Karen Diemert

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AQUATIC RESOURCE BASELINE STUDIES

TELKWA COAL PROJECT

1997

prepared by

DAVID BUSTARD AND ASSOCIATES LTD.

LIMNOTEK RESEARCH AND DEVELOPMENT INC.

for

MANALTA COAL LTD.

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SUMMARY

Aquatic studies were conducted in the vicinity of the Telkwa Coal Project during 1997. These studies included updating baseline information describing the periphyton and benthic communities in Goathorn and Tenas creeks (Section 1), as well as studies of fish populations in the project area (Section 2). The studies improved the baseline data in specific areas so that it is relevant to the revised mine plans.

SECTION 1 - PERIPHYTON AND BENTHIC INVERTEBRATE STUDIES

Periphyton (mainly algae that grows on stream substrata) accumulation rates and community structure were examined at four locations including two control sites in upper Goathorn and Tenas creeks during the early fall of 1997. Benthic invertebrate monitoring was conducted at these same four sites. Monitoring was completed using the same methods that were used for earlier sample collections in 1983 and 1984 to allow time series comparisons. Water quality data from 1997 were provided by Agra Earth and Environmental Ltd.

Goathorn and Tenas creeks were found to be pristine headwater streams having low to moderate productivity. Stream periphyton were mainly diatoms characteristic of undisturbed mountain streams. Common species were *Hannaea arcus*, *Achnanthes minutissima*, *Fragilaria* sp., *Gomphonema olivaceum*, and *Synedra ulna*. Benthic invertebrates were larval stages of mainly three insect orders including mayflies, stoneflies and chironomids. All of the periphyton and invertebrate taxa are common in cool mountain streams that have high water quality.

Nitrogen and phosphorus concentrations were low at all stations, and they were in a range where a combination of both nutrients may limit production of periphyton which forms the basis of the stream food web. Alkalinity was almost twice as high in Tenas Creek compared to Goathorn Creek. As a result of this difference, Tenas Creek may be able to sustain more acid loading from any source than Goathorn Creek before changes to biological communities are apparent.

Periphyton biomass was higher at upstream stations compared to downstream stations at both creeks. This biomass can be influenced by nutrient concentration, temperature, substrata stability, scour from high water velocity and sediment transport, and grazing by invertebrates. Of these factors, the higher concentration of soluble N and P upstream compared to downstream may be most important in determining the observed biomass of periphyton in all years.

Mayflies and stonefly abundance and invertebrate taxon richness (number of taxa) were greater at upstream sites compared to downstream sites. Factors including temperature, water velocity, substratum variability, and food supply (mainly periphyton) would have

contributed to this difference. Periphyton biomass was considered most important. While invertebrate abundance and diversity usually increases over downstream gradients, the significantly greater periphyton biomass upstream compared to downstream was the single most important factor differentiating sites.

To assist future assessments, taxa that can indicate a structural and functional change in the streams were identified. Sustained high abundance of the diatoms *Achnanthes minitussima*, and *Fragilaria* sp. to the exclusion of other common diatoms can indicate a major change. The disappearance of heptagenid mayflies including *Rhithrogena*, *Eporous*, and *Cinygmula* at downstream sites but not at control stations in future monitoring would be another indication of structural and functional change in the biological communities in Goathorn and Tenas creeks.

The combination of water quality, periphyton and benthos data from 1983, 1984, and 1997 provide a baseline for comparison with data from future monitoring. There are options for analysis of data in the future, all of which will be capable of differentiating natural background variation from stressors that may change stream community structure and function.

Before further assessments of stream water quality and biological communities in Goathorn and Tenas creeks can be addressed, it is essential that accurate water chemistry data be collected. To date, the data are sparse and inadequate to make decisions on the potential ecological consequences of altered chemical characteristics. Laboratories that support a detection limit of ≤ 0.001 mg$\bullet L^{-1}$ for SRP, 0.002 mg$\bullet L^{-1}$ for TDP and TP, 0.005 mg$\bullet L^{-1}$ for NH_4^+-N, and 0.002 mg$\bullet L^{-1}$ for NO_3^--N should be used for future water quality analyses.

SECTION 2 - FISHERIES STUDIES

Fish and habitat assessments were conducted throughout the Goathorn and Tenas creeks, lower Telkwa River and Hubert creek during 1997. Repeat sampling was conducted at 20 index locations for comparison to similar information collected between 1983 and 1985.

Fish sampling was also undertaken at an additional 20 sites to better distinguish between bull trout and Dolly Varden distribution and abundance in the project watersheds, and to provide better baseline information relative to crossing sites in Goathorn and Hubert creeks and the Telkwa River.

A 1:20000 scale aquatic map was prepared for the project area incorporating all past fisheries information together with 1997 data collected during this study and a concurrent Telkwa Watershed fish sampling program funded by Forest Renewal BC.

The results verified that lower Goathorn Creek, Tenas Creek and the lower Telkwa River are important steelhead trout systems. Steelhead fry and parr dominated the catches and densities are comparable to other important steelhead tributaries in the Skeena Watershed. Steelhead fry were distributed upstream as far as Cabinet Creek in the Goathorn system and had higher densities in the upper reaches of Tenas Creek than noted in past studies. Steelhead yearling numbers were low throughout the watersheds sampled in 1997, leading to an overall decline in steelhead parr estimates for the systems.

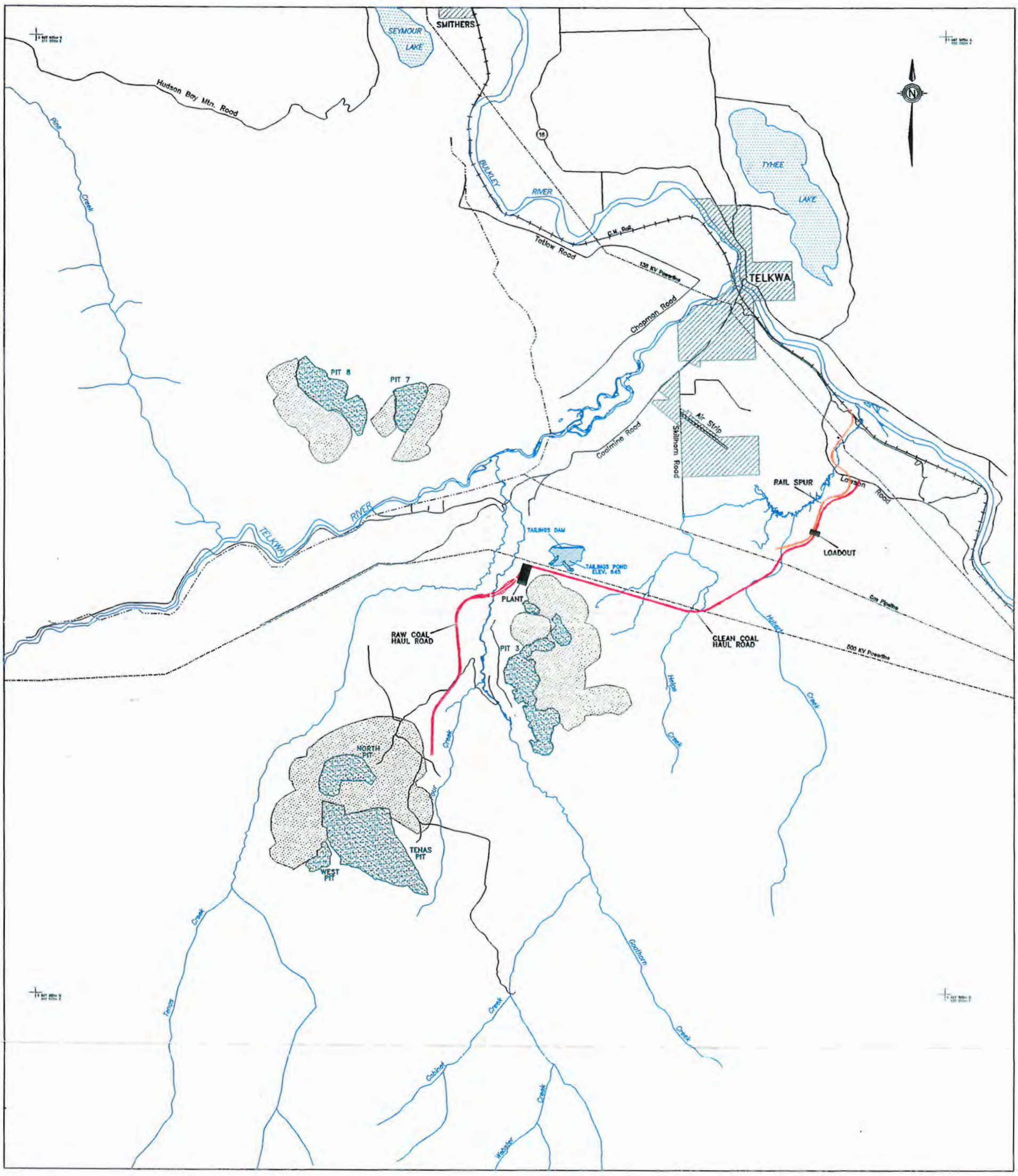
The studies suggest that Tenas and lower Goathorn creeks are the most productive steelhead tributaries in the Telkwa Watershed. Tenas Creek is an important spawning and rearing system, utilized by steelhead for at least 13 kms, with heavy use in the lower 9 kms. The data also suggest that the Telkwa River mainstem and sidechannels are very important steelhead rearing areas. Together these systems probably account for much of the steelhead production in the Telkwa Watershed.

Bull trout, a blue-listed species, are present in Goathorn and Tenas creeks. The highest abundance of juvenile bull trout occurred in the mid-reaches of Goathorn Creek and lower Cabinet Creek. Bull trout rearing densities were very low in Tenas Creek. A small number of bull trout spawners and redd sites were identified, mainly in the mid and upper reaches of Goathorn and Tenas creeks.

The low rearing densities and small numbers of adult spawners suggests that bull trout populations in these systems may be suffering from many years of heavy fishing pressure as well as liberal fishing regulations for this species. The overall life history of these fish in the Bulkley and Telkwa river systems is poorly understood.

Resident Dolly Varden dominated the catches in upper Goathorn and Tenas creeks, similar to past sampling results. However, overall abundance estimates were lower in 1997 than those measured in earlier years. Dolly Varden also dominated catches in smaller tributary streams in the Goathorn and Tenas watersheds. They were present at low densities for approximately 5 km of Four Creek, a small tributary in the middle of the project area.

Fish sampling in Hubert and Helps creeks indicated low abundances of juvenile coho in the lower creek compared to past sampling. Similarly, cutthroat juvenile numbers were down to 10% of levels recorded in the mid-1980's, probably a result of beaver dams preventing upstream migration from the mid-reaches of Helps and Hubert creeks. Fish distributions were better delineated in the upper sections of these creeks to assist with planning for fish passage at road crossing sites.



LEGEND:

Note: UTM Coordinates are NAD27

- ROAD
- POWERLINE
- GAS PIPELINE
- PROPOSED PIT
- PROPOSED DUMP

FIGURE 1

manalta coal ltd.

TELKWA COAL PROJECT

MINE AND INFRASTRUCTURE

Dwn. by:	M.L.E.	Date:	MARCH 1998
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INTRODUCTION

Aquatic studies were conducted from August through November 1997 for Manalta Coal Ltd. at their proposed Telkwa Coal Project located near Smithers B.C (Figure 1). These studies were conducted to address specific issues raised by the Telkwa Coal Project Committee outlined in a *Draft Project Report Specifications* document (July 1997). This document was prepared following a review of aquatic information submitted in Manalta Coal's *Application for a Project Approval Certificate* (February 1997).

BACKGROUND

Extensive studies describing fish species distribution, abundance and habitat utilization in the project area were undertaken during the period 1982-86 for Crows Nest Resources Ltd. As well studies describing the periphyton and benthic communities were undertaken at this time. The results of these studies are summarized in the *Application for a Project Approval Certificate* prepared by Manalta Coal Ltd. The full text of a key study entitled *Telkwa Coal Project Aquatic Resource Assessment 1984* (Bustard 1985a) was presented as Appendix 12 of that application.

Additional studies conducted in the project area but not included in the application include surveys outlining pink salmon spawning in lower Goathorn Creek and the lower Telkwa River (Bustard 1984b); more detailed fisheries and habitat studies in Hubert Creek (Bustard 1986a) and a third year of detailed fish assessments at index sites in the project area (Bustard 1985b).

The aquatic studies focused on developing a biological database with sufficient detail to serve as background for evaluating year-to-year variability within the system prior to mine development and to detect possible changes resulting from a mine operation. The studies had been designed so that sites above the proposed mine operation could serve as controls for monitoring potential impacts from the mine's operation over time.

Since these earlier studies, the mine project proposal has been modified, including changes to the loadout and access road location, and to the location, size, and sequencing of pits and the plant site. As well, considerable time has elapsed since the earlier aquatic studies, and some verification that the database reflected the existing situation was needed.

One important change that has been identified since the earlier studies was the presence of bull trout, a blue-listed species[1], in the Goathorn Creek drainage (Bustard 1996). During earlier studies, bull trout distribution and abundance information had been

[1] Blue-listed species are sensitive/vulnerable indigenous species that are not threatened but are considered at risk. This ranking is undertaken by the Conservation Data Center, Ministry of Environment, Lands and Parks. Bull trout were given this ranking due to their consideration for the Endangered Species List in the U.S. and their noted decline in Alberta and B.C.

combined with Dolly Varden, due to the inability to separate the two species. These two species have only recently been recognized as distinct (Cavender 1978). Both species are present in the Goathorn Creek system. Bull trout were identified at 6 of 26 sites examined during the Bulkley char study, including a single individual in Cumming Creek, also in the Telkwa drainage (Bustard 1996).

A second change since the earlier studies is that additional fish and habitat inventory work at a scale of 1:20000 has been undertaken in the project area. This inventory, funded by Forest Renewal B.C. (FRBC)[2], is near completion, and provides useful additional fish distribution information for the project area.

Given these changes, the development of an aquatic map for the project area that reflects changes in fish species now known to be present, and that incorporates more detailed and updated fish information, was an important objective of the 1997 baseline studies.

This baseline data provides the foundation for assessing potential impacts from the proposed mine and associated corridor and for developing a strategy to mitigate or compensate for potential impacts and to ensure no loss of fish habitat.

This report is presented in two sections. Section 1 outlines the results of the periphyton and benthic invertebrate monitoring studies prepared by Dr. P. Kiffney and Chris Perrin of Limnotek Research and Development. Section 2 presents updated fisheries and habitat information prepared by David Bustard.

An Impact Assessment of the proposed Telkwa Coal Project will be prepared under separate cover as more detailed information describing the mine proposal becomes available.

[2] This work is being undertaken by Triton Envionmental Consultants Ltd., Vancouver.

