Cobbles	Cobbles	Boulders	Boulders	Sands-Cobbles
Subdominant substrate	Gravels	Gravels	Gravels	Boulders	Cobbles	Cobbles	Sands
Total % cover	12.8	15.6	21.3	18.6	32.4	40.3	23.8
% small woody debris	4	10	9	38	1	-	45

CHARACTERISTICS	REACH 3	REACH 4	REACH 5	REACH 6	REACH 7	REACH 8	LITTLE STAWAMUS
% large woody debris	30	18	19	21	1	1	14
% boulder	10	-	-	23	97	83	-
% deep pool	49	61	67	3	2	17	-
% undercut banks	-	4	1	2	-	-	-
% overhanging vegetation	8	7	4	14	-	-	41
% instream vegetation	-	-	-	-	-	-	-
Riparian vegetation type	Deciduous dominated	Deciduous dominated	Deciduous dominated	Deciduous dominated - Mixed conifer-deciduous	Mixed conifer-deciduous	Mixed conifer-deciduous	Deciduous dominated
Riparian structural stage	Young forest	Young forest	Young forest	Young forest	Mature forest	Mature forest	Young forest
Canopy closure	2.5	1.5	1.3	1.4	2.6	1.3	3.9
Compaction	Medium	Medium	Low - Medium	Low	Medium - High	Medium	Low
Gravel type	Anadromous	Anadromous	Anadromous	Anadromous	Anadromous	Resident	-
Amount	Isolated pockets	Isolated pockets	Isolated pockets	Isolated pockets	Isolated pockets	Isolated pockets	Isolated pockets

Table 2: Summary of restoration prescriptions for the Stawamus River Watershed. Prescriptions are grouped into eight major procedures: C = build or re-build stream crossing; E = stabilize eroding banks; G = reduce gradient to allow fish access; J = dislodge debris or log jams; L = install LWD and rootwad structures; O = creation/re-connection/excavation of off-channel habitat; R = revegetation of banks; X = remove old railway bridge support. Land tenure status: P = Private (federal, municipal, individual, etc.); C = Crown.

REACH	METERS UPSTREAM FROM MOUTH	RESTORATION PRESCRIPTION	PRIORITY	GROUP	LAND TENURE STATUS*	PHOTO #
3	586	Remove old railway bridge supports to encourage infilling	Low	X	P	4
4	817	Enlarge off-channel habitat on left bank to maintain flow	High	O	P	5
4	942	Stabilize eroding bank of off-channel tributary habitat	Low	E	P	
4	1,233	Removal of some LWD to facilitate access by migratory fish	High	J	P	6
5	1,504	Connect off-channel pool to mainstem and stabilize eroding banks	Low	E, O	P	8
5	1,540	Create nursery side channels in elevated side gravel bar	High	O	P	9
5	1,545	Create nursery side channels in elevated side gravel bar	High	O	P	
6	1,592	Stabilize eroding bank with rip rap or bioengineering	High	E	P	
6	1,826	Unstable banks introducing sediment; potential for blow-down of mature trees; stabilize banks and LWD	Nil[1]	E	P	
6	2,008	Excavate isolated side-channel to connect to mainstem	Low[2]	O	P	
6	2,080	Create off-channel habitat in natural abandoned channel	Low[2]	O	P	
6	2,088	Create off-channel habitat in natural abandoned channel	Low[2]	O	P	
6	2,412	Excavate channel parallel to main channel on left bank in high flow area at base of forest from beginning of dike up to distance 2,774 m	High	O	P	23

REACH	METERS UPSTREAM FROM MOUTH	RESTORATION PRESCRIPTION	PRIORITY	GROUP	LAND TENURE STATUS*	PHOTO #
6	2,455	Lack of cover; plant shrubs; Install LWD and rootwad structures along dike	High	L, R	P	
6	2,662	Lack of cover; plant shrubs; Install LWD and rootwad structures along dike	High	L, R	P	10
6	3,048	Excavate old abandoned channel approx. 80m upstream of the beginning of the unit	High	O	P	
6	3,170	Excavate old channel and re-connect to existing channel	High	O	P	
6	3,265	Excavate old channel and re-connect to existing channel	High	O	P	
6	3,344	Stabilize eroded banks	Low	E	P	11
6	3,569	Lack of cover; plant shrubs; Install LWD and rootwad structures along dike; Stabilize sediment source	Low	E, L, R	P	
7	4,291	Cascade possible barrier to fish; add boulders to reduce flow velocity and gradient	Nil[1]	G	P, C	15
7	4,637	Cascade may pose velocity barrier; investigate means to reduce gradient	Nil[1]	G	P, C	14
8	4,920	Landslide on left bank; stabilize bank and LWD to halt sediment introduction	Nil[3]	E	C	17
Little Stawamus	105	Side-channel (50 m long) is isolated during low flow periods; excavate to connect with mainstem	High	O	P	
Little Stawamus	202	Dredge side channel to provide consistent flow at low water; remove log jam	High	J, O	P	
Little Stawamus	215	Remove part of log jam to allow fish access	High	J	P	

Reach	Meters Upstream from Mouth	Restoration Prescription	Priority	Group	Land Tenure Status*	Photo #
Little Stawamus	259	Remove anthropogenic debris	Low	J	P	
Little Stawamus	291	Excavate existing side-channel to allow better flow	High	O	P	
Little Stawamus	361	Large pool formed upstream of stream crossing; rebuild stream crossing (bridge), pronounced sediment infilling	High**	C	P	19, 20
Little Stawamus	631	Build small pedestrian bridge for stream crossing	Low	C	P	
Little Stawamus	791	Stabilize eroding banks; fix culvert to allow passage of fish at low flow	High**	C, E	P	22
Little Stawamus	846	Stabilize eroding banks and remove tree dam to allow fish passage	High	E, J	P	
Little Stawamus	1,019	Remove log jam which creates partial barrier	Low	J	P	
Little Stawamus	1,075	Stabilize eroding banks; remove deposited sediment	Low	E	P	
Little Stawamus	1,181	Rebuild stream crossing (log bridge)	High**	C	P	21
Little Stawamus	1,226	Remove debris in creek which creates a barrier to fish passage	High	J	P	18
Little Stawamus	1,281	Dislodge log jam which creates a barrier to fish at low flow	Low	J	P	
Little Stawamus	1,361	Replace existing stream crossing which passes directly through stream	Low**	C	P	
Little Stawamus	1,856	Stabilize eroding banks	Low	E	P	

* = Land tenure conflicts may arise when accessing the restoration sites and/or performing the restoration - refer to section 2.5.1.
** = Restoration not covered under the auspices of WRP, yet should still be addressed.
1 No/difficult access by equipment
2 Possible significant confounding effects
3 Not production limiting to anadromous fish

Table 3: Summary of habitat features identified as poor according to criteria from Table 5 in Johnston and Slaney (1996) and ranked as high or low priority for rehabilitation prescriptions. Blank spaces indicate fair or good habitat quality according to criteria from Table 5.

REACH	PERCENT POOLS	POOL FREQUENCY	LWD PIECES	COVER	SUBSTRATE	OFF-CHANNEL HABITAT	SPAWNING GRAVEL	SPAWNING ACCESS	HOLDING POOLS PER KM
3				High	Low	High			
4	Low			Low					
5	High			High			High		
6	High	High		High					High
7			Nil[1]			Nil[1]	Nil[1]	Nil[1]	
8	Nil[3]		Nil[3]			Low		Nil[3]	
Little Stawamus		High			Low		Low	Low	High

[1] No/difficult access by equipment

[3] No production limiting to anadromous fish.

Table 4: Results of water chemistry for nitrate-nitrogen and dissolved phosphate (mg/L) for the Stawamus River on August 10, 1998.

REACH	NITRATE-NITROGEN (MG/L)	DISSOLVED ORTHO-PHOSPHATE (MG/L)
8	0.055	0.001
5	0.187	0.002
3	0.080	0.002
LITTLE STAWAMUS	0.072	0.001

Table 5: Lot numbers which border the Stawamus River and Little Stawamus (LS) Creek, spanning west to east from Reach 3 up to the water intake at Reach 8. Information was obtained from: Ministry of Forests; Ministry of Environment, Lands & Parks; and 1: 50,000/1: 20,000 Land Use and Land Tenure maps

LOT #	LOCATION	LAND TENURE	ADJACENT REACHES
4267	Borders river (north) at railway & highway bridge	Private (Federal)	3, 4
4266	Straddles river, beside and below Lot #4267	Private (Subdivided)*	3, 4
912	Straddles river	Private (Subdivided)*	4, 5, 6, LS
833	Straddles river	Private (Subdivided)*	6, LS
7032	Straddles river	Private (Subdivided)*	6
514	Encompasses headwaters of the Little Stawamus	Private (Subdivided)*	LS
515	Straddles river	Private (Subdivided)*	6, 7, LS
Woodlot 28	Borders river	Crown	7, 8, LS

LS = Little Stawamus Creek

* Private ownership indicates federal, municipal, individual etc., ownership. Upon conducting a land titles search on these private lots, it was revealed that all of these lots were subdivided. Therefore ownership was not possible to determine until the exact geographic location and Lot/Plan/Block identifiers of the prescribed sites are known.

Table 6: Polygon numbers corresponding to reaches along the Stawamus River.

REACH #	POLYGON #S	REACH #	POLYGON #S	REACH #	POLYGON #S
1	1 - 8	12	165 - 177	23	282 - 283
2	9 - 18	13	178 - 184	24	284 - 287
3	19 - 28	14	185 - 195	25	288 - 294
4	29 - 50	15	196 - 216	26	295 - 302
5	51 - 60	16	217 - 230	27	303- 317
6	61 - 99	17	231 - 240	28	318 - 324
7	100 - 110	18	241 - 245	29	325 - 340
8	111 - 115	19	246 - 257	30	341 - 344
9	116 - 124	20	258 - 267	31	345 - 353
10	125 - 158	21	268 - 272	32	354 - 362
11	159 - 164	22	273 - 281	33	363 - 376

Table 7: Riparian vegetation type definitions and corresponding numbers for the Stawamus River.

Riparian Vegetation Types	RVT Numbers		
	CWHdm	CWHvm1	CWHvm2
INIT - initial succession (0-1 years)	1	13	24
SHd - deciduous shrub herb (1-20 years)	2	14	25
SHc - coniferous shrub herb (1-20 years)	3	15	26
SHm - mixed shrub herb (1-20 years)	4	16	27
PSd - deciduous pole sapling - (20-40 years)	5		28
PSc - coniferous pole sapling - (20-40 years)		17	29
PSm - mixed pole sapling - (20-40 years)	6		30
YFd - deciduous young forest (40-80 years)	7	18	31
YFc - coniferous young forest (40-80 years)	8	19	32
YFm - mixed young forest (40-80 years)	9	20	33
MFc - coniferous mature forest (80-250 years)	10	21	34
MFm - mixed mature forest (80-250 years)	11	22	
OFc - coniferous old forest (250+ years)	12	23	35

Table 8: Level of functioning of impaired polygons within the Riparian Management Area of the mainstem of the Stawamus River. Polygons with a total rating score of 5 or less require further assessment.

	Polygon Number																		
Riparian Function	**64**	**71**	**90**	**121**	**122**	**127**	**139**	**141**	**230**	**231**	**234**	**289**	**291**	**313**	**320**	**325**	**330**	**339**	**343**
LWD	0	0	0	0	0	1	1	1	1	1	1	0	1	0	0	0	1	1	1
Shade	1	0	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1
SOD	1	1	2	0	0	1	1	1	1	1	1	1	2	2	2	2	1	1	1
SSF	1	1	1	0	0	1	0	0	1	1	0	2	1	2	2	2	0	0	0
CS	2	2	0	2	2	2	0	1	1	1	1	1	1	1	1	1	1	1	1
BS	2	2	0	0	0	2	0	0	1	1	0	2	2	2	2	2	0	0	0
Total	7	6	4	2	2	8	3	4	6	6	4	7	8	8	8	8	4	4	4
Level I	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Level II	N	Y	Y	Y	Y	N	Y	Y	N	N	Y	N	N	N	N	N	Y	Y	Y

Table 9: Summary of impaired riparian polygons identified along the Stawamus River. Dr = red alder; W = willow; MB = bigleaf maple Act - black cottonwood.

Polygon #	Reach #	Habitat Conditions	Level of Assessment Conducted or Required	Preliminary Riparian Restoration Recommendations
64	6	Slopes stable; natural regeneration occurring	None	None recommended
71	6	Riparian vegetation poorly established due to flood control dike	Level II	Innovative bioengineering; create habitat at base of dikes using crib walls and W, Act cuttings
90	6	Dense, young stand of Dr, Act and Mb	Level I Level II	Conifer regeneration in understorey dense; alder thinning and conifer spacing may be beneficial
121	9	Small slide from road	possible Level II field reconnaissance	Slide stable; rocky substrate not suitable for bioengineering
122	9	Small slide from road	possible Level II field reconnaissance	Slide stable; rocky substrate not suitable for bioengineering
127	10	Rock slide from pipeline ROW; appears stable	None	None recommended
139	10	Slope failure from ROW; soil erosion ongoing	Level II	Bioengineering (more major engineering solutions may be necessary)
141	10	Slide at Ray Creek mouth	possible Level II	Bioengineering using W
230	16	Slide due to natural conditions; still active	None	None recommended; source difficult to address
231	17	Slide due to natural conditions; still active	None	None recommended; source difficult to address
234	17	Small slide	possible Level II	Bioengineering using W
289	25	Dense shrub vegetation established; access poor	None	None recommended
291	25	Shrub vegetation good; conifer stocking poor; access poor	None	None recommended

POLYGON #	REACH #	HABITAT CONDITIONS	LEVEL OF ASSESSMENT CONDUCTED OR REQUIRED	PRELIMINARY RIPARIAN RESTORATION RECOMMENDATIONS
313	27	Dense shrub vegetation; conifer stocking poor	None	None recommended
320	28	Dense shrub vegetation; conifer stocking poor	None	None recommended
325	29	Dense shrub vegetation; conifer stocking poor	None	None recommended
330	29	Small slide from road	Level II	Bioengineering using W; drainage control
339	29	Small slide from road	Level II	Bioengineering using W; drainage control
343	29	Small slide from road	Level II	Bioengineering using W; drainage control

Table 10: Stawamus River Field Data Summary from channel assessment criteria.

Reach	Average Bankfull Width	Average Channel Depth (m)	Average Channel Gradient	Average Rock Diameter	Relative Roughness	Power Index	Sensitivity Rating[1]	Channel Condition[2]	Channel Type[3]
	W_b (m)		S (%)	D (m)	D/d	($W_b dS$)			
9	26.75	1.33	6.00	1.10	0.83	212.66	M	A	CANYON
10	17.40	2.08	6.20	1.08	0.52	224.39	M	D	CANYON
11	22.00	1.75	8.50	1.55	0.89	327.25	M	A	CPB
12	22.00	1.48	6.00	1.25	0.85	194.70	M	A	CPB
13	23.75	1.48	6.75	1.18	0.80	231.48	M	A	SPB
14	26.25	1.58	3.75	1.00	0.63	155.04	M	A	CPB
15	26.67	1.30	4.67	1.33	1.03	161.78	M	A	CPB
16	27.50	0.80	4.50	0.95	1.19	99.00	M	A	CPB
17	23.50	1.10	5.00	1.10	1.00	129.25	M	A	CPB
18	24.00	1.10	4.50	1.50	0.95	113.85	M	A	CPB
19	24.00	1.30	3.50	1.25	0.96	109.20	M	A	CPB
20	24.00	1.40	4.00	1.15	0.82	134.40	M	A	CPB
21	25.00	1.00	3.00	1.00	1.00	75.00	M	A	CPB
22	25.00	1.10	2.50	1.05	0.95	68.75	M	A	CPB
23	20.67	1.20	4.00	1.10	0.92	99.20	M	A	CPB
24	12.00	1.80	4.00	1.00	0.56	86.40	M	S	CPB
25	18.00	1.60	5.20	1.10	0.69	149.76	M	D	SPB
26	2.50	1.95	6.50	1.00	0.51	259.88	M	S	CPB
27	15.00	1.15	4.50	1.45	1.26	77.63	M	S	CPB
28	18.00	1.00	5.00	1.20	1.20	90.00	M	S	CPB
29	15.00	1.20	5.00	1.00	0.83	90.00	M	S	CPB

M = Moderate; A = Aggrading; D = Degrading; S = Stable; CPB = Boulder Cascade Pool; SPB = Boulder Step Pool.

Table 11: Sites on the Stawamus River originally identified as *high* or *low* priority and changed to *nil* priority after re-evaluation at the Integrated Assessment Workshop.

REACH	# M FROM MOUTH	PRESCRIPTION	REASON FOR CHANGE
4	1,233	Remove LWD to facilitate access	Access probably not impeded by LWD at higher flow
5	1,504	Connect off-channel pool to mainstem	Unlikely to succeed due to dynamic hydraulic conditions of the channel
5	1,540	Create nursery side channel in gravel bar	Unlikely to succeed due to dynamic hydraulic conditions of the channel
5	1,545	Create nursery side channel in gravel bar	Unlikely to succeed due to dynamic hydraulic conditions of the channel
6	1,592	Stabilize eroding bank	Bank located within the active channel
6	3,048	Excavate and re-connect old channel	Unlikely to succeed due to dynamic hydraulic conditions of the channel
6	3,170	Excavate and re-connect old channel	Unlikely to succeed due to dynamic hydraulic conditions of the channel
6	3,265	Excavate and re-connect old channel	Unlikely to succeed due to dynamic hydraulic conditions of the channel

Table 12: Summary of high priority restoration prescriptions for the Stawamus River and Little Stawamus Creek (LS) identified during the Stawamus River Integrated Assessment Workshop.

REACH	ADJACENT LOT #	METERS UPSTREAM FROM MOUTH	RESTORATION PRESCRIPTION	PHOTO #
4	4267 4266 912	817	Enlarge two off-channel habitats on left bank to increase usage by juvenile coho	5
5	912	1,500	Lay a gallery in an abandoned channel from DFO's off-channel habitat upstream to the main channel to increase flow within the off-channel habitat	9
6	912 833 7032 515	2,412	Lay an infiltration gallery parallel to main channel on left bank in high flow area at base of mature forest from beginning of dike to approximately 350 m upstream for creation of an alcove at the downstream section	23
6	912 833 7032 515	2,455	Plant shrubs in clumps at regular intervals; Install LWD and rootwad structures along the toe of the dike	
6	912 833 7032 515	2,662	Plant shrubs in clumps at regular intervals; Install LWD and rootwad structures along the toe of the dike	10
6	912 833 7032 515	3,344	Stabilize eroded bank through bioengineering	11
6	912 833	3,569	Plant shrubs in clumps at regular intervals on the right bank along the dike; install LWD and rootwad structures on the right bank along the toe of the	

REACH	ADJACENT LOT #	METERS UPSTREAM FROM MOUTH	RESTORATION PRESCRIPTION	PHOTO #
	7032 515		dike; thin alders and space conifer seedlings on left bank (RAP polygon 90)	
LS	912 4266	105	Excavate and connect to mainstem side-channel which is isolated during low flow periods	
LS	912 4266	202	Excavate existing side-channel to provide consistent flow at low water level	
LS	912 4266 833	291	Excavate existing side-channel to provide consistent flow at low water level	
LS	833 515	791 - 850	Create riffle-pool habitat within the channelized section parallel to residential development	

Table 13: Summary of high priority restoration prescriptions identified during the Stawamus River Integrated Assessment Workshop to be addressed by the Squamish Community.

Reach	Adjacent Lot #	Meters Upstream from Mouth	Restoration Prescription	Photo #
LS	912 4266 833	361	Rebuild stream crossing (log bridge)	19, 20
LS	912 833 515	791	Fix culvert to allow passage of fish at low flow	22
LS	833 515 514	1,181	Rebuild stream crossing (log bridge)	21
LS	833 515 514	1,361	Install new stream crossing to halt erosion caused by human passage	

LS = Little Stawamus

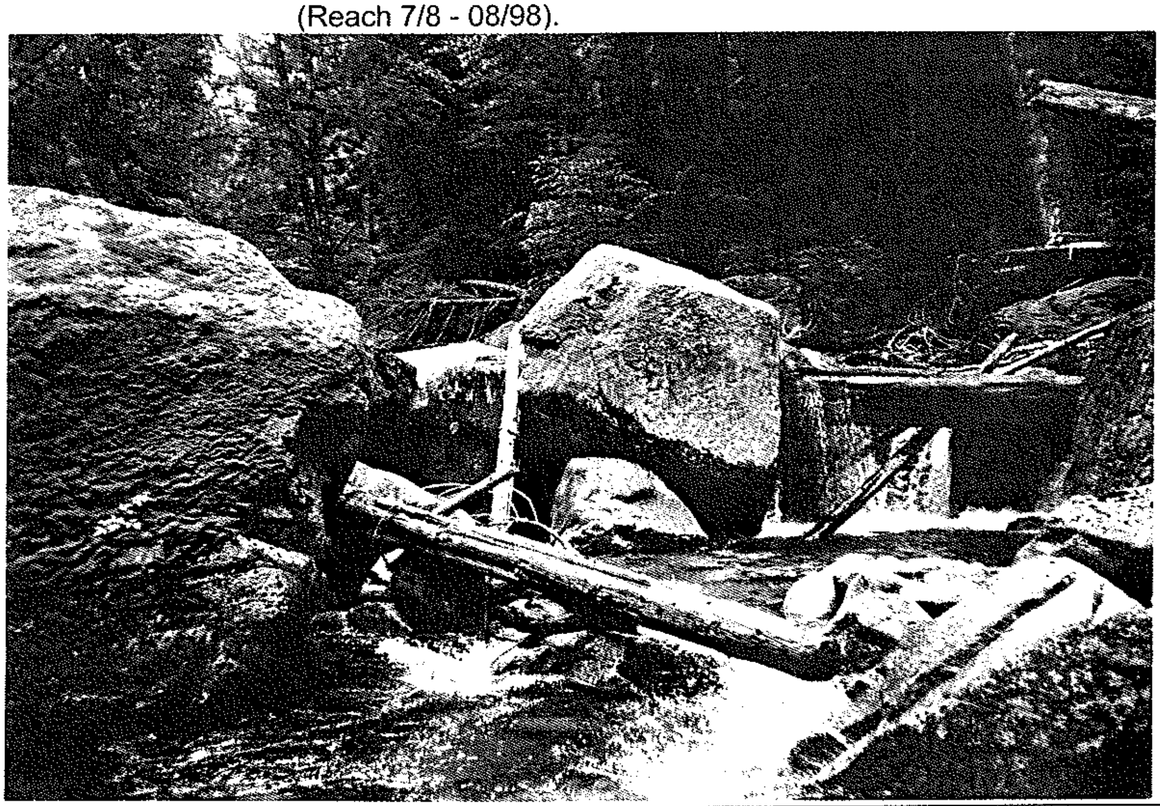
Table 14: Sites on the Little Stawamus originally identified as *high* priority and subsequently changed to *low* priority after re-evaluation at the Integrated Assessment Workshop.

# M FROM MOUTH	PRESCRIPTION	REASON FOR CHANGE
215	Remove log jam to facilitate access	Access probably not impeded by log jam
846	Stabilize banks and remove tree dam	Access probably not impeded by tree dam
1,226	Remove debris	Not an impediment to fish movement

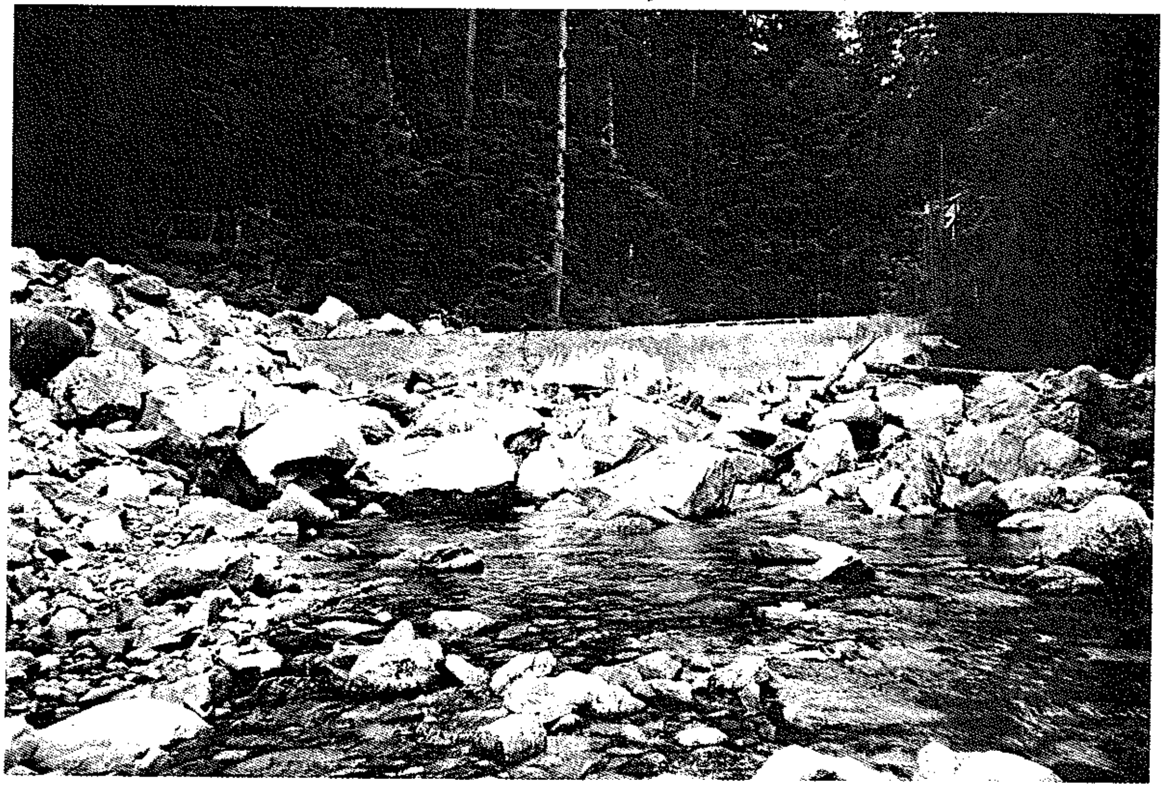
PHOTOGRAPHS

Photograph 1: Looking downstream along right bank at pool used for swimming (Reach 3 - 08/98).