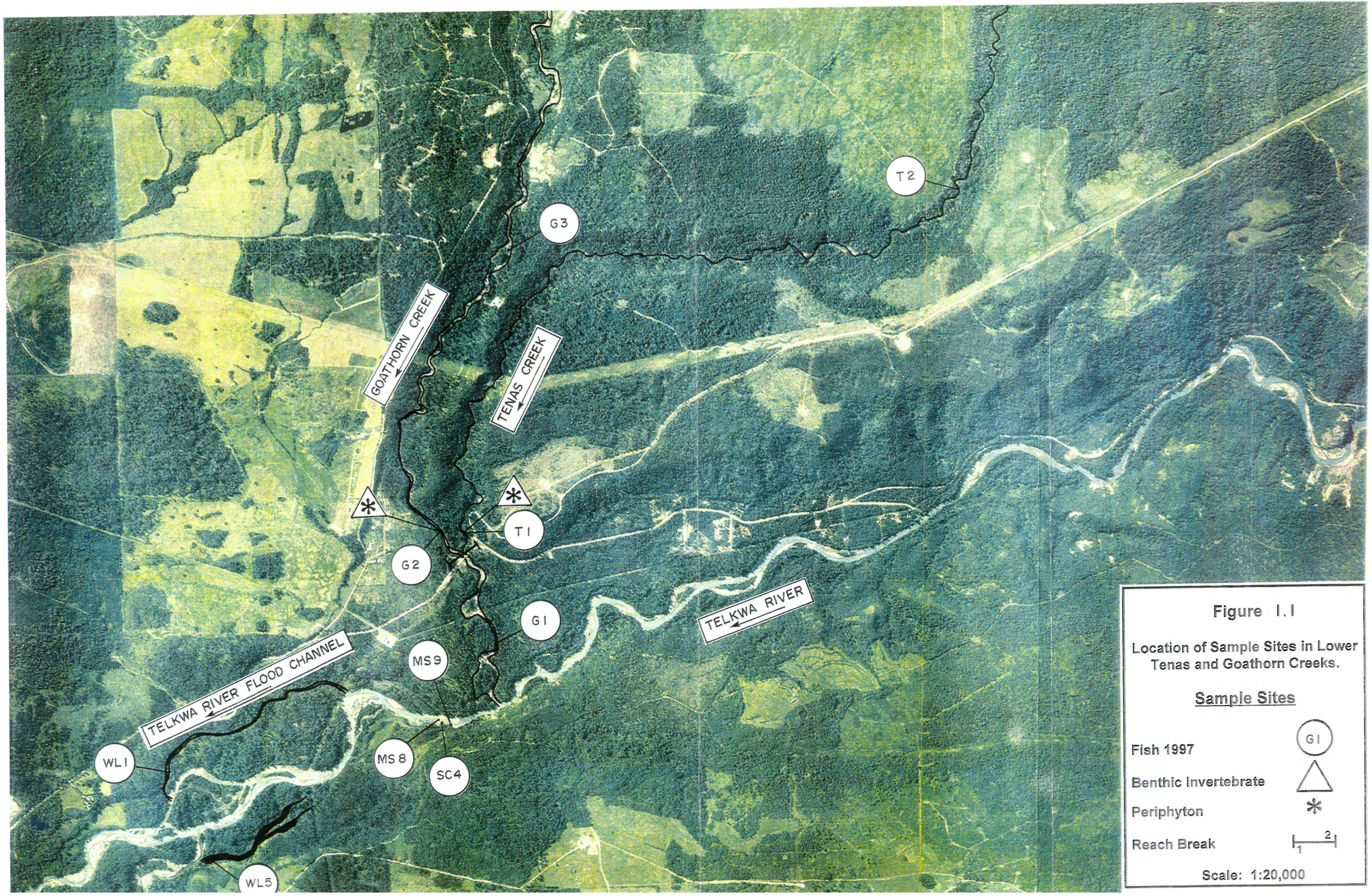


Figure 1.1

Location of Sample Sites in Lower Tenas and Goathorn Creeks.

Sample Sites

Fish 1997 — G1

Benthic Invertebrate

Periphyton

Reach Break — 1, 2

Scale: 1:20,000

SECTION 1

PERIPHYTON AND BENTHIC INVERTEBRATE STUDIES

Prepared by P. Kiffney, PhD. and C.J. Perrin, MSc. RPBio.

1.1 INTRODUCTION

The biomass and community composition of algal periphyton and the abundance and composition of benthic invertebrates was assessed at stations on upper and lower Goathorn and Tenas creeks. Periphyton accrual (the time course accumulation of algal biomass on substrata) and benthic invertebrate abundance and composition that was found in 1997 was also compared to similar measurements collected in 1983 and 1984. By combining these data, the spatial and temporal variation of algal and invertebrate community structure in Goathorn and Tenas creeks could be described before mine development. This baseline information can be compared with similar data collected during and after mine development. The review of this ecological data has provided insight into the selection of ecological indicators that can be used during and after mine development to monitor ecological structure and function in Goathorn and Tenas creeks.

There were three specific objectives:

- To repeat sampling of periphyton biomass and composition in Tenas and Goathorn creeks using methods similar to those of previous years.
- To repeat monitoring of benthic invertebrate abundance and composition in Goathorn and Tenas creeks using methods similar to those of previous years.
- To identify ecological indicators that can be used to monitor ecological structure and function in Goathorn and Tenas creeks.

1.2 METHODS

1.2.1 Sample Stations

Sample stations were selected upstream and downstream of the proposed mine pits on Tenas Creek and Goathorn Creek (Figure 1.1 and 1.2). The upstream stations were labelled T3 and G5 respectively and the downstream stations were T1 and G2. The 1997 water quality data were provided by Agra Earth and Environmental Ltd. from sample collections at sites on upper and lower Goathorn and Tenas creeks that were the same as those reported by Bustard (1985a) for data collected in 1984. In both 1984 and 1997,

water samples were collected in September and October. Periphyton accrual was measured at G5 and G2 in 1984 and 1997 and from T3 and T1 in 1997. Benthic invertebrate samples were collected from G5, G2, T3 and T1 in 1983, 1984 and 1997.

1.2.2 Water Quality

Water samples were analysed for pH, conductivity, alkalinity, and several forms of inorganic nitrogen and phosphorus. These data were selected from a suite of chemical analyses that were provided by Agra Earth and Environmental Ltd. from samples collected in 1997 and by Crows Nest Resources Ltd. from samples that were collected in 1984. In 1984, analytical methods followed those reported in MOE (1976) and APHA (1980).

1.2.3 Periphyton Accrual

Using artificial substrata, the periphyton community structure was described and the accrual of biomass (measured as chlorophyll *a*) was measured over five weeks between 5 September and 10 October, 1997. In 1984 a six-week period was used between 5 September and 17 October for the same measurements (Bustard 1985a). Four replicate artificial substrata were placed at each sample station in 1984 and three replicates were used in 1997. The substrata were composed of open-celled Styrofoam-DB (D.L. Jones Wholesale, Burnaby, BC) cut to dimensions of 0.6 cm x 30.5 cm x 5 cm and attached to a concrete block of similar size. The styrofoam provided a uniform surface that limited variation due to differences in texture and particle size that can occur on natural substrata between locations and points in time. Trends in chlorophyll *a* concentrations and algal species composition accruing on Styrofoam-DB are similar to that found on natural substrata (Perrin 1997). To minimize differences in environmental factors (i.e., current, water depth, and light) that may influence periphyton accrual among sample stations, the substrata were placed in riffle habitats where water depths were 20 to 30 cm and current velocities were 20 to 30 $cm \bullet s^{-1}$.

In 1984 and 1997, the styrofoam substrata on which the periphyton was growing was sampled weekly. Cores were extracted using the open end of a 12 dram plastic vial and frozen at -15°C. Stream temperature was measured using a pocket thermometer on each sampling date. The cores were packed on dry ice and shipped air freight to Vancouver for analysis. Chlorophyll *a* concentration was determined by fluorometry (APHA 1980) after homogenization of the cores in a high-speed tissue grinder. On the last sampling date of each accrual series, an additional core was collected and preserved in Lugol's solution for taxonomic analysis. In 1984, the relative abundance of each algal species was determined using an inverted, phase contrast microscope at 500x magnification. In 1997, absolute abundance and cell biovolume were also determined.

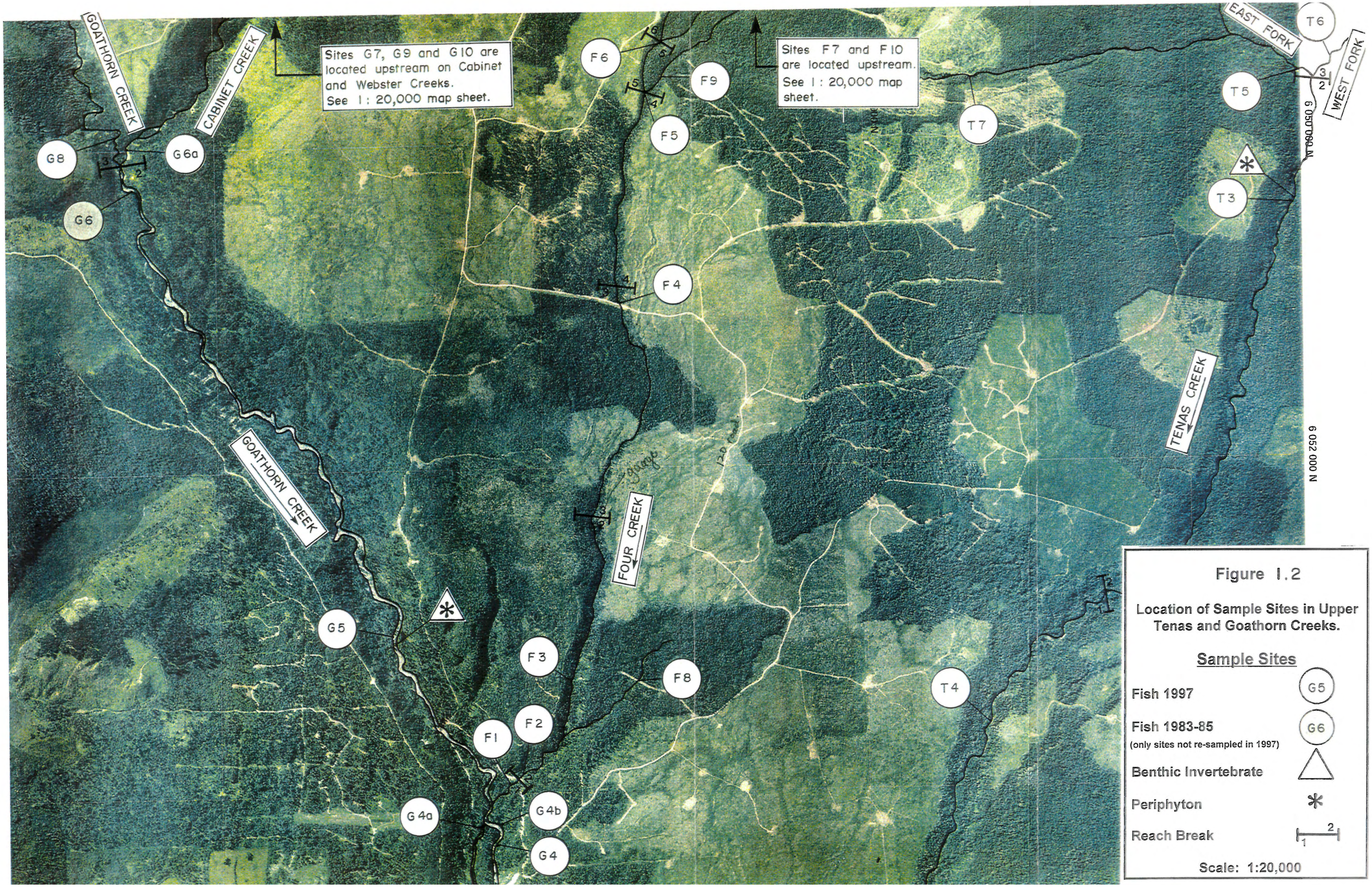


Figure 1.2

Location of Sample Sites in Upper Tenas and Goathorn Creeks.

Sample Sites

Fish 1997 — G5

Fish 1983-85 (only sites not re-sampled in 1997) — G6

Benthic Invertebrate — △

Periphyton — *

Reach Break — 1, 2

Scale: 1:20,000

1.2.4 Benthic Invertebrates

Benthic invertebrates were sampled at four locations - two sites in Goathorn Creek and two site in Tenas Creek (Figures 1.1 and 1.2). Site G5 in Goathorn and T3 in Tenas Creek were upstream from the proposed mine operations and they served as controls. Sites G2 and T1 were in the stream sections that may be affected by mine operations.

Six replicate benthos samples were collected at each station within riffle habitats using a Waters-Knapp sampler (Waters and Knapp 1961) with a 250 μm mesh net and a 0.1 m^2 sample area. Substrata within the sampler cylinder was disturbed to a depth of approximately 10 cm. Large stones were brushed by hand to dislodge attached organisms. All samples were preserved in a 5% buffered formalin solution.

Samples were shipped to Dr. Charles Low (Victoria, B.C.) for identification and enumeration. Samples were washed through coarse (1 mm) and fine (180 μm) screens and sorted from debris. Invertebrates were identified to genus or species and counted. No sample splitting was required. A reference collection was prepared and verified by an independent identifier. Sort checks were conducted on 10% of the samples as part of the QA/QC procedure.

1.2.5 Statistical Analysis

All statistical analyses were conducted using a PC-version of Statistical Analysis System (SAS 1990). The relationship between chlorophyll *a* concentration and time was examined using regression techniques. Location and year effects were also tested on peak biomass (PB), which was defined as the maximum chlorophyll *a* concentration accruing on the styrofoam substrata. T-tests were used to examine location effects within years and two and three-way analysis of variance (ANOVA) was used to examine station, day, and year effects. PB was the highest average concentration of chlorophyll *a* attained during an accrual series. Because PB is directly related to growth (Bothwell 1989), PB was the metric used to examine the effect of year and location on periphyton accrual. A one-way ANOVA was used to determine if there were differences in absolute diatom abundance as well as cell biovolume between stations. If the ANOVA model was significant (indicating differences between stations), Tukey's multiple comparison procedure was used to determine which stations were different from one another.

A two-way ANOVA was also used to determine the influence of date and station and the interaction of date with station on benthic invertebrate community structure. Main and interactive effects were tested using the following response variables: abundance of Ephemeroptera (mayfly), Plecoptera (stonefly), Trichoptera (caddisfly), Chironomidae, and Diptera; total abundance; total taxon richness; mayfly, stonefly, and caddisfly richness; and EPT richness (number of ephemeropteran, plecopteran and trichopteran

taxa). The least-squared means procedure was used to determine differences between stations within a year and within a station between years.

All data except for measures of richness were log-transformed prior to analysis, as evaluation of residuals indicated non-homogeneity of variances. Statistical differences were determined to exist at $p < 0.05$. Values presented in figures and tables are of untransformed means ($\pm$ 1 standard error).

1.3 RESULTS

1.3.1 Water Quality

Conductivity was highest in Tenas Creek and ranged between 131 and 145 µmhos/cm in September and early October 1997 (Table 1.1). In Goathorn Creek, conductivity was 115 - 124 µmhos/cm during the same time periods, indicating lower ionic content than in Tenas Creek. Conductivity also increased from upstream to downstream stations in both Tenas Creek and Goathorn Creek, indicating net contribution of dissolved solids in water transit downstream.

Conductivity values collected on October 16, 1997 were somewhat lower than those collected earlier in 1997 and in 1984. The October 16 data also showed that conductivity was similar for all stations (G5, G2, T3, and T1), whereas this similarity was not found previously.

Alkalinity is a measure of acid neutralizing capacity (ANC). It increased between upstream and downstream stations and it was almost twice as high in Tenas Creek compared to Goathorn Creek (Table 1.1). The pH of natural waters is determined mainly by the interaction of H^+ ions arising from the dissociation of H_2CO_3 and from OH^- ions produced during the hydrolysis of bicarbonate. The pH of waters at Goathorn and Tenas creek stations was either at neutral (pH = 7) or slightly greater than neutral (pH > 7). In general, pH was lower in Goathorn Creek than in Tenas Creek. This finding is consistent with the higher ANC likely from bicarbonate in Tenas Creek. It may also be caused by photosynthetic activity, which if greater in Tenas Creek, would consume CO_2 and cause the carbonate equilibria to shift to the right and increase pH. Within each stream, pH was lower at upstream stations, potentially due to greater alkalinity downstream compared to upstream.

Nitrate is the form of inorganic nitrogen that usually occurs in highest concentrations in pristine mountain streams compared to other forms. Nitrate was below or at levels of analytical detection (0.01 $mg \bullet L^{-1}$ in 1984 and 0.05 $mg \bullet L^{-1}$ in 1997) at most sites during 1984 and 1997 (Table 1.1). The same was reported for ammonia which is the other common form of inorganic N (detection limit of 0.01 $mg \bullet L^{-1}$ in 1984 and 0.1 $mg \bullet L^{-1}$ in 1997). With most values below laboratory detection limits, particularly in 1997, the

inorganic N data were not suitable for interpretation of differences in concentrations between streams and dates. They were, however, in a range that is considered typical of pristine streams.

Total dissolved phosphorus (TDP) concentrations were higher at G5 than at G2 on both sampling occasions in 1984. In addition, TDP concentration was 6-10 times higher at both Goathorn stations in October 1984 than in September 1984. TDP concentrations in Goathorn Creek were also higher in September and October 1997 than in September 1984. Although TDP concentrations were greater at G5 than at G2 in 1984, this trend was reversed in 1997. In 1997, TDP was higher at T3 than at T1. Despite these differences, all TDP concentrations were in a range that indicates moderate productivity in a stream food web. In streams where the food web for fish is severely limited by phosphorus, the TDP concentrations are generally <0.010 $mg \bullet L^{-1}$. If this guideline and data in Table 1.1 are compared, Goathorn Creek may be considered more productive in 1997 than it was in 1984.

Table 1.1. Water quality characteristics in upper and lower Goathorn and Tenas creeks in 1984 and 1997.

Date	Sample site	pH	Conductivity (µmhos/cm)	Alkalinity (mg/L)	NO_3-N (mg/L)	NH_3-N (mg/L)	TDP (mg/L)
Sept 1984	G5		105	45	<0.01	<0.01	0.003
	G2		119	49	<0.01	0.011	<0.001
Oct 1984	G5		110	53	<0.01	0.011	0.03
	G2		113	54	<0.01	0.02	0.006
18 Sept 1997	G5	7.1	115	42			
	G2	7.5	124	52			
	T3	7.6	133	76			
	T1	7.7	145	84			
1 Oct 1997	G5	7.2	117	36	0.06	<0.1	0.02
	G2	7.1	122	44	<0.05	<0.1	0.03
	T3	7.6	131	76	<0.05	<0.1	0.04
	T1	7.7	144	80	<0.05	<0.1	0.02
16 Oct 1997	G5	7.3	95	38	0.08	<0.1	0.02
	G2	7.4	99	50	0.06	<0.1	0.06
	T3	7.4	95	64	<0.05	<0.1	0.07
	T1	7.5	99	70	<0.05	<0.1	0.05

1.3.2 Periphyton Accrual and Algal Community Structure

Periphyton biomass accruing on the styrofoam substrata reached 2.7 μg chl-a•cm^{-2} in 1984 and 2.0 μg chl-a•cm^{-2} in 1997 (Figure 1.3). This amount of biomass accruing in a 5 or 6 week period is considered low to moderate. In this accrual period, the periphyton community can reach a maximum biomass that is sustainable on the substrata for given nutrient, flow, and rate of grazing by aquatic invertebrates. An indication that maximum biomass is attained is by an initial decline in chlorophyll *a* concentration during the time series. This event occurred after day 30 in 1984 and after day 28 in 1997. The maximum biomass which is also called peak biomass (PB) in Goathorn and Tenas creeks was 3.7 times lower than the maximum amount of 10 μg chl-a•cm^{-2} that is recognized in B.C water quality guidelines (Nordin 1985). This difference is typical for pristine and undisturbed streams of the central interior of British Columbia that have low concentrations of dissolved phosphorus.

For all stations and years, regression analysis showed a highly significant relationship between time and chlorophyll *a* concentration (Table 1.2; Fig. 1.3a-d). The time series data in Figure 1.3 show that periphyton accrual was linear.

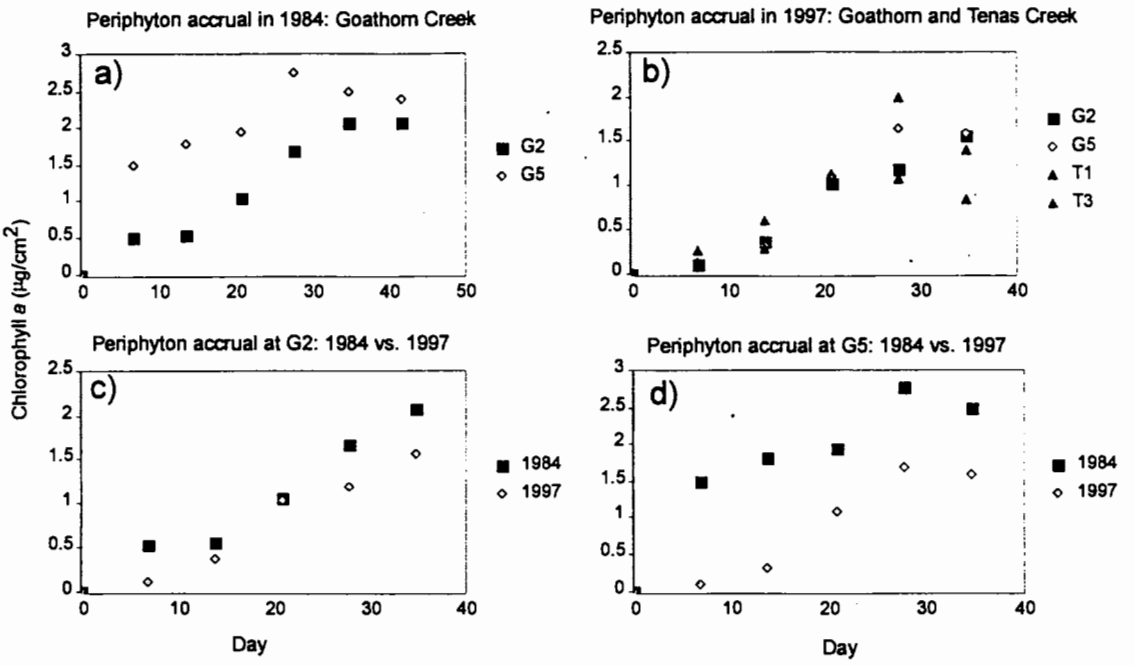
Table 1.2. Regression equations for relationship between time and chlorophyll *a* concentration for sample stations at Goathorn and Tenas creeks.

	G5	G2	T3	T1
1984	Y=0.052(x) + 0.764 R^2=0.72	y=0.054(x) + 0.024 R^2=0.96	Not collected	Not collected
1997	y=0.055(x) + -0.154 R^2=0.92	y=0.048(x) + -0.12 R^2=0.96	y=0.055(x) + -0.13 R^2=0.81	y=0.0296(x) + 0.14 R^2=0.76

In 1984, initial colonization of artificial substrata by algae was higher at G5 than at G2 (Fig. 1.3a, p=0.0006).). This difference in chlorophyll *a* concentration between sites can also be observed in the large difference in y-intercepts for the regression models for the two sites (Table 1.2). On day 35 when chlorophyll *a* reached peak biomass (PB) at G2, concentrations were higher at G5 (2.5 ± 0.4 μg chl-a•cm^{-2}) than at G2 (2.1 ± 0.2 μg chl-a•cm^{-2}) but this difference was not statistically significant (p-value=0.17). G5 reached PB of 2.75 μg chl-a•cm^{-2} on day 28.

In 1997, accrual was similar among stations (Fig.1.3b). PB occurred between day 28 and 35 for all sites. PB at T3 (2.03 ± 0.2 μg chl-a•cm^{-2}), G5 (1.66 ± 0.4 μg/cm^2) and T1 (1.1 ± 0.2 μg chl-a•cm^{-2}) occurred on day 28 followed by G2 (1.57 ± 0.4 μg chl-a•cm^{-2}) on day 35. Statistically significant differences in PB were observed on day 28 for the following comparisons: T3 > G2 (p=0.002); T3 > T1 (p=0.0006); G5 > T1 (p=0.03).

Figure 1.3 Mean concentration of chlorophyll *a* ($\mu g/cm^2$) over time at sample stations on Goathorn and Tenas creeks in 1984 and 1997.



PB was higher at G2 and G5 in 1984 than at these sites in 1997 (Fig. 1.3c and d). These differences were only statistically significant for G5 (p-value=0.006).

Diatoms dominated algal community composition in 1984 and 1997 (Tables 1.3-1.5 and Appendix 1 (Tables 2 and 3)). There were only three taxa other than diatoms observed colonizing artificial substrates. These included the chlorophytes, *Closterium* sp. and *Ulothrix* sp. and the cyanophyte *Oscillatoria* sp. The most common taxa in 1984 and 1997 at G2 and G5 based on sample volumes were the diatoms *Hannaea arcus*, *Achnanthes minutissima*, *Diatoma tenne v. elongatum*, *Synedra ulna*, and *Fragilaria* sp. (Table 1.3).

In 1997, cell counts and biovolume were determined in samples from all sites (Table 1.4 and 1.5). The most abundant taxa were the diatoms *Achnanthes minutissima*, *Gomphonema olivaceum*, *Synedra ulna*, *Fragilaria* sp., and *Hannaea arcus*. In some cases, it was possible to conduct a means comparison procedure to determine which means were statistically different between stations. If small letters that are located below each mean value are the same (see Table 1.4 and 1.5), mean abundance was the same in the between station comparison. If letters are different, the means were different with one station having a statistically greater (or lesser) mean abundance than another station. For example, the diatom *A. minutissima* was present at all stations; therefore, allowing the determination of which mean abundance values were statistically greater between stations. Abundance of *A. minutissima* was highest at G5≥G2>T3>T1 (Tukey's multiple

Table 1.3. Mean (±1SE) proportion by volume of most common algae species colonizing artificial substrata at sample stations on Goathorn Creek (G2 and G5) in September 1984 and 1997.

Species	G5 (%)		G2 (%)	
	1984	1997	1984	1997
Achnanthes minutissima	8 (2)	5 (1)	10	3 (0.1)
A. sp.			8 (3)	
Cocconeis caesitosa		1 (0.4)		
C. ventricosa		2 (0.7)		
Diatoma hiemle		1 (1)		
D. tenne v. elongatum	25 (0)	1 (0)	26 (1)	4 (2)
Fragilaria sp.	20 (0)	13 (2)	20 (2)	1 (0.3)
Gomphonema sp.	7 (2)	5 (2)	17 (2)	
G. olivaceum		27 (10)		6 (1)
Hannaea arcus	20 (3)	19 (9)	18 (2)	1(0.7)
Nitzschia. palea		11 (1)		1 (0.3)
Synedra ulna	20 (3)	22 (6)	21 (2)	76 (6)

comparison procedure). Abundance of most diatom species and total diatom abundance was highest at the two upstream sites (G5 and T3). In contrast, there were no differences in species richness (number of taxa) among sites.

Diatoms also dominated the periphyton community in terms of cell biovolume (Table 1.5). The three most dominant taxa in terms of biovolume were *S. ulna*, *H. arcus*, and *G. olivaceum*. Similar to species counts, mean biovolume for most taxa was higher at upstream stations. Based on Tukey's multiple comparison procedure, mean cell biovolume of *H. arcus* from most to least was the following: G5=T3>G2=T1.

1.3.3 Benthic Invertebrate Community Structure

Most common benthic invertebrates at all stations were insects, primarily the orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and Chironomidae (chironomids) (Fig. 1.4a-d). Common mayfly genera included *Baetis*, *Ameletus*, and *Rhithrogena*, while the most common stoneflies included the families nemouridae and chloroplerlidae. While chironomids were identified in some cases to the genus level in 1997, chironomids were simply separated according to adult, pupae and larvae in the 1983 and 1984 data. For the present analysis that involves inter-year comparisons, only numbers of chironomid larvae

Table 1.4. Mean (±1SE) abundance of common algae species colonizing artificial substrata at sample stations on Goathorn (G5 and G2) and Tenas creeks (T3 and T1) in September, 1997. Different small letters below mean values indicate significant differences ($p<0.05$) in abundance between stations within a taxa.

Species or metric	Mean ± SE cell count (cells x $10^6/m^2$)			
	G5	G2	T3	T1
Achnanthes minutissima	1543 (385)	584 (187)	88 (20)	19 (6)
	a	a	c	b
A. sp.		55 (11)	33	
Cocconeis placentula		22	12 (1)	12 (5)
C. caesitosa	12 (2)		34 (15)	
C. ventricosa	55 (1)		70 (25)	
Diatoma hiemle	21 (7)	272 (106)	85 (28)	
D. tenne v. elongatum	123 (45)			
Fragilaria sp.	847 (181)	24 (14)	133 (28)	
	b	a	ab	
Gomphonema herculeanum			39	12 (4)
G. olivaceum	968 (152)	186 (25)	482 (62)	131 (5)
	b	a	c	a
Hannaea arcus	346 (227)	8 (3.2)	522 (69)	4 (2)
	a	b	a	b
Meridion circulare		7	12 (3)	
Nitzshia palea	349 (145)	22 (11)	70 (14)	138 (14)
	b	a	abc	bc
Synedra ulna	174 (93)	420 (167)	220 (49)	277 (20)
	a	a	a	a
Total abundance	4132 (1295)	1563 (415)	1754 (234)	605 (19)
	a	ab	ab	b
Number of species	10 (1)	10 (0.3)	12 (0.3)	11 (1)

were used because the detailed taxonomic analysis was not available in the earlier data. Detailed results are listed in Appendix 2 (Tables 1 and 2).

There was significant ($p<0.05$) year to year variation in absolute abundance of the benthic invertebrates (Figure 1.4 and Table 1.6). Stonefly abundance was greater in 1997 than in 1983 and 1984. Chironomid abundance was greater in 1983 than in other years at G2 but it was greater in 1984 at T1. Total abundance, dominated by stoneflies and chironomids, was greater in 1983 and 1997 compared to 1984.