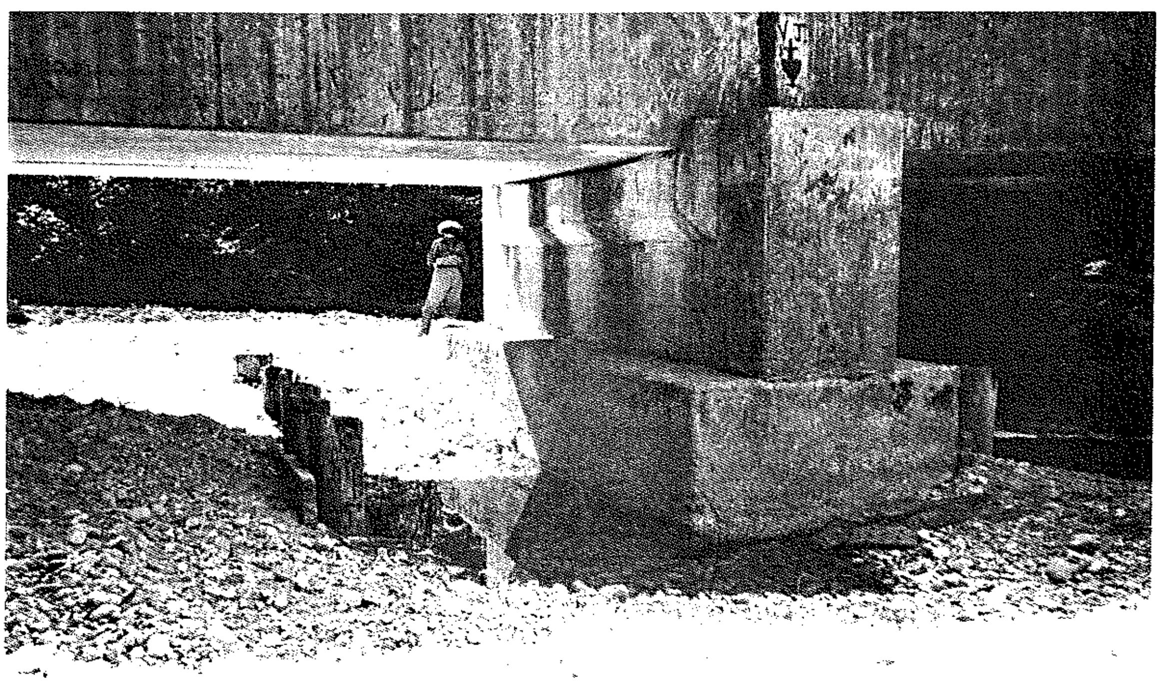
Photograph 2: Upstream view to falls/impassable fish barrier reach break 7 (Reach 7/8 - 08/98).



Photograph 3: Upstream view to weir and scour reduction/boulder zone associated with community water intake (Reach 8 - 08/98).



Photograph 4: Upstream view of confined pool created by railway bridge support block at the beginning of Reach 3 (Freshwater/Tidal boundary). Coho fry presence in pool (Reach 2/3 - 08/98).

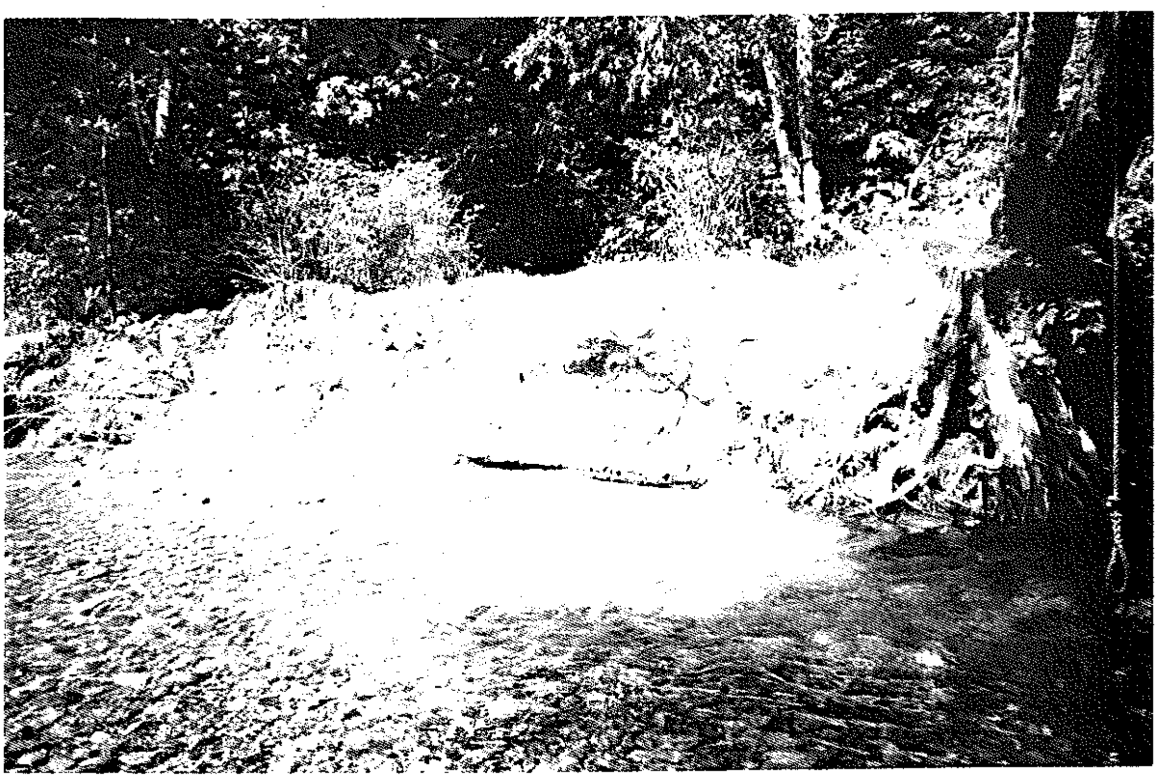


Photograph 5: Side channel on left bank under powerline R.O.W. Shrub dominant riparian/canopy zone (Reach 4 - 08/98).

Photograph 6: Confluence of mainstem and Little Stawamus at boundary between Reach 4 and Reach 5. Significant large woody debris accumulation with notable cobble and gravel deposition (Reach 4/5 - 08/98).

Photograph 7: Downstream view of swimming pool created in mainstem (Reach 5 - 08/98).

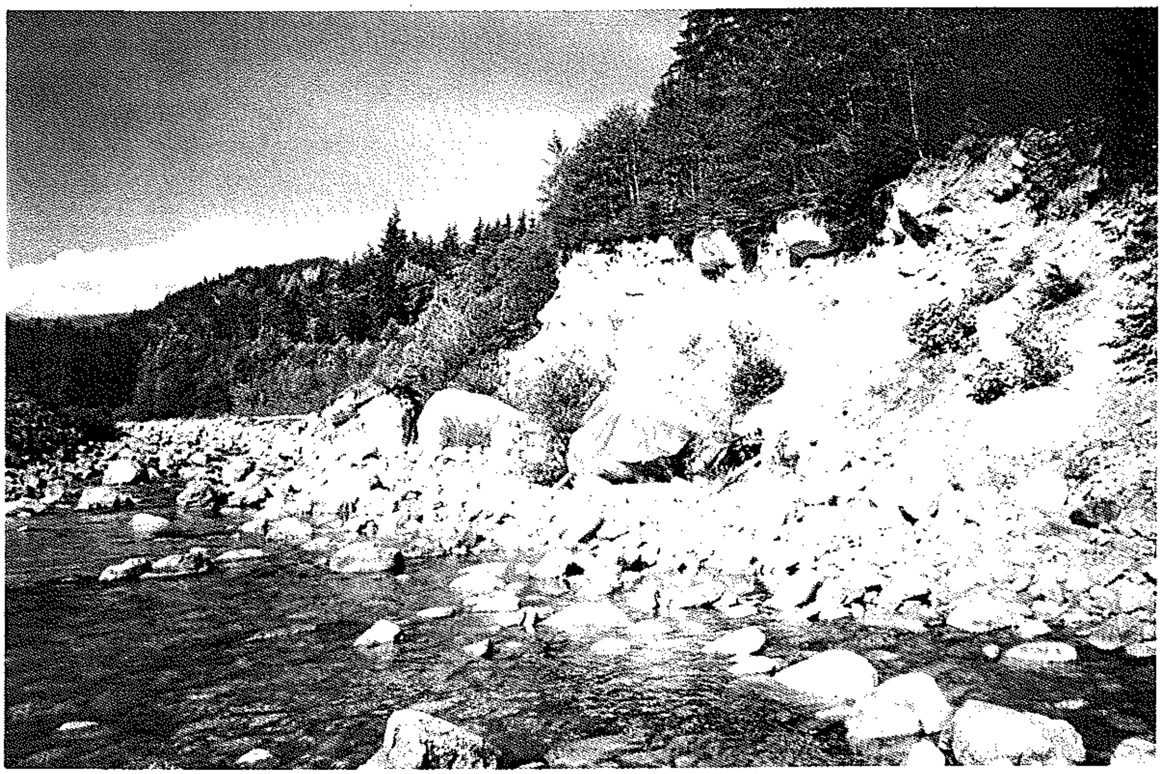
Photograph 8: Eroding banks - potential area for restoration (Reach 5 - 08/98)



Photograph 9: Upstream view of abandoned channel adjacent to logging road. Isolated pools created from low flow conditions (Reach 5 - 08/98).

Photograph 10: Upstream view of dike on right bank, channel is trained and has an elongated riffle zone. Potential for restoration to vegetate the banks (Reach 6 - 08/98).

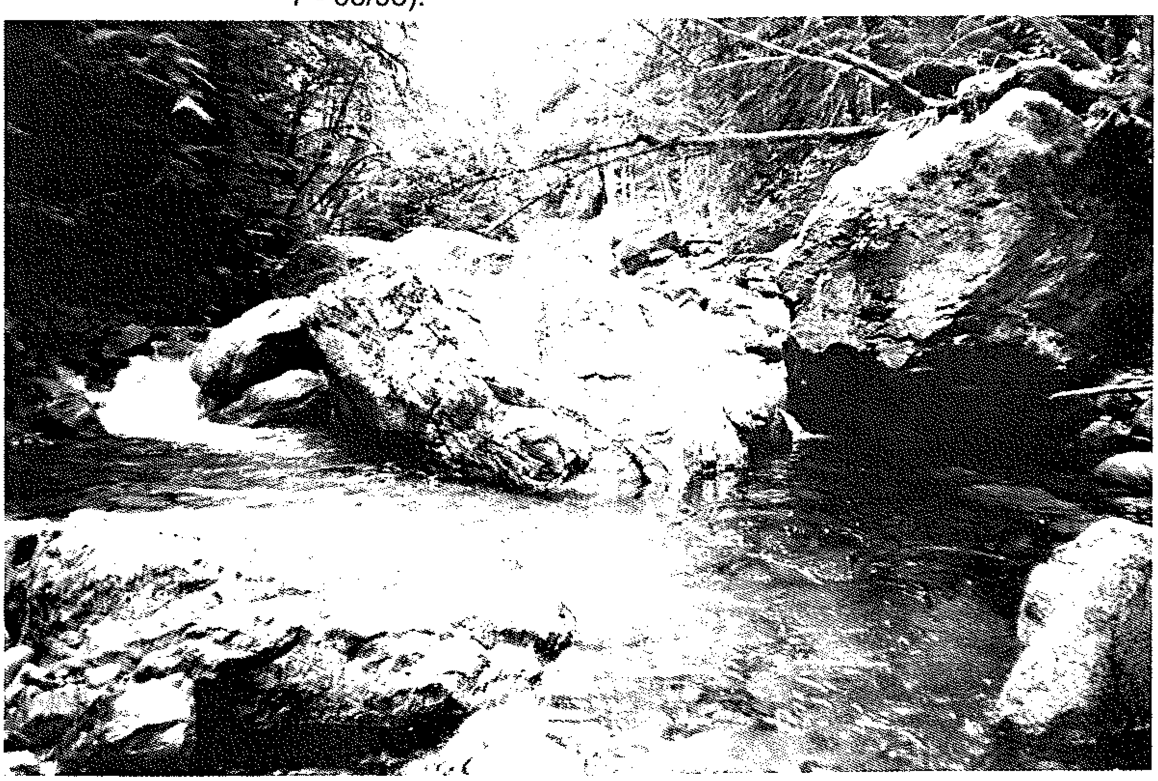
Photograph 11: Upstream view of eroded and highly unstable left bank. Potential for restoration to pull back and bioengineer the bank (Reach 6 - 08/98).



Photograph 12: Upstream view to eroding banks. Potential for restoration to stabilize bank (Reach 6 - 08/98).

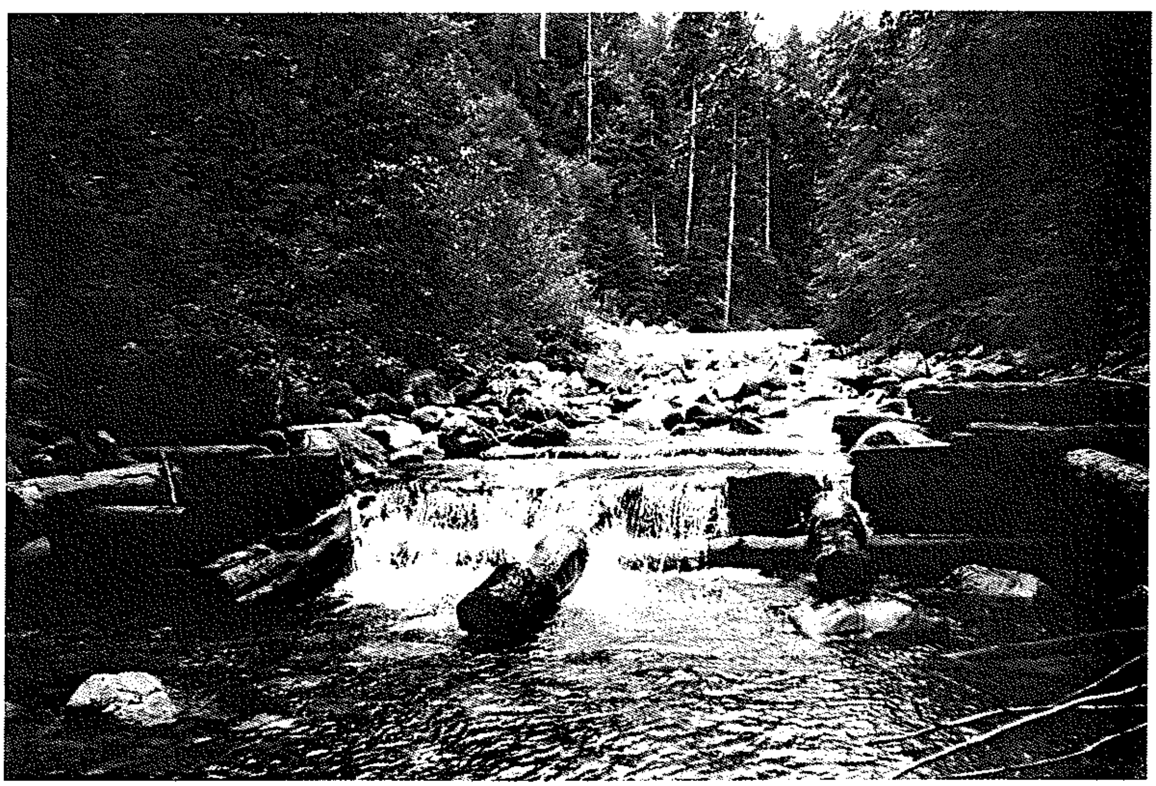
Photograph 13: Downstream view to recent bank failure and subsequent tree/root mass infilling mainstem along left bank. Erosion evident. Potential for restoration to stabilize bank (Reach 6 - 08/98).

Photograph 14: Upstream view to large holding pool. Fry presence noted (Reach 7 - 08/98).

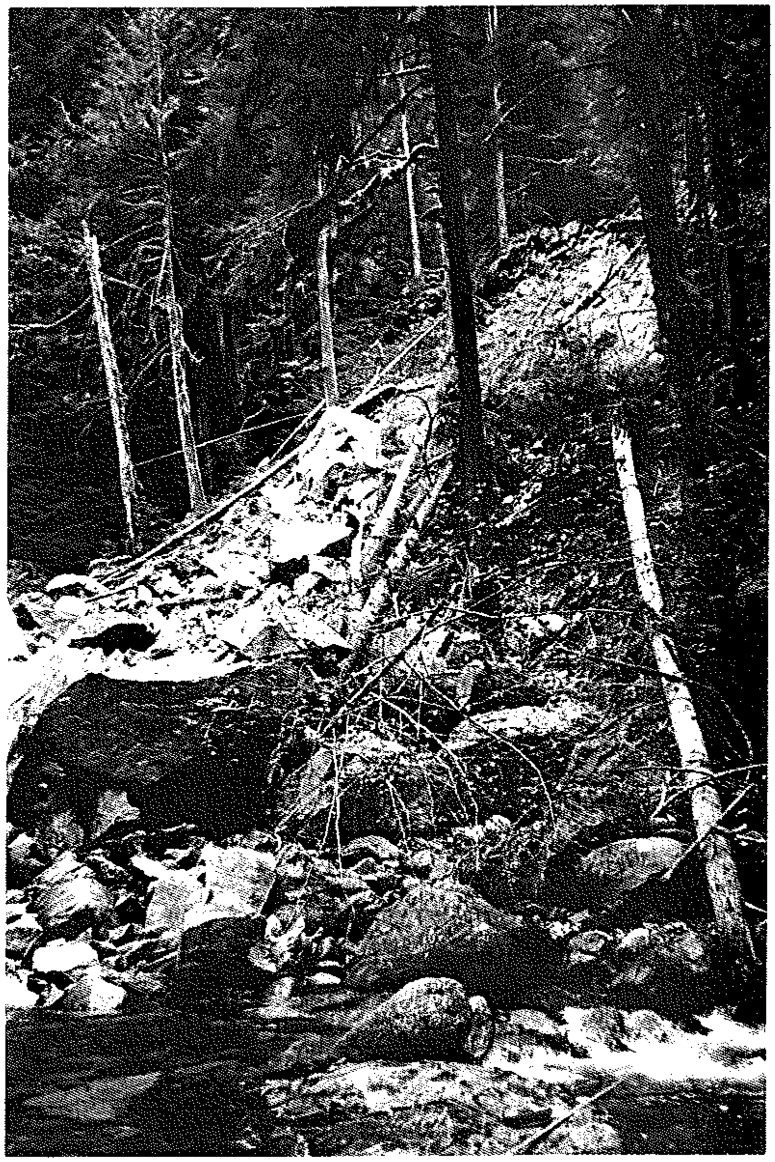


Photograph 15: Upstream view to extensive cascade/pool sequence. Impassable for fish at low flow (Reach 7 - 08/98).

Photograph 16: Upstream view to both the old and active weirs associated with community water intake. Significant decrease in channel gradient and canopy cover (Reach 8 - 08/98).



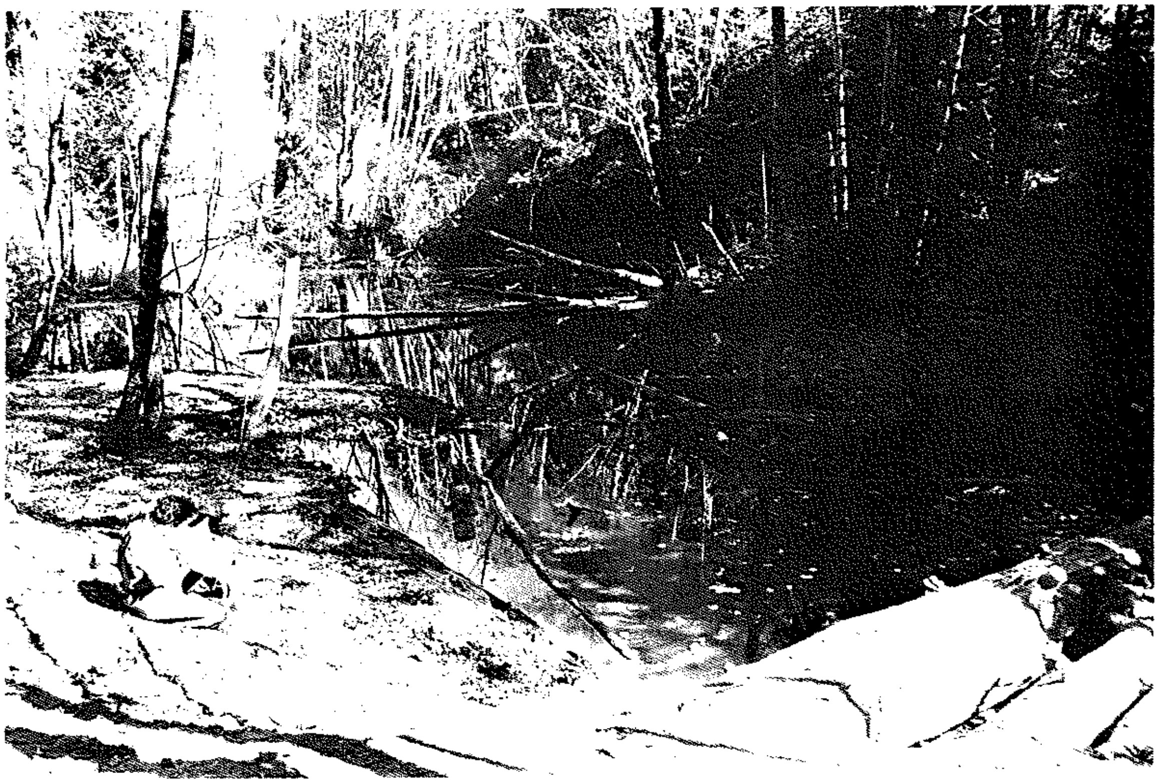
Photograph 17: Recent landslide on left bank. Major disturbance resulting in deposition of sediment, large woody debris and boulders to mainstem (Reach 8 - 08/98).



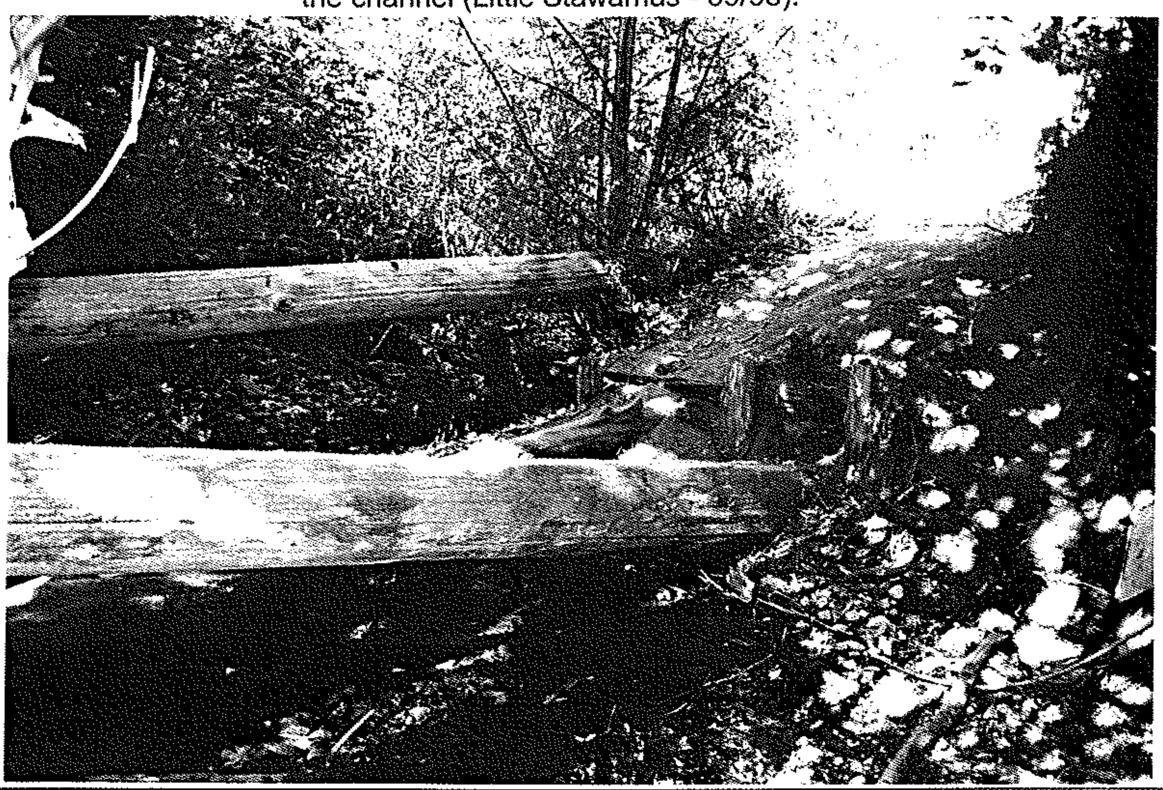
Photograph 18: Log and debris jam (wood, steel, garbage) (Little Stawamus - 09/98).

Photograph 19: Foot bridge resulting in sediment deposition to stagnant water upstream (Little Stawamus - 09/98).

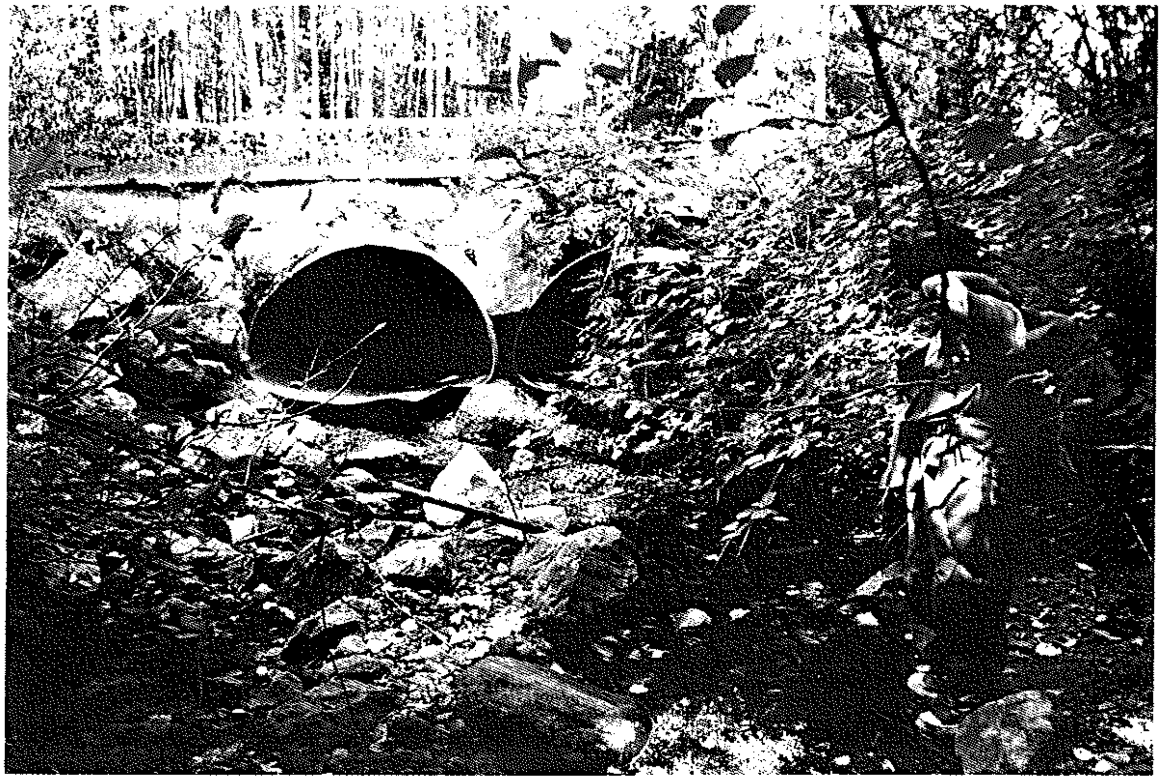
Photograph 20: Pond created as flow impeded by foot bridge (Little Stawamus - 09/98).