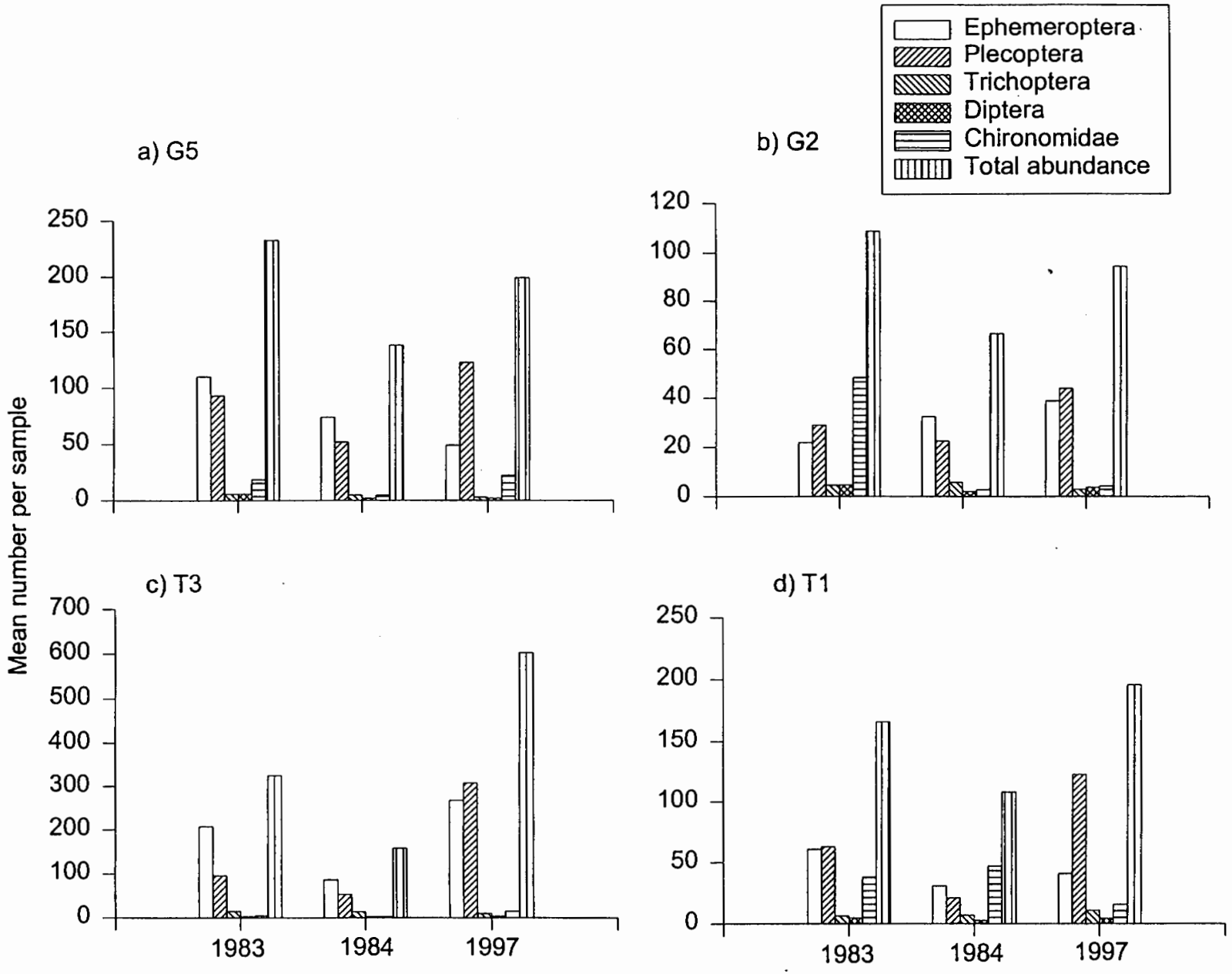


Figure 1.4 Mean absolute abundance of most common insect orders and total abundance in Goathorn and Tenas creeks in 1983, 1984 and 1997.

Table 1.5. Mean (±1SE) biovolume of common algae species colonizing artificial substrata at sample stations on Goathorn (G5 and G2) and Tenas creeks (T3 and T1) in September, 1997. Different small letters below mean values indicate significant differences ($p<0.05$) in biovolume between stations within a taxa.

Species	Mean ± SE cell biovolume ($\mu^3 \times 10^9/m^2$)			
	G5	G2	T3	T1
Oscillatoria sp.	80	9 (2)		
Closterium sp.				11
Ulothrix sp.		76	129	
Achnanthes minutissima	108 (27)	41 (13)	6 (1)	1 (0)
	a	a	c	b
A. sp.				
Cocconeis placentula		20	10 (1)	11 (5)
C. caesitosa	14 (2)		41 (18)	2
C. ventricosa	27 (1)		34 (12)	
Diatoma hiemle	13 (5)		54 (18)	1.8 (0)
	a		b	a
D. tenne v. elongatum	22 (8)	49 (19)		
Fragilaria sp.	424 (90)	12 (7)	66 (14)	2 (0)
	b	ad	d	ac
Gomphonema herculeanum			152	50 (17)
G. olivaceum	464 (73)	89 (12)	231 (29)	63 (3)
	b	a	c	a
Hannaea arcus	658 (431)	15 (6)	992 (131)	7 (4)
	a	b	a	b
Meridion circulare		3.6	5.7 (1)	
Nitzshia. Palea	384 (160)	24 (12)	77 (15)	151 (15)
	b	a	abc	bc
Synedra ulna	521 (279)	1253 (499)	656 (147)	827 (61)
	a	a	a	a
Total diatom	2468	1546 (516)	2226	1124 (43)
	(1083)	a	(314)	a
	a		a	
Total other	80	46 (35)	129	

Table 1.6. *P*-values for F-tests from a two-way ANOVA testing the influence of date and station, and the interaction of date with station on indices of benthic invertebrate abundance in Goathorn and Tenas creeks. Analysis was conducted using log-transformed values, except for measures of richness which were not transformed.

Invertebrate Order	*P*-value from 2-way ANOVA		
	Date	Station	Date x Station interaction
Ephemeroptera abundance	0.2	0.0001	0.005
Plecoptera abundance	0.0001	0.0001	0.1
Trichoptera abundance	0.4	0.01	0.9
Chironomidae abundance	.0005	0.001	0.002
Diptera abundance	0.9	0.3	0.6
Total abundance	0.002	0.0001	0.2
Ephemeroptera taxa richness	0.0001	0.1	0.05
Plecoptera taxa richness	0.0001	0.0001	0.09
Trichoptera taxa richness	0.6	0.01	0.8
EPT richness	0.0001	0.0017	0.1
Total Taxon richness	0.0001	0.03	0.8

In addition to temporal variation in abundance, there was considerable variation in abundance among stations. A station effect was found for all orders except the dipterans. The station effect on mayflies and chironomids varied significantly with year ($p \leq 0.005$). There were more mayflies and stoneflies upstream than downsteam in both streams. Furthermore, total invertebrate abundance was higher at T3 (range 200-600 individuals/sample) than at all other stations.

The greater invertebrate abundance at T3 in 1997 than at other stations corresponded to relatively high periphyton PB at this station (Figure 1.3c), which suggests that overall productivity at T3 may have been greater than at the other sites in 1997.

Total invertebrate abundance was similar at G5 (range 125-225 individuals/sample) and T1 (range100-175 individuals/sample), while station G2 (range 60-110 individuals per sample) had the lowest total abundance. Mayfly and chironomid abundance did not vary consistently among stations and years (interaction term was statistically significant: Table 1.6). Mayfly abundance progressively increased at station G2 during the years 1983-1997, whereas mayfly abundance decreased at G5 from 1983 to 1997.

There were both year and station effects on total taxon, stonefly and EPT (number of ephemeropteran, plecopteran, and trichopteran taxa) richness while mayfly richness differed among dates and caddisfly richness differed among stations (Table 1.6; Fig. 1.5a-d). There were more taxa identified in 1997 compared to 1983 and 1984. Given the

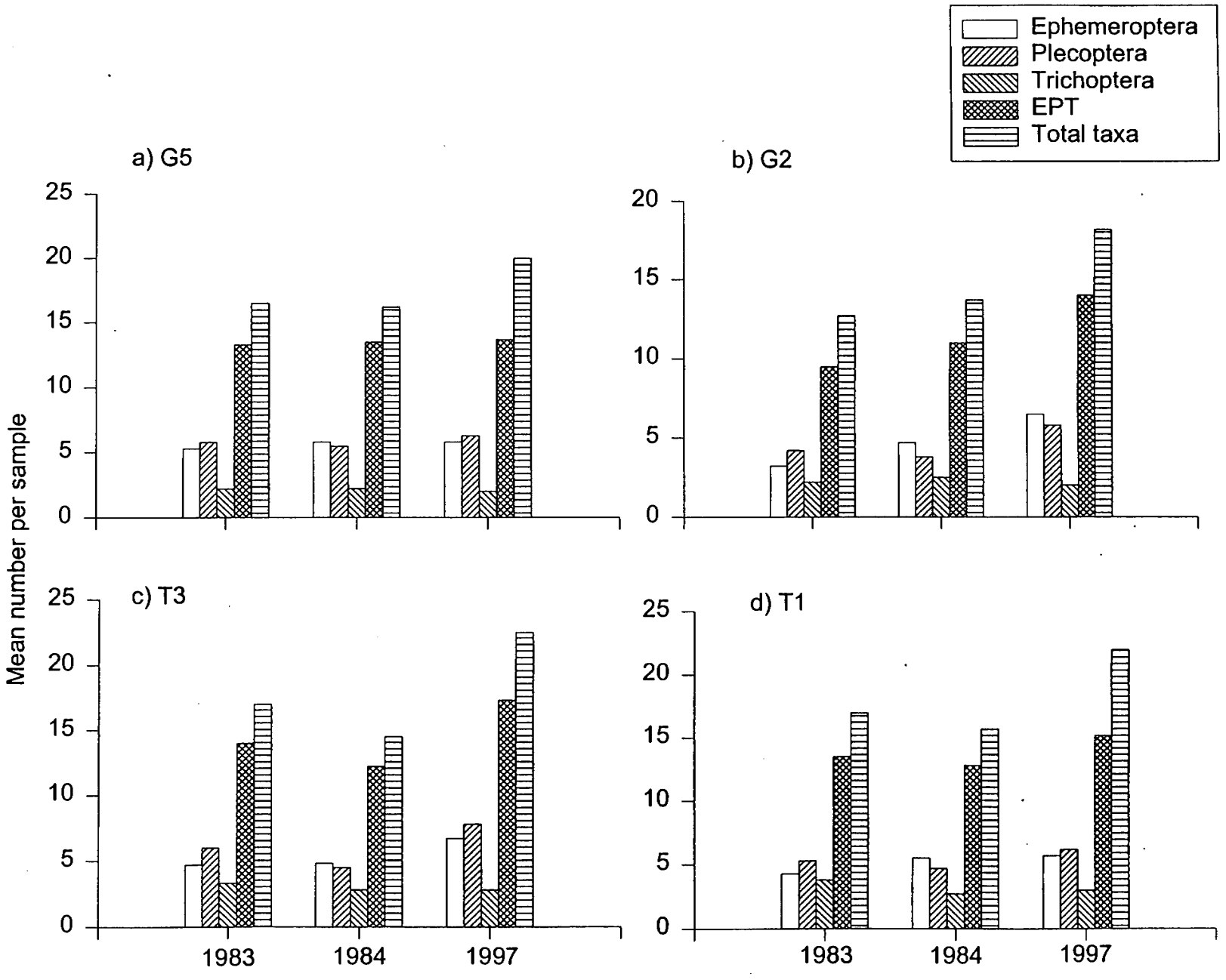


Figure 1.5. Mean ephemeropteran, plecopteran, trichopteran, EPT, and total taxon richness at Goathorn and Tenas creeks.

differences in effort of taxonomic analysis between years (chironomids identified to genus in 1997 but no identification of chironomids in 1983 and 1984), this result may be an effect of lab procedures rather than due to actual changes in richness between years. By combining location data from all years, total taxon richness and EPT richness from most to least were T3=T1 >G5≥G2. Mayfly and stonefly taxa richness was greater at upstream stations (G5 and T3) compared with downstream stations. When averaged across years, mayfly taxa richness was significantly higher at G5 vs. G2 (p=0.02). G5 and T3 had significantly more stonefly taxa than G2 and T1, respectively.

1.4 DISCUSSION

1.4.1 General Characteristics of Goathorn and Tenas Creeks

Goathorn and Tenas creeks are pristine, low to moderately productive stream ecosystems. The inorganic nitrogen and total dissolved phosphorus concentrations in water were in a range that is typically found in nutrient deficient streams in B.C. (Perrin et al. 1987, Johnston et al. 1990, Mundie et al. 1991, Stockner and Shortreed 1978, Bothwell 1989, Perrin and Richardson 1997). The nitrate concentrations were all ≤0.08 mg•L^{-1}, ammonia concentrations were ≤0.011 mg•L^{-1} and TDP concentrations were between 0.001 mg•L^{-1} and 0.07 mg•L^{-1}. Only a small fraction of the TDP is actually available for biological uptake. This fraction is analytically called soluble reactive phosphorus (SRP) but it was not available in data supplied for this study. The concentration of SRP would be expected to be substantially lower than TDP concentration which potentially puts it in a range typical of streams having low to moderate productivity.

Due to high detection limits for nutrient analyses and lack of replication in data supplied for this report, it is difficult to comment on differences in nutrient concentrations between the two streams across years. Lower detection limits, however, were used in 1984 and these data are useful for a preliminary interpretation of whether nitrogen or phosphorus primarily limits algal growth and thereby production of the stream food webs.

The nitrogen:phosphorus (N:P) ratio can provide an index of which of these nutrients potentially limits the growth of algae in streams. This algae is, at least in part, the basic biomass that supports the food web upon which fish depend. Rhee (1978) has shown that for a given species of algae there is a sharp transition between phosphorus (P)-limited and nitrogen (N)-limited growth. Assuming all other nutrients are in excess of algal requirements, N-limitation will occur at low N:P ratios, while at high ratios P-limitation will prevail. The particular ratio at which the transition from N-limitation to P-limitation will occur is species dependent, varying from as low as 7:1 for some diatoms (Rhee and Gotham 1980) to as high as 50:1 for some blue-greens (Healey 1985).

In the 1984 data, the sum of nitrate (NO_3^--N) and ammonia (NH_4^+-N) concentrations yielded values generally ≤20 μg•L^{-1}, while soluble reactive phosphorus (SRP)

concentrations were 3-8 $\mu g \bullet L^{-1}$. If we assume a median SRP concentration of 5 $\mu g \bullet L^{-1}$ and an inorganic N concentration of 20 $\mu g \bullet L^{-1}$, the molar N:P approximates 9. This value is at the low end of the range of ratios that indicates P limitation in algae (Rhee and Gotham 1980), suggesting that growth of many algal species in Goathorn Creek (Tenas Creek chemistry was not examined in 1984) was potentially limited by N and some others were limited by P in 1984. While limitation of algal growth by N is not common in oligotrophic streams of British Columbia (e.g., Stockner and Shortreed 1978, Bothwell 1989, Perrin et al. 1987), it does occur where there is localized P enrichment, producing what appears as co-limitation by N and P (Perrin and Richardson 1997). Goathorn Creek may be another example where this co-limitation by N and P occurs.

The implication of potential N-limitation of algal growth is that any introduction of inorganic N to Goathorn or Tenas creeks has the potential to increase algal growth rates and biomass, but only to a point where it is limited by P concentration. If both N and P are added to N and P deficient streams, there is potential for an increase in algal biomass by up to several orders of magnitude (Perrin et al. 1987).

While very high N and P loading can produce water quality problems, moderate enrichment can increase stream food web productivity (e.g., fish biomass). This concept is the basis behind case studies of intentional river fertilization projects on Vancouver Island (Perrin et al. 1987) and in Alaska (Deegan et al. 1997). In these projects, N and P addition resulted in substantial increases in fish growth (Johnston et al. 1990, Deegan and Peterson 1992). This effect is thought to occur by nutrient addition causing an increase in algal biomass, which supports increased survival of fish food organisms (Mundie et al. 1991; Perrin and Richardson 1997). Results from this work are now being used to support fertilization as a restoration measure in British Columbia streams (Ashley and Slaney 1997).

In the Vancouver Island project, algal biomass reached 15 μg chl-$a \bullet cm^{-2}$ and in the Alaskan work, biomass up to 20 μg chl-$a \bullet cm^{-2}$ was measured where inorganic N concentrations were in excess of algal requirements (near 0.1 $mg \bullet L^{-1}$) and SRP concentrations were near 0.005 $mg \bullet L^{-1}$. There was no evidence from this work that periphyton biomass up to these concentrations caused a deterioration of fish habitat. Based on these findings, a several fold increase in algal biomass from current concentrations <3 μg chl-$a \bullet cm^{-2}$ in Goathorn and Tenas creeks would not be expected to be detrimental to water quality and may improve food supply to fish populations.

The amount of periphyton biomass in Goathorn and Tenas creeks is consistent with the nutrient concentrations that were found. The peak concentration of chlorophyll *a* that accrued on substrata over the 5 to 6 week period was 1 μg chl-$a \bullet cm^{-2}$ to 2.75 μg chl-$a \bullet cm^{-2}$ which is commonly found in low and moderately productive streams (Perrin et al. 1987, Johnson et al. 1990, Mundie et al. 1991, Stockner and Shortreed 1978, Bothwell 1989, Perrin and Richardson 1997). That range of values was also several times less than the maximum value of 10 μg chl-$a \bullet cm^{-2}$ that is cited in Provincial water quality

guidelines for protection of fish habitat (Nordin 1985). The guideline of 10 μg chl-a•cm^{-2} is conservative and is set despite the evidence cited above that fish habitat is not necessarily impacted when periphyton biomass is greater.

Diatoms typical of cool pristine streams were the most abundant algal periphyton at all stations on all dates. Common taxa included *Hannaea arcus*, *Achnanthes minutissima*, *Fragilaria* sp., *Gomphonema olivaceum*, and *Synedra ulna* which are diatoms common to uncontaminated streams in BC (Stockner and Shortreed 1978, Perrin et al. 1987, Mundie et al. 1991), and to other coldwater streams in western North America (Leland and Carter 1984, Deniseger et. al. 1986, Ward 1986).

Mayflies, stoneflies, and chironomids were the most common benthic invertebrates in both Goathorn and Tenas creeks. These taxa are typically found in other pristine, coldwater streams in western North America (Ward 1986, Leland et al. 1989, Johnston et al. 1990, Clements and Kiffney 1995, Kiffney and Clements 1996). The mayflies, in particular, are indicative of pristine undisturbed headwater streams (Kiffney and Clements 1994a and 1994b, Clements and Kiffney 1995).

1.4.2 Temporal and Spatial Variation

Water Quality

There were important and detectable differences in the electrochemical data between streams in 1997. Most importantly, alkalinity was higher in Tenas Creek than in Goathorn Creek (Table 1.1). Because alkalinity is a measure of acid neutralizing capacity (ANC), this difference suggests that Tenas Creek may be able to sustain more acid loading than Goathorn Creek before any shift in pH and potential change in biological structure and function occurs. It also means that there may be greater capacity for metals in Tenas Creek to be bound on exchange substrates and thereby made less available and less toxic to periphyton, invertebrates, and fish (Howarth and Sprague 1978, Chakoumakos et. al. 1979, Meador 1991) than in Goathorn Creek.

Periphyton

While the concentration of soluble phosphorus and nitrogen is usually the most important factor in determining biomass of stream periphyton (Bothwell 1988), many other factors can also contribute to determining periphyton biomass and composition. These factors include temperature (Bothwell 1988), substrata stability (Stevenson 1990), scour associated with water velocity and sediment transport (Stevenson 1983), current velocity (Stevenson and Glover 1993), and rate of grazing by aquatic invertebrates (Lamberti and Resh 1983, McCormick and Stevenson 1991). Any one or combination of these factors, particularly

nutrient concentration, would have produced the higher PB at upstream sites (G5 and T3) compared to downstream sites (G2 and T1), and the higher PB in 1984 compared to 1997. Many of the benthic invertebrates found in all years in both streams are known to graze periphyton. *Baetis*, *Ameletus*, and *Rhithrogena* were common in Goathorn and Tenas creeks and these insects can deplete algal biomass levels through feeding. For this reason, any variation in the abundance of these taxa has the potential to influence algal biomass. During fertilization of the Kuparuk River, Alaska, grazing insects reduced areal periphyton biomass to a concentration that was similar to that in unfertilized reaches (Peterson et al 1993). This observation is consistent with several other studies in which grazers were found to be highly effective in reducing periphyton biomass with or without fertilization (Lamberti and Resh 1983, Jacoby 1985, Rosemond 1994, McCormick and Stevenson 1991).

Given the greater water flows in Goathorn Creek compared to Tenas Creek, shear stress associated with water velocity may contribute to the observed variation in periphyton biomass between streams. High velocities (e.g., >60 cm/s) will increase shear stress, leading to increased drift and reduced immigration or colonization of diatoms (McIntire 1966, Stevenson 1983), but only extreme events that are accompanied by bedload movement cause large losses of periphyton biomass (Stevenson 1990). Moderate velocities (e.g., 20-60 cm/s) can be too low to have a scouring effect (Grimm and Fisher 1989, Stevenson 1990), but can stimulate algal metabolism by reducing boundary layer effects and optimizing diffusion through the algal mat (Whitford and Schumacher 1964, Stevenson and Glover 1993). At very low velocities (e.g., ≤ 20 cm/s), growth and biomass may decline due to differing supply of nutrients to diatom cells (Stevenson and Glover 1993).

Benthic Invertebrates

Many factors that influence periphyton abundance can also affect the abundance of benthic invertebrates and may have contributed to variation in benthos abundance in Goathorn and Tenas creeks.

Stream temperature determines rates of metabolism and growth and it affects the timing of adult emergence and reproductive success (Wallace and Anderson 1996). Instantaneous measurements of temperature at times of periphyton sampling showed that Goathorn Creek was warmer than Tenas Creek (Appendix 1 Table 1). However, the temperature ranges in both streams of 11°C in September to 1.5°C in October was ideal to support the abundant mayflies, stoneflies and chironomids (Wallace and Anderson 1996). For this reason temperature difference between streams was likely not enough to influence benthos abundance.

Extreme substratum variation (e.g., sand versus gravel and cobble) can select for invertebrate communities (Wallace and Anderson 1996). However, in mountain streams

like Goathorn and Tenas creeks that have a substratum of some sand but more surficial gravel, cobble and boulder, water velocity is more important in modifying invertebrate abundance (Statzner et al. 1988). A wide diversity of body types have evolved in stream benthos for purposes of optimizing use of wide ranging flow regimes around substratum particles. Stream insects are found on surfaces or under rocks or they can be found buried in gravel below surface water and rocks. Many mayflies and stoneflies occupy surfaces of rocks for feeding. In headwater streams where flows are relatively low, these taxa may occupy these surfaces for longer durations than in larger order systems where flows and particle transport may limit feeding on those surfaces. This may be one factor explaining greater mayfly and stonefly abundance and taxon richness at upstream stations in Goathorn and Tenas creeks (T3 and G5) compared to downstream (T1 and G2). Finding greater total taxon abundance upstream compared to downstream is, however, unusual. Other studies that have examined longitudinal variation in stream invertebrate communities report increasing abundance and richness with increasing stream size and order (Ward 1986, Kiffney and Clements 1996) due to increasing diversity and abundance of flow habitats and food with increasing stream size.

A most important factor explaining the inverse trend in Goathorn and Tenas creeks may be abundance of the periphyton food supply. Higher algal biomass that was found at the upstream stations (Fig. 1.3a-d) compared to downstream can increase the abundance of invertebrates (Johnston et al. 1990, Hart and Robinson 1990). The more abundant periphyton provides an improved food supply (Hershey et al. 1988) which increases invertebrate survival and greater larval abundance compared to sites where periphyton biomass is lower (Mundie et al. 1991, Perrin and Richardson 1997). The greater periphyton biomass at the upstream stations may be attributed to relatively high dissolved phosphorus concentrations at the upstream stations (Table 1.1).

Because, insects can move, mainly by crawling, they can avoid and survive extreme flood events by crawling into subsurface pore water which is called the hyporheic zone of streams. Some stonefly larvae are known to bury themselves several metres into the hyporheic zone (Stanford and Gaufin 1974). It is this process that explains why invertebrate abundance in streams is similar before and after major stormflow events (Williams 1984). For this reason, stormflows in Goathorn and Tenas creeks may not be an important factor determining benthos abundance particularly given that the timing of stormflows is likely to be similar between streams.

1.4.3 Indicator Taxa

A study conducted in Colorado coldwater streams to determine the sensitivity of attached algal communities to acid-mine drainage showed that certain species are indicative of mine pollution (Medley and Clements in press). *Achnanthes minutissima* and *Fragilaria vaucherie* were present in streams impacted by mine drainage in Colorado and in other impacted streams of western North America (Leland and Carter 1984, Deniseger et al.

1986). These same species were found in Goathorn and Tenas creeks. By recognizing these species as tolerant taxa, any increase in the relative abundance of these taxa to the exclusion of others listed in Tables 1.3-1.5 during future monitoring at downstream sites but not at control stations, would be an indication of a structural and functional change in the biological communities in Goathorn and Tenas creeks.

It is possible to recommend a few invertebrate groups that have been found to be sensitive to mine drainage and therefore useful as indicator organisms in future monitoring. Heptageniid mayflies have been found in a number of studies throughout North America to be sensitive to a range of environmental stressors (Leland et. al. 1989, Feldman and Conner 1992, Clements and Kiffney 1995, Kiffney and Clements 1996). Experiments (Kiffney and Clements 1994a) and surveys (Kiffney and Clements 1994b, Clements and Kiffney 1995) have showed that heptageniid abundance is reduced downstream of discharges of mine effluent compared to upstream reference stations. Heptageniid mayflies, particularly the genera, *Rhithrogena*, *Eporous*, and *Cinygmula*, were one of the most abundant mayfly families at Goathorn and Tenas creek stations. The disappearance of these taxa at downstream sites but not at control stations in future monitoring of Goathorn and Tenas creeks would be another indication of structural and functional change in the biological communities in Goathorn and Tenas creeks.
Another useful indicator is total mayfly abundance and mayfly taxa richness (Clements and Kiffney 1995). These measures are generally less variable in space and time compared to taxa-specific abundance measures and for practical purposes, they are robust, clear indicators. They may be particularly useful in Goathorn and Tenas creeks because mayfly abundance and taxa richness was high at all stations. Because the mayflies are a numerically important part of the stream communities, any large decline that exceeds background variability that is defined in the present data, can be regarded as a definitive change in community structure.

1.4.4 Application to Future Monitoring

The combination of water quality, periphyton and benthos data from 1983, 1984, and 1997 provide a baseline for comparison with data from future monitoring. It is expected that sampling of the same parameters will occur in any additional monitoring year. Using the same approach that was presented in this study, analyses of variance can be used to examine a location effect, year effect, and interactions between year and location on any of the measured parameters. If there is more than one year of monitoring after mine start-up, years can be used as replicates to compare with replicate years before mine operation (1983, 1984 and 1997) to examine change in parameter values between the two blocks of years. This approach is called a before-after-control-impact design (Smith et al. 1993). It can be a relatively robust analysis to examine time course change in chemical concentration or biological measures in streams between time periods. Whichever approach is used, the upstream sites control for natural factors that can influence stream community structure and function while the downstream sites may be exposed to these

factors and additional stresses. This layout and statistical analysis can separate effects of the natural factors from other stresses on community structure and function. For the effect of those other stresses to be significant, they must cause parameter values to substantially differ from the variability in measurements that are found occurring naturally across all years.

Before further assessments of stream water quality and biological communities in Goathorn and Tenas creeks can be addressed, it is essential that accurate water chemistry data be collected. To date, the data are sparse and inadequate to make decisions on the potential ecological consequences of altered chemical characteristics. Laboratories that support a detection limit of ≤ 0.001 mg$\bullet L^{-1}$ for SRP, 0.002 mg$\bullet L^{-1}$ for TDP and TP, 0.005 mg$\bullet L^{-1}$ for NH_4^+-N, and 0.002 mg$\bullet L^{-1}$ for NO_3^--N should be used for future water quality analyses.

SECTION 2

FISHERIES STUDIES

Prepared by David Bustard MSc. RPBio.

2.1 STUDY OBJECTIVES

- To verify the existing fish database by repeating sampling at approximately 20 index sites throughout Goathorn, and Tenas creeks and the lower Telkwa River. These are the same locations that were sampled from 1983-85.

- To distinguish between bull trout and Dolly Varden use of all systems in the project area including key spawning and rearing habitats. The surveys were to extend into the upper portions of the Goathorn and Tenas watersheds to identify critical habitats on a watershed basis.

- To undertake more detailed fish and habitat work in Four Creek (Goathorn tributary) relative to the Tenas Pit and haul road.

- To update pink salmon spawner distribution data for Goathorn Creek and the lower Telkwa River.

- To repeat fish sampling in Helps and lower Hubert creeks and conduct additional sampling in the mid and upper reaches of Hubert Creek relative to the proposed haul road and loadout facilities.

- To collect more detailed fish and habitat information at specific road crossing sites on Goathorn Creek[3] and the Telkwa River relative to proposed haul roads.

- To collate all fisheries information from past studies and incorporate new data from the 1997 studies and a recent stream reconnaissance inventory program onto a single project area fisheries map at a scale of 1:20000.

It was not an objective of this study to repeat all of the habitat measurements previously conducted and reported in earlier studies. Some summaries will be included, but the

[3] Field studies assessing a proposed haul road crossing site from the Tenas Pit located on Goathorn Creek 100 m downstream from the confluence of Four Creek were undertaken during the fall of 1997. Subsequent to this evaluation, the proposed crossing site has been relocated downstream to an area in the vicinity of Site G3. The results of the field assessment at the original crossing site have not been included in this report and the assessment of the new crossing site is not complete.

reader will be referred to previous studies. As well, the results from studies of insect drift, fish diet, and metal analysis of fish tissue are presented in the appendices of the *Application for a Project Approval Certificate* and are considered adequate for baseline information.

Similarly, no further field studies were conducted on coho salmon spawning due to good baseline information in the Telkwa River for this species. A summary of ongoing coho salmon work in the Telkwa Watershed will be included in this report.