Photograph 21: Foot bridge and access path, resulting in sediment deposition to the channel (Little Stawamus - 09/98).



Photograph 22: Culverts under Guilford Road displaying low flow conditions (Little Stawamus - 09/98).



Photograph 23: Downstream view to potential off-channel habitat site (abandoned channel) which parallels the mainstem (115m). Potential for restoration to enhance side channel morphology to ensure flow during dry season (Reach 6 - 08/98).

APPENDIX A

FHAP - HABITAT SURVEY DATA

(FORM 4 - FHAP)

Level 1 - Habitat Summary Diagnosis Report

Form Number:	4
Forest District:	Squamish
Watershed Name:	Stawamus River
Watershed Code:	900-091000-000
urvey Date:	05/08/98
Weather:	Hot / Sunny / Few Clouds
Survey Crew:	Francois Landry (FPL) and Julie Orban (JL
Discharge:	0.65 (cubic meters per secon

Subsampling Fractions:

Riffles	Pools	Glides	Cascades	Other
1 in 4	1 in 6	1 in 4	1 in 6	1 in 5

NTS Maps (1:50,000) : 092G11

BGGS Maps (1:20,000) : 092G065, 092G075

Detail No	Sub Basin Name	Reach No	Section No	UTM Zone	UTM Easting	UTM Northing	Distance (m)	Habitat Unit Type	Habitat Unit Cat	Length (m)	Grad (%)	Mean Depth Bankfull (m)	Mean Depth Water (m)	Mean Width Bankfull (m)	Mean Width Wetted (m)	Pools Only Max Depth	Pools Only Crest (m)	Pools Only Residual	Pools Only Pool Type
1	MAINSTEM	3	3	10	489428	5504132	586	P	1	15	0	1.5	0.8	28.5	7.5	1.05	0.15	0.9	D
Comments: subsampling fractions R=1:2, P =1:2, G =1:2, C =1:2, O =1:5 -confined pool due to RWY bridge post- approx. 50 c																			
2	MAINSTEM	3	3				603	R	1	18	1	1.25	0.45	22	6.4				
Comments:																			
3	MAINSTEM	3	3				611	P	1	8									
Comments:																			
4	MAINSTEM	3	3				621	G	1	10	1	0.85	0.15	18.8	6.7				
Comments:																			
5	MAINSTEM	3	3				654	P	1	33	0	1.55	0.9	19.8	18.7	1.8	0.5	1.3	D
Comments:																			

The following table cross-references photo numbers as stated in the *WRPDES - Form 4* comments with the corresponding photo numbers in the text of the report.

WRPDES PHOTO #	**REPORT TEXT** PHOTO #
3	1
36	2
41	3
5	4
15	5
11	6
8	7
6	8
17	9
26	10
30	11
20	12
19	13
31	14
34	15
39	16
40	17
56	18
48	19
50	20
54	21
52	22
27	23

Form Number	Detail Number	Sub-Basin	Reach #	Distance from mouth	UTM Zone	UTM Easting	UTM Northing	Habitat Unit Type	Habitat Unit Cat.	Length (m)	Gradient (%)	Mean Depth Bankfull	Mean Depth Water	Mean Width Bankfull	Mean Width Wetted	Pool Max Depth	Pool Crest	Pool Residual
4	1	MAINSTEM	3	586	10	489428	5504132	P	1	15	0	1.5	0.8	28.5	7.5	1.05	0.15	0.9
4	2	MAINSTEM	3	603				R	1	18	1	1.25	0.45	22	6.4			
4	3	MAINSTEM	3	611				P	1	8								
4	4	MAINSTEM	3	621				G	1	10	1	0.85	0.15	18.8	6.7			
4	5	MAINSTEM	3	654				P	1	33	0	1.55	0.9	19.8	18.7	1.8	0.5	1.3
4	6	MAINSTEM	3	707				R	1	53								
4	7	MAINSTEM	3	752				G	1	45								
4	8	MAINSTEM	4	780	10	489725	5504278	R	1	28	1	0.5	0.2	21.5	15			
4	9	MAINSTEM	4	794				P	1	14	0	0.6	0.35	16.8	5	0.65	0.2	0.45
4	10	MAINSTEM	4	817				R	1	23	1	0.35	0.15	21.6	15.6			
4	11	MAINSTEM	4	852				G	1	35								
4	12	MAINSTEM	4	877				P	1	25								
4	13	MAINSTEM	4	898				G	1	21								
4	14	MAINSTEM	4	942				R	1	44								
4	15	MAINSTEM	4	980				P	1	38								
4	16	MAINSTEM	4	991				G	1	11								
4	17	MAINSTEM	4	999				P	1	8	0	1.15	0.55	35	11.1	1	0.35	0.65
4	18	MAINSTEM	4	1033				R	1	34	2	0.45	0.1	26.7	7.3			
4	19	MAINSTEM	4	1053				G	1	20	1	1.55	0.35	32	11.7			
4	20	MAINSTEM	4	1071				P	1	18								
4	21	MAINSTEM	4	1085				R	1	14								
4	22	MAINSTEM	4	1119				P	1	34								
4	23	MAINSTEM	4	1136				G	1	17								
4	24	MAINSTEM	4	1159				R	1	23								
4	25	MAINSTEM	4	1172				P	1	13	0	1.1	0.65	18.5	5	1.1	0.15	0.95
4	26	MAINSTEM	4	1202				R	1	30	2	0.7	0.2	19	8.3			
4	27	MAINSTEM	4	1233				P	1	31								
4	28	MAINSTEM	5	1258	10	490053	5504393	R	1	25	2	0.55	0.15	24.8	4.9			
4	29	MAINSTEM	5	1267				P	1	9	0	1.6	0.4	24.8	5.8	1	0.2	0.8
4	30	MAINSTEM	5	1280				R	1	13								
4	31	MAINSTEM	5	1294				P	1	14								
4	32	MAINSTEM	5	1311				R	1	17								
4	33	MAINSTEM	5	1328				P	1	17								
4	34	MAINSTEM	5	1340				R	1	12								

Detail Number	Pool Type	Bed Material Dom	Bed Material Sub-Dom	Bed Compaction	Spawning Gravel Type	Spawning Gravel Amount	Total LWD Tally	LWD Tally 10-20	LWD Tally 20-50	LWD Tally 50 plus	Cover Type 1	Cover Percent 1	Cover Type 2	Cover Percent 2	Offchannel Type	Offchannel Access	Offchannel Length (m)
1	D	C	G	M			0	0	0	0	B	5	OV	2			
2		C	G	M	A	L	2	0	1	1	LWD	10					
3																	
4		G	C	M	A	L	1	1	0	0	SWD	2	OV	2			
5	D	G	S	L			3	0	1	2	DP	25	LWD	5			
6																	
7																	
8		C	G	M	A	L	1	0	1	0	OV	2	SWD	2			
9	U	C	G	L			3	0	2	0	LWD	15					
10		C	G	M	A	L	1	0	0	0	OV	2			PD		
11																	
12																	
13																	
14																	
15																	
16																	
17	U	C	G	M	A	L	4	1	1	0	DP	2	SWD	5	SC	P	10
18		C	G	M			4	1	2		LWD	5			PD	P	20
19		G	C	M	AR	L	1	1			OV	5	SWD	5	SC	P	15
20																	
21																	
22																	
23																	
24																	
25	U	C		M			1	0	0	1	DP	70	C	5	SC	P	12
26		C	G	M	AR	L	3	0	0	3	LWD	2	DP	5			
27																	
28		C		L			2	0	0	0	OV	5	SWD	2			
29	D	C	G	L	A	L	6	0	2	2	LWD	5	SWD	5			
30																	
31																	
32																	
33																	
34																	

Detail Number	Disturbance Indicator 1	Disturbance Indicator 2	Disturbance Indicator 3	Riparian Veg Type	Riparian Veg Structure	Riparian Veg Canopy Closure	Barriers
1				D	YF	2	BR
2				D	YF	3	N
3							
4				D	YF	3	N
5				D	YF	2	N
6							
7							
8	EB	MC		D	YF	1	N
9	EB	MC		D	YF	1	N
10	MC			S	SHR	1	N
11							
12							
13							
14							
15							
16							
17	MC			D	YF	2	N
18				D	YF	1	N
19				D	YF	1	N
20							
21							
22							
23							
24							
25	MC			M	MF	4	N
26	MC			D	YF	1	N
27							
28	MC			M	YF	2	N
29	MC			M	YF	2	N
30							
31							
32							
33							
34							

Detail Number	COMMENTS
1	subsampling fractions R=1:2, P =1:2, G =1:2, C =1:2, O =1:5 -confined pool due to RWY bridge post- approx. 50 coho fry/ restoration-remove supports to encourage infilling-1st reach above interdial zone/PHOTO #5-pond , #4-DS view lowtide 50 m DS of rwy bri
2	
3	
4	
5	
6	
7	
8	SUBSAMPLING FRACTIONS : R = 1:3, P = 1:3, G = 1:3, C = 1:3, O = 1:5 /
9	
10	FISH PRESENCE - COHO ID 4/4/CAT 2 POOL (20m), CAT 2 GLIDE (11m), CAT 2 RIFFLE (23m)/ OCH-2 Side Channels off left bank - PTL RESTORATION AREA - enlarge the channel to ensure low flow maintained-Below hydroline ROW/ PHOTO #15 (off channel habitat)
11	CAT 2 RIFFLE (15m), CAT 2 POOL (25m), CAT 2 GLIDE (15m), CAT 2 CASCADE (4m)
12	
13	
14	POTENTIAL FISH HABITAT RESTORATION - existing off channel habitat (small tributary) which is at the base of an eroding bank which may be a target for STABILIZATION - PHOTO #14 (looking upstream at OCH and eroding bank)
15	FISH PRESENCE - fish sighted against LWD - ID not confirmed
16	
17	
18	
19	CAT 2 POOL (20m) - This pool is considered to be off-channel habitat which only receives flow at high water and pockets of water are left behind / confined at low flow
20	
21	
22	
23	
24	
25	FISH PRESENT IN OFF - CHANNEL HABITAT POOL (rainbow trout fry identified) PHOTO #13 (Downstream to OCH)
26	CAT 2 POOL (5m long) - PHOTO #12 (downstream from confluence with Little Stawamus)
27	CONFLUENCE WITH LITTLE STAWAMUS / SIGNIFICANT LARGE WOODY DEBRIS ACCUMULATION / SIGNIFICANT GRAVEL AND COBBLE DEPOSITS - PHOTO #11 (Across to confluence)
28	SUBSAMPLING FRACTIONS : R = 1:4, P = 1:4, G = 1:4, C = 1:4, O = 1:5 /
29	
30	
31	
32	
33	
34	CAT 2 RIFFLE (10m) / SIGNIFICANT VOLUME OF LWD ACCUMULATION - creating a mid-channel barrier / PHOTO #10 (view across channel from Right Bank)

Form Number	Detail Number	Sub-Basin	Reach #	Distance from mouth	UTM Zone	UTM Easting	UTM Northing	Habitat Unit Type	Habitat Unit Cat.	Length (m)	Gradient (%)	Mean Depth Bankfull	Mean Depth Water	Mean Width Bankfull	Mean Width Wetted	Pool Max Depth	Pool Crest	Pool Residual
4	35	MAINSTEM	5	1380				G	1	40	1	0.7	0.4	17	9.7			
4	36	MAINSTEM	5	1411				P	1	31								
4	37	MAINSTEM	5	1421				G	1	10								
4	38	MAINSTEM	5	1442				C	1	21	4	0.8	0.15	28.5	15			
4	39	MAINSTEM	5	1473				P	1	31	0	2.85	0.8	18.7	13.5	2.05	0.15	1.9
4	40	MAINSTEM	5	1504				R	1	31	1	1.4	0.15	35.6	13.2			
4	41	MAINSTEM	5	1519				P	1	15								
4	42	MAINSTEM	5	1540				R	1	21								
4	43	MAINSTEM	5	1545				P	1	5								
4	44	MAINSTEM	6	1556	10	491588	5505865	P	1	11	0	1.6	1.5	11.7	7	1.1	0.1	1
4	45	MAINSTEM	6	1567				G	1	11	1	1.65	0.3	9.9	8.1			
4	46	MAINSTEM	6	1579				R	1	12	3	1.85	0.25	16.4	6.2			
4	47	MAINSTEM	6	1592				G	1	13								
4	48	MAINSTEM	6	1603				C	1	11	6	1.85	0.15	15.3	7.3			
4	49	MAINSTEM	6	1613				P	1	10								
4	50	MAINSTEM	6	1625				G	1	12								
4	51	MAINSTEM	6	1636				P	1	11								
4	52	MAINSTEM	6	1647				R	1	11								
4	53	MAINSTEM	6	1650				P	1	3								
4	54	MAINSTEM	6	1674				R	1	24								
4	55	MAINSTEM	6	1683				G	1	9								
4	56	MAINSTEM	6	1691				P	1	8								
4	57	MAINSTEM	6	1710				G	1	19								
4	58	MAINSTEM	6	1717				P	1	7	0	1.5	0.75	15.5	5.8	1.15	0.15	1
4	59	MAINSTEM	6	1742				G	1	25	1	2.4	0.4	22.8	5			
4	60	MAINSTEM	6	1760				C	1	18								
4	61	MAINSTEM	6	1793				R	1	33								
4	62	MAINSTEM	6	1826				G	1	33								
4	63	MAINSTEM	6	1884				R	1	58								
4	64	MAINSTEM	6	1901				P	1	17								
4	65	MAINSTEM	6	1934				R	1	33	3	1.15	0.15	23	4.8			
4	66	MAINSTEM	6	1949				P	1	15								
4	67	MAINSTEM	6	1963				G	1	14								

Detail Number	Pool Type	Bed Material Dom	Bed Material Sub-Dom	Bed Compaction	Spawning Gravel Type	Spawning Gravel Amount	Total LWD Tally	LWD Tally 10-20	LWD Tally 20-60	LWD Tally 60 plus	Cover Type 1	Cover Percent 1	Cover Type 2	Cover Percent 2	Offchannel Type	Offchannel Access	Offchannel Length (m)
35		C		M			3	0	2	0	LWD	2	SWD	5			
36																	
37																	
38		C		M			3	0	2	0	LWD	2					
39	D	G	C	L			5	0	2	0	DP	85	LWD	5			
40		C	G	M			8	0	2	1	LWD	10	C	2	SC	P	35
41																	
42																	
43																	
44	D	C	B	L			15	0	8	3	LWD	30	DP	5	SC	P	12
45		C	G	M	A	L	2	0	0	1	SWD	2	OV	2			
46		C	B	L			0	0	0	0	OV	2	SWD	2			
47																	
48		C	B	L			1	0	0	1	SWD	5	LWD	2			
49																	
50																	
51																	
52																	
53																	
54																	
55																	
56																	
57																	
58	D	C	B	L			20	2	4	4	SWD	20	LWD	20			
59		C	B	L	AR	L	2			2	LWD	5	SWD	2			
60																	
61																	
62																	
63																	
64																	
65		C	B	M	AR	L	5	0	2	1	LWD	2	SWD	2			
66																	
67																	

Detail Number	Disturbance Indicator 1	Disturbance Indicator 2	Disturbance Indicator 3	Riparian Veg Type	Riparian Veg Structure	Riparian Veg Canopy Closure	Barriers
35				D	YF	1	N
36							
37							
38	MC			D	YF	1	N
39	EB			D	YF	1	BD
40	EB	MC	BC	D	YF	1	N
41							
42							
43							
44	JM	MC		D	YF	1	X
45	EB	WG		D	YF	2	N
46	MC			D	YF	1	N
47							
48	EB	MC	JM	D	YF	1	N
49							
50							
51							
52							
53							
54							
55							
56							
57							
58	JM	MC		D	YF	1	X
59	MC			D	YF	2	N
60							
61							
62							
63							
64							
65	EB	LR	MC	M	MF	4	N
66							
67							

Detail Number	COMMENTS
35	FRY SIGHTED
36	FRY SIGHTED
37	
38	MAN-MADE DAM (BOULDER) CONSTRUCTED AT UPSTREAM BORDER OF HABITAT UNIT TO CREATE A SWIMMING 'POOL' / PHOTO#9 (Upstream view to swimming 'pool')
39	THIS POOL WAS CREATED AS A RESULT OF MAN-MADE BOULDER DAM CONSTRUCTION / PHOTO #8 (Downstream view of swimming pool taken from the Right Bank) - The barrier mentioned here is actually a man-made dam and not a beaver dam
40	FRY PRESENCE (>100 fish)- in mainstem and in OCH / OCH is isolated due to low flow/Eroding banks-significant sediment source/PTL for RESTORATION-stabilizing the bank- i.e. rip rap or pull-back to angle of repose/PHOTO #6 and PHOTO #7 (eroding banks & isol
41	
42	POTENTIAL FOR FISH HABITAT RESTORATION - by creating side channels in the elevated mid channel bar
43	POTENTIAL FOR FISH HABITAT RESTORATION - by creating side channels in the elevated mid channel bar
44	SUBSAMPLING FRACTIONS : R = 1:5, P = 1:5, G = 1:5, C = 1:5, O = 1:5 / fish presence/significant decrease in algae as compared to reach #5/pool formed by log jam with significant build-up of SWD and LWD/ photo #17- DS view cutbank - small pools below ro
45	
46	
47	LWD DEPOSITION THIS YEAR FROM BANK FAILURE - POTENTIAL FOR FISH HABITAT RESTORATION by stabilizing the banks with rip rap or bioengineering / PHOTO #19 (Downstream to left bank) and PHOTO #20 (Upstream to logjam)
48	
49	
50	
51	
52	
53	
54	
55	
56	FISH PRESENCE IN POOL - (0+ and 1+) TROUT FRY
57	
58	RECENT LOG JAM (THIS YEAR) - SIGNIFICAN BUILD-UP AND SIZE OF LWD AND SWD ALONG BANKS / PHOTO #21 (Downstream to jam)
59	MAN-MADE ROCK DAM CONSTRUCTED AT BOTTOM OF UNIT TO CREATE A SWIMMING POOL - SEMI-COMPLETE BARRIER TO FISH
60	CASCADE WITH A MAN-MADE ROCK DAM IN THE MIDDLE OF THE UNIT CREATED TO FORM A SWIMMING POOL (Human camping area)
61	GOOD FISH HABITAT - boulders and spawning substrate (anadromous and resident) - RIFFLE AREA
62	ERODING BANKS - SEDIMENT SOURCE - MATURE FOREST ON BANKS IS SUSCEPTIBLE TO FALLING INTO STREAM CHANNEL / FISH HABITAT RESTORATION OPPORTUNITIES - difficult to implement due to natural flow intensity and flow path / PHOTO #22 (Across channel to the erodin
63	
64	CAT 2 RIFFLE (18m)
65	FISH PRESENCE - 2 FRY OBSERVED - CAT 2 POOL (7.2m) / FISH PRESENCE NOTED - FRY - CAT 2 POOL (9m)
66	FISH PRESENCE OBSERVED / ERODED YET STABLE BANKS
67	ERODED BANKS - UNSTABLE MATERIAL REMAINING / LWD JAM AT END OF UNIT

Form Number	Detail Number	Sub-Basin	Reach #	Distance from mouth	UTM Zone	UTM Easting	UTM Northing	Habitat Unit Type	Habitat Unit Cat.	Length (m)	Gradient (%)	Mean Depth Bankfull	Mean Depth Water	Mean Width Bankfull	Mean Width Wetted	Pool Max Depth	Pool Crest	Pool Residual
4	68	MAINSTEM	6	1991				R	1	28								
4	69	MAINSTEM	6	2008				P	1	17								
4	70	MAINSTEM	6	2031				R	1	23								
4	71	MAINSTEM	6	2049				P	1	18								
4	72	MAINSTEM	6	2070				R	1	21								
4	73	MAINSTEM	6	2080				G	1	10								
4	74	MAINSTEM	6	2088				P	1	8	0	1.55	0.55	8	4.8	1.15	0.2	0.95
4	75	MAINSTEM	6	2109				G	1	21								
4	76	MAINSTEM	6	2121				P	1	12								
4	77	MAINSTEM	6	2173				R	1	52								
4	78	MAINSTEM	6	2178				P	1	5								
4	79	MAINSTEM	6	2211				R	1	33	3	1	0.2	9.5	5.7			
4	80	MAINSTEM	6	2229				P	1	18								
4	81	MAINSTEM	6	2257				R	1	28								
4	82	MAINSTEM	6	2269				P	1	12								
4	83	MAINSTEM	6	2292				G	1	23	1	1.25	0.25	38	5			
4	84	MAINSTEM	6	2298				P	1	6	0	1.45	0.55	40	7.3	1.05	0.15	0.9
4	85	MAINSTEM	6	2412				R	1	114								
4	86	MAINSTEM	6	2455				G	1	43								
4	87	MAINSTEM	6	2662				R	1	207								
4	88	MAINSTEM	6	2694				G	1	32								
4	89	MAINSTEM	6	2703				P	1	9								
4	90	MAINSTEM	6	2774				R	1	71								
4	91	MAINSTEM	6	2791				C	1	17								
4	92	MAINSTEM	6	2805				R	1	14	1	2.25	0.25	54	6.7			
4	93	MAINSTEM	6	2821				P	1	16								
4	94	MAINSTEM	6	3048				R	1	227								
4	95	MAINSTEM	6	3067				P	1	19								
4	96	MAINSTEM	6	3083				C	1	16								
4	97	MAINSTEM	6	3103				P	1	20								
4	98	MAINSTEM	6	3122				C	1	19	6	0.3	0.2	30.2	10.2			
4	99	MAINSTEM	6	3170				G	1	48								

Detail Number	Pool Type	Bed Material Dom	Bed Material Sub-Dom	Bed Compaction	Spawning Gravel Type	Spawning Gravel Amount	Total LWD Tally	LWD Tally 10-20	LWD Tally 20-50	LWD Tally 50 plus	Cover Type 1	Cover Percent 1	Cover Type 2	Cover Percent 2	Offchannel Type	Offchannel Access	Offchannel Length (m)
68																	
69																	
70																	
71																	
72																	
73																	
74	S	G	C	L	A	L	1	0	0	1	SWD	10	OV	5			
75																	
76																	
77																	
78																	
79		C	B	M			1	0	0	0	SWD	2	C	2	SC	G	10
80																	
81																	
82																	
83		C	G	M	A	L	2	0	1	0	SWD	30	OV	30			
84	D	C	B	L			5	0	2	0	SWD	30	C	2			
85																	
86																	
87																	
88																	
89																	
90																	
91																	
92		C	B	M			0	0	0	0	B	5					
93																	
94																	
95																	
96																	
97																	
98		B	C	H			1	0	0	0	B	10					
99																	

Detail Number	Disturbance Indicator 1	Disturbance Indicator 2	Disturbance Indicator 3	Riparian Veg Type	Riparian Veg Structure	Riparian Veg Canopy Closure	Barriers
68							
69							
70							
71							
72							
73							
74	WG	EB		M	MF	1	N
75							
76							
77							
78							
79	EB	JM		M	MF	2	N
80							
81							
82							
83	PD	MC		M	MF	1	N
84	PD	MC	WG	M	MF	1	N
85							
86							
87							
88							
89							
90							
91							
92	DW	MC		D	YF	1	N
93							
94							
95							
96							
97							
98	EB	DW		M	YF	1	N
99							

Detail Number	COMMENTS
68	MULTIPLE CHANNEL DOMINANT
69	POTENTIAL FISH HABITAT RESTORATION - excavate abandoned channel / PHOTO #23 (across the mainstem to the side channel)
70	
71	
72	
73	POTENTIAL FOR FISH HABITAT RESTORATION - create off-channel habitat in natural abandoned channel formed by past log placement / PHOTO #24 (Across channel to potential OCH)
74	FISH PRESENCE NOTED - fry / POTENTIAL FOR FISH HABITAT RESTORATION - create OCH in natural abandoned channel - scour location (as above)
75	CAT 2 RIFFLE (10m)
76	
77	GOOD OFF - CHANNEL HABITAT ALONG THE LEFT BANK, CLOSE TO THE UPPER HABITAT BOUNDARY - AMPLE OVERHANGING VEGETATION AND SUITABLE SPAWNING SUBSTRATE FOR BOTH ANADROMOUS AND RESIDENT
78	FISH PRESENCE NOTED - fry
79	GOOD OCH - POOL
80	FISH PRESENCE NOTED - HIGHEST FISH ABUNDANCE FROM THIS POINT DOWNSTREAM / FRY AND 1+ FISH OBSERVED / GOOD REARING HABITAT - AMPLE COVER / OCH - FRY NOTED - AMPLE LWD IN THIS OCH LOCATION / PHOTO #25 (Downstream to lwd jam)
81	
82	
83	CAT 2 RIFFLE (60m)
84	FISH PRESENCE NOTED - FRY PRESENT IN THE POOL
85	beginning of dike- increase in algae/poor overall fish habitat(yet fry observed in small side channel along LB near start of unit)/No OHV/Long riffle/OCH PTL parallel to channel in high flow area - will provide good rearing habitat as more OHV and more po
86	FISH HABITAT RESTORATION POTENTIAL - plant more trees and shrubs along the dyke walls to provide cover / OCH POTENTIAL MENTIONED ABOVE STILL RUNNING PARALLEL TO MAINSTEM
87	FISH HABITAT RESTORATION POTENTIAL - plant more trees and shrubs along the dyke walls to provide cover / LONG RIFFLE / OCH POTENTIAL MENTIONED ABOVE STILL RUNNING PARALLEL TO MAINSTEM / PHOTO #26 (Upstream to eroding banks) and PHOTO #27 (Across channel t
88	
89	
90	OCH FROM ABOVE ENDS AT THE TOP OF THIS UNIT (i.e. the channel would intercept the mainstem here) / LARGE OLD CEMENT CULVERTS LODGED IN THE MAINSTEM
91	
92	CAT 2 RIFFLE (30m) / ROCK BARRIER CONSTRUCTED AT THE UPPER LIMIT OF THIS HABITAT UNIT TO CREATE A SWIMMING POOL
93	
94	EXTENSIVE RIFFLE WITH VARYING GRADIENT AND RIPARIAN CVR/ERODING LB (non-dyked bank)/Upper limit of hab unit dammed by rocks for swimming/Approx. 80m up this unit-PTL RESTORATION to CREATE OCH BY EXCAVATING ABANDONED CHNL/PHOTO #27 (U/S view of unit)
95	
96	
97	ROCK DAM CONSTRUCTED FOR SWIMMING / PHOTO # 28 (Looking upstream to the pool)
98	
99	POTENTIAL FISH HABITAT RESTORATION - excavate abandoned channel / ISOLATED ANADROMOUS SPAWNING HABITAT

Form Number	Detail Number	Sub-Basin	Reach #	Distance from mouth	UTM Zone	UTM Easting	UTM Northing	Habitat Unit Type	Habitat Unit Cat.	Length (m)	Gradient (%)	Mean Depth Bankfull	Mean Depth Water	Mean Width Bankfull	Mean Width Wetted	Pool Max Depth	Pool Crest	Pool Residual
4	100	MAINSTEM	6	3265				R	1	95								
4	101	MAINSTEM	6	3282				G	1	17								
4	102	MAINSTEM	6	3311				C	1	29								
4	103	MAINSTEM	6	3344				G	1	33	1	0.75	0.35	19.5	11.7			
4	104	MAINSTEM	6	3569				R	1	225								
4	105	MAINSTEM	6	3609				G	1	40								
4	106	MAINSTEM	6	3660				C	1	51								
4	107	MAINSTEM	6	3746				R	1	86								
4	108	MAINSTEM	6	3755				P	1	9	0	1.6	0.6	16.5	10.6	1.1	0.25	0.85
4	109	MAINSTEM	6	3819				C	1	64								
4	110	MAINSTEM	6	3900				R	1	81								
4	111	MAINSTEM	6	4036				C	1	136								
4	112	MAINSTEM	6	4084				G	1	48								
4	113	MAINSTEM	6	4089				P	1	5								
4	114	MAINSTEM	7	4101	10	492378	5505822	P	1	12	0	2.2	0.5	12.2	6.9	0.9	0.15	0.75
4	115	MAINSTEM	7	4104				C	1	3	6	1.9	0.2	7.6	6.1			
4	116	MAINSTEM	7	4111				P	1	7								
4	117	MAINSTEM	7	4114				C	1	3								
4	118	MAINSTEM	7	4120				P	1	6								
4	119	MAINSTEM	7	4130				C	1	10								
4	120	MAINSTEM	7	4137				P	1	7								
4	121	MAINSTEM	7	4143				C	1	6								
4	122	MAINSTEM	7	4153				P	1	10								
4	123	MAINSTEM	7	4178				C	1	25								
4	124	MAINSTEM	7	4221				R	1	43	2	1.25	0.35	17.5	12.3			
4	125	MAINSTEM	7	4232				P	1	11								
4	126	MAINSTEM	7	4240				C	1	8								
4	127	MAINSTEM	7	4251				R	1	11								
4	128	MAINSTEM	7	4258				P	1	7								
4	129	MAINSTEM	7	4263				R	1	7								
4	130	MAINSTEM	7	4267				C	1	4								
4	131	MAINSTEM	7	4288				P	1	21								
4	132	MAINSTEM	7	4291				C	1	3								
4	133	MAINSTEM	7	4323				R	1	32								
4	134	MAINSTEM	7	4339				C	1	16								

Detail Number	Pool Type	Bed Material Dom	Bed Material Sub-Dom	Bed Compaction	Spawning Gravel Type	Spawning Gravel Amount	Total LWD Tally	LWD Tally 10-20	LWD Tally 20-50	LWD Tally 50 plus	Cover Type 1	Cover Percent 1	Cover Type 2	Cover Percent 2	Offchannel Type	Offchannel Access	Offchannel Length (m)
100																	
101																	
102																	
103		B	C	M			0	0	0	0	B	20					
104																	
105																	
106																	
107																	
108	S	B	C	L	A	L	0	0	0	0	B	30	DP	2			
109																	
110																	
111																	
112																	
113																	
114	U	B	C	H			1	0	0	0	B	40					
115		B	C	H			0	0	0	0	B	40					
116																	
117																	
118																	
119																	
120																	
121																	
122																	
123																	
124		B	C	M	A	L	1	0	1	0	B	25	LWD	2			
125																	
126																	
127																	
128																	
129																	
130																	
131																	
132																	
133																	
134																	

Detail Number	Disturbance Indicator 1	Disturbance Indicator 2	Disturbance Indicator 3	Riparian Veg Type	Riparian Veg Structure	Riparian Veg Canopy Closure	Barriers
100							
101							
102							
103	EB			M	YF	1	N
104							
105							
106							
107							
108	EB	WG		D	YF	1	N
109							
110							
111							
112							
113							
114	WG			M	MF	1	N
115				M	MF	1	N
116							
117							
118							
119							
120							
121							
122							
123							
124	WG			M	MF	2	N
125							
126							
127							
128							
129							
130							
131							
132							
133							
134							

Detail Number	COMMENTS
100	SAME OCH DEVELOPMENT WOULD RUN PARALLEL TO THIS UNIT
101	CAT 2 RIFFLE (17m) / ERODED BANKS - LEFT BANK / FROM THIS UNIT TO THE END OF THE REACH ALGAE DECREASES AS THE GRADIENT INCREASES
102	CAT 2 RIFFLE (29m)
103	ERODED BANK (LEFT BANK) / PHOTO #29 (looking upstream)
104	HABITAT RESTORATION POTENTIAL - plant more trees and shrubs along the dyke (right bank) / ISOLATED SEDIMENT AND GRAVEL DEPOSITS ON THE UPPER BANK
105	ISOLATED SPAWNING HABITAT FOR RESIDENT
106	ERODING BANK (LEFT BANK) - MAJOR SEDIMENT SOURCE FOR THE ENTIRE UNIT
107	
108	
109	
110	
111	FISH PRESENCE NOTED - FRY / ISOLATED ANADROMOUS SPAWNING POCKETS / CASCADE-POOL SEQUENCE - ISOLATED SMALL POOLS
112	
113	END OF DYKE / ROAD BRIDGE
114	SUBSAMPLING FRACTIONS : R = 1:5, P = 1:10, G = 1:5, C = 1:10, O = 1:5 / RIPARAIN HABITAT LACKING AS MOST OF THIS UNIT IS BENEATH THE ROAD BRIDGE
115	
116	BOULDER CASCADE - MEDIUM STEEP - LOW FLOW - YET ACCESSIBLE TO SALMON
117	
118	
119	
120	
121	
122	
123	
124	FISH PRESENCE OBSERVED (FRY NOTED - X 2)
125	
126	
127	
128	
129	
130	
131	DEEP LARGE ADULT HOLDING POOL - DOWNSTREAM OF BEDROCK-BOULDER FLOW RESISTOR / PHOTO #30 (UPSTREAM TO POOL)
132	HABITAT RESTORATION POTENTIAL - add large boulders to mainstem to reduce the gradient / CASCADE UNIT WHICH MAY BE A BARRIER TO FISH AT LOW FLOW / PHOTO #31 (Upstream to falls / cascade)
133	
134	FISH PRESENCE NOTED - (0 - 1 +) fry observed

Form Number	Detail Number	Sub-Basin	Reach #	Distance from mouth	UTM Zone	UTM Easting	UTM Northing	Habitat Unit Type	Habitat Unit Cat.	Length (m)	Gradient (%)	Mean Depth Bankfull	Mean Depth Water	Mean Width Bankfull	Mean Width Wetted	Pool Max Depth	Pool Crest	Pool Residual
4	135	MAINSTEM	7	4363				P	1	24								
4	136	MAINSTEM	7	4383				R	1	20								
4	137	MAINSTEM	7	4393				P	1	10								
4	138	MAINSTEM	7	4405				C	1	12								
4	139	MAINSTEM	7	4418				G	1	13								
4	140	MAINSTEM	7	4431				C	1	13								
4	141	MAINSTEM	7	4437				P	1	6	0	1.7	1.65	20.6	12.1	1.05	0.25	0.8
4	142	MAINSTEM	7	4444				C	1	7	16	1	0.55	17.3	8.1			
4	143	MAINSTEM	7	4450				R	1	6	1	0.6	0.25	14	7.8			
4	144	MAINSTEM	7	4460				P	1	10								
4	145	MAINSTEM	7	4470				C	1	10								
4	146	MAINSTEM	7	4475				P	1	5								
4	147	MAINSTEM	7	4480				C	1	5								
4	148	MAINSTEM	7	4494				G	1	14								
4	149	MAINSTEM	7	4514				C	1	20								
4	150	MAINSTEM	7	4521				P	1	7								
4	151	MAINSTEM	7	4526				C	1	5								
4	152	MAINSTEM	7	4531				P	1	5								
4	153	MAINSTEM	7	4536				C	1	5								
4	154	MAINSTEM	7	4548				P	1	12								
4	155	MAINSTEM	7	4564				C	1	16								
4	156	MAINSTEM	7	4568				P	1	4								
4	157	MAINSTEM	7	4591				G	1	23								
4	158	MAINSTEM	7	4602				P	1	11								
4	159	MAINSTEM	7	4616				C	1	14								
4	160	MAINSTEM	7	4629				P	1	13								
4	161	MAINSTEM	7	4637				C	1	8								
4	162	MAINSTEM	7	4658				P	1	21								
4	163	MAINSTEM	7	4692				C	1	34								
4	164	MAINSTEM	7	4703				P	1	11	0	1.45	0.45	16.2	8.2	0.95	0.2	0.75
4	165	MAINSTEM	7	4709				C	1	6	13	1.15	0.4	19.1	7.3			
4	166	MAINSTEM	7	4717				P	1	8								
4	167	MAINSTEM	7	4725				C	1	8								
4	168	MAINSTEM	7	4734				P	1	9								
4	169	MAINSTEM	7	4751				C	1	17								
4	170	MAINSTEM	7	4772				P	1	21								
4	171	MAINSTEM	7	4774				C	1	2								

Detail Number	Pool Type	Bed Material Dom	Bed Material Sub-Dom	Bed Compaction	Spawning Gravel Type	Spawning Gravel Amount	Total LWD Tally	LWD Tally 10-20	LWD Tally 20-50	LWD Tally 50 plus	Cover Type 1	Cover Percent 1	Cover Type 2	Cover Percent 2	Offchannel Type	Offchannel Access	Offchannel Length (m)
135																	
136																	
137																	
138																	
139																	
140																	
141	D	B	C	L			2	0	0	1	B	25	DP	5			
142		B	C	H			0	0	0	0	B	30					
143		B	C	L			0	0	0	0	B	20					
144																	
145																	
146																	
147																	
148																	
149																	
150																	
151																	
152																	
153																	
154																	
155																	
156																	
157																	
158																	
159																	
160																	
161																	
162																	
163																	
164	S	B	C	L			1				B	30					
165		B	C	H			0	0	0	0	B	40	SWD	2			
166																	
167																	
168																	
169																	
170																	
171																	

Detail Number	Disturbance Indicator 1	Disturbance Indicator 2	Disturbance Indicator 3	Riparian Veg Type	Riparian Veg Structure	Riparian Veg Canopy Closure	Barriers
135							
136							
137							
138							
139							
140							
141	MB			M	MF	4	N
142	MB			M	MF	4	N
143	SC	MB		M	MF	4	N
144							
145							
146							
147							
148							
149							
150							
151							
152							
153							
154							
155							
156							
157							
158							
159							
160							
161							
162							
163							
164	PD			M	MF	3	N
165	EB			M	MF	2	N
166							
167							
168							
169							
170							
171							

Detail Number	COMMENTS
135	
136	
137	
138	
139	FISH PRESENCE NOTED - (0 + and 1+) fry observed / CAT 2 (begin) - 63m - LONG RIFFLE - SMALL POOLS - 2ND CHANNEL
140	
141	FISH PRESENCE NOTED - fry / STEEP CASCADE - UPPER LIMIT OF HABITAT UNIT
142	PHOTO #32 - (Upstream to cascade)
143	
144	
145	FISH PRESENCE OBSERVED (IN CAT 2 RIFFLE) / CAT 2 - LONG RIFFLE FROM ABOVE ENDS (63m)
146	
147	
148	ISOLATED POCKETS OF ANADROMOUS SPAWNING SUBSTRATE
149	
150	
151	
152	ADULT DEEP HOLDING POOL
153	
154	
155	
156	
157	
158	
159	ISOLATED POCKETS OF ANADROMOUS SPAWNING SUBSTRATE
160	PHOTO #33 (Upstream to cascades)
161	CASCADES - IMPASSABLE TO FISH AT LOW FLOW /
162	
163	
164	
165	ADULT HOLDING POOL
166	PHOTO #34 (Upstream to cascades)
167	
168	
169	
170	
171	STEEP FALLS /LONG DROP-IMPASSABLE FOR FISH AT ALL FLOWS/FALLS ARE IDENTIFIED IN FISS/These FALLS determine the reach break/From this unit up to the WEIR(S)-there are a series of mostly IMPASSABLE CASCADES AT LOW FLOW/PHOTO #1 (U/S to falls), PHOTO # 2 (

Form Number	Detail Number	Sub-Basin	Reach #	Distance from mouth	UTM Zone	UTM Easting	UTM Northing	Habitat Unit Type	Habitat Unit Cat.	Length (m)	Gradient (%)	Mean Depth Bankfull	Mean Depth Water	Mean Width Bankfull	Mean Width Wetted	Pool Max Depth	Pool Crest	Pool Residual
4	172	MAINSTEM	8	4804	10	492497	5505554	P	1	30	0	1.9	1	13.2	8.4	2.1	0.15	1.95
4	173	MAINSTEM	8	4819				C	1	15	25	1.1	0.4	20	12			
4	174	MAINSTEM	8	4824				P	1	5								
4	175	MAINSTEM	8	4830				C	1	6								
4	176	MAINSTEM	8	4844				P	1	14								
4	177	MAINSTEM	8	4858				C	1	14								
4	178	MAINSTEM	8	4873				P	1	15								
4	179	MAINSTEM	8	4886				C	1	13								
4	180	MAINSTEM	8	4899				P	1	13								
4	181	MAINSTEM	8	4902				C	1	3								
4	182	MAINSTEM	8	4908				P	1	6								
4	183	MAINSTEM	8	4910				C	1	2								
4	184	MAINSTEM	8	4920				R	1	10	3	1.3	0.4	17.9	7.6			
4	185	MAINSTEM	8	4930				P	1	10								
4	186	MAINSTEM	8	4940				C	1	10								
4	187	MAINSTEM	8	4950				P	1	10								
4	188	MAINSTEM	8	4957				C	1	7								
4	189	MAINSTEM	8	4974				P	1	17								
4	190	MAINSTEM	8	5026				C	1	52								
4	191	MAINSTEM	8	5044				P	1	18								
4	192	MAINSTEM	8	5051				C	1	7								
4	193	MAINSTEM	8	5060				P	1	9	0	1.85	0.5	13.6	7.5	1.15	0.1	1.05
4	194	MAINSTEM	8	5070				C	1	10	17	1.25	0.25	20	7.7			
4	195	MAINSTEM	8	5104				R	1	34								
4	196	MAINSTEM	8	5114				P	1	10								
4	197	MAINSTEM	8	5155				R	1	41	2	1.1	0.4	16	9.1			
4	198	MAINSTEM	8	5167				P	1	12								
4	199	MAINSTEM	8	5174				C	1	7								
4	200	MAINSTEM	8	5240				R	1	66								
4	201	MAINSTEM	8	5247				P	1	7								
4	202	LITTLE STAW	1	10	10	489725	5504278	G	1	10	1	0.5	0.1	5.9	3.2			
4	203	LITTLE STAW	1	16				R	1	6	1	0.65	0.15	6.9	3.7			
4	204	LITTLE STAW	1	21				P	1	5	0	0.2	0.15	11	3.5	0.3	0.05	0.25

Detail Number	Pool Type	Bed Material Dom	Bed Material Sub-Dom	Bed Compaction	Spawning Gravel Type	Spawning Gravel Amount	Total LWD Tally	LWD Tally 10-20	LWD Tally 20-50	LWD Tally 50 plus	Cover Type 1	Cover Percent 1	Cover Type 2	Cover Percent 2	Offchannel Type	Offchannel Access	Offchannel Length (m)
172	D	B	C	L	R	L	0	0	0	0	DP	35	B	60			
173		B	R	H			3	0	1	2	B	40	LWD	2			
174																	
175																	
176																	
177																	
178																	
179																	
180																	
181																	
182																	
183																	
184		B		M			0	0	0	0	B	25					
185																	
186																	
187																	
188																	
189																	
190																	
191																	
192																	
193	U	B	C	L			0	0	0	0	B	40	DP	5			
194		B	C	H			0	0	0	0	B	20					
195																	
196																	
197		B	G	M	R	L	0	0	0	0	B	15					
198																	
199																	
200																	
201																	
202		S	G	L			15	3			OV	30	SWD	20			
203		S	G	L			2				SWD	10	OV	5			
204	U	S		L			3	1			LWD	10	SWD	5			

Detail Number	Disturbance Indicator 1	Disturbance Indicator 2	Disturbance Indicator 3	Riparian Veg Type	Riparian Veg Structure	Riparian Veg Canopy Closure	Barriers
172	PD			M	MF	2	C
173	JM	PD		M	MF	1	C
174							
175							
176							
177							
178							
179							
180							
181							
182							
183							
184	EB			M	MF	2	N
185							
186							
187							
188							
189							
190							
191							
192							
193	PD			M	MF	1	N
194	PD	EB		M	MF	1	N
195							
196							
197	WG			M	MF	1	N
198							
199							
200							
201							
202	PD			D	PS	5	X
203				D	PS	5	N
204	MB			D	PS	4	N

Detail Number	COMMENTS
172	SUBSAMPLING FRACTIONS : R = 1:3, P = 1:10, G = 1:5, C = 1:10, O = 1:5 / FISH OBSERVED - many fry IDENTIFIED BY NET CATCHING AS RAINBOW TROUT / LOWER END OF HABITAT UNIT = STEEP IMPASSABLE FALLS / UPPER HABITAT UNIT - MEDIUM STEEP FALLS - AGAIN IMPASS
173	
174	
175	PHOTO #3 (Upstream to cascades)
176	
177	
178	
179	
180	
181	
182	
183	
184	MAJOR LANDSIDE (1998) ON LEFT BANK - (SPANS A FEW HABITAT UNITS) SIGNIFICANT SOURCE OF LWD, SEDIMENT, BOULDER AND COBBLE TO THE MAINSTEM / PHOTO #4 (Across the stream to the slide)
185	FRY OBSERVED
186	BOULDER BARRIERS RESULTING FROM THE SLIDE
187	
188	EXTENSIVE POCKETS FOR RESIDENT SPAWNING / HIGH ON RIGHT BANK WATER APPEARED TO BE FLOWING DOWNHILL THROUGH A SMALL PIPE
189	
190	EXTENSIVE SEDIMENT WEDGES / POCKETS ON LEFT BANK
191	
192	
193	
194	
195	FISH OBSERVED - fry / OVERGROWN ROAD PARALLELS RIFFLE ALONG RIGHT BANK
196	
197	FISH OBSERVED - adult / PHOTO #5 (Upstream to old and new weir)
198	SIGNIFICANT DECREASE IN CHANNEL GRADIENT and CANOPY COVER FROM THIS POINT UP TO THE WEIR / TOP OF THIS HABITAT UNIT IS THE OLD WEIR / ISOLATED SPAWNING FOR RESIDENT IN THE QUICKER WATER
199	
200	BOULDERS AT BASE OF NEW WEIR PRESENT - to prevent scour / PHOTO #6 (Upstream to new weir)
201	
202	SUBSAMPLING FRACTIONS : R=1:5, P=1:5, G=1:5, C=1:5, O=1:5/ organic coating on substrate, murky film floating on the surface of the pools-These organically coated rocks are more evident downstream of the pond-The rocks upstream are not as coated and the H2
203	
204	CAT 2 POOL ¯ 15M

Form Number	Detail Number	Sub-Basin	Reach #	Distance from mouth	UTM Zone	UTM Easting	UTM Northing	Habitat Unit Type	Habitat Unit Cat.	Length (m)	Gradient (%)	Mean Depth Bankfull	Mean Depth Water	Mean Width Bankfull	Mean Width Wetted	Pool Max Depth	Pool Crest	Pool Residual
4	205	LITTLE STAW	1	26				R	1	5								
4	206	LITTLE STAW	1	34				P	1	8								
4	207	LITTLE STAW	1	46				R	1	12								
4	208	LITTLE STAW	1	60				G	1	14								
4	209	LITTLE STAW	1	65				R	1	5								
4	210	LITTLE STAW	1	70				G	1	5								
4	211	LITTLE STAW	1	73				R	1	3	2	0.6	0.15	5.9	3.4			
4	212	LITTLE STAW	1	79				G	1	6								
4	213	LITTLE STAW	1	93				R	1	14								
4	214	LITTLE STAW	1	102				G	1	9	1	0.36	0.16	8	3.2			
4	215	LITTLE STAW	1	105				R	1	3								
4	216	LITTLE STAW	1	118				G	1	13								
4	217	LITTLE STAW	1	120				P	1	2								
4	218	LITTLE STAW	1	122				R	1	2								
4	219	LITTLE STAW	1	128				G	1	6								
4	220	LITTLE STAW	1	140				R	1	12								
4	221	LITTLE STAW	1	148				G	1	8								
4	222	LITTLE STAW	1	156				P	1	7								
4	223	LITTLE STAW	1	196				R	1	40	1	0.25	0.15	8.1	3.6			
4	224	LITTLE STAW	1	202				P	1	6	0	0.3	0.15	6.6	5.6	0.5	0.05	0.45
4	225	LITTLE STAW	1	210				P	1	8								
4	226	LITTLE STAW	1	215				R	1	5								

Detail Number	Pool Type	Bed Material Dom	Bed Material Sub-Dom	Bed Compaction	Spawning Gravel Type	Spawning Gravel Amount	Total LWD Tally	LWD Tally 10-20	LWD Tally 20-50	LWD Tally 50 plus	Cover Type 1	Cover Percent 1	Cover Type 2	Cover Percent 2	Offchannel Type	Offchannel Access	Offchannel Length (m)
205																	
206																	
207																	
208																	
209																	
210																	
211		C	S	M			1	1			SWD	40	OV	20			
212																	
213																	
214		C	S	L			1								SC	P	150
215																	
216																	
217																	
218																	
219																	
220																	
221																	
222																	
223		C	S	L			0				OV	10	SWD	5			
224	D	S	C	L			1	1			LWD	5	SWD	2	SC	P	20
225																	
226																	

Detail Number	Disturbance Indicator 1	Disturbance Indicator 2	Disturbance Indicator 3	Riparian Veg Type	Riparian Veg Structure	Riparian Veg Canopy Closure	Barriers
205							
206							
207							
208							
209							
210							
211	EB			D	YF	3	N
212							
213							
214	BC			D	YF	4	N
215							
216							
217							
218							
219							
220							
221							
222							
223	LR			D	PS	4	N
224	BC			D	YF	4	N
225							
226							

Detail Number	COMMENTS
205	***FISH NOTED***
206	
207	GOOD SPAWNING - SALMON (BIGGER SUBSTRATE)
208	
209	
210	
211	
212	CHANNEL WIDENS, FLOW HAS MORE VOLUME / ISOLATED SPAWNING POCKETS
213	
214	
215	***POTENTIAL RESTORATION OPPORTUNITY - DREDGING OF SIDE CHANNEL FOR FISH ACCESS IN LOW FLOW PERIODS*** / SIDE CHANNEL CONNECTS TO MAINSTEM - STAGNANT WATER EXISTS WITHIN - THIS SIDE CHANNEL EXISTS FROM DETAIL 215 - 222...APPROX 50M LONG
216	
217	
218	
219	
220	SHALLOW RIFFLE WITH ISOLATED POCKETS
221	***FISH NOTED***
222	
223	>>>PHOTO #1 - COATED SUBSTRATE>>>
224	***POTENTIAL AREA FOR RESTORATION - TO DREDGE THE SIDE CHANNEL AT LOW FLOW*** / SIDE CHANNEL EXISTS / LOG DAM AT UPPER END OF HABITAT UNIT
225	
226	***POTENTIAL AREA FOR RESTORATION - TO REMOVE PART OF THE LOG JAM SO FISH HAVE EASIER ACCESS / LOG JAM AT UPPER END OF HABITAT UNIT / >>>PHOTO#2 - UPSTREAM TO LOG JAM>>>

Form Number	Detail Number	Sub-Basin	Reach #	Distance from mouth	UTM Zone	UTM Easting	UTM Northing	Habitat Unit Type	Habitat Unit Cat.	Length (m)	Gradient (%)	Mean Depth Bankfull	Mean Depth Water	Mean Width Bankfull	Mean Width Wetted	Pool Max Depth	Pool Crest	Pool Residual
4	227	LITTLE STAW	1	225				G	1	10								
4	228	LITTLE STAW	1	243				R	1	18								
4	229	LITTLE STAW	1	249				G	1	6	1	0.2	0.1	3.7	3.6			
4	230	LITTLE STAW	1	252				R	1	3								
4	231	LITTLE STAW	1	259				P	1	7								
4	232	LITTLE STAW	1	271				G	1	12								
4	233	LITTLE STAW	1	277				P	1	6								
4	234	LITTLE STAW	1	286				R	1	9								
4	235	LITTLE STAW	1	291				C	1	5	4	0.15	0.05	10.5	3.7			
4	236	LITTLE STAW	1	361				P	1	70	0	0.15	0.4	15	10	0.75	0.1	0.65
4	237	LITTLE STAW	1	631						270								
4	238	LITTLE STAW	1	791						160								
4	239	LITTLE STAW	1	846						55								
4	240	LITTLE STAW	1	988														
4	241	LITTLE STAW	1	1003														
4	242	LITTLE STAW	1	1019														
4	243	LITTLE STAW	1	1075														
4	244	LITTLE STAW	1	1141														
4	245	LITTLE STAW	1	1178														
4	246	LITTLE STAW	1	1181														
4	247	LITTLE STAW	1	1226														
4	248	LITTLE STAW	1	1281														

Detail Number	Pool Type	Bed Material Dom	Bed Material Sub-Dom	Bed Compaction	Spawning Gravel Type	Spawning Gravel Amount	Total LWD Tally	LWD Tally 10-20	LWD Tally 20-50	LWD Tally 50 plus	Cover Type 1	Cover Percent 1	Cover Type 2	Cover Percent 2	Offchannel Type	Offchannel Access	Offchannel Length (m)
227																	
228																	
229		S	C	L			2	0	1		OV	20	SWD	5			
230																	
231																	
232																	
233																	
234																	
235		C	S	M			1	1			SWD	5	OV	2	SC	P	10
236	D	C	G	L			15	5			LWD	15	SWD	5	SL	G	
237																	
238																	
239																	
240																	
241																	
242																	
243																	
244																	
245																	
246																	
247																	
248																	

Detail Number	Disturbance Indicator 1	Disturbance Indicator 2	Disturbance Indicator 3	Riparian Veg Type	Riparian Veg Structure	Riparian Veg Canopy Closure	Barriers
227							
228							
229	MB			D	YF	4	N
230							
231							
232							
233							
234							
235	PD	DW		D	YF	3	N
236	EB			D	YF	3	BR
237							
238							
239							
240							
241							
242							
243							
244							
245							
246							
247							
248							