2.2 METHODS

Field studies were conducted from August through early November 1997. The main fish sampling program in Goathorn and Tenas creeks was conducted from the middle of September to early October to correspond to the same timing as past studies. High flows in Goathorn Creek during early October meant some of the fish population work had to wait until late October when flows were more manageable.

Access to all juvenile fish sample sites was either by vehicle or ATV. The mid and upper fish sample sites in Tenas Creek that had been accessed by helicopter in the 1980's were re-located to sites that allowed for vehicle access to within reasonable walking distance from newly-logged areas. The new sites were close to the original locations, and are considered representative of the reaches that were being sampled.

A helicopter was used during the spawning surveys in upper Goathorn and Webster creeks.

2.2.1 Fish Habitat Studies

Fish habitat descriptions including stream profiles, channel width, area, and gradient information for the main project area are presented in (Bustard 1983 and 1985a).

The 1997 studies extended the habitat information into upper sections of Goathorn and Tenas creeks and in Four Creek. This extension provides a more detailed evaluation over a larger area than previously available. The fish habitat data has been used in conjunction with the mapping at a 1:20000 scale.

Reach breaks were identified in the new areas using a combination of air photo interpretation, 1:20000 TRIM mapping, and ground surveys. Habitat information within each of these reaches was collected during ground surveys evaluating bull trout spawning areas, and as part of the juvenile fish sampling program.

This information was supplemented with observations made during a helicopter survey conducted on September 3, 1997. This flight was used to estimate the upper extent of

fish use in the watershed and to identify the most suited areas for potential spawning, barrier locations and potential access into tributary streams.

A total of 45 km of stream channel were identified as potential areas suitable for bull trout use and were examined by ground surveys during early September. As part of these surveys, potential spawning sites for bull trout and Dolly Varden were delineated. As well, barriers to fish migration (debris jams and falls) and areas of bank instability were noted. The ground surveys also allowed for an evaluation of potential fish use in the lower ends of small tributaries entering these stream reaches.

Additional habitat information was collected at fish sample sites and recorded on DFO/MOE Stream Survey Forms according to the procedures standardized by MOELP (1995)[4]. As well, more detailed habitat information was collected in the vicinity of proposed stream crossings in Goathorn Creek[5] and the Telkwa River.

2.2.2 Juvenile Fish Studies

For those fish species such as steelhead and coho salmon, it is generally recognized that given adequate spawning escapements, limitation to production in these species typically occur at the stream rearing stage. Habitat differences (summer and winter) make some streams and specific reaches more suited as juvenile rearing habitat compared to others. Juvenile fish index sites provide valuable information concerning the capability of the habitat to support juvenile fish, especially if they are conducted over a range of different spawning escapements. This information, combined with a measure of adult spawner abundance, provides important background to help determine whether changes to stream habitat due to land-use activities may have led to a decline in a stream's capability to support rearing fish.

A total of 40 juvenile fish sample sites were evaluated in Goathorn and Tenas creeks and the lower Telkwa River (Figures 1.1, 1.2, and 2.1). This included 20 index sites that had been sampled during previous surveys (1983 to 1985).

An effort was made to locate these index sites at the same location as in past years. Several of the upper Tenas Creek sites were re-located to take advantage of new logging road access nearby. Sites in the Telkwa River were in the same general location, but substantial channel changes in all areas in the lower river over the past 14 years meant that the sites were not identical. Habitat conditions in sidechannel sites, in particular, were changed from past years.

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[4] The revised 1997 version of the Fish and Fish Habitat Inventory: Standards and Procedures was being tested during the summer of 1997 and not readily available for use at the time of the project development.

[5] The location of the crossing has changed subsequent to the field surveys.

Sampling procedures varied between sites depending upon objectives. All tributary sites were blocked at their upstream and downstream ends and sampled using a Smith-Root BP-15 backpack electroshocker. A combination of bipods, rebar and ropes were used to hold the nets in place.

Key sites in Goathorn and Tenas creeks that have been sampled since 1983 encompassed large stream areas (typically 50-100 m long) and a 3-pass removal (Schnute 1983) was used to estimate populations. These sites serve as the best indicators for changes in long-term trends in juvenile fish populations in the vicinity of the proposed mine.

A decision was made to not conduct a modified Peterson mark-recapture estimate (Ricker 1975) in these sites similar to the 1983-85 period. In order to separate the bull trout and Dolly Varden juveniles, branchiostegal ray counts were conducted. The handling involved in conducting these counts would probably not allow for the full recovery of char needed to conduct a mark-recapture within a reasonable time period of initial capture.

Two-pass removal estimates (Seber and LeCren 1967) were conducted at most of these other sites. This method is fast and effective for estimating fish densities, but the confidence intervals tend to be not as tight as with the 3-pass removal. This sampling was useful for conducting assessments at sites that may not serve as long-term index sites, but are important for determining fish distribution and abundance within the stream systems. Some single-pass removal sampling was conducted at sites to determine whether fish were present or not (e.g., Four Creek).

New sites were established in upper Tenas Creek, upper Goathorn and Webster creeks, and in the Telkwa River in the vicinity of the proposed bridge site. As well, an additional 10 sites were established in Four Creek to delineate fish distribution in this tributary located in the middle of the project area.

Main channel sites in the Telkwa River were enclosed with two 15 m long seine nets held in place by rebar positioned prior to sampling. The main channel sites extended to the edge of the fast water encompassing most habitat utilized by juvenile fish. A 2-pass removal was used at these locations.

Appendix 3 Table 1 summarizes the sampling method, length of site and date of sampling for each of the juvenile fish sites in Goathorn and Tenas creeks, the lower Telkwa River, Bulkley River, and Hubert Creek.

An additional 20 sample sites were located in Hubert Creek and along the mainstem Bulkley River associated with the proposed road corridor and loadout facility (Figure 2.1). Sites in the upper free-flowing sections of Hubert and Helps creek, and in the Bulkley River were mainly sampled using 2-pass removal.

Figure 2.1

Location of Fish Sample Sites in the Lower Telkwa River and Hubert Creek.

Sample Sites

Fish 1997 — H1

Fish 1983-85 (only sites not re-sampled in 1997) — H5

Reach Break — 1 2

Scale: 1:20,000

BULKLEY RIVER

B1 B2 B3 B4

HUB1 HUB2 HUB3 HUB4 HUB5

HUBERT CREEK

HELPS LAKE

HELPS CREEK

HUB6 HUB7 HUB8 HUB9 HUB10

H1 H2 H3 H4 H5 H6 H6a H7 H8 H9 H10 H11 H11a

SC1 SC2 SC3

MS1 MS2 MS3 MS4 MS5 MS6 MS7

TELKWA DYKE

TELKWA RIVER FLOOD CHANNEL

TELKWA RIVER

Slow-flowing and ponded sections in lower Hubert Creek were sampled using minnow traps baited with roe and set overnight. In total 56 minnow traps were used in lower Hubert and an additional 10 traps were set at WL1 (a wetland complex on the Telkwa River downstream from Goathorn Creek - Figure 1.1).

Sample site areas were calculated from measurements of length and a series of width measurements made at 5 to 10 m intervals along the site. Fish captured were sorted by species and measured to the nearest mm and most were returned to the stream at the end of sampling.

Scales for fish age analyses were retained from 157 steelhead parr (Goathorn Creek - 49; Tenas Creek - 59; and lower Telkwa River - 49). As well age analyses were conducted on scales from 15 juvenile coho taken in the lower Telkwa River. This allowed for the separation of juvenile steelhead and coho by age class. A summary of all steelhead scale information is presented in Appendix 9 Tables 1-3.

Branchiostegal ray counts were conducted on char larger than 50 mm fork length. These counts, in conjunction with head shape, were used to separate bull trout from Dolly Varden juveniles in the study. Results from previous DNA analyses have indicated that field crews have been very effective at separating these two species based on these morphometric characteristics (Bustard 1995). Bull trout counts were 26 or more while Dolly Varden were typically 25 or less.

Caudal fin clips were retained from Dolly Varden and bull trout juveniles larger than 50 mm fork length. Samples were preserved in ethanol and separated for each site. All DNA samples were shipped to Dr. E. Taylor's lab in the Zoology Department at the University of BC.

Char fry were visually separated into bull trout and Dolly Varden, but were combined for data analysis due to uncertainty associated with char identification at this small size. Char fry from the main Goathorn and Tenas creek sites were retained in alcohol for future genetic analysis.

2.2.3 Adult Surveys

2.2.3.1 Pink Salmon

Ground surveys for adult pink salmon spawners and redds were conducted on September 2 and 12 in the lower 1.5 km section Goathorn Creek. These dates correspond to peak spawning periods for pink salmon in the Telkwa Watershed based on past surveys (Bustard 1984b).

Aerial surveys planned for the lower Telkwa River were cancelled based on the low spawner numbers present in the watershed in 1997.

2.2.3.2 Bull Trout and Dolly Varden

Ground surveys looking for bull trout spawners and redd development were conducted throughout the accessible sections of Tenas, Goathorn, Cabinet and Webster creeks. The surveys were conducted during the week of September 2 to 5th by two crews.

The timing of these surveys was based on observations of two bull trout spawners moving upstream in Goathorn Creek at the upper bridge on August 14th 1996 (Bustard 1996). This is also the week of peak bull trout spawning in a population studied in the headwaters of the Finlay River (Bustard 1997a).

Ground surveys consisted of observers walking stream sections and carefully examining for evidence of either spawning fish or redd development. Observers could generally cover 5-8 km per day and used a hip chain and air photos to keep track of their location . Most stream sections had good visibility during the surveys, although heavy debris accumulations, particularly in Webster Creek did restrict observations. A wading stick was used to probe under overhanging banks and debris. Redd sites were ribboned and redd dimensions were measured. Visual estimates were made of the size of bull trout spawners.

An estimate of the area of potential bull trout spawning habitat was made during the ground surveys. These estimates of suitability were made based on a combination of velocity, depth, cover and bed material. The sites had to have the right combination of these habitat characteristics to be included as potential bull trout spawning habitat. Observers were experienced in evaluating the bull trout spawning habitat based on three years of spawning observations in bull trout streams in the upper Finlay.

Efforts to tag bull trout spawners in the study streams during these ground surveys were limited by low numbers of fish and heavy cover at spawning sites. A spaghetti tag was applied to a single bull trout spawner in Webster Creek.

Specific surveys of Dolly Varden spawners were not undertaken in the Goathorn and Tenas watersheds, since no areas of high suitability (e.g., groundwater channels and seepages) were identified during the preliminary surveys. Some potential habitat areas were noted during the bull trout ground surveys and limited spawner information was collected during the juvenile surveys.

2.3 RESULTS

This section updates the fish habitat information presented in Bustard (1985a) and presents the results of juvenile and adult fish surveys by study stream section. It is separated into five sub-sections:

1.) Goathorn Creek (including Cabinet, Webster and Four creeks).
2.) Tenas Creek
3.) Lower Telkwa River
4.) Bulkley River
5.) Hubert and Helps creeks

A significant addition to the fisheries baseline studies is the detailed mapping of areas that constitute fish habitat. This is presented on the 1:20000 aquatic map delineating streams with known or suspected fish habitat (marked as red on the maps) versus those that do not offer fish habitat (marked as blue). As well, the map identifies fish sample sites (historic and 1997 sites), fish spawning locations, species distribution, and significant habitat features.

This map combines information collected during habitat assessments conducted during the studies for Manalta Coal Ltd. as well as reconnaissance stream inventory work funded by Forest Renewal B.C. (FRBC) in the Telkwa watershed during 1997[6], and other incidental studies conducted in the Telkwa Watershed.

2.3.1 Goathorn Creek

2.3.1.1 Habitat Description - Goathorn Creek

The mainstem of Goathorn Creek is accessible to fish for approximately 15 km upstream from its confluence with the Telkwa River to a 5 m rock falls located in a canyon section in Reach 4. No fish are present in the upper reaches of Goathorn Creek. A massive debris jam located 0.5 km upstream from the Cabinet Creek confluence is a point of difficult passage and is presently the upper extent of fish migration for species moving upstream from the Telkwa and Bulkley rivers. At least two other very large debris jams and sediment wedges are present in this section downstream from the permanent canyon barrier (Photo 1).

During the 1980s, a 1-2 m high beaver dam located in lower Goathorn Creek used to be a point of difficult passage during the late summer and early fall period, and was the upper extent of pink salmon access (Bustard 1984b). This beaver dam is no longer present, and fish are able to move upstream into Tenas and Goathorn creeks.

[6] Data collected by Triton Environmental Consultants Ltd. and kindly provided at a draft stage for incorporation into the project area mapping on this project.

The lower two reaches of Goathorn Creek are typically 2-3% slope and are classified as riffle-pool in the lower section and cascade-pool in the upper reaches. Reach 1 tends to have more gravels and deeper and more extensive pools than the upper reach. Moderate bed material aggradation in sections of this reach have led to channel widening and side and mid-channel bar development. Upstream from the reach break at Tenas Creek the bed material is dominated by cobbles and boulders. Streamflow tends to be shallow and rapid, and channel widening is evident. Large woody debris tends to be oriented parallel to the banks.

Ground surveys during 1982 (Bustard 1983) indicated limited spawning potential in Goathorn Creek. While the lower reach offered pockets of gravel suitable for pink salmon and steelhead constituting less than 1% of the overall stream area, upstream sites had even less habitat suitable for spawning.

Habitat conditions in Goathorn Creek do favour species such as steelhead and char that spend at least several years rearing in tributary streams. These species are able to find isolated pockets of gravels for spawning.

Goathorn Creek appears poorly suited for coho spawning and incubation due to generally low groundwater inflows and severe ice conditions that can occur in this system during the late fall spawning period (Bustard 1985a). More importantly, the system has few wetlands and sidechannel sites favoured by juvenile coho for rearing.

The cobble and boulder bed material with clean interstitial spaces provides ideal rearing conditions during both the summer and winter periods for both steelhead and char. However the highly fluctuating flow regime and tendency for channel scouring poses risk for rearing juveniles, especially during the snowmelt period in May and June.

Although steelhead and the two char species occur together in Goathorn Creek, steelhead dominate the lower sections, bull trout are predominant in the mid-reaches and Dolly Varden are most common in the upper system. The distribution probably reflects subtle differences in habitat, including water temperatures.

Other than Tenas, Four, Cabinet, and Webster creeks, most tributaries to Goathorn Creek provide little potential fish habitat due to poor access from the mainstem creek due to a distinct topographic break creating a steep drop from the bench areas down to the creek.

Cabinet and Webster Creeks

Cabinet Creek is accessible for approximately 5 km upstream from Goathorn Creek. The lower 3.4 km has a slope of 2% and is dominated by cobbles and small boulders. Sediment wedges associated with debris jams are present in this section. The channel is entrenched through much of this reach, with the lower end of a single tributary (Tributary CA3 on 1:20000 aquatic map) accessible to Dolly Varden.

Although the bed material is large, pockets of potential spawning areas are present and bull trout spawning does occur in this section of Cabinet Creek. Dolly Varden dominate fish use in this reach, and some pockets of potential spawning were noted in sidechannel areas near the Webster Creek confluence.

The creek steepens sharply upstream from the Webster Creek confluence and is accessible to a 1.5 m rock falls located 1400 m upstream. The channel has a stepped - pool morphology in this section, with heavy debris accumulations across the channel (Photo 2).

Webster Creek is a major tributary to Goathorn Creek and is accessible to 6.7 kms above Cabinet Creek. Upstream from this, the creek rises sharply in a series of chutes and falls. The lower reach of Webster Creek is characterized by large cobbles and bouders and heavy debris accumulations. A large tributary in this section (Tributary WB4) is accessible from Webster Creek and Dolly Varden have been sampled up to 2.5 kms upstream during past surveys.

Reach 2 of Webster Creek has some of the best potential spawning habitat in the Goathorn Watershed, including some gravel accumulations associated with pools and debris cover suitable for bull trout use. Most tributaries entering the upper two reaches tend to be small and steep, with no potential fish use.

Four Creek

Four Creek enters directly into Goathorn Creek in the middle of the project area. This small creek has been able to cut down through the valley sidewalls of Goathorn Creek and has adequate flows to support a small resident Dolly Varden population in its upper reaches. Access for fish moving upstream from Goathorn Creek is restricted to the fan downstream from the culvert at the lower road crossing (Reach 1), a distance of approximately 100 m. This section offers potential spawning for Dolly Varden and possibly steelhead.

Four Creek climbs at a 4-5% slope for approximately 2 kms onto the bench area. Fish are present for an additional 3 kms to a point where the channels become small and steep.

Reach summaries for habitat characteristics in Goathorn Creek are presented in Appendix 4 Table 1. Individual sample site habitat descriptions are in Appendix 5.

2.3.1.2 Juvenile Fish Sampling - Goathorn Creek

Fish density estimates were conducted at 12 sites in Goathorn Creek (including Cabinet and Webster creeks) during the 1997 program. Five of these sites (G1 to G5) are index sites where sampling had also been conducted during the period 1983 to 1985. Sample

areas at these five locations were large, and effort was high (3-pass removal), compared to smaller sites and lower effort (2-pass removal) at other sites. The detailed results for fish sampling at all sites in Goathorn Creek are presented in Appendix 6.

A total of 3560 m^2 was sampled in 1997 over a total stream length of 297 m (Table 2.1). The greater wetted area sampled reflects higher streamflow condition in Goathorn Creek during September and October 1997 compared to past years. The shorter total stream length sampled is the result of sampling a smaller site at Site G5 than in past years due to high and fast water conditions.

The species composition (combined for the five index sites) remained similar to past years. Juvenile steelhead comprised over 70% of the catch, largely a result of high steelhead fry numbers at the lower two sites. The remainder of the catch was comprised almost entirely of char.

Char juveniles were separated into bull trout and Dolly Varden for the first time in 1997. Of the 67 juveniles estimated in the five index sites, 49 (73%) were identified as bull trout. Preliminary identification of the char fry also indicated that most were bull trout[7].

Mountain whitefish comprised just under 2% of the overall catch in 1997. A total of 13 whitefish (108-178 mm fork length) were sampled - all at Site G1. Only two whitefish have been sampled at the Goathorn index site in the three previous years. Similar to past years, no coho juveniles were sampled at any site in Goathorn Creek in 1997.

Juvenile Steelhead - Goathorn Creek

Figure 2.2 compares the estimated number of steelhead at the two main sites in Goathorn Creek (Sites G1 and G2). The data indicate that the total number of fry estimated in 1997 is comparable to past estimates of between 300 and 500 fry in these two sites. Mean fry densities have ranged between 23-34 fry/100m^2 of habitat at these lower Goathorn sites (Table 2.2). Fry densities have consistently been higher at Site G1 located downstream from the confluence of Tenas Creek, and may reflect some fry recruitment into lower Goathorn Creek from Tenas Creek.

Figure 2.3a shows the decline in steelhead fry with distance upstream from the Telkwa River. No steelhead fry were sampled at sites more than 6.9 kms upstream. The pattern of declining steelhead fry with distance upstream has been similar during all four years of sampling in Goathorn Creek (Appendix 7 Table 1).

[7] Char fry at these sites were retained for DNA analysis to confirm species identification. These samples have been sent to UBC for analysis, but results are not available at this time. See comments re char fry at each site in Appendix 6.

Photo 1. Goathorn Creek upstream from the Cabinet Creek confluence is characterized by several large debris jams and associated sediment wedges. A debris jam located 0.5 km upstream from Cabinet Creek is presently the upstream limit for steelhead and bull trout moving upstream from the Telkwa and Bulkley rivers.

Photo 2. Cabinet Creek upstream from the Webster Creek confluence is comprised of a series of stepped pools and heavy debris accumulations. This section is accessible for 1.4 km and is utilized by resident Dolly Varden.

Table 2.1. Summary of fish species and age class composition at Goathorn Creek index sites (Combined G1 to G5).

Species	Age	1983		1984		1985		1997	
		Number	%	Number	%	Number	%	Number	%
Steelhead	0+	470	52.0	378	47.6	519	62.2	457	62.7
	1+	107	11.8	138	17.4	28	3.4	7	1.0
	>=2+	58	6.4	48	6.0	33	4.0	70	9.6
Char	0+	123	13.6	78	9.8	152	18.2	115	15.8
Bull trout	>=1+	ns		ns		ns*		49	6.7
Dolly Varden	>=1+	145	16.0	151	19.0	102	12.2	18	2.5
Mountain whitefish	>=1+	1	0.1	1	0.1	0	0.0	13	1.8
TOTAL		904	100	794	100	834	100	729	100
Area sampled (m^2)		3238		3323		2950		3560	
Length of stream sampled (m)		323		323		323		297	

* Bull trout and Dolly Varden were not separated as different species from 1983 to 1985.

Table 2.2. Densities of steelhead fry and parr (fish/100m^2) at the two main steelhead index sites in lower Goathorn Creek from 1983-85 and in 1997.

	Age 0+			Parr[8]		
	G1	G2	Mean	G1	G2	Mean
1983	49.3	12.7	31.0	10.9	6.8	8.9
1984	38.9	9.0	24.0	12.7	8.4	10.6
1985	42.4	24.7	33.6	3.4	3.0	3.2
Mean 1983-85	43.5	15.5	29.5	9.0	6.1	7.5
1997	25.0	20.5	22.8	3.8	3.2	3.5

Steelhead parr numbers at Sites G1 and G2 were low compared to 1983 and 1984, but similar to the 1985 results at these sites (Figure 2.2a). Numbers of age 1+ steelhead were very low in Goathorn Creek in 1997, with only 7 estimated for the five sites combined. However, older parr numbers (≥age 2+) were the highest estimated in the four years of sampling (Table 2.1). Steelhead parr densities in these Goathorn index sites have ranged from 3 to 11 parr/100m^2 of habitat during the four years of study.

Similar to the steelhead fry distribution pattern, steelhead parr abundance declined with distance upstream from the Telkwa River. Steelhead parr were present in Goathorn Creek up to the Cabinet Creek confluence and in the lowest section of Cabinet Creek (Figure 2.3a). No steelhead parr were present in upper Cabinet or Webster creeks. This distribution has not changed significantly compared to past years (Appendix 7 Table 1).

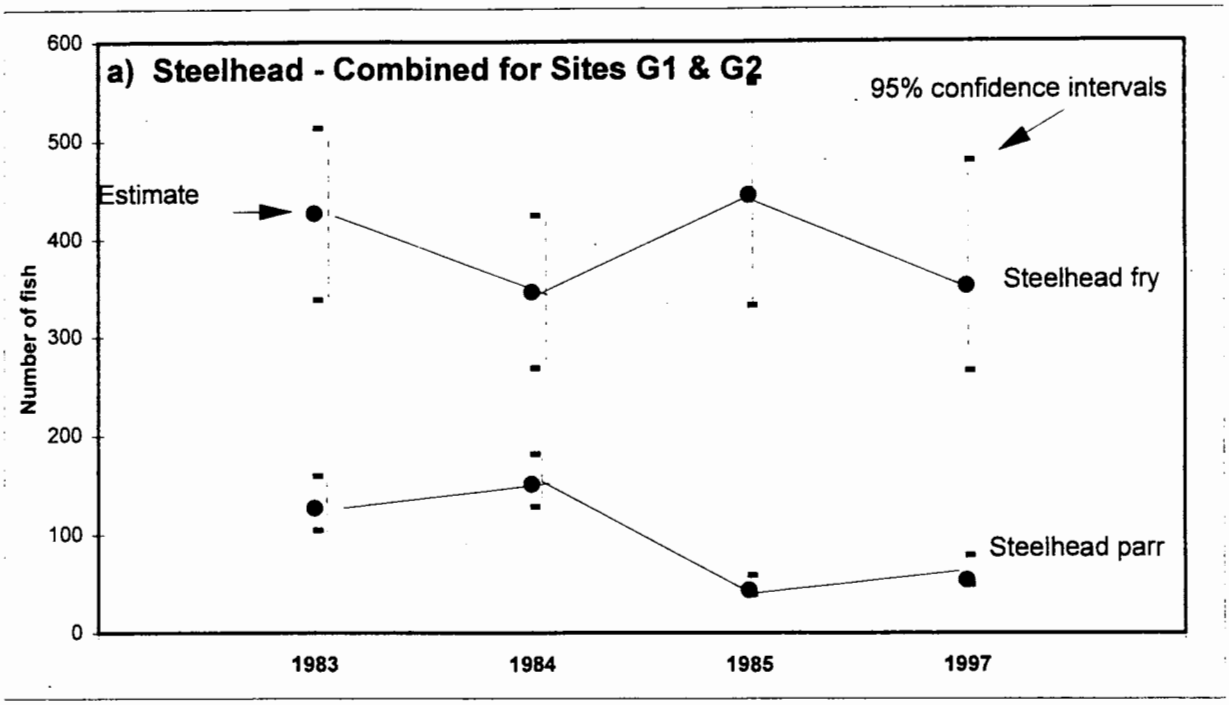
The mean fork length of steelhead fry combined for the five sites was 38.2 mm (Appendix 8 Table 1). This is in the mid-range of sizes compared to past years. Age 1+ and older steelhead averaged 78.4 mm and 112.7 mm respectively. It is interesting to note that the 1983 sample of steelhead in Goathorn Creek included fish exceeding 180 mm fork length (typical maximum steelhead smolt size) at four of the five sites sampled. Some rainbow up to 260 mm fork length were sampled, suggesting the presence of residual steelhead or a small population of stream residents. This pattern has not been noted at the index sites since 1983.

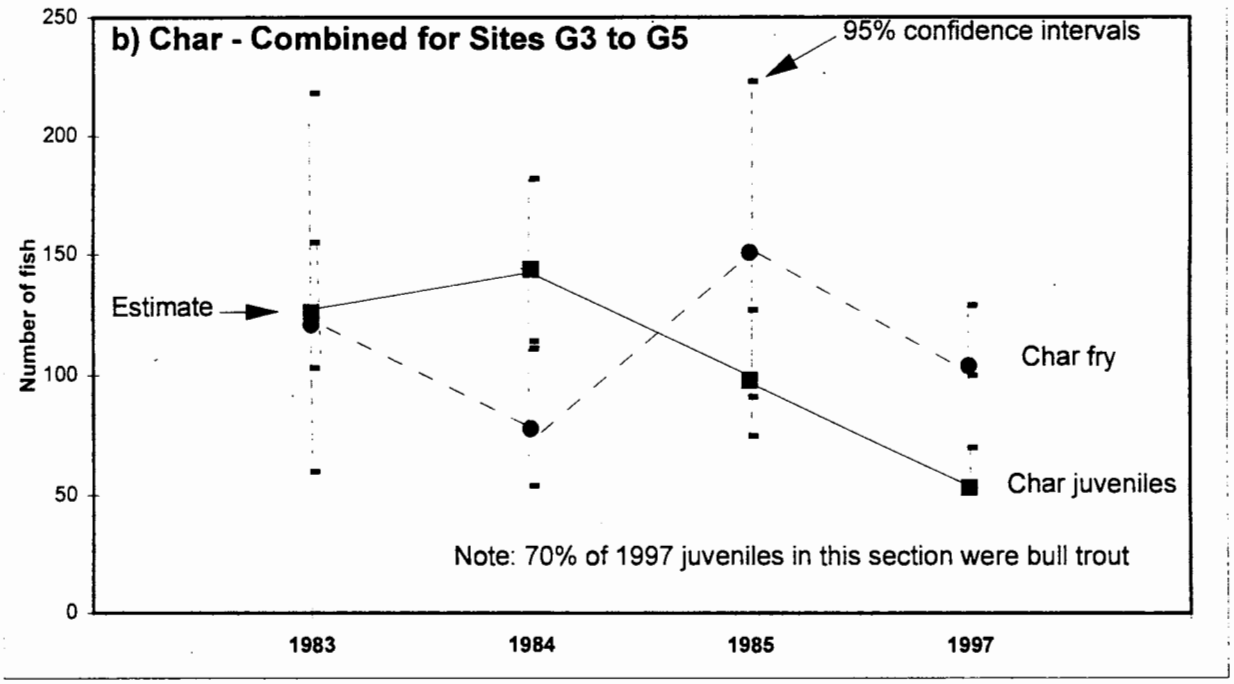
More detailed length-frequency information for Goathorn Creek fish is presented in Appendix 9 Figures 1 and 2.

Some additional fish data were collected in Goathorn Creek during the summer of 1996 as part of a Ministry of Environment project (Bustard 1996). Sampling at two locations in Goathorn Creek on August 14, 1996 yielded no steelhead fry in the catches despite 3-

[8] Combination of Age 1+ and older steelhead.

Figure 2.2. Estimated fish numbers and confidence intervals for steelhead and char at Goathorn Creek index sites.





pass removal at enclosed sites comprising 1110 m^2 of habitat (Appendix 5). This sampling was conducted near Site G2, in the steelhead section of Goathorn Creek. Sampling conducted by Tredger (1986) on August 21, 1986 indicated that newly-emerged steelhead fry were present in Goathorn Creek on this date. All of these fry were less than 30 mm fork length. Some of the fry captured in mid-September during the 1997 sampling were recently-emerged. Together these observations suggest that steelhead fry emergence occurs quite late in Goathorn Creek - starting near the end of August and continuing through until mid-September.

Juvenile Char - Goathorn Creek

Figure 2.2b summarizes the estimated number of char fry at the three main Goathorn Creek index sites (G3-G5) from 1983-85 and 1997. The numbers range from a low of 78 in 1984 to a high of 151 in 1985. The results for 1997 are in the mid-range. It should be emphasized that char fry tend to be bottom-oriented and are difficult to retrieve during electrofishing in the large bed material characteristic of Goathorn Creek. Preliminary estimates suggests 84% of the char fry were bull trout (65 of 77 fish examined).