Detail Number	COMMENTS
227	
228	
229	CAT 2 POOL (4M) / CAT 2 GLIDE (6M) / CAT 2 RIF (2M) / CAT 2 POOL (3.5M)
230	
231	***RESTORATION PTL***- REMOVE ANTHROPOGENIC DEBRIS/ANTHROPOGENIC DEBRIS PRESENT FROM DETAIL 231 - 238-i.e. tires, metal strapping, garbage, wood framing/FLOW IS STEADY-DTL 231 - 236/ORGANIC COATING-SCUM-FE? ON ROCKS-DTL 231 - 237
232	
233	
234	
235	SIDE CHANNEL PRESENCE - DOMINANTLY DRIED UP WITH SOME STAGNANT H20 POCKETS / >>>PHOTO# 3 - STAGNANT POOL IN SIDECHANNEL<<<
236	sediment source-resulting from access to pedestrain bridge/backpooling occurring above bridge-creating pond-H2O murky -sediment infilling reducing flow- pond being fed by trib/DFO surveying pond and trib-Russel Jacob-Squamish Nation/DFO crew working for M
237	Flow intermittent DTL 237 - 238 (430M U/S from pond at sed. source-ped bridge)/substrate cleaner- less evidence of scum fr DTL 237- 238/Spawning substrate present (A&R)/ pwline above-Shrub dominant, less canopy/Ample OHV/pool morpoholgy anticipated during
238	FOR THE NEXT 160M UP TO THE ROAD CROSSING CULVERT, THE BANKS ARE ERODING / NO FLOW AT THE CULVERT / *FISH PRESENCE NOTED** / *POTENTIAL FOR RESTORATION - STABILIZE - RIP RAP THE BANKS and fix culvert to allow fish passage at low flow>PHOTO #8 - CULVERT<
239	***FISH IN POOLS*** / CHANNEL TRAINED fr residential devpt/ERODING BANKS/INTERMITTENT FLOW/TREE DAM creating a PARTIAL BARRIER/Residences bordering LB/ >80% CVR/COBBLE dominant/PWRLINE NOT ABOVE
240	CHANNEL MEANDERING / OLD CHANNEL CONFLUENCE - DRY NOW / HIGH BANK ON OLD CHANNEL RIGHT SIDE / BOULDERS PRESENT IN UPPER COMPONENT OF THIS INTERVAL /
241	CHANNEL MEANDERING / TRIBUTARY CONFLUENCE
242	***FISH IN POOLS *** / FLOW CONSISTENT/CHNL MEANDERING/ LOG JAM creating partial barrier/ DENSE CANOPY/AMPLE OHV/ HIGH FERN CVR/RESIDENSES not visible/PWLINE APPEARS at end of hab unit, reducing canopy, shrub dominating
243	INTERMITTENT yet ALMOST STEADY FLOW/CHNL TRAINING EVIDENT/ERODED BANKS & SED WEDGES/ Residences reappear/ ***RESTORATION PTL-to STABILIZE BANK & REDUCE SED LOADING (RIP RAP?) *** /PHOTO #9-eroded bank/sed wedge
244	***FISH PRESENCE NOTED*** / FLOW IS LOW BUT STEADY / CHANNEL MEANDERING MORE EVIDENT THAN IMMEDIATELY DOWNSTREAM / AMPLE OVERHANGING VEGETATION / RESIDENCES CLOSE TO LEFT BANK / SMALL BOULDERS / CHANNEL CONSTRICTED? /
245	TRIBUTARY CONFLUENCE / FLOW IS LOW BUT STEADY /
246	***FISH PRESENCE NOTED*** / LOW BUT STEADY FLOW / FOOT LOG BRIDGE - SEDIMENT SOURCE / FLOW IS LOW BUT STEADY / DENSE BRUSH / >>>PHOTO #10 - BRIDGE <<< /
247	FLOW IS LOW BUT STEADY / HIGH VOLUME OF DEBRIS IN CREEK (WOOD, STEEL ETC) CREATING A DEBRIS - LOG JAM / RESIDENCES DISAPPEAR FROM THE BANK / MATURE FOREST PRESENT IN THE RIPARIAN / POWERLINE ROW NOT VISIBLE / >>>PHOTO S #11 AND #12 - DEBRIS JAM /
248	***FISH PRESENCE NOTED IN POOLS *** / INTERMITTENT FLOW / LOG JAM PRESENT WHICH WOULD CREATE A BARRIER IN LOW FLOW / AMPLE OVERHANGING VEGETATION / RESIDENCES STILL NOT VISIBLE /

Form Number	Detail Number	Sub-Basin	Reach #	Distance from mouth	UTM Zone	UTM Easting	UTM Northing	Habitat Unit Type	Habitat Unit Cat.	Length (m)	Gradient (%)	Mean Depth Bankfull	Mean Depth Water	Mean Width Bankfull	Mean Width Wetted	Pool Max Depth	Pool Crest	Pool Residual
4	249	LITTLE STAW	1	1295														
4	250	LITTLE STAW	1	1361														
4	251	LITTLE STAW	1	1446														
4	252	LITTLE STAW	1	1481														
4	253	LITTLE STAW	1	1538														
4	254	LITTLE STAW	1	1565														
4	255	LITTLE STAW	1	1691														
4	256	LITTLE STAW	1	1701														
4	257	LITTLE STAW	1	1856														
4	258	LITTLE STAW	1	1937														
4	259	LITTLE STAW	1	2017														
4	260	LITTLE STAW	1	2158														
4	261	LITTLE STAW	1	2208														
4	262	LITTLE STAW	1	2258														
4	263	LITTLE STAW	1	2308														
4	264	LITTLE STAW	1	2358														
4	265	LITTLE STAW	1	2408														
4	266	LITTLE STAW	1	2458														
4	267	LITTLE STAW	1	2508														
4	268	LITTLE STAW	1	2558														
4	269	LITTLE STAW	1	2608														
4	270	LITTLE STAW	1	2658														

Detail Number	Pool Type	Bed Material Dom	Bed Material Sub-Dom	Bed Compaction	Spawning Gravel Type	Spawning Gravel Amount	Total LWD Tally	LWD Tally 10-20	LWD Tally 20-50	LWD Tally 50 plus	Cover Type 1	Cover Percent 1	Cover Type 2	Cover Percent 2	Offchannel Type	Offchannel Access	Offchannel Length (m)
249																	
250																	
251																	
252																	
253																	
254																	
255																	
256																	
257																	
258																	
259																	
260																	
261																	
262																	
263																	
264																	
265																	
266																	
267																	
268																	
269																	
270																	

Detail Number	Disturbance Indicator 1	Disturbance Indicator 2	Disturbance Indicator 3	Riparian Veg Type	Riparian Veg Structure	Riparian Veg Canopy Closure	Barriers
249							
250							
251							
252							
253							
254							
255							
256							
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267							
268							
269							
270							

Detail Number	COMMENTS
249	NO FLOW / RESIDENCES REAPPEAR ON LEFT BANK / POWERLINE ROW ABOVE / CANOPY MINIMAL - SHRUB DOMINANT /
250	RESTORATION PTL-build bridge & replace pedestrian path through ck/fish in isolated pond/no flow/river trained /pwline ROW above residences on LB/ apartment LB & McNaughton Park RB/eroded banks/3 parking block cement barriers in ck~25m apart-pool creation
251	NO FLOW / POWERLINE ROW ABOVE / RIVER TRAINED / DIRT ROAD CROSSING WITH CULVERTS IN STREAM / MATURE FOREST PRESENT IN RIPARIAN ZONE / RESIDENCES ON LEFT BANK /
252	INTERMITTENT FLOW / NO POWERLINE ROW / CHANNEL MEANDERING PRESENT / TRIBUTARY CONFLUENCE / CLIFFSIDE PUB ON LEFT BANK /
253	INTERMITTENT FLOW / CHANNEL MEANDERING / POWERLINE ROW RETURNS / RESIDENCES ON LEFT BANK / LOWER SIDE CHANNEL CONFLUENCE - CHANNEL IS DRY /
254	***FISH PRESENCE NOTED*** / INTERMITTENT FLOW / CHANNEL MEANDERING / POWERLINE ROW RETURNS AND DEPARTS IN UPPER SEGMENT / SIDE CHANNEL IS DRY - UPPER SIDE CHANNEL CONFLUENCE / RESIDENCES ON LEFT BANK / SUBSTRATE IS LARGER COBBLE /
255	INTERMITTENT FLOW / NO POWERLINE ROW / CHANNEL MEANDERING / STORM H20 CULVERT ENTERING ON LEFT BANK / RESIDENCES LEFT BANK / MATURE FOREST PRESENT IN RIPARIAN
256	NO FLOW / NO POWERLINE ROW / CHANNEL TRAINED / RESIDENCES LEFT BANK /RIPRAP PRESENT ON L.B. / BOULDERS PRESENT /
257	***FISH PRESENCE NOTED*** / ERODING BANKS / ***POTENTIAL FOR RESTORATION - STABILIZE ERODING BANKS (RIP RAP?) *** / INTERMITTENT FLOW / RESIDENCES LEFT BANK / NO POWERLINE ROW / CHANNEL TRAINED /
258	INTERMITTENT FLOW/ RESIDENCES ON LEFT BANK / NO POWERLINE ROW ABOVE / CHANNEL TRAINED / LARGE RIP RAP PRESENT ON LEFT BANK /
259	***FISH PRESENCE NOTED*** / LOW BUT STEADY FLOW (TRICKLE) / CHANNEL IS CONSTRICTED / RESIDENCES SETBACK FROM BANK / NO POWERLINE ROW ABOVE / CHANNEL TRAINED / LARGE RIP RAP PRESENT ON LEFT BANK /
260	LOW BUT STEADY FLOW (TRICKLE)/ RESIDENCES ON LEFT BANK / NO POWERLINE ROW ABOVE / CHANNEL TRAINED / PARTIAL ROCK LOG BARRIER /
261	STEADY FLOW / CHANNEL MEANDERING / NO POWERLINE ABOVE / RESIDENCES ON LEFT BANK /CREEK RESEMBLES ALPINE STREAM - MORE PRISTINE / CHANNEL CONSTRICTED / LARGER BOULDERS PRESENT / H20 APPEARS CLEARER THAN DOWNSTREAM /
262	STEADY FLOW / CHANNEL MEANDERING / NO POWERLINE ABOVE / RESIDENCES ON LEFT BANK /CREEK RESEMBLES ALPINE STREAM - MORE PRISTINE /SPAWNING HABITAT FOR BOTH ANADROMOUS AND RESIDENT /
263	STEADY FLOW / CHANNEL MEANDERING / NO POWERLINE ABOVE / RESIDENCES ON LEFT BANK /CREEK RESEMBLES ALPINE STREAM - MORE PRISTINE /SPAWNING HABITAT FOR BOTH ANADROMOUS AND RESIDENT /
264	***FISH PRESENCE***/STEADY FLOW/CHNL MEANDERING/NO PWRLINE ABOVE/RESIDENCES on LB/CRK resembles ALPINE STRM-PRISTINE/ISOLATED POCKETS of RES-TROUT SPAWNING SUBSTRATE/RIP RAP on LB/ROCK PLACEMENT-creating pools
265	STEADY FLOW / CHANNEL MEANDERING / NO POWERLINE ABOVE / RESIDENCES ON LEFT BANK /CREEK RESEMBLES ALPINE STREAM - MORE PRISTINE / RESIDENCES OBSERVED ATOP HIGH RIGHT BANK /
266	STEADY FLOW / CHANNEL MEANDERING / NO POWERLINE ABOVE / RESIDENCES ON LEFT BANK /CREEK RESEMBLES ALPINE STREAM - MORE PRISTINE / ISOLATED POCKETS OF TROUT SPAWNING SUBSTRATE /
267	STEADY FLOW / CHANNEL MEANDERING / NO POWERLINE ABOVE / RESIDENCES ON LEFT BANK /CREEK RESEMBLES ALPINE STREAM - MORE PRISTINE / ABUNDANT RESIDENT TROUT SPAWNING SUBSTRATE /
268	STEADY FLOW / CHANNEL MEANDERING / NO POWERLINE ABOVE / RESIDENCES ON LEFT BANK /CREEK RESEMBLES ALPINE STREAM - MORE PRISTINE / POLE SAPLING RIPARIAN DOMINATES - EVIDENCE OF RELATIVELY RECENT FLOODING TO THIS ZONE??? /
269	STEADY FLOW/CHNL MEANDERING/NO PWRLINE ABOVE/RESIDENCES LB/CRK RESEMBLES ALPINE STREAM-Pristine /H20 TEMP apparently lower than at Staw confluence/ROAD PARALLELS CRK/AMPLE OHV/BOULDERS/CASCADE Habitat/CHNL CONSTRICTS/CULVERT & DEBRIS In CRK
270	STEADY FLOW / CHANNEL MEANDERING/ NO POWERLINE ABOVE / NO RESIDENCES ON LEFT BANK /CREEK RESEMBLES ALPINE STREAM - MORE PRISTINE /MORE ALGAL GROWTH ON SUBSTRATE / SPAWNING SUBSTRATE - RESIDENT /

Form Number	Detail Number	Sub-Basin	Reach #	Distance from mouth	UTM Zone	UTM Easting	UTM Northing	Habitat Unit Type	Habitat Unit Cat.	Length (m)	Gradient (%)	Mean Depth Bankfull	Mean Depth Water	Mean Width Bankfull	Mean Width Wetted	Pool Max Depth	Pool Crest	Pool Residual
4	271	LITTLE STAW	1	2698														
4	272	LITTLE STAW	1	2748														
4	273	LITTLE STAW	1	2798														
4	274	LITTLE STAW	1	2848														
4	275	LITTLE STAW	1	2898														
4	276	LITTLE STAW	1	2948														
4	277	LITTLE STAW	1	2998														
4	278	LITTLE STAW	1	3048														
4	279	LITTLE STAW	1	3098														
4	280	LITTLE STAW	1	3323														
4	281	MAINSTEM	3	586				P	2	5								
4	282	MAINSTEM	4	817				P	2	20								
4	283	MAINSTEM	4	837				G	2	11								
4	284	MAINSTEM	4	848				R	2	23								
4	285	MAINSTEM	4	852				R	2	15								
4	286	MAINSTEM	4	867				P	2	25								
4	287	MAINSTEM	4	892				G	2	15								
4	288	MAINSTEM	4	907				C	2	4								
4	289	MAINSTEM	4	1053				P	2	20								
4	290	MAINSTEM	4	1202				P	2	5								
4	291	MAINSTEM	5	1340				R	2	10								
4	292	MAINSTEM	6	1901				R	2	18								
4	293	MAINSTEM	6	1934				P	2	7								
4	294	MAINSTEM	6	1941				P	2	9								
4	295	MAINSTEM	6	2109				R	2	10								
4	296	MAINSTEM	6	2292				R	2	60								
4	297	MAINSTEM	6	2805				R	2	30								
4	298	MAINSTEM	6	3282				R	2	17								
4	299	MAINSTEM	6	3311				R	2	29								
4	300	MAINSTEM	7	4418				R	2	63								
4	301	LITTLE STAW	1	21				P	2	15								

Detail Number	Pool Type	Bed Material Dom	Bed Material Sub-Dom	Bed Compaction	Spawning Gravel Type	Spawning Gravel Amount	Total LWD Tally	LWD Tally 10-20	LWD Tally 20-50	LWD Tally 50 plus	Cover Type 1	Cover Percent 1	Cover Type 2	Cover Percent 2	Offchannel Type	Offchannel Access	Offchannel Length (m)
271																	
272																	
273																	
274																	
275																	
276																	
277																	
278																	
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294																	
295																	
296																	
297																	
298																	
299																	
300																	
301																	

Detail Number	Disturbance Indicator 1	Disturbance Indicator 2	Disturbance Indicator 3	Riparian Veg Type	Riparian Veg Structure	Riparian Veg Canopy Closure	Barriers
271							
272							
273							
274							
275							
276							
277							
278							
279							
280							
281							
282							
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298							
299							
300							
301							

Detail Number	COMMENTS
271	STEADY FLOW / CHANNEL MEANDERING / NO POWERLINE ABOVE / NO RESIDENCES ON LEFT BANK /CREEK RESEMBLES ALPINE STREAM - MORE PRISTINE /CHANNEL WIDENS AND RESEMBLES A LARGER STREAM (HIGHER ORDER STREAM) /
272	*FISH PRESENCE*/BOG-LIKE HABITAT/FLOW DECREASE/CHNL MEANDERING /NO PWRLINE ABOVE/NO RESIDENCES onLB/CRK RESEMBLES ALPINE STREAM-pristine/SAND DEPOSITS in CRK/HEAVY ALGAL GROWTH on SUBSTRATE/RIPARIAN ZONE IS MATURE FOREST
273	*FISH PRESENCE */BOG-LIKE HABITAT/FLOW DECREASING/CHNL MEANDERING/NO PWRLINE ABOVE/NO RESIDENCES on LB/CRK RESEMBLES ALPINE STRM-pristine/LWD & SWD/ROAD PARALLELS CRK/RIPARIAN HABITAT-MATURE FOREST/AMPLE OHV
274	BOG-LIKE HABITAT PRESENT / FLOW DECREASING / CHANNEL MEANDERING / NO POWERLINE ABOVE / NO RESIDENCES ON LEFT BANK / CREEK RESEMBLES ALPINE STREAM - MORE PRISTINE /LWD AND SWD PRESENT /
275	BOG-LIKE HABITAT MORE EVIDENT / FLOW DECREASING / CHANNEL MEANDERING / NO POWERLINE ABOVE / NO RESIDENCES ON LEFT BANK /WATER STARTING TO STAGNATE / AREA IS WELL MARKED WITH SURVEY STAKES FOR FUTURE DEVELOPMENT /
276	BOG-LIKE HABITAT MORE EVIDENT / FLOW DECREASING / CHANNEL MEANDERING / NO POWERLINE ABOVE / NO RESIDENCES ON LEFT BANK / ***FISH PRESENCE NOTED***
277	BOG-LIKE HABITAT MORE EVIDENT/ FLOW DECREASING / CHANNEL MEANDERING / NO POWERLINE ABOVE / NO RESIDENCES ON LEFT BANK /SOME CASCADE POOL SEQUENCES / CHANNEL SPLITS INTO 3 - SURVEY CREW EXPLORED THE BRANCH WITH THE STEADIEST FLOW /
278	BOG-LIKE HABITAT MORE EVIDENT / NO FLOW / CHANNEL MEANDERING / NO POWERLINE ABOVE / NO RESIDENCES ON LEFT BANK /
279	BOG-LIKE HABITAT MORE EVIDENT / NO FLOW / CHANNEL MEANDERING / NO POWERLINE ABOVE / NO RESIDENCES ON LEFT BANK / APPROACHING THE POWERLINE CLEARING /
280	NO EVIDENCE OF WATER IN CHANNEL FOR AT LEAST 1 YEAR AS BED MATERIAL IS COVERED WITH A THICK LAYER OF MOSS / NO WATER AT ALL / BED CONTINUES PAST THE SURVEY / >>>PHOTO #13 - DRIED UP CREEK BED<<< /
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301	

Form Number	Detail Number	Sub-Basin	Reach #	Distance from mouth	UTM Zone	UTM Easting	UTM Northing	Habitat Unit Type	Habitat Unit Cat.	Length (m)	Gradient (%)	Mean Depth Bankfull	Mean Depth Water	Mean Width Bankfull	Mean Width Wetted	Pool Max Depth	Pool Crest	Pool Residual
4	302	LITTLE STAW	1	249				P	2	4								
4	303	LITTLE STAW	1	253				G	2	6								
4	304	LITTLE STAW	1	259				R	2	2								
4	305	LITTLE STAW	1	261				P	2	4								

Detail Number	Pool Type	Bed Material Dom	Bed Material Sub-Dom	Bed Compaction	Spawning Gravel Type	Spawning Gravel Amount	Total LWD Tally	LWD Tally 10-20	LWD Tally 20-50	LWD Tally 50 plus	Cover Type 1	Cover Percent 1	Cover Type 2	Cover Percent 2	Offchannel Type	Offchannel Access	Offchannel Length (m)
302																	
303																	
304																	
305																	

Detail Number	Disturbance Indicator 1	Disturbance Indicator 2	Disturbance Indicator 3	Riparian Veg Type	Riparian Veg Structure	Riparian Veg Canopy Closure	Barriers
302							
303							
304							
305							

Detail Number	COMMENTS
302	
303	
304	
305	
	SPECIAL NOTE - REFER TO THE BACK OF FIRST PAGE IN APPENDIX A FROM THE STAWAMUS FHAP/CAP/RAP REPORT TO X-REFERENCE THE PHOTO #S IN WRPDES COMMENTS (above) WITH THE CORRESPONDING PHOTO NUMBERS IN THE REPORT TEXT

APPENDIX B

FHAP - FISH DISTRIBUTION SUMMARY

(FORM 5 - FHAP)

Level 1 - Fish Distribution Summary Report

Form Number:	5
Watershed Name:	Stawamus River
Watershed Code:	900-091000-000
Forest District:	Squamish
Survey Date (YYYY/MM/DD):	1998/08/11
Survey Crew:	Francois Landry (FPL) and Julie Orban (J
UTM Zone:	
Easting:	
Northing:	
NTS Maps (1:50,000):	ENTER 092G11 092G12
BCGS Maps (1:20,000):	092G065 092G075

Detail No	Sub Basin	Reach No	Section No	Habitat Type	Survey Method		SK			CH			CM			CO			PK			ST			RB			CT			DV			BT			KO		
					Adults	Juv	juv	ad	sp	juv	ad	sp	juv	ad	sp	juv	ad	sp	juv	ad	sp	juv	ad	sp	juv	ad	sp	juv	ad	sp	juv	ad	sp	juv	ad	sp	juv	ad	sp
13	MAINSTEM	5		P		EL										K																							
12	MAINSTEM	8		P		EL																																	
11	MAINSTEM	7		P		EL										K									K														
10	MAINSTEM	6		P		EL										K									K														
8	MAINSTEM	4		R		EL										K																							
7	LITTLE STAWA			R		EL										K									K														
6	LITTLE STAW			P		EL										K									K	K		K											
5	MAINSTEM	8		P		DN																			K														
4	MAINSTEM	6		P		DN										K																							
3	MAINSTEM	5		P		DN										K																							
2	MAINSTEM	4		P		SN										K																							
1	MAINSTEM	3		P		SN										K																							

APPENDIX C

FHAP - HABITAT DIAGNOSIS SUMMARY

(FORM 6 - FHAP)

Level 1 Field Assessment - Habitat Diagnosis Summary Report

Form Number:	Watershed Name:	Stawamus River
6	Watershed Code:	900-091000-000
	Forest District:	Squamish
	UTM Zone:	10
	Easting:	488881
	Northing:	5504062

Detail No	Sub Basin Name	Reach No	Section No	Percent Pools		Pool Frequency		LWD Pieces		Cover				Substrate			Offchannel Habitat		Spawning Gravel			Spawning Access	
				Value	Rating	Value	Rating	Value	Rating	Wood	Boulder	Overhead	Rating	Dom	Sub	Rating	Value	Rating	uantit	ualit	Rating	Quality	Rating
7	LITTLE STA	1		48	F	4.9	P	2.1	G	14	14	10	F	C	S	P	H	G	L	L	P	L	P
6	MAINSTEM	8		21	P	2	F	0.4	P	0	33	0	F	B	C	G	L	P	M	H	F	L	P
5	MAINSTEM	7		40	G	1.8	G	0.8	P	1	31	0	F	B	C	G	L	P	L	H	P	L	P
4	MAINSTEM	6		11	P	5.3	P	4.7	G	11	4	3	P	C	B	G	M	F	M	H	F	H	G
3	MAINSTEM	5		38	P	1.8	G	4.3	G	6	0	1	P	C	G	F	M	F	L	H	P	H	G
2	MAINSTEM	4		27	P	2.5	F	2.5	G	4	0	1	P	C	G	F	H	G	M	H	F	H	G
1	MAINSTEM	3		50	G	2.7	F	1.8	F	4	1	1	P	C	G	P	L	P	M	M	F	H	G

Form Numba
6

Holding Pools per km		Scour		Nutrients	
Qty	Rating	Qty	Rating	Quality	Rating
0	P	L	G	M	F
30	G	M	F	M	F
12	F	L	G		
9	P	M	F		
22	G	M	F	H	G
11	F	L	G		
16	F	L	G	H	G

APPENDIX D

RAP - RIPARIAN OVERVIEW ASSESSMENT

(FORM 1 - RAP)

Form 1: Riparian Overview Assessment

Watershed Name: Stawamus River **NTS Map:** 92 G/11
Watershed Code: -900-091000 **Air Photo Series/Scale:** SRS 56811 - 1-54; 23 SEP 96

Reach No.	Polygon No.	Stand Structure	Tentative RVT No.	Stream Class	Harvesting/Restocking History	Other Disturbances	Priority for Level 1 or 2
1	1	INIT	1	S2		estuarine; flooding	
1	2	YFm	9	S2		flooding	
1	3	SHd	2	S2		flooding	
1	4	INIT	1	S2		estuarine; flooding	
1	5	SHd	2	S2		flooding	
1	6	INIT	1	S2		estuarine; flooding	
1	7	YFd	7	S2		possible flooding	
1	8	INIT	1	S2		dry land sort & log dump	
2	9	SHd	2	S2		flooding	
2	10	INIT	1	S2		estuarine; flooding	
2	11	SHd	2	S2		flooding	
2	12	YFm	9	S2		flooding	
2	13	INIT	1	S2		road and dyke	
2	14	YFm	9	S2		possible flooding	
2	15	YFd	7	S2		flooding	
2	16	SHd	2	S2		flooding	
2	17	INIT	1	S2		dry land sort & railway	
2	18	YFd	7	S2		possible flooding	
3	19	YFm	9	S2		possible flooding	
3	20	INIT	1	S2		railway corridor	
3	21	YFd	7	S2		flooding	
3	22	SHd	2	S2		hydroline corridor	
3	23	INIT	1	S2		hydroline corridor	
3	24	YFd	7	S2		possible flooding	
3	25	INIT	1	S2		hydroline corridor	
3	26	SHd	2	S2		hydroline corridor	

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Reach No.	Polygon No.	Stand Structure	Tentative RVT No.	Stream Class	Harvesting/Restocking History	Other Disturbances	Priority for Level 1 or 2
3	27	YFd	7	S2		highway corridor	
3	28	INIT	1	S2		highway corridor	
4	29	INIT	1	S2		highway corridor	
4	30	YFm	9	S2		flooding	
4	31	SHd	2	S2		hydroline corridor	
4	32	YFd	7	S2		flooding	
4	33	SHd	2	S2		hydroline corridor	
4	34	SHd	2	S2		flooding	
4	35	YFd	7	S2		flooding	
4	36	SHd	2	S2		hydroline corridor	
4	37	YFc	8	S2			
4	38	PSd	5	S2			
4	39	YFd	7	S2		flooding	
4	40	YFd	7	S2		flooding	
4	41	INIT	1	S2		gravel road	
4	42	SHd	2	S2		hydroline corridor	
4	43	YFm	9	S2		flooding	
4	44	PSd	5	S2		flooding	
4	45	PSd	5	S2		flooding	
4	46	YFm	9	S2		possible flooding	
4	47	YFd	7	S2		flooding	
4	48	YFd	7	S2		flooding	
4	49	SHd	2	S2		flooding	
4	50	INIT	1	S2		logging road	
5	51	PSd	5	S2	L. 1949-52		
5	52	YFd	7	S2	L. 1949-52	flooding	

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Reach No.	Polygon No.	Stand Structure	Tentative RVT No.	Stream Class	Harvesting/Restocking History	Other Disturbances	Priority for Level 1 or 2
5	53	YFd	7	S2	L. 1949-52	flooding	
5	54	YFd	7	S2	L. 1949-52	flooding	
5	55	YFd	7	S2	L. 1949-52	flooding	
5	56	YFd/SHd	7/2	S2	L. 1949-52	flooding	
5	57	SHd	2	S2	L. 1949-52	flooding	
5	58	SHd	2	S2	L. 1949-52	flooding	
5	59	YFm	9	S2	L. 1949-52	possible flooding	
5	60	OFc	12	S2			
6	61	YFd	7	S2	L. 1949-52	flooding	
6	62	YFm	9	S2	L. 1949-52	flooding	
6	63	PSd	5	S2	L. 1949-52	flooding	
6	64	INIT	1	S2	L. 1949-52	logging road cutbank	Yes
6	65	OFc	12	S2			
6	66	MFm	11	S2	L. 1949-52	possible flooding	
6	67	MFm	11	S2	L. 1949-52	residential & Dyke	
6	68	PSm	6	S2		residential & dyke	
6	69	SHd	2	S2		dyke	
6	70	SHd	2	S2		dyke	
6	71	INIT	1	S2		dyke	Yes
6	72	INIT	1	S2	L. 1949-52	residential & dyke	
6	73	SHd	2	S2	L. 1949-52	residential & dyke	
6	74	YFc	8	S2	L. 1949-52	flooding	
6	75	YFd	7	S2	L. 1949-52	flooding	
6	76	SHm	4	S2	L. 1949-52	logging road & flooding	
6	77	SHd	2	S2	L. 1949-52	flooding	
6	78	SHd	2	S2	L. 1949-52	logging road	

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Reach No.	Polygon No.	Stand Structure	Tentative RVT No.	Stream Class	Harvesting/Restocking History	Other Disturbances	Priority for Level 1 or 2
6	79	PSm	6	S2	L. 1949-52	logging road	
6	80	PSd	5	S2	L. 1949-52	flooding	
6	81	MFc	10	S2	L. 1949-52	logging road	
6	82	SHd	2	S2	L. 1949-52	flooding	
6	83	SHd	2	S2	L. 1949-52	flooding	
6	84	SHd	2	S2	L. 1949-52	flooding	
6	85	SHd	2	S2	L. 1949-52	flooding	
6	86	SHd	2	S2	L. 1949-52	flooding	
6	87	SHm	4	S2	L. 1949-52	logging road	
6	88	MFm	11	S2		possible flooding	
6	89	SHd	2	S2	L. 1949-52	logging road	
6	90	SHd	2	S2	L. 1949-52	flooding	Yes
6	91	YFm	9	S2	L. 1949-52	possible flooding	
6	92	MFc	10	S2		possible flooding	
6	93	YFc	8	S2	L. 1949-52	possible flooding	
6	94	YFc	8	S2	L. 1949-52		
6	95	INIT	1	S2		gravel road	
6	96	YFc	8	S2	L. pre. 1947		
6	97	MFm	11	S2			
6	98	INIT	1	S2		logging road	
6	99	MFc	10	S2			
7	100	YFc	8	S2	L. pre. 1947	logging road	
7	101	INIT	1	S2		logging road	
7	102	PSd	5	S2	L. pre. 1947	possible flooding	
7	103	YFc	8	S2	L. pre. 1947		
7	104	YFc	8	S2	L. pre. 1947		

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Reach No.	Polygon No.	Stand Structure	Tentative RVT No.	Stream Class	Harvesting/Restocking History	Other Disturbances	Priority for Level 1 or 2
7	105	INIT	1	S2		logging road	
7	106	YFm	9	S2	L. pre. 1947	flooding	
7	107	MFc	10	S2			
7	108	YFm	9	S2	L. pre. 1947		
7	109	INIT	1	S2		storage shack & clearing	
7	110	YFm	9	S2	L. pre. 1947		
8	111	PSd	5	S2	L. pre. 1947		
8	112	YFm	9	S2	L. pre. 1947	intake structure	
8	113	YFc	8	S2	L. pre. 1947		
8	114	YFc	8	S2	L. pre. 1947		
8	115	OFc	12	S2			
9	116	YFc	8	S2	L. pre. 1947		
9	117	YFc	8	S2	L. pre. 1947		
9	118	YFc	8	S2	L. pre. 1947		
9	119	SHc	3	S2	L. pre. 1947	logging road cutbank	
9	120	OFc	12	S2			
9	121	INIT	1	S2	L. pre. 1947	slide area off road	Yes
9	122	INIT	1	S2	L. pre. 1947	slide area off road	Yes
9	123	SHc	3	S2	L. pre. 1947	logging road & bridge	
9	124	YFc	8	S2	L. 1955, B. 1955, J. 1981 (Op. 77)	logging road	
10	125	SHc	3	S2	L. pre. 1947	logging road & bridge	
10	126	YFc	8	S2	L. pre. 1947		
10	127	INIT/YFm	1/9	S2	L. pre. 1947	slide & pipeline ROW	Yes
10	128	YFc	8	S2	L. pre. 1947		
10	129	MFm	11	S2			
10	130	YFc	8	S2	L. 1955, B. 1955, J. 1981 (Op. 77)		

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Reach No.	Polygon No.	Stand Structure	Tentative RVT No.	Stream Class	Harvesting/Restocking History	Other Disturbances	Priority for Level 1 or 2
10	131	YFc/MFc	8/10	S2			
10	132	YFc	19	S2	L. pre. 1947		
10	133	MFc	21	S2			
10	134	YFc	19	S2			
10	135	YFc/MFc	19/21	S2			
10	136	YFc	19	S2			
10	137	OFc	23	S2			
10	138	YFc	19	S2			
10	139	YFc	19	S2	L. pre. 1947	slide	Yes
10	140	MFc	21	S2	L. pre. 1947		
10	141	SHm	16	S2	L. pre. 1947	slide	Yes
10	142	MFc	21	S2	L. pre. 1947		
10	143	OFc	23	S2			
10	144	YFc/MFc	19/21	S2			
10	145	YFc	19	S2	L. 1951, B. 1951, J.1988 (Op. 114)		
10	146	YFc	19	S2	L. 1951, B. 1951, J.1988 (Op. 114)		
10	147	OFc	23	S2			
10	148	YFc	19	S2	L. pre. 1947		
10	149	YFc	19	S2	L. pre. 1947		
10	150	SHc	15	S2	L. pre. 1947		
10	151	YFc	19	S2	L. pre. 1947		
10	152	YFm	20	S2			
10	153	YFc	19	S2	L. 1951, B. 1951, J.1988 (Op. 114)		
10	154	OFc	23	S2			
10	155	YFc	19	S2	L. 1951, B. 1951, J.1988 (Op. 114)		
10	156	INIT	13	S2		logging road	

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Reach No.	Polygon No.	Stand Structure	Tentative RVT No.	Stream Class	Harvesting/Restocking History	Other Disturbances	Priority for Level 1 or 2
10	157	YFc	19	S2	L. 1951, B. 1951, J.1988 (Op. 114)		
10	158	YFd	18	S2	L. pre. 1947		
11	159	YFc	19	S2	L. pre. 1947		
11	160	INIT	13	S2	L. pre. 1947	logging road	
11	161	OFc	23	S2			
11	162	PSc	17	S2	L. 1955, B. 1955 (Op. 136)		
11	163	YFc	19	S2	L. 1955, B. 1955 (Op. 136)		
11	164	OFc	23	S2			
12	165	PSc	17	S2	L. 1955, B. 1955 (Op. 136)		
12	166	MFc/OFc	21/23	S2			
12	167	YFd	18	S2	L. 1955, B. 1955 (Op. 136)	hydroline corridor	
12	168	INIT	13	S2	L. 1955, B. 1955 (Op. 136)	pipeline corridor	
12	169	YFd	18	S2	L. 1955, B. 1955 (Op. 136)		
12	170	MFc	21	S2			
12	171	OFc	23	S2			
12	172	OFc	23	S2			
12	173	PSc	17	S2	L. 1955, B. 1955 (Op. 136)		
12	174	YFm	20	S2	L. 1955, B. 1955 (Op. 136)		
12	175	YFd	18	S2	L. 1955, B. 1955 (Op. 136)		
12	176	MFm	22	S2	L. 1955, B. 1955 (Op. 136)		
12	177	YFd	18	S2	L. 1955, B. 1955 (Op. 136)		
13	178	MFm	22	S2			
13	179	YFc	19	S2	L. 1955, B. 1955 (Op. 136)		
13	180	MFc	21	S2	L. 1955, B. 1955 (Op. 136)		
13	181	SHd	14	S2	L. 1955, B. 1955 (Op. 136)	old slide	
13	182	YFc	19	S2	L. 1955, B. 1955 (Op. 136)		

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Reach No.	Polygon No.	Stand Structure	Tentative RVT No.	Stream Class	Harvesting/Restocking History	Other Disturbances	Priority for Level 1 or 2
13	183	MFc	21	S2			
13	184	MFc	21	S2			
14	185	SHd	14	S2	L. 1955, B. 1955 (Op. 136)	old slide	
14	186	YFd	18	S2	L. 1955, B. 1955 (Op. 136)		
14	187	MFc/SHm	21/16	S2	L. 1955, B. 1955 (Op. 136)		
14	188	SHm	16	S2	L. 1955, B. 1955 (Op. 136)	old slide	
14	189	PSc	17	S2	L. 1955, B. 1955 (Op. 136)		
14	190	YFm	20	S2	L. 1955, B. 1955 (Op. 136)		
14	191	MFc	21	S2			
14	192	YFc	19	S2	L. 1955, B. 1955 (Op. 136)		
14	193	YFd	18	S2	L. 1955, B. 1955 (Op. 136)		
14	194	YFc	19	S2	L. 1955, B. 1955 (Op. 136)		
14	195	OFc	23	S2			
15	196	YFm	20	S2	L. 1955, B. 1955 (Op. 136)		
15	197	PSc	17	S2	L. 1955, B. 1955 (Op. 136)		
15	198	OFc	23	S2			
15	199	YFc	19	S2	L. 1955, B. 1955 (Op. 136)		
15	200	YFm	33	S2	L. 1955, B. 1955 (Op. 136)		
15	201	YFc	32	S2	L. 1955, B. 1955 (Op. 136)		
15	202	YFc	32	S2	L. 1955, B. 1955 (Op. 136)		
15	203	YFm/OFc	33/35	S2	L. 1955, B. 1955 (Op. 136)		
15	204	YFm	33	S2	L. 1955, B. 1955 (Op. 136)		
15	205	INIT	24	S2	L. 1955, B. 1955 (Op. 136)	pipeline corridor	
15	206	YFd	31	S2	L. 1955, B. 1955 (Op. 136)		
15	207	YFc/OFc	32/35	S2	L. 1955, B. 1955 (Op. 136)		
15	208	SHd	25	S2	L. 1955, B. 1955 (Op. 136)	old slide	

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Reach No.	Polygon No.	Stand Structure	Tentative RVT No.	Stream Class	Harvesting/Restocking History	Other Disturbances	Priority for Level 1 or 2
15	209	OFc	35	S2			
15	210	OFc	35	S2			
15	211	PSc	29	S2	L. 1955, B. 1955 (Op. 136)		
15	212	INIT	24	S2	L. 1955, B. 1955 (Op. 136)	logging road	
15	213	MFc	34	S2			
15	214	SHd	25	S2		avalanche chute	
15	215	OFc	35	S2			
15	216	SHm	27	S2		avalanche chute	
16	217	YFc	32	S2	L. 1955, B. 1955 (Op. 136)		
16	218	INIT	24	S2	L. 1955, B. 1955 (Op. 136)	pipeline corridor & road	
16	219	YFm	33	S2	L. 1955, B. 1955 (Op. 136)		
16	220	YFd	31	S2	L. 1955, B. 1955 (Op. 135)		
16	221	YFd	31	S2	L. 1955, B. 1955 (Op. 135)		
16	222	YFd	31	S2	L. 1955, B. 1955 (Op. 135)		
16	223	YFc	32	S2	L. 1955, B. 1955 (Op. 135)		
16	224	YFm	33	S2	L. 1955, B. 1955 (Op. 135)		
16	225	YFc	32	S2	L. 1955, B. 1955 (Op. 135)		
16	226	YFd	31	S2	L. 1955, B. 1955 (Op. 135)		
16	227	YFd	31	S2	L. 1955, B. 1955 (Op. 135)		
16	228	PSc/SHm	29/27	S2	L. 1955, B. 1955 (Op. 135)		
16	229	SHm	27	S2	L. 1955, B. 1955 (Op. 135)		
16	230	INIT	24	S2	L. 1955, B. 1955 (Op. 135)	slide	Yes
17	231	INIT	24	S2	L. 1955, B. 1955 (Op. 135)	slide	Yes
17	232	SHd	25	S2		old slide area	
17	233	YFc	32	S2	L. 1955, B. 1955 (Op. 135)		
17	234	INIT	24	S2	L. 1955, B. 1955 (Op. 135)	slide	Yes

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Reach No.	Polygon No.	Stand Structure	Tentative RVT No.	Stream Class	Harvesting/Restocking History	Other Disturbances	Priority for Level 1 or 2
17	235	SHd	25	S2	L. 1955, B. 1955 (Op. 135)	hydroline corridor	
17	236	YFc	32	S2	L. 1955, B. 1955 (Op. 31)		
17	237	YFc	32	S2	L. 1955, B. 1955 (Op. 135)		
17	238	OFc	35	S2			
17	239	PSc/YFc	29/32	S2	L. 1955, B. 1955 (Op. 135)		
17	240	YFc	32	S2	L. 1955, B. 1955 (Op. 135)		
18	241	YFc	32	S2	L. 1955, B. 1955 (Op. 31)		
18	242	SHm	27	S2	L. 1955, B. 1955 (Op. 31)	hydroline corridor	
18	243	YFc	32	S2	L. 1955, B. 1955 (Op. 31)		
18	244	YFc	32	S2	L. 1955, B. 1955 (Op. 135)		
18	245	OFc	35	S2			
19	246	SHd	25	S2	L. 1955, B. 1955 (Op. 31)	hydroline corridor	
19	247	SHd	25	S2	L. 1955, B. 1955 (Op. 31)	hydroline corridor	
19	248	OFc	35	S2			
19	249	SHd	25	S2		hydroline corridor	
19	250	SHc	26	S2		hydroline corridor	
19	251	SHm	27	S2		hydroline corridor	
19	252	OFc	35	S2			
19	253	PSd	28	S2	L.1963,72; B.1965; P.1966,70 (Op..38)	old logging road	
19	254	SHm	27	S2		hydroline corridor	
19	255	SHm	27	S2		hydroline corridor	
19	256	SHm	27	S2		hydroline corridor	
19	257	YFc	32	S2	L.1963,72; B.1965; P.1966,70 (Op..38)		
20	258	SHm	27	S2		hydroline corridor	
20	259	SHc	26	S2		hydroline corridor	
20	260	SHd	25	S2		hydroline corridor	

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Reach No.	Polygon No.	Stand Structure	Tentative RVT No.	Stream Class	Harvesting/Restocking History	Other Disturbances	Priority for Level 1 or 2
20	261	OFc	35	S2			
20	262	YFc	32	S2	L.1963,72; B.1965; P.1966,70 (Op..38)		
20	263	SHc	26	S2		hydroline corridor	
20	264	SHm	27	S2		hydroline corridor	
20	265	YFc	32	S2	L.1963,72; B.1965; P.1966,70 (Op..38)		
21	266	SHm	27	S2	L.1963,72; B.1965; P.1966,70 (Op..38)		
21	267	SHd	25	S2	L.1963,72; B.1965; P.1966,70 (Op..38)		
21	268	OFc	35	S2			
21	269	PSm	30	S2			
21	270	SHm	27	S2		hydroline corridor	
21	271	SHm	27	S2		hydroline corridor	
21	272	OFc	35	S2			
22	273	SHd	25	S2		hydroline corridor	
22	274	OFc	35	S2			
22	275	SHd	25	S2		old river channel	
22	276	OFc	35	S2			
22	277	SHm	27	S2		hydroline corridor	
22	278	OFc	35	S2			
22	279	SHm	27	S2			
22	280	YFc	32	S2	L.1963,72; B.1965; P.1966,70 (Op..38)		
22	281	OFc	35	S2			
23	282	OFc	35	S2			
23	283	OFc	35	S2			
24	284	OFc	35	S2			
24	285	OFc	35	S2			
24	286	PSc	29	S2	L.1963,72; B.1965; P.1966,70 (Op..38)		

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Reach No.	Polygon No.	Stand Structure	Tentative RVT No.	Stream Class	Harvesting/Restocking History	Other Disturbances	Priority for Level 1 or 2
24	287	SHc	26	S2	L.1963,72; B.1965; P.1966,70 (Op..38)		
25	288	OFc	35	S2			
25	289	SHd/PSc	25/29	S2	L. 1965-69; B.1967 (Op.42)		Yes
25	290	PSc	29	S2	L. 1965-69; B.1967 (Op.42)		
25	291	SHm	27	S2	L.1963,72; B.1965; P.1966,70 (Op..38)		Yes
25	292	OFc	35	S2			
25	293	OFc	35	S2			
25	294	SHm/PSc	27/29	S2	L.1964,68;B.1965,68;P.1966,70 (Op.45)		
26	295	SHc/PSc	26/29	S2	L. 1965-69; B.1967 (Op.42)		
26	296	SHd/PSc	25/29	S2	L. 1965-69; B.1967 (Op.42)		
26	297	PSc	29	S2	L. 1965-69; B.1967 (Op.42)		
26	298	SHd/PSc	25/29	S2	L.1964,68;B.1965,68;P.1966,70 (Op.45)		
26	299	SHd	25	S2	L.1964,68;B.1965,68;P.1966,70 (Op.45)		
26	300	PSc	29	S2	L.1964,68;B.1965,68;P.1966,70 (Op.45)		
26	301	SHm	27	S2	L.1964,68;B.1965,68;P.1966,70 (Op.45)		
26	302	PSm	30	S2	L.1964,68;B.1965,68;P.1966,70 (Op.45)		
27	303	SHd	25	S2	L. 1965-69; B.1967 (Op.42)		
27	304	SHm/PSc	27/29	S2	L. 1965-69; B.1967 (Op.42)		
27	305	SHd	25	S2	L. 1965-69; B.1967 (Op.42)		
27	306	SHd	25	S2	L. 1965-69; B.1967 (Op.42)	old logging road	
27	307	SHd	25	S2	L. 1965-69; B.1967 (Op.42)	old logging road	
27	308	PSc	29	S2	L. 1965-69; B.1967 (Op.42)		
27	309	SHm	27	S2	L. 1965-69; B.1967 (Op.42)		
27	310	PSc	29	S2	L. 1965-69; B.1967 (Op.42)		
27	311	SHc	26	S2	L.1964,68;B.1965,68;P.1966,70 (Op.45)		
27	312	SHc	26	S2	L.1964,68;B.1965,68;P.1966,70 (Op.45)		

Form 1: Riparian Overview Assessment

Watershed Name: Stawamus River **NTS Map:** 92 G/11
Watershed Code: -900-091000 **Air Photo Series/Scale:** SRS 56811 - 1-54; 23 SEP 96

Reach No.	Polygon No.	Stand Structure	Tentative RVT No.	Stream Class	Harvesting/Restocking History	Other Disturbances	Priority for Level 1 or 2
27	313	SHm	27	S2	L.1964,68;B.1965,68;P.1966,70 (Op.45)		Yes
27	314	SHd	25	S2	L.1964,68;B.1965,68;P.1966,70 (Op.45)	old logging road	
27	315	PSc	29	S2	L.1964,68;B.1965,68;P.1966,70 (Op.45)		
27	316	PSc	29	S2	L.1964,68;B.1965,68;P.1966,70 (Op.45)		
27	317	PSc	29	S2	L.1964,68;B.1965,68;P.1966,70 (Op.45)		
28	318	SHd	25	S2	L. 1965-69; B.1967 (Op.42)		
28	319	PSc	29	S2	L. 1965-69; B.1967 (Op.42)		
28	320	SHd	25	S2	L. 1965-69; B.1967 (Op.42)		Yes
28	321	SHd	25	S2	L. 1965-69; B.1967 (Op.42)		
28	322	SHm	27	S2	L.1964,68;B.1965,68;P.1966,70 (Op.45)		
28	323	PSc	29	S2	L.1964,68;B.1965,68;P.1966,70 (Op.45)		
28	324	SHd	25	S2		avalanche chute	
29	325	SHd	25	S2	L. 1965-69; B.1967 (Op.42)		Yes
29	326	PSc	29	S2	L. 1965-69; B.1967 (Op.42)		
29	327	SHd	25	S2	L. 1965-69; B.1967 (Op.42)	flooding	
29	328	SHd	25	S2		avalanche chute	
29	329	PSc	29	S2	L.1964,68;B.1965,68;P.1966,70 (Op.45)		
29	330	INIT	24	S2	L.1964,68;B.1965,68;P.1966,70 (Op.45)	small slide	Yes
29	331	PSc	29	S2	L.1964,68;B.1965,68;P.1966,70 (Op.45)		
29	332	SHd/PSc	25/29	S2	L.1964,68;B.1965,68;P.1966,70 (Op.45)		
29	333	PSc	29	S2	L.1964,68;B.1965,68;P.1966,70 (Op.45)		
29	334	PSc	29	S2	L.1964,68;B.1965,68;P.1966,70 (Op.45)		
29	335	SHd	25	S2		talus slope	
29	336	SHm	27	S2			
29	337	PSc	29	S2	L.1964,68;B.1965,68;P.1966,70 (Op.45)		
29	338	SHd	25	S2	L.1964,68;B.1965,68;P.1966,70 (Op.45)		

Form 1: Riparian Overview Assessment

Watershed Name: Stawamus River **NTS Map:** 92 G/11
Watershed Code: -900-091000 **Air Photo Series/Scale:** SRS 56811 - 1-54; 23 SEP 96

Reach No.	Polygon No.	Stand Structure	Tentative RVT No.	Stream Class	Harvesting/Restocking History	Other Disturbances	Priority for Level 1 or 2
29	339	INIT	24	S2	L.1964,68;B.1965,68;P.1966,70 (Op.45)	slide	Yes
29	340	SHm	27	S2	L.1964,68;B.1965,68;P.1966,70 (Op.45)	flooding	
30	341	PSc/SHd	29/25	S2	L.1964,68;B.1965,68;P.1966,70 (Op.45)		
30	342	SHm	27	S2	L.1964,68;B.1965,68;P.1966,70 (Op.45)		
30	343	PSc	29	S2	L.1964,68;B.1965,68;P.1966,70 (Op.45)	slide	Yes
30	344	SHm	27	S2	L.1964,68;B.1965,68;P.1966,70 (Op.45)		
31	345	PSc	29	S2	L.1964,68;B.1965,68;P.1966,70 (Op.45)		
31	346	SHm	27	S2	L.1964,68;B.1965,68;P.1966,70 (Op.45)		
31	347	SHd	25	S2	L.1964,68;B.1965,68;P.1966,70 (Op.45)		
31	348	SHd	25	S2	L.1964,68;B.1965,68;P.1966,70 (Op.45)		
31	349	SHd	25	S2	L.1964,68;B.1965,68;P.1966,70 (Op.45)		
31	350	PSc	29	S2	L.1964,68;B.1965,68;P.1966,70 (Op.45)		
31	351	SHm/PSc	27/29	S2	L.1964,68;B.1965,68;P.1966,70 (Op.45)		
31	352	PSc/SHm	29/27	S2	L.1964,68;B.1965,68;P.1966,70 (Op.45)		
31	353	SHm	27	S2	L.1964,68;B.1965,68;P.1966,70 (Op.45)		
32	354	PSc	29	S2	L.1964,68;B.1965,68;P.1966,70 (Op.45)		
32	355	SHd	25	S2	L.1964,68;B.1965,68;P.1966,70 (Op.45)		
32	356	PSc	29	S2	L.1964,68;B.1965,68;P.1966,70 (Op.45)		
32	357	OFc	35	S2			
32	358	SHm	27	S2	L.1964,68;B.1965,68;P.1966,70 (Op.45)		
32	359	PSc	29	S2	L.1964,68;B.1965,68;P.1966,70 (Op.45)		
32	360	SHm	27	S2	L.1964,68;B.1965,68;P.1966,70 (Op.45)		
32	361	SHm	27	S2	L.1964,68;B.1965,68;P.1966,70 (Op.45)		
32	362	SHd	25	S2	L.1964,68;B.1965,68;P.1966,70 (Op.45)		
32	363	OFc	35	S2			
33	364	SHd	25	S2		talus slope	

Form 1: Riparian Overview Assessment

Watershed Name: Stawamus River **NTS Map:** 92 G/11
Watershed Code: -900-091000 **Air Photo Series/Scale:** SRS 56811 - 1-54; 23 SEP 96

Reach No.	Polygon No.	Stand Structure	Tentative RVT No.	Stream Class	Harvesting/Restocking History	Other Disturbances	Priority for Level 1 or 2
33	365	OFc	35	S2			
33	366	SHd/PSc	25/29	S2	L.1964,68;B.1965,68;P.1966,70 (Op.45)		
33	367	OFc	35	S2			

Form 1: Riparian Overview Assessment

Watershed Name: Little Stawamus River **NTS Map:** 92 G/11
Watershed Code: -900-091000 **Air Photo Series/Scale:** SRS 56811- 45-51; 23 SEP 96

Reach No.	Polygon No.	Stand Structure	Tentative RVT No.	Stream Class	Harvesting/Restocking History	Other Disturbances	Priority for Level 1 or 2
na	1s	YFd	7	S3		flooding	
na	2s	PSd	5	S3		flooding	
na	3s	INIT	1	S3		slide	
na	4s	PSd	5	S3		flooding	
na	5s	YFd	7	S3		flooding	
na	6s	PSd	5	S3		dyke	
na	7s	YFm	9	S3			
na	8s	YFm	9	S3		flooding	
na	9s	YFm	9	S3		flooding	
na	10s	SHd	2	S3		hydroline corridor	
na	11s	PSm	6	S3		road	
na	12s	YFm	9	S3		flooding	
na	13s	SHd	2	S3		hydroline corridor	
na	14s	YFm	9	S3		hydroline corridor	
na	15s	YFm	9	S3		flooding	
na	16s	YFd	7	S3		hydroline corridor	
na	17s	SHd	2	S3		hydroline corridor	
na	18s	INIT	1	S3		hydroline corridor	
na	19s	SHd	2	S3		hydroline corridor	
na	20s	INIT	1	S3		hydroline corridor	
na	21s	PSd	5	S3		hydroline corridor	
na	22s	YFd	7	S3			
na	23s	YFd	7	S3			
na	24s	INIT	1	S3		residential	
na	25s	YFd	7	S3			
na	26s	INIT	1	S3		residential	

Form 1: Riparian Overview Assessment

Watershed Name: Little Stawamus River **NTS Map:** 92 G/11
Watershed Code: -900-091000 **Air Photo Series/Scale:** SRS 56811- 45-51; 23 SEP 96

Reach No.	Polygon No.	Stand Structure	Tentative RVT No.	Stream Class	Harvesting/Restocking History	Other Disturbances	Priority for Level 1 or 2
na	27s	YFm	9	S3			
na	28s	INIT	1	S3		residential	
na	29s	YFm	9	S3			
na	30s	INIT	1	S3		residential	
na	31s	PSd	5	S3		flooding	
na	32s	PSd	5	S3		flooding	
na	33s	PSd	5	S3		road maintenance	
na	34s	SHd	2	S3		flooding	
na	35s	MFm	11	S3		flooding	
na	36s	YFm	9	S3			
na	37s	YFd	7	S3		flooding	
na	38s	YFd	7	S3			
na	39s	INIT	1	S3		hydroline corridor	
na	40s	INIT	1	S3		hydroline corridor	
na	41s	YFd	7	S3		flooding	
na	42s	YFm	9	S3		flooding	
na	43s	YFd	7	S3		flooding	
na	44s	MFm	11	S3			

APPENDIX E

RAP - FIELD NOTES AND LITTLE STAWAMUS
PLANT SPECIES LIST

30 July 1997

- Road 100 - major failures on steep sections that need to be stabilized
- noticed some willow wattling along unstable slopes along road
- clearcut at southeast end of drainage (on Indian Arm Road) has small drainage running through it; drainage is ephemeral; some skunk cabbage; counted rings on hemlock in clearcut (400-500 years); counted a balsam that is over 600 years
- across valley can see main stem of Stawamus; regrowth of old clearcuts appears to be quite good
- regeneration under hydrolines is good and consists of a wide diversity of species; however, regular cutting by B.C. Hydro limits growth
- small slide running across logging road; mostly rocky substrates; probably only 10x10m area where could plant species like Douglas-fir; some natural alder and willow are colonizing the site
- birds seen: DEJU, RBSA, SWTH, WIWR
- mammal sign seen: black bear

09 September 1997

- Opening 1: all tidal; plants are mostly sedges, but some angelica, aster as well; shrubs such as alder and willow along the edges
- Opening 2: side channel of Stawamas along Mamquam River Road; some reasonable regrowth includes RuPa, RuSp, AlRu, Salix, SaRa, raspberry, SpDo, AcMa; does not require restoration works
- Opening 3: mostly open along dyke, however, are some areas with approximately 5 m width of red alder; appears to be numerous opportunities for recolonization since are many young conifer seedlings and shrubs; shrubs include AlRu, Cw, Hw, Willow, cottonwood, SpDo; replanting opportunities likely limited by dyke maintenance policies; other plant species include raspberry, AnMa, AcMa, SaRa, broom, Fd, SoSi, RuPa, PoMu; if area allowed to regenerate would come back quickly; good growth especially near base of dyke; some areas of dyke have large rip rap - difficult to establish plants
- Opening 4: most of this opening is similar to Opening 3; good seedling establishment on dyke itself; very little growth along the dyke edge because of an absence of soils; plant species include AcMa, raspberry, AnMa, EpAn, SpDo, PoBa, SaRa, PoMu, RuSp, Fd, RuPa, Hw, BePa, Cw; AlRu and BePa are most common deciduous species;
- Opening 5: is some vegetation between rock slide and river; species include AcMa, Hw, Fd, AlRu; material is quite large; bedrock exposed along deactivated ROW; regrowth of shrub species including raspberry, AlRu, RuPa
- Opening 6: is a significant slope failure; definitely a result of ROW construction; are quite a few fine materials but some larger rocks too; likely contributing significant amount of sediment to stream; is a narrow riparian buffer but it may not be adequate for filtering all sediments; species in buffer include Hw, AcMa, Fd, AlRu; slide would likely be very difficult to stabilize
- Opening 7: Ray Creek; major erosional slopes in upslope areas; appears to be natural although logging has occurred on both sides of creek; significant amounts of sediment must be coming down this tributary

- Opening 8: is narrow treed buffer along the base which provides good stream shading; AlRu is primary species but are some old-growth Hw on either side; shrub regrowth on old failure is excellent and includes AlSi, RuPa, SpDo, SaRa, AyFf
- Opening 9: Continued problems with this ephemeral stream are anticipated; source is a steep gully above the hydroline; appears to be no way of stabilizing to avoid torrent flows; some minor opportunities near mouth; mass movement of bedload expected to continue periodically; some regrowth of Salix, ArDi, AnMa, Fd, RuPa, AcMi, AlSi, Ba
- Opening 10 (from heliflight); under the hydrolines; many shrubs established; plant species include Fd, Cw, raspberry, RuSp, RuPa, EpAn, RiLa, VaOv, SaRa, Ba, AcRu, galium, OpHo, AlRu, BePa, PoBa, AlSi, DrEx, Hw, LyAm, ArDi, Salix; riparian functions present except for shading
- Opening 11 (from heliflight): AlRu, Hw, Fd; some sediment coming down Copilot Creek because of logging activities; generally growth of conifers and shrubs in opening is excellent; no major problems anticipated here
- Opening 12 (from heliflight): conifer growth is reasonable immediately adjacent to river; some minor openings exist away from river, but young conifers and deciduous vegetation are well established
- Opening 13 (from heliflight): mostly good conifer growth with some openings; openings have a dense cover of deciduous shrub species
- Opening 14 (from heliflight): small opening with limited conifer regrowth, however, is a dense and prolific growth of shrub species; no problems here with erosion; other riparian functions, other than stream shading, are present
- Opening 15 (from heliflight): source of fair bit of sediment; failure appears to be the result of logging and presence of logging roads; not much to be done in riparian zone until upslope problems are addressed
- Opening 16 (from heliflight): small tributary running through this opening; some sedimentation into Stawamus River is occurring; no real opportunities to establish riparian vegetation; all failures appear to be road induced; road appears to be channeling water
- Opening 17 (from heliflight): small opening in trees but conifer regrowth is excellent along creek; open area is very brushy with good establishment of species such as *Vacciniums*
- Opening 18 (from heliflight): is well grown in and is of no concern; regrowth is excellent
- Opening 19 (from heliflight): at bridge; area appears well grown in with coniferous and deciduous shrubs and trees; Hw, *Vacciniums* etc.; no riparian concerns
- birds seen: DEJU, HAWO, RECR, STJA, VASW
- mammal sign seen: black-tailed deer

Plant species observed along three sections of Little Stawamus Creek: A) Stawamus River to Guilford Road; B) Guilford Road to Plateau Crescent; and C) Plateau Road to Hydroline.

Common Name	Botanical Name	A	B	C
Trees				
Bigleaf maple	*Acer macrophyllum*	✓	✓	✓
Douglas-fir	*Pseudotsuga menziesii*		✓	✓
Black cottonwood	*Populus trichocarpa*	✓	✓	✓
Red alder	*Alnus rubra*	✓	✓	✓
Sitka spruce	*Picea sitchensis*	✓		✓
Western hemlock	*Tsuga heterophylla*		✓	✓
Western red cedar	*Thuja plicata*	✓	✓	✓
Shrubs				
Devil's club	*Oplopanax horridus*			✓
Dull Oregon-grape	*Mahonia nervosa*		✓	
Hardhack	*Spiraea douglasii*		✓	✓
Himalayan blackberry	*Rubus discolor*	✓		
Mountain-ash sp.	*Sorbus sp.*	✓		
Northern gooseberry	*Ribes lacustre*			✓
Orange honeysuckle	*Lonicera ciliosa*		✓	
Oval-leafed blueberry	*Vaccinium ovalifolium*			✓
Red elderberry	*Sambucus racemosa*	✓	✓	✓
Red huckleberry	*Vaccinium parvifolium*			✓
Red-osier dogwood	*Cornus stolonifera*	✓	✓	
Salal	*Gaultheria shallon*			✓
Salmonberry	*Rubus spectabilis*	✓	✓	✓
Stink currant	*Ribes bracteosum*	✓		
Thimbleberry	*Rubus parviflorus*	✓	✓	
Trailing blackberry	*Rubus ursinus*	✓	✓	✓
Vine maple	*Acer circinatum*	✓	✓	✓
Willow sp.	*Salix sp.*	✓	✓	
Herbs				
Bedstraw sp.	*Galium sp.*			✓
Clasping twisted stalk	*Streptopus amplexifolius*		✓	✓
Common horsetail	*Equisetum arvense*	✓		
Common plantain	*Plantago major*			✓
Creeping buttercup	*Ranunculus repens*	✓	✓	
Enchanter's-nightshade	*Circaea alpina*	✓		✓
False lily-of-the-valley	*Maianthemum dilatatum*	✓	✓	
Foamflower	*Tiarella trifoliata*			✓
Goat'sbeard	*Aruncus dioicus*		✓	
Grass sp.	*Graminae sp.*	✓	✓	
Herb-Robert	*Geranium robertianum*	✓		
Large-leaved avens	*Geum macrophyllum*	✓	✓	
Pacific bleeding heart	*Dicentra formosa*	✓	✓	

Pearly everlasting	*Anaphalis margaritacea*			✓
Piggy-back plant	*Tolmiea menziesii*	✓		
Rosy twistedstalk	*Streptopus roseus*			✓
Siberian miner's-lettuce	*Claytonia sibirica*			✓
Skunk cabbage	*Lysichiton americanum*	✓		✓
Small-flowered bulrush	*Scirpus microcarpus*	✓		
Smartweed sp.	*Polygonum sp.*	✓		
Wall Lettuce	*Lactuca muralis*	✓	✓	✓
Ferns				
Bracken fern	*Pteridium aquilinum*			✓
Deer fern	*Blechnum spicant*			✓
Lady fern	*Athyrium felix-femina*	✓	✓	✓
Licorice fern	*Polypodium glycyrrhiza*	✓		
Maidenhair fern	*Adiantum pedatum*			✓
Oak fern	*Gymnocarpium dryopteris*			✓
Spiny wood fern	*Dryopteris expansa*	✓		✓
Sword fern	*Polystichum munitum*	✓	✓	✓
Mosses and Liverworts				
Cat-tail moss	*Isothecium myosuroides*			✓
Coastal leafy moss	*Plagiomnium insigne*			✓
Haircap moss	*Polytrichum spp.*			✓
Rough moss	*Claopodium crispifolium*			✓
Snake liverwort	*Conocephalum conicum*			✓
Step moss	*Hylocomium splendens*			✓
Tree moss	*Climacium dendroides*			✓
Wavy-leaved cotton moss	*Plagiothecium undulatum*			✓

APPENDIX F

RAP - RIPARIAN ASSESSMENT FIELD FORMS

(FORM 2 - RAP)

Form 2. Riparian Assessment Field Form

POLYGON #: 90	1. PRELIMINARY INFORMATION		
PLOT #: 1	SSt: SH	CREEK NAME: STAWAMUS	REACH #: 6
LOCATION: ~500 m W. of [illegible] Bridge : Left side	CREEK ASPECT: 288		BEC ZONE: CWH dm /06
AIR PHOTO: SRS 56811 - 47	RVT SLOPE: 10 %		STREAM GRADIENT: 5 %
MAP #: 92 G/11	UTM: 4915 55056	PLOT RADIUS/MULT: 3.99m/200x ✓ 11.28m/25x	
Wb: ~12 m	FPC STREAM CLASS: S2	RRZ: 30 m	RMZ: 20 m · RMA: 50 m
DATE: 15/07/98	TIME: 1400	CREW: MG	YR OF HARVEST/REPLANT: L 1949 - 52

2. OVERSTORY

LAYER (DBH)	Tree Species Stem Tally: Dr	Act	Hw	Fd	Cul		Total SPH: Conif.	Decid.	Dom. Species: HGT (m)	DBH (cm)
1a >22 cm							0	0	NA	NA
1b 12.6 - 21.9 cm							0	0	NA	NA
2 7.5 - 12.5 cm	2	2					0	800	Act (10)	12
3 0.1 - 7.4 cm	28	0	16	4			4000	5600	Dr (8)	6
4 < 1.3m Height			36	1	1		7600	0	Hw (1.5)	1

COMMENTS:

- many young hemlock in understorey; Cul & Fd present to lesser extent.
- expect continued growth of hemlock as forest succeeds

Form 2. Riparian Assessment Field Form

POLYGON #: 90	1. PRELIMINARY INFORMATION		
PLOT #: 2	SSt: PS	CREEK NAME: STAWAMUS	REACH #: 6
LOCATION: ~350m W. of Mamquam R. bridge - Left side	CREEK ASPECT: 244		BEC ZONE: CWHdm /07
AIR PHOTO: SRS 56811 - 47	RVT SLOPE: 5 %		STREAM GRADIENT: 5 %
MAP #: 92 G/11	UTM: 4916 - 55056	PLOT RADIUS/MULT: 3.99m/200x ✓ 11.28m/25x	
Wb: ~12 m	FPC STREAM CLASS: S2	RRZ: 30 m	RMZ: 20 m · RMA: 50 m
DATE: 15/07/98	TIME: 1515	CREW: MG	YR OF HARVEST/REPLANT: L 1949 - 52

2. OVERSTORY

LAYER (DBH)	Tree Species Stem Tally: Dr	Mb	Ep	Hw	Cw		Total SPH: Conif.	Decid.	Dom. Species: HGT (m)	DBH (cm)
1a >22 cm	1						0	200	Dr (18)	24
1b 12.6 - 21.9 cm	4	1					0	1000	Dr (16)	15
2 7.5 - 12.5 cm			1				0	200	Ep (15)	11
3 0.1 - 7.4 cm		2					0	400	Mb (13)	5
4 < 1.3m Height				49	5		10 800	0	Hw (0.3)	< 1.0

COMMENTS:

significant stocking of young hemlock

Form 2. Riparian Assessment Field Form (p 2)

PLOT 1

3. UNDERSTORY				MEAN HEIGHT OF DOMINANT LAYER:					m
LAYER	% C	SPECIES	HGT	% C	SPECIES	HGT	% C	SPECIES	HGT
TALL SHRUB (>2m)	[illegible]	[illegible]							
SHORT SHRUB	15	RuPa	1.0	10	RuSp	10	<1	AmAl	0.2
HERB	1	DiFo	0.2	1	AcRu	0.3			
MOSS		NONE							

4. PLOT SUMMARY	TOTAL % C	TOTAL SPH
OVERSTORY (1a, 1b)	90	0
UNDERSTORY	60	

5. SNAGS (> 5 m height)
TOTAL/PLOT 0 | DBH RANGE NA
SPECIES NA | %LWD 0 | TTL/ha 0

6. DISTURBANCE INDICATORS	Y	N	C		Y	N	C
Beaver Activity	-			Flooding	✓		1
Blow Down				Fire			
Surface Erosion				Slide		✓	
Slope Failure				Road	✓		2
Bridge/Culvert				Grazing			
Insects/Disease				Other			

7. SOIL HORIZONS			
HORIZON	DEPTH	TEXTURE	%CF
H	1		
HORIZON	DEPTH	TEXTURE	%CF
Ae	2	Sand	90
HORIZON	DEPTH	TEXTURE	%CF

8. LEVEL OF FUNCTIONING		
LWD:	(L,M,H)	L
SHADE:	(L,M,H)	L
SOD:	(L,M,H)	H
SURF. SED. FILTER:	(L,M,H)	M
CHANNEL STAB:	(L,M,H)	L
BANK STAB:	(L,M,H)	L

9. PHOTOS: Roll: 1 Frame #'s: 1, 2 & 3

COMMENTS:
1). Floodplain area - fluvial deposition evident.
2) Old skidder or logging road

Form 2. Riparian Assessment Field Form (p 2)

PLOT 2

3. UNDERSTORY				MEAN HEIGHT OF DOMINANT LAYER:					m
LAYER	% C	SPECIES	HGT	% C	SPECIES	HGT	% C	SPECIES	HGT
TALL SHRUB (>2m)	5	SaRa	2.2						
SHORT SHRUB	45	SaRa	1.6	15	RuSp	1.6	5	RiLa	0.2
HERB	5	TiUn	0.2	1	PoMu	0.3	2	DrEx	0.4
MOSS	20	moss spp.	NA						

4. PLOT SUMMARY	TOTAL % C	TOTAL SPH
OVERSTORY (1a, 1b)	90	1200
UNDERSTORY	80	

5. SNAGS (> 5 m height)
TOTAL/PLOT 0 | DBH RANGE NA
SPECIES NA | %LWD 0 | TTL/ha 0

6. DISTURBANCE INDICATORS	Y	N	C		Y	N	C
Beaver Activity	✓			Flooding	✓		
Blow Down				Fire			
Surface Erosion				Slide			
Slope Failure				Road			
Bridge/Culvert				Grazing			
Insects/Disease				Other			

7. SOIL HORIZONS			
HORIZON	DEPTH	TEXTURE	%CF
H	10	NA	
HORIZON	DEPTH	TEXTURE	%CF
Ah	25	SILT	<5
HORIZON	DEPTH	TEXTURE	%CF

8. LEVEL OF FUNCTIONING		
LWD:	(L,M,H)	L
SHADE:	(L,M,H)	M
SOD:	(L,M,H)	H
SURF. SED. FILTER:	(L,M,H)	M
CHANNEL STAB:	(L,M,H)	L
BANK STAB:	(L,M,H)	L

9. PHOTOS: Roll: 1 Frame #'s: 4, 5 & 6

COMMENTS:

APPENDIX G

RAP - RIPARIAN LEVEL I ASSESSMENT SUMMARY

(FORM 3 - RAP)

Form 3: Riparian Level 1 Assessment Summary

Watershed Name: Stawamus River
Watershed Code: -900-091000

	Polygon				Level of Functioning									
Rch No.	**No.**	**(ha)**	**RVT No.**	**RVT label**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**Disturbance Indicators**	**Recommendations**	**Priority (H,M,L)**
6	90	1.6	1 2	SHd/Dr(Act)/Hw PSd/Dr(Mb)/HwCw	1	3	5	3	1	1	14	occasional flooding	none; good conifer regen. in understorey	L
	Total	1.6	**(ha)**											

Area (Ha) by restoration priority for Level 2 High Priority	
Medium Priority	
Low Priority	1.6

A = LWD/CWD; B = Stream Shading; C = SOD; D = Surface Sediment Filtering; E = Channel Stability; F = Bank Stability; G = Summation

APPENDIX H

CAP - FIELD DATA ENTRY FORMS

Squamish River Watershed Restoration Program Forest Renewal B.C.
Channel Assessment Procedure (CAP) Field Data Entry Form

Stream: Stawamus River Date: 28/09/97 Crew: Jeff Westlake, Jeff Isnert, George Gabrielle

Reach #: 9

Cross-Section	Distance from Reach Bottom (m)	Bank Full Width (m)	Bank Full Depth (m)	Channel Slope (%)	Elevation (m)	Aspect	Channel Condition	General Bed Material	Largest Rock Diameter (m)	Total Gravel Bar Width (m)	Bank Left Bank Slope (%)	Right Bank Slope (%)	Valley Flat Width (m)	Large Woody Debris (Y/N)	Logging Past/Present (Y/N)
1	Weir	30	0.9	4			A	CBS	1	1	90	90	0	N	Y
2	100	30	1.3	6			A	CBS	1.2	7	90	90	0	N	Y
3	200	22	2	8			A	CBS	1.1	3	90	90	0	Y	Y
4	300	25	1.1	6			S	CB	1.1		90	90	0	N	Y
	Canyon														
	Bridge #1, (718m)														

Field data checked by: JW

Electronic data entry checked by: JW

Reviewed by:

Notes and Observations

No prescription at this time.

Average channel width, W_b (m): 26.75 **Channel Type:** Step pool / Canyon
Average channel depth, d (m): 1.33
Average channel gradient, S (%): 6.00
Average Rock, D (m): 1.10
Average Gravel Bar Width (m): 3.67

Relative roughness (D/d): 0.83
Power Index (W_b d S): 212.66

Hillslope-valley flat connection: H
Average Valley Width: L
Upstream Disturbance: H

Sensitivity Rating: M

Lillooet River Watershed Restoration Program Forest Renewal B.C.
Channel Assessment Procedure (CAP) Field Data Entry Form

Stream: Stawamus River Date: 27/09/97 Crew: Jeff Westlake
Jeff Isnert
Reach #: 10 George Gabriele

Cross-Section	Distance from Reach Bottom (m)	Bank Full Width (m)	Bank Full Depth (m)	Channel Slope (%)	Channel Elevation (m)	Channel Aspect	Channel Condition	General Bed Material	Largest Rock Diameter (m)	Total Gravel Bar Width (m)	Bank Left Bank Slope (%)	Bank Right Bank Slope (%)	Bank Valley Flat Width (m)	Large Woody Debris (Y/N)	Logging Past/Present (Y/N)
1	100	6	3	7			D	B	1	0	110	110	0	Y	Y
2	300	16	2	6			A	BC	1.2	3	110	110	0	Y	Y
3	450	20	1.8	6			D	B	1	0	110	110	0	N	Y
4	550	28	2	6			A	BC	1.2	6	110	110	0	Y	Y
5	770	17	1.6	6			S	Bedrock	1	0	90	90	0	N	Y
	Canyon														
	Bridge #2, (2158m)														

Field data checked by: JW

Electronic data entry checked by: JW

Reviewed by:

Notes and Observations

No prescriptions at this time.
Left bank has numerous bank failuresconnected and partially connected to the main stem.
The channel is mainly canyon with exposed bedrock.
The mouth of Ray Creek is approx. 40m wide.

Average channel width, W_b (m): 17.40 **Channel Type:** Step pool / Canyon
Average channel depth, d (m): 2.08
Average channel gradient, S (%): 6.20
Average Rock, D (m): 1.08
Average Gravel Bar Width (m): 1.80

Relative roughness (D/d): 0.52
Power Index (W_b d S): 224.39

Hillslope-valley flat connection: H
Average Valley Width: L
Upstream Disturbance: H

Sensitivity Rating: M

Squamish River Watershed Restoration Program Forest Renewal B.C.
Channel Assessment Procedure (CAP) Field Data Entry Form

Stream: Stawamus River Date: 25/09/97 Crew: Jeff Westlake, Trevor Neil

Reach #: 11

Cross-Section	Distance from Reach Bottom (m)	Bank Full Width (m)	Bank Full Depth (m)	Channel Slope (%)	Elevation (m)	Aspect	Channel Condition	General Bed Material	Largest Rock Diameter (m)	Total Gravel Bar Width (m)	Bank Left Bank Slope (%)	Right Bank Slope (%)	Valley Flat Width (m)	Large Woody Debris (Y/N)	Logging Past/Present (Y/N)
1	110	20	3	10			A	CBS	2	5	80	80	60	N	Y
2	210	19	1.2	7			A	CBS	1.2	4	60	60	40	Y	Y
3	280	27	1.5	8			A	CBS	1.5	5	50	60	32	Y	Y
4	310	22	1.3	9			A	CBS	1.5	1	50	50	0	Y	Y
5															

Field data checked by: JW

Electronic data entry checked by: JW

Reviewed by:

Notes and Observations

No prescription at this time.
Reach begins at bridge #2.
Some bedrock evident throughout reach.

Average channel width, W_b (m): 22.00 **Channel Type:** Cascade pool
Average channel depth, d (m): 1.75
Average channel gradient, S (%): 8.50
Average Rock, D (m): 1.55
Average Gravel Bar Width (m): 3.75

Relative roughness (D/d): 0.89
Power Index (W_b d S): 327.25

Hillslope-valley flat connection: L
Average Valley Width: L
Upstream Disturbance: H

Sensitivity Rating: M

Squamish River Watershed Restoration Program Forest Renewal B.C.
Channel Assessment Procedure (CAP) Field Data Entry Form

Stream: Stawamus River   Date: 97/09/26   Crew: Jeff Westlake, Trevor Neil

Reach #: 12

Cross-Section	Distance from Reach Bottom (m)	Bank Full Width (m)	Bank Full Depth (m)	Channel Slope (%)	Elevation (m)	Aspect	Channel Condition	General Bed Material	Largest Rock Diameter (m)	Total Gravel Bar Width (m)	Bank Left Bank Slope (%)	Right Bank Slope (%)	Valley Flat Width (m)	Large Woody Debris (Y/N)	Logging Past/Present (Y/N)
1	40	14	2	5			A	CBS	1.2	0	50	50	30	Y	Y
2	140	22	1.5	7			A	CBS	1.2	1	60	60	10	N	Y
3	240	30	1.2	6			A	CBS	1.2	2	70	70	0	Y	Y
4	280	22	1.2	-			A	CBS	1.4	1	80	80	0	Y	Y

Field data checked by: JW

Electronic data entry checked by: JW

Reviewed by:

Notes and Observations

No precription at this time.

Average channel width, W_b (m): 22.00   **Channel Type:** Cascade-pool
Average channel depth, d (m): 1.48
Average channel gradient, S (%): 6.00
Average Rock, D (m): 1.25
Average Gravel Bar Width (m): 1.00

Relative roughness (D/d): 0.85
Power Index (W_b d S): 194.70

Hillslope-valley flat connection: M
Average Valley Width: L
Upstream Disturbance: H

Sensitivity Rating: M

Squamish River Watershed Restoration Program Forest Renewal B.C.
Channel Assessment Procedure (CAP) Field Data Entry Form

Stream: Stawamus River   Date: 97/9/26   Crew: Trevor Neil, Jeff Westlake

Reach #: 13

Cross-Section	Distance from Reach Bottom (m)	Bank Full Width (m)	Bank Full Depth (m)	Channel Slope (%)	Channel Elevation (m)	Channel Aspect	Channel Condition	General Bed Material	Largest Rock Diameter (m)	Total Gravel Bar Width (m)	Bank Left Bank Slope (%)	Bank Right Bank Slope (%)	Bank Valley Flat Width (m)	Large Woody Debris (Y/N)	Logging Past/Present (Y/N)
1	30	25	2	8			A	CBS	1.1	6	80	80	0	Y	Y
2	125	25	1.5	6			A	CBS	1.2	2	50	60	60	N	Y
3	180	21	1.2	6			S	CBS	1	1	60	60	20	Y	Y
4	285	22	1.2	7			S	CBS	1.4	-	50	90	60	N	Y
5															

Field data checked by: JW

Electronic data entry checked by: JW

Reviewed by: ______

Notes and Observations

No precription at this time.
Stone lines appear to be buried by sediment.

Average channel width, W_b (m): 23.25   **Channel Type:** Step-pool
Average channel depth, d (m): 1.48
Average channel gradient, S (%): 6.75
Average Rock, D (m): 1.18
Average Gravel Bar Width (m): 3.00

Relative roughness (D/d): 0.80
Power Index (W_b d S): 231.48

Hillslope-valley flat connection: M
Average Valley Width: L
Upstream Disturbance: H

Sensitivity Rating: M

Squamish River Watershed Restoration Program Forest Renewal B.C.
Channel Assessment Procedure (CAP) Field Data Entry Form

Stream: Stawamus River   Date: 97/9/26   Crew: Jeff Westlake
Trevor Neil

Reach #: 14

Cross-Section	Distance from Reach Bottom (m)	Bank Full Width (m)	Bank Full Depth (m)	Channel Slope (%)	Elevation (m)	Aspect	Channel Condition	General Bed Material	Largest Rock Diameter (m)	Total Gravel Bar Width (m)	Bank Left Bank Slope (%)	Right Bank Slope (%)	Valley Flat Width (m)	Large Woody Debris (Y/N)	Logging Past/Present (Y/N)
1	200	30	1.6	4			A	CBS	1	10			100+	N	Y
2															
3															
4															
5															

Field data checked by: ______

Electronic data entry checked by: ______

Reviewed by: ______

Notes and Observations

No prescription at this time.

Average channel width, W_b (m): 30.00   **Channel Type:** Cascade-pool
Average channel depth, d (m): 1.60
Average channel gradient, S (%): 4.00
Average Rock, D (m): 1.00
Average Gravel Bar Width (m): 10.00

Relative roughness (D/d): 0.63
Power Index (W_b d S): 192.00

Hillslope-valley flat connection: L
Average Valley Width: L
Upstream Disturbance: H

Sensitivity Rating: M

Squamish River Watershed Restoration Program Forest Renewal B.C.
Channel Assessment Procedure (CAP) Field Data Entry Form

Stream: Stawamus River   Date: 25/09/97   Crew: Jeff Westlake, Trevor Neil

Reach #: 15

Cross-Section	Distance from Reach Bottom (m)	Bank Full Width (m)	Bank Full Depth (m)	Channel Slope (%)	Elevation (m)	Aspect	Channel Condition	General Bed Material	Largest Rock Diameter (m)	Total Gravel Bar Width (m)	Bank Left Bank Slope (%)	Right Bank Slope (%)	Valley Flat Width (m)	Large Woody Debris (Y/N)	Logging Past/Present (Y/N)
1	170	25	1.6	4			A	CBS	1.3	6	60		100	Y	Y
2	330	25	1	5			A	CBS	1.3	1	90		100	Y	Y
3	508	30	1.3	5			A	CBS	1.4	3	90	90	60	Y	Y
4															
5															

Field data checked by: JW

Electronic data entry checked by: JW

Reviewed by:

Notes and Observations

No prescription at this time.

Average channel width, W_b (m): 26.67

Channel Type: Cascade-pool

Average channel depth, d (m): 1.30
Average channel gradient, S (%): 4.67
Average Rock, D (m): 1.33
Average Gravel Bar Width (m): 3.33

Relative roughness (D/d): 1.03
Power Index (W_b d S): 161.78

Hillslope-valley flat connection: L
Average Valley Width: L
Upstream Disturbance: H

Sensitivity Rating: M

Squamish River Watershed Restoration Program Forest Renewal B.C.
Channel Assessment Procedure (CAP) Field Data Entry Form

Stream: Stawamus River   Date: 25/09/97   Crew: Jeff Westlake, Trevor Neil

Reach #: 16

Cross-Section	Distance from Reach Bottom (m)	Bank Full Width (m)	Bank Full Depth (m)	Channel Slope (%)	Elevation (m)	Aspect	Channel Condition	General Bed Material	Largest Rock Diameter (m)	Total Gravel Bar Width (m)	Bank Left Bank Slope (%)	Right Bank Slope (%)	Valley Flat Width (m)	Large Woody Debris (Y/N)	Logging Past/Present (Y/N)
1	100	30	1	5			A	CBS	1.3	20	100	100	0	N	Y
2	300	30	1.2	6			A	CBS	1.4	2	100	100	0	Y	Y
3	400	25	0.7	4			A	CBS	1	20	80	70	0	Y	Y
4	500	30	0.9	5			A	CBS	0.9	10	70	70	0	Y	Y
5															

Field data checked by: JW

Electronic data entry checked by: JW

Reviewed by:

Notes and Observations

Location of debris torent, right bank looking downstream.
No prescription at this time.

Average channel width, W_b (m): 27.50   **Channel Type:** Cascade-pool

Average channel depth, d (m): 0.80

Average channel gradient, S (%): 4.50

Average Rock, D (m): 0.95

Average Gravel Bar Width (m): 15.00

Relative roughness (D/d): 1.19

Power Index (W_b d S): 99.00

Hillslope-valley flat connection: M

Average Valley Width: L

Upstream Disturbance: H

Sensitivity Rating: M

Squamish River Watershed Restoration Program Forest Renewal B.C.
Channel Assessment Procedure (CAP) Field Data Entry Form

Stream: Stawamus River Date: 25/09/97 Crew: Jeff Westlake

Trevor Neil

Reach #: 17

Cross-Section	Distance from Reach Bottom (m)	Bank Full Width (m)	Bank Full Depth (m)	Channel Slope (%)	Channel Elevation (m)	Channel Aspect	Channel Condition	General Bed Material	Largest Rock Diameter (m)	Total Gravel Bar Width (m)	Bank Left Bank Slope (%)	Bank Right Bank Slope (%)	Bank Valley Flat Width (m)	Large Woody Debris (Y/N)	Logging Past/Present (Y/N)
1	150	25	1.2	5			A	CB	1.2	10	90	20	60	Y	Y
2	345	22	1	5			A	CB	1	2	70	30	50	N	Y
3															
4															
5															

Field data checked by: JW

Electronic data entry checked by: JW

Reviewed by:

Notes and Observations

No prescriptions at this time.

Average channel width, W_b (m): 23.50 **Channel Type:** Cascade-pool
Average channel depth, d (m): 1.10
Average channel gradient, S (%): 5.00
Average Rock, D (m): 1.10
Average Gravel Bar Width (m): 6.00

Relative roughness (D/d): 1.00
Power Index (W_b d S): 129.25

Hillslope-valley flat connection: M
Average Valley Width: L
Upstream Disturbance: H

Sensitivity Rating: M

Squamish River Watershed Restoration Program Forest Renewal B.C.
Channel Assessment Procedure (CAP) Field Data Entry Form

Stream: Stawamus River   Date: 25/09/97   Crew: Jeff Westlake, Trevor Neil

Reach #: 18

Cross-Section	Distance from Reach Bottom (m)	Bank Full Width (m)	Bank Full Depth (m)	Channel Slope (%)	Channel Elevation (m)	Channel Aspect	Channel Condition	General Bed Material	Largest Rock Diameter (m)	Total Gravel Bar Width (m)	Bank Left Bank Slope (%)	Bank Right Bank Slope (%)	Bank Valley Flat Width (m)	Large Woody Debris (Y/N)	Logging Past/Present (Y/N)
1	150	22	1	4			A	CB	1.2	5	70	30	50	Y	Y
2	360	24	1.2	5			A	CB	0.9	8	70	30	50	N	Y
3	Canyon														
4	Remnant Bridge														
5															

Field data checked by: JW

Electronic data entry checked by: JW

Reviewed by:

Notes and Observations

No prescriptions at this time.
Remnant bridge at 466m.

Average channel width, W_b (m): 23.00
Average channel depth, d (m): 1.10
Average channel gradient, S (%): 4.50
Average Rock, D (m): 1.05
Average Gravel Bar Width (m): 6.50

Channel Type: Cascade-pool

Relative roughness (D/d): 0.95
Power Index (W_b d S): 113.85

Hillslope-valley flat connection: M
Average Valley Width: L
Upstream Disturbance: H

Sensitivity Rating: M

Squamish River Watershed Restoration Program Forest Renewal B.C.
Channel Assessment Procedure (CAP) Field Data Entry Form

Stream: Stawamus River Date: 25/09/97 Crew: Jeff Westlake

Trevor Neil

Reach #: 19

Cross-Section	Distance from Reach Bottom (m)	Bank Full Width (m)	Bank Full Depth (m)	Channel Slope (%)	Channel Elevation (m)	Channel Aspect	Channel Condition	General Bed Material	Largest Rock Diameter (m)	Total Gravel Bar Width (m)	Bank Left Bank Slope (%)	Bank Right Bank Slope (%)	Bank Valley Flat Width (m)	Large Woody Debris (Y/N)	Logging Past/Present (Y/N)
1	200	30	1	3			A	BCG	1.3	10	20	80	60	N	Y
2	293	18	1.6	4			A	BCG	1.2	2			100+	N	Y
3															
4															
5															

Field data checked by: JW

Electronic data entry checked by: JW

Reviewed by:

Notes and Observations

No prescription at this time.

Average channel width, W_b (m): 24.00

Average channel depth, d (m): 1.30

Average channel gradient, S (%): 3.50

Average Rock, D (m): 1.25

Average Gravel Bar Width (m): 6.00

Channel Type: Cascade-pool

Relative roughness (D/d): 0.96

Power Index (W_b d S): 109.20

Hillslope-valley flat connection: L

Average Valley Width: L

Upstream Disturbance: H

Sensitivity Rating: M

Squamish River Watershed Restoration Program Forest Renewal B.C.
Channel Assessment Procedure (CAP) Field Data Entry Form

Stream: Stawamus River   Date: 25/09/97   Crew: Jeff Westlake
Trevor Neil

Reach #: 20

Cross-Section	Distance from Reach Bottom (m)	Bank Full Width (m)	Bank Full Depth (m)	Channel Slope (%)	Elevation (m)	Aspect	Channel Condition	General Bed Material	Largest Rock Diameter (m)	Total Gravel Bar Width (m)	Bank Left Bank Slope (%)	Right Bank Slope (%)	Valley Flat Width (m)	Large Woody Debris (Y/N)	Logging Past/Present (Y/N)
1	150	18	1.6	4			A	CBG	1.1	2	40	40	0	Y	Y
2	260	30	1.2				A	CBG	1.2	10			100	N	Y
3															
4															
5															

Field data checked by: JW

Electronic data entry checked by: JW

Reviewed by: ____________

Notes and Observations

No prescriptions at this time.

Average channel width, W_b (m): 24.00   **Channel Type:** Cascade-pool
Average channel depth, d (m): 1.40
Average channel gradient, S (%): 4.00
Average Rock, D (m): 1.15
Average Gravel Bar Width (m): 6.00

Relative roughness (D/d): 0.82
Power Index (W_b d S): 134.40

Hillslope-valley flat connection: L
Average Valley Width: L
Upstream Disturbance: H

Sensitivity Rating: M

Squamish River Watershed Restoration Program Forest Renewal B.C.
Channel Assessment Procedure (CAP) Field Data Entry Form

Stream: Stawamus River   Date: 25/09/97   Crew: Jeff Westlake
Trevor Neil

Reach #: 21

Cross-Section	Distance from Reach Bottom (m)	Bank Full Width (m)	Bank Full Depth (m)	Channel Slope (%)	Channel Elevation (m)	Channel Aspect	Channel Condition	General Bed Material	Largest Rock Diameter (m)	Total Gravel Bar Width (m)	Bank Left Bank Slope (%)	Bank Right Bank Slope (%)	Bank Valley Flat Width (m)	Large Woody Debris (Y/N)	Logging Past/Present (Y/N)
1	100	25	1	3			A	BCG	1	2			100	N	Y
2															
3															
4															
5															

Field data checked by: JW

Electronic data entry checked by: JW

Reviewed by:

Notes and Observations

No prescription at this time.

Average channel width, W_b (m): 25.00   Channel Type: Cascade-pool
Average channel depth, d (m): 1.00
Average channel gradient, S (%): 3.00
Average Rock, D (m): 1.00
Average Gravel Bar Width (m): 2.00

Relative roughness (D/d): 1.00
Power Index (W_b d S): 75.00

Hillslope-valley flat connection: L
Average Valley Width: L
Upstream Disturbance: H

Sensitivity Rating: M

Squamish River Watershed Restoration Program Forest Renewal B.C.
Channel Assessment Procedure (CAP) Field Data Entry Form

Stream: Stawamus River   Date: 25/09/97   Crew: Jeff Westlake
Trevor Neil

Reach #: 22

Cross-Section	Distance from Reach Bottom (m)	Bank Full Width (m)	Bank Full Depth (m)	Channel Slope (%)	Channel Elevation (m)	Channel Aspect	Channel Condition	General Bed Material	Largest Rock Diameter (m)	Total Gravel Bar Width (m)	Bank Left Bank Slope (%)	Bank Right Bank Slope (%)	Bank Valley Flat Width (m)	Large Woody Debris (Y/N)	Logging Past/Present (Y/N)
1	100	30	1	2			A	BCG	1	1			100	Y	Y
2	280	20	1.2	3			A	BCG	1.1				100	N	Y
3															
4															
5															

Field data checked by: JW

Electronic data entry checked by: JW

Reviewed by:

Notes and Observations

No prescriptions at this time.

Average channel width, W_b (m): 25.00
Average channel depth, d (m): 1.10
Average channel gradient, S (%): 2.50
Average Rock, D (m): 1.05
Average Gravel Bar Width (m): 1.00

Channel Type: Cascade-pool

Relative roughness (D/d): 0.95
Power Index (W_b d S): 68.75

Hillslope-valley flat connection: L
Average Valley Width: L
Upstream Disturbance: H

Sensitivity Rating: M

Squamish River Watershed Restoration Program Forest Renewal B.C.
Channel Assessment Procedure (CAP) Field Data Entry Form

Stream: Stawamus River   Date: 25/09/97   Crew: Jeff Westlake
Trevor Neil

Reach #: 23

Cross-Section	Distance from Reach Bottom (m)	Bank Full Width (m)	Bank Full Depth (m)	Channel Slope (%)	Channel Elevation (m)	Channel Aspect	Channel Condition	General Bed Material	Largest Rock Diameter (m)	Total Gravel Bar Width (m)	Bank Left Bank Slope (%)	Bank Right Bank Slope (%)	Bank Valley Flat Width (m)	Large Woody Debris (Y/N)	Logging Past/Present (Y/N)
1	108	20	1.5	3			A	CBG	1.3				100	Y	Y
2	200	20	1	5			A	CBG	1	1			100	N	Y
3	300	22	1.1	4			A	BCG	1	3			100	N	Y
4															
5															

Field data checked by: JW

Electronic data entry checked by: JW

Reviewed by:

Notes and Observations

No prescriptions at this time.

Average channel width, W_b (m): 20.67

Average channel depth, d (m): 1.20

Average channel gradient, S (%): 4.00

Average Rock, D (m): 1.10

Average Gravel Bar Width (m): 2.00

Channel Type: Cascade-pool

Relative roughness (D/d): 0.92

Power Index (W_b d S): 99.20

Hillslope-valley flat connection: L

Average Valley Width: L

Upstream Disturbance: H

Sensitivity Rating: M

Squamish River Watershed Restoration Program Forest Renewal B.C.
Channel Assessment Procedure (CAP) Field Data Entry Form

Stream: Stawamus River   Date: 26/09/97   Crew: Jeff Westlake
Jeff Isnert

Reach #: 24

Cross-Section	Distance from Reach Bottom (m)	Bank Full Width (m)	Bank Full Depth (m)	Channel Slope (%)	Channel Elevation (m)	Channel Aspect	Channel Condition	General Bed Material	Largest Rock Diameter (m)	Total Gravel Bar Width (m)	Bank Left Bank Slope (%)	Bank Right Bank Slope (%)	Bank Valley Flat Width (m)	Large Woody Debris (Y/N)	Logging Past/Present (Y/N)
1	120	12	1.8	4			S	CBG	1	0	40	100	0	N	Y
2															
3															
4															

Field data checked by: JW

Electronic data entry checked by: JW

Reviewed by:

Notes and Observations

No prescription at this time.

Average channel width, W_b (m): 12.00
Average channel depth, d (m): 1.80
Average channel gradient, S (%): 4.00
Average Rock, D (m): 1.00
Average Gravel Bar Width (m): 0.00

Channel Type: Cascade-pool

Relative roughness (D/d): 0.56
Power Index (W_b d S): 86.40

Hillslope-valley flat connection: M
Average Valley Width: L
Upstream Disturbance: H

Sensitivity Rating: M

Squamish River Watershed Restoration Program Forest Renewal B.C.
Channel Assessment Procedure (CAP) Field Data Entry Form

Stream: Stawamus River | Date: 26/09/97 | Crew: Jeff Westlake, Jeff Isnert

Reach #: 25

Cross-Section	Distance from Reach Bottom (m)	Bank Full		Channel							Bank			Large Woody Debris (Y/N)	Logging Past/Present (Y/N)
		Width (m)	Depth (m)	Slope (%)	Elevation (m)	Aspect	Channel Condition	General Bed Material	Largest Rock Diameter (m)	Total Gravel Bar Width (m)	Left Bank Slope (%)	Right Bank Slope (%)	Valley Flat Width (m)		
1	47	14	1.9	5			S	CBG	1		100	100	0	N	Y
2	147	20	2	6			A	CBG	1.2	2	100	100	0	Y	Y
3	247	17	1.5	5			A	CBG	1.1	2	100	100	0	N	Y
4	377	25	0.8	5			S	BC	1.2	0	30	50	100	Y	Y
5	505	14	1.8	5			D	B	1	0	100	100	0	N	Y

Field data checked by: JW

Electronic data entry checked by: JW

Reviewed by:

Notes and Observations

No prescriptions at this time.

Average channel width, W_b (m): 18.00

Average channel depth, d (m): 1.60

Average channel gradient, S (%): 5.20

Average Rock, D (m): 1.10

Average Gravel Bar Width (m): 1.00

Channel Type: Canyon

Relative roughness (D/d): 0.69

Power Index (W_b d S): 149.76

Hillslope-valley flat connection: H

Average Valley Width: L

Upstream Disturbance: H

Sensitivity Rating: M

Squamish River Watershed Restoration Program Forest Renewal B.C.
Channel Assessment Procedure (CAP) Field Data Entry Form

Stream: Stawamus River

Date: 26/09/97

Crew: Jeff Westlake
Jeff Isnert

Reach #: 26

Cross-Section	Distance from Reach Bottom (m)	Bank Full Width (m)	Bank Full Depth (m)	Channel Slope (%)	Channel Elevation (m)	Channel Aspect	Channel Condition	General Bed Material	Largest Rock Diameter (m)	Total Gravel Bar Width (m)	Bank Left Bank Slope (%)	Bank Right Bank Slope (%)	Valley Flat Width (m)	Large Woody Debris (Y/N)	Logging Past/Present (Y/N)
1	14	20	2	7			D	B	1	0	100	100	0	Y	Y
2	214	21	1.9	6			S	BC	1	0	70	70	0	N	Y
3															
4															
5															

Field data checked by: JW

Electronic data entry checked by: JW

Reviewed by:

Notes and Observations

No prescriptions at this time.

Average channel width, W_b (m): 20.50
Average channel depth, d (m): 1.95
Average channel gradient, S (%): 6.50
Average Rock, D (m): 1.00
Average Gravel Bar Width (m): 0.00

Channel Type: Cascade-pool

Relative roughness (D/d): 0.51
Power Index (W_b d S): 259.84

Hillslope-valley flat connection: H
Average Valley Width: L
Upstream Disturbance: H

Sensitivity Rating: M

Squamish River Watershed Restoration Program Forest Renewal B.C.
Channel Assessment Procedure (CAP) Field Data Entry Form

Stream: Stawamus River Date: 26/09/97 Crew: Jeff Westlake
Jeff Isnert

Reach #: 27

Cross-Section	Distance from Reach Bottom (m)	Bank Full Width (m)	Bank Full Depth (m)	Channel Slope (%)	Elevation (m)	Aspect	Channel Condition	General Bed Material	Largest Rock Diameter (m)	Total Gravel Bar Width (m)	Bank Left Bank Slope (%)	Right Bank Slope (%)	Valley Flat Width (m)	Large Woody Debris (Y/N)	Logging Past/Present (Y/N)
1	100	18	0.8	4			A	BCG	1.6	1	10	60	0	N	Y
2	200	12	1.5	5			S	BCG	1.3	0	10	10	60	Y	N
3															
4															
5															

Field data checked by: JW

Electronic data entry checked by: JW

Reviewed by:

Notes and Observations

No prescriptions at this time.

Average channel width, W_b (m): 15.00 **Channel Type:** Cascade-pool
Average channel depth, d (m): 1.15
Average channel gradient, S (%): 4.50
Average Rock, D (m): 1.45
Average Gravel Bar Width (m): 0.50

Relative roughness (D/d): 1.26
Power Index (W_b d S): 77.63

Hillslope-valley flat connection: L
Average Valley Width: L
Upstream Disturbance: H

Sensitivity Rating: M

Squamish River Watershed Restoration Program Forest Renewal B.C.
Channel Assessment Procedure (CAP) Field Data Entry Form

Stream: Stawamus River Date: 26/09/97 Crew: Jeff Westlake
Jeff Isnert

Reach #: 28

Cross-Section	Distance from Reach Bottom (m)	Bank Full Width (m)	Bank Full Depth (m)	Channel Slope (%)	Channel Elevation (m)	Channel Aspect	Channel Condition	General Bed Material	Largest Rock Diameter (m)	Total Gravel Bar Width (m)	Bank Left Bank Slope (%)	Bank Right Bank Slope (%)	Bank Valley Flat Width (m)	Large Woody Debris (Y/N)	Logging Past/Present (Y/N)
1	100	18	1	5			S	BCG	1.2	0	0	0	100	Y	Y
2															
3															
4															
5															

Field data checked by: JW

Electronic data entry checked by: JW

Reviewed by: ____________

Notes and Observations

No prescriptions at this time.

Average channel width, W_b (m): 18.00 **Channel Type:** Cascade-pool
Average channel depth, d (m): 1.00
Average channel gradient, S (%): 5.00
Average Rock, D (m): 1.20
Average Gravel Bar Width (m): 0.00

Relative roughness (D/d): 1.20
Power Index (W_b d S): 90.00

Hillslope-valley flat connection: L
Average Valley Width: L
Upstream Disturbance: H

Sensitivity Rating: M

Squamish River Watershed Restoration Program Forest Renewal B.C.
Channel Assessment Procedure (CAP) Field Data Entry Form

Stream: Stawamus River   Date: 26/09/97   Crew: Jeff Westlake
Jeff Isnert

Reach #: 29

Cross-Section	Distance from Reach Bottom (m)	Bank Full Width (m)	Bank Full Depth (m)	Channel Slope (%)	Elevation (m)	Aspect	Channel Condition	General Bed Material	Largest Rock Diameter (m)	Total Gravel Bar Width (m)	Bank Left Bank Slope (%)	Right Bank Slope (%)	Valley Flat Width (m)	Large Woody Debris (Y/N)	Logging Past/Present (Y/N)
1	20	14	1.6	5			S	BCG	1	0	40	40	60	N	Y
2	120	16	0.8	5			A	BCG	1	1	10	10	40	Y	Y
3															
4															
5															

Field data checked by: JW

Electronic data entry checked by: JW

Reviewed by:

Notes and Observations

No prescriptions at this time.

Average channel width, W_b (m): 15.00
Average channel depth, d (m): 1.20
Average channel gradient, S (%): 5.00
Average Rock, D (m): 1.00
Average Gravel Bar Width (m): 0.50

Channel Type: Cascade-pool

Relative roughness (D/d): 0.83
Power Index (W_b d S): 90.00

Hillslope-valley flat connection: M
Average Valley Width: L
Upstream Disturbance: H

Sensitivity Rating: M

APPENDIX I

CAP - CLASSIFYING CHANNEL REACHES

(FORM 1 - CAP)

CHANNEL ASSESSMENT PROCEDURE

Stawamus Creek Channel Assessment Procedure

Form 1. Classifying channel reaches

Sub-basin	Reach Number	Reach Length (m)	Drainage network class	Check if CAP is applicable
SB-4	9	718	CB1bii	Yes
SB-4	10	2158	CB1bii	Yes
SB-5	11	311	CB1aiii	Yes
SB-5	12	281	CA1biii	Yes
SB-5	13	285	CB1biii	Yes
SB-5	14	165	CB1aiii	Yes
SB-5	15	712	CA1biii	Yes
SB-5	16	511	CA1biii	Yes
SB-5	17	347	CB1biii	Yes
SB-5	18	466	CA1aiii	Yes
SB-5	19	439	CA1aii	Yes
SB-5	20	284	CA1aiii	Yes
SB-5	21	182	CA1aiii	Yes
SB-5	22	297	CA1aii	Yes
SB-3	23	317	CA1aii	Yes
SB-3	24	193	CA1bii	Yes
SB-2	25	739	CB1bii	Yes
SB-2	26	272	CB1bii	Yes
SB-2	27	269	CA1aii	Yes
SB-2	28	180	CA1aii	Yes
SB-2	29	547	CA1aii	Yes

APPENDIX J

CAP - GENERAL ASSESSMENT OF CHANNEL MORPHOLOGY

(FORM 2 - CAP)

CHANNEL ASSESSMENT PROCEDURE

Form 2. General assessment of channel morphology

	Stawamus Creek Channel Assessment				
	Length of mainstem channel (m)				
Sub-basin name	(a) Total	(b) Downstream of logging	{c} Total b with non-erodible channels	(d) Length of b with erodible and and visible channels	(e) Length of d with altered channel morphology
Skypilot SB-2	2007	2007	850	1157	1000
Copilot SB-3	510	510	0	510	480
Ray Creek SB-4	2876	2876	1800	1076	800
Hydroline SB-5	4280	4280	1690	2590	2400
Total Watershed	9673	9673	4340	5333	4680

APPENDIX K

CAP - GENERAL ASSESSMENT OF CHANNEL IMPACT VALUES

(FORM 3 - CAP)

CHANNEL ASSESSMENT PROCEDURE

Form 3. General assessment of channel impact values

Stawamus Creek

	Channel Impact			
		Observed	Potential	
			Changes 1	Potential CIV 2
Sub-basin name	**Observed Changes (e/a)**	**Observed CIV**	**((b-c)-(d-e))/a**	
Skypilot SB-2	**0.49**	**0.9**	**0.49**	**0.9**
Copilot SB-3	**0.94**	**1**	**0.94**	**1**
Ray Creek SB-4	**0.28**	**0.8**	**0.27**	**0.8**
Hydroline SB-5	**0.56**	**0.9**	**0.56**	**0.9**
Residual	**0**	**0**	**0**	**0**
Total watershed	**0.48**	**0.90**	**0.48**	**0.90**

Notes:

1. *Values transferred from Form 2.*
2. *Refer to Table 2 for conversion factors.*

Table 2. Channel impact value conversion guide

	Low impact (<0.5)					Medium impact (0.5–0.7)			High impact (>0.7)		
Channel impact value (CIV)	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
Channel impact proportion (m/m)	0.000	0.005	0.01	0.02	0.03	0.06	0.10	0.15	0.30	0.60	≥0.90

APPENDIX L

CAP - MAIN CHANNEL IMPACT VALUE

(FORM 7 - CAP)

CHANNEL ASSESSMENT PROCEDURE

[illegible]

Form 7. Main channel impact value

Stawamus Creek

Sub-basin name	(a) Total mainstem channel length (m)	(b) Length of altered small and intermediate channel morphology (m)	(c) Length of altered large channel morphology (m)	(d) Total length of altered channel morphology (m) =(b+c)	(e) Observed changes =(d/a)	(f) Channel mainstem CIV*
SB-2	2007	1157	0	1157	0.57	0.9
SB-3	510	250	50	300	0.58	0.9
SB-4	2876	350	0	350	0.12	0.6
SB-5	4280	1692	708	2400	0.56	0.9
Residual	0	0	0	0	0	0
Watershed	9673	3449	758	4207	0.43	0.9

Refer to table # 2 for conversion factors

Table 2. Channel impact value conversion guide

	Low impact (<0.5)					Medium impact (0.5–0.7)			High impact (>0.7)		
Channel impact value (CIV)	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
Channel impact proportion (m/m)	0.000	0.005	0.01	0.02	0.03	0.06	0.10	0.15	0.30	0.60	≥0.90

Figure 2. Summary of high and low priority habitat restoration prescriptions for the Stawamus River and the Little Stawamus Creek.