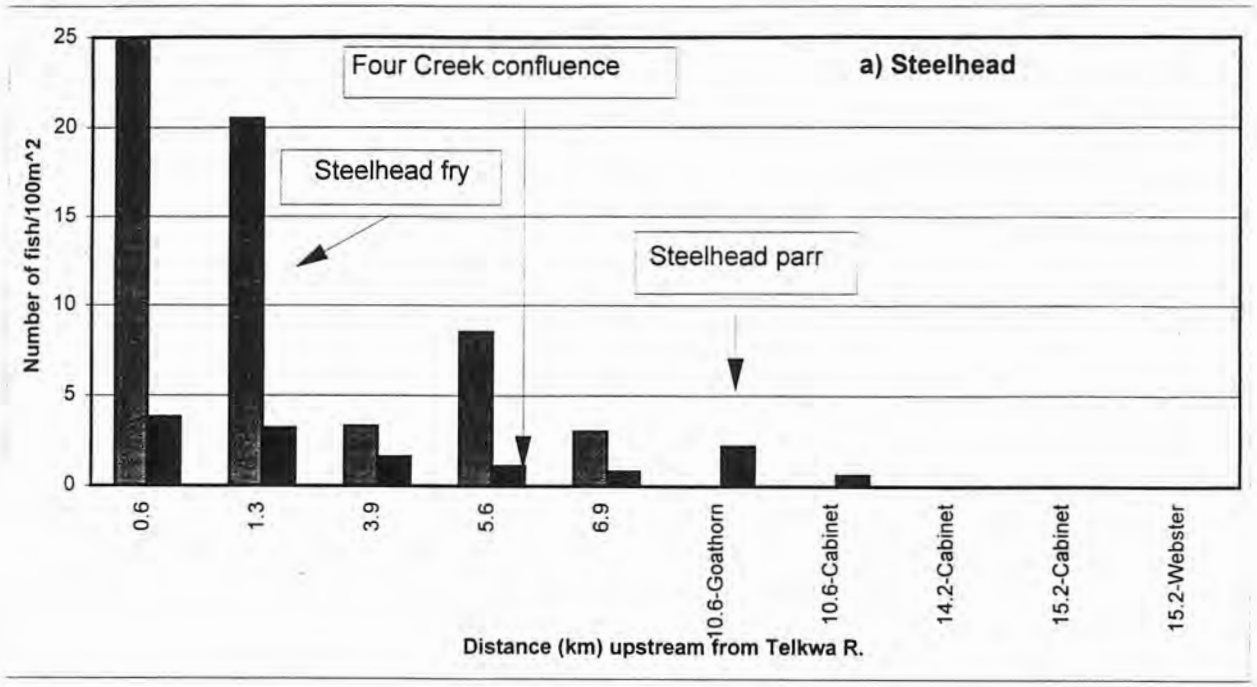
Char fry densities have ranged between 5 and 11 fry/100m^2 of habitat at the three best index sites (Table 2.3). The 1997 results were at the low end of this range. Fry densities have been highest at Site G4 located just downstream from the confluence of Four Creek (Figure 1.2).

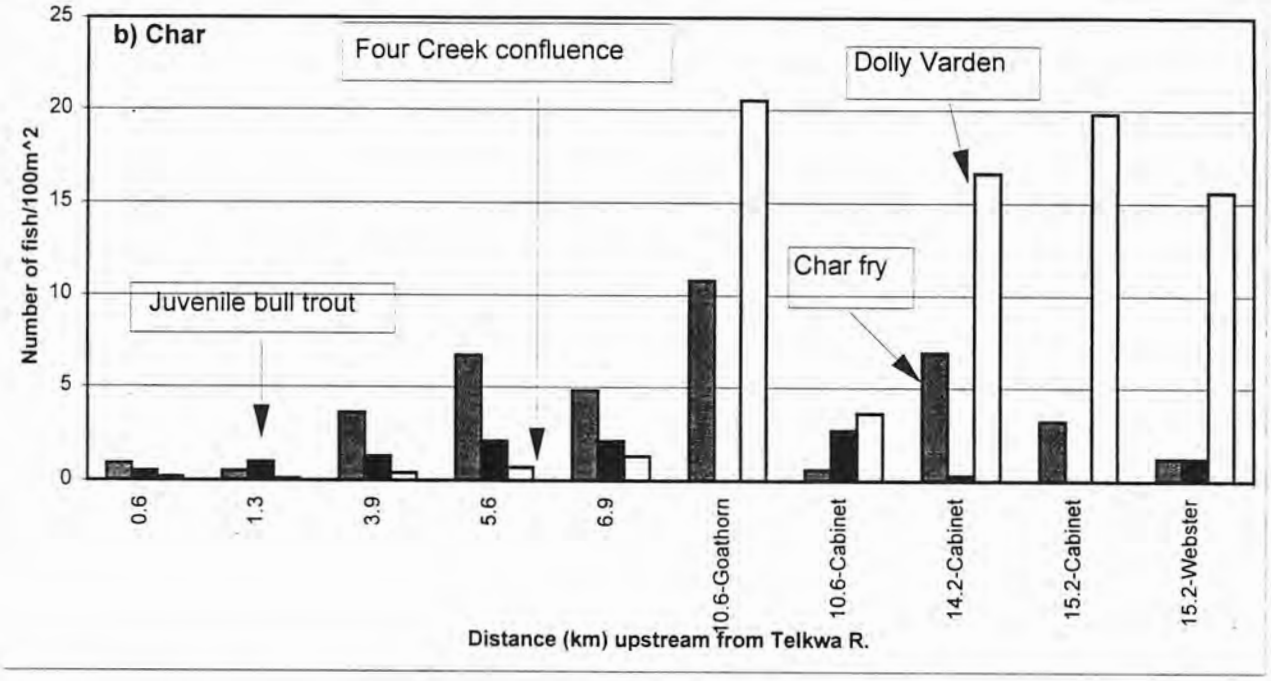
Table 2.3 Densities of char fry and parr (fish/100/m^2) at the three main char index sites in lower Goathorn Creek from 1983-85 and in 1997.

	Char fry				Char juveniles			
	G3	G4	G5	Mean	G3	G4	G5	Mean
1983	6.5	14.0	3.2	7.9	4.1	8.6	8.2	7.0
1984	6.6	6.6	1.8	5.0	6.8	7.2	8.2	7.4
1985	7.0	18.6	6.1	10.6	7.5	4.3	6.7	6.2
Mean 1983-85	6.7	13.1	3.7	7.8	6.1	6.7	7.7	6.8
1997	3.6	6.7	4.8	5.0	1.7	2.8	3.4	2.6

Char fry densities were also high at several of the upper sites including Site G8 in Goathorn Creek upstream from the Cabinet Creek confluence, and at Site G7 just downstream from the Webster Creek confluence (Figure 2.3b). Field observations suggest that most of these are Dolly Varden fry. Interestingly, no char fry were sampled

Figure 2.3. Density of steelhead and char in Goathorn Creek at different distances upstream from the Telkwa River, 1997.





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at Site G7 in 1984 (Bustard 1985), suggesting considerable variability between years at these upper sites.

Figure 2.2b shows the total number of char juveniles[9] combined for the three index sites for the four years of sampling. Total numbers in the sites have ranged from 53 in 1997 to 144 in 1984, indicating considerable fluctuation between years. Densities of juveniles have ranged from 2.6 juvenile/100m^2 in 1997 to between 6 and 7 juveniles/100m^2 during the period 1983-85.

Bull trout juveniles were present in Goathorn Creek to the Cabinet Creek confluence and into lower Webster Creek. They were not present in Goathorn Creek upstream from Cabinet Creek (Site G8) or in upper Cabinet Creek (Site G9). The highest abundance of bull trout juveniles was in the mid-reaches of Goathorn Creek and lower Cabinet Creek. Bull trout juveniles did not exceed 3 fish/100m^2 at any of the Goathorn Creek locations in 1997 (Figure 2.3b).

Dolly Varden densities increased in the upper reaches of Goathorn, Cabinet and Webster creeks and typically ranged from 15-20 fish/100m^2 of habitat (Figure 2.3b). These headwater sections of streams are dominated by Dolly Varden, and achieved the highest biomass for fish at any of the Goathorn Creek sites (Appendix 10 Table 1).

Char fry averaged 51 mm fork length in 1997, slightly higher than average fry lengths measured in past years (Appendix 8 Table 1). Juvenile sizes have consistently averaged from 100-105 mm fork length for the four years of sampling. On average, juvenile bull trout were approximately 10 mm longer than Dolly Varden.

2.3.1.3 Adult Fish Observations - Goathorn Creek

Adult fish observations in Goathorn Creek concentrated on pink salmon and bull trout spawning surveys during early September.

Pink Salmon - Goathorn Creek

Two surveys were conducted in the lower 1.5 km of Goathorn Creek looking for pink salmon spawners or redds. The surveys were conducted on September 2nd and 12th - near the peak of use of the lower creek based on past observations (Bustard 1984b).

No pink salmon spawners or redds were observed in lower Goathorn Creek during the two surveys, suggesting minimal use of this system during 1997 - a year of low pink escapements throughout the Bulkley River. A single unspawned dead pink salmon was found in the lower 100 m of Tenas Creek, just upstream from the Goathorn Creek

[9] A small number of these fish are Dolly Varden adults that typically mature in the 150-200 mm fork length range (see Appendix 9 Figure 2).

confluence on September 3rd. A local resident reports that during some years he has observed significant numbers of pinks spawning in lower Tenas Creek, but not in Goathorn Creek upstream from the Tenas confluence[10].

A total of 58 pinks was observed in the lower 600 m of Goathorn Creek in 1983 (Bustard 1984b), a year of high escapements throughout the Bulkley Watershed. No pinks were observed in 1984.

Bull Trout - Goathorn Creek

Bull trout spawner and redd surveys were conducted throughout the mainstem of Goathorn, Cabinet and Webster creeks during the first week of September (Table 2.4). Approximately 28 km of creek were examined. Visibility was generally good during these surveys, however Webster Creek was difficult to survey due to extensive debris accumulations that made both redd and spawner observations difficult.

In total, 16 bull trout spawners and 6 redds were observed during the surveys. The redd sites were mainly located in a 2 km section of Goathorn Creek downstream from Cabinet Creek (Photo 3), in lower Cabinet Creek and in a section between 3.8 and 4.2 km upstream on Webster Creek. A single bull trout redd (suspected) was observed in lower Goathorn Creek. The specific redd site locations are shown on the 1:20000 aquatic map.

Eight of the 16 bull trout spawners observed were not holding in spawning locations and were thought to be moving upstream. These observations suggest that the surveys were conducted early into the spawning period. Four of the redd sites had bull trout present, including three of the redds with pairs of fish actively spawning. The detailed results of the surveys are presented in Appendix 11 Tables 1 and 3.

Goathorn Creek bull trout spawners typically ranged in size from 40-55 cm fork length,. based mostly on visual estimates made by experienced observers. Three bull trout spawners that have been captured in Goathorn Creek during the years of study have ranged from 43-45 cm fork length[11]. Redd dimensions ranged from 0.5 to 1.5 m^2 based on a small number of sites (Appendix 11 Table 3).

It is interesting to note that a female bull trout that was tagged at a redd site 3.8 km upstream in Webster Creek on September 4 was recaptured by an angler in the Telkwa River upstream from Goathorn Creek approximately 3 weeks later (Photo 4). This was the only bull trout tagged during the study, and suggests that Goathorn Creek bull trout spawners are probably very vulnerable to angling in the Telkwa and Bulkley rivers.

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[10] Bruce Kerr, Telkwa.

[11] Includes a 43 cm bull trout angled in lower Goathorn (600 m upstream) in August 1984; a 45 cm bull trout electrofished at Goat2 (upper bridge) in August 1996; and a 44 cm bull trout angled at a redd site in Webster Creek during September 1997.

Table 2.4. Summary of bull trout spawner and redd observations in Goathorn Creek during September 2-4th, 1997.

Stream Section	Length (m)	Spawners	Redds	Comments
Lower Goathorn to Cabinet Ck.	10500	7	3	Most redds and bull trout spawners observed from 8.5 to 10.5 km upstream. Single redd in lower system.
Goathorn Ck. above Cabinet Ck.	4400	0	0	Suspect no access beyond 435 m debris jam.
Cabinet Ck. to Webster Ck.	3800	7	1	Fish mainly moving upstream through-out this section.
Cabinet Ck. above Webster Ck.	1400	0	0	Appears mainly DV use of this section. No bull trout spawning potential identified.
Webster Ck. upstream from Cabinet Ck.	6700	2	2	Spawning from 3.8 to 4.2 km upstream. Difficult observations due to debris. Suspect more spawning and holding fish may use this section.
Lower Four Ck.	1350	0	0	Suspect no access beyond road culvert at 150 m. Probably too small for bull trout.

This population of bull trout is assumed to be fluvial and to reside in the Telkwa and Bulkley rivers except during migration and spawning periods in August and September.

Dolly Varden - Goathorn Creek

Dolly Varden spawning in Goathorn Creek is likely scattered throughout the upper watershed. Specific areas identified during the September ground surveys included Goathorn Creek upstream from the Cabinet Creek confluence (based on maturing fish in this section), and Cabinet Creek in the vicinity of the Webster Creek confluence (good sidechannel section and pockets of suitable gravel upstream from Webster Creek). Other

Photo 3. This good potential bull trout spawning habitat was located in the mid-reaches of Goathorn Creek. Most bull trout spawning occurs upstream from the proposed mine project.

Photo 4. This female bull trout was tagged at a redd site in Webster Creek in early September. It was recaptured by an angler in the Telkwa River three weeks later.

potential sites include the lower sections of Four Creek and possibly a small tributary just upstream (Tributary GT2 on 1:20000 aquatic map) where Dolly Varden were captured during the FRBC fish inventory sampling.

Based on observations elsewhere in the Bulkley Watershed in tributaries arising in the Telkwa Range similar to Goathorn and Tenas creeks, Dolly Varden spawning likely occurs at least several weeks later than the peak of bull trout spawning, typically in late September, with spawning continuing into early October (Bustard 1997c)

Four Creek

Fish abundance and distribution in Four Creek was examined in detail in 1997 due its proximity to the Tenas West Pit and the proposed haul road from the pit to the plant site. The results, based on sampling at 10 locations in conjunction with ground surveys (Figure 1.2) and additional sampling conducted during the FRBC stream inventory studies, indicated that most of Four Creek is utilized by resident fish.

Steelhead fry and Dolly Varden were present in the lower reach of Four Creek - a short fan area located downstream from the lower road crossing (Table 2.5). Two maturing Dolly Varden were captured at this location, and it is likely that some spawning may occur in this section.

Upstream from the road crossing, sampling indicated that Four Creek is utilized by a small population of Dolly Varden for a distance of approximately 5 kms (see the 1:20000 aquatic map for the distribution). No fish were captured at a site immediately upstream from the road crossing (Site F2).

However, Dolly Varden were present in the mid-reaches of Four Creek at densities of 6-11 fish/100m^2. Based on the catches at sites F4 and F5 and applying these to the upper 4 kms of Four Creek (i.e., excluding a 1 km steeper section in vicinity of F2 where there was no catch) leads to an estimate of just under 1000 Dolly Varden in Four Creek[12].

Dolly Varden in Four Creek are likely a resident population maturing at a small size (12-15 cm). The largest fish captured during sampling above the road culvert was 122 cm. Dolly Varden to 145 mm were captured in Four Creek during forest inventory sampling[13].

[12] Mean fry catch of 6.7 fry/100 m and 17.1 juveniles-adults /100 m of stream length over 4 kms leads to an estimate of 268 fry and 684 juveniles and adults combined.

[13] Fish site card information provided by Triton Environmental Consultants Ltd.

Table 2.5. Summary of densities of fish captured at sample sites in Four Creek during 1997.

Site	Fish/100m^2		
	Steelhead	Dolly Varden	
	Age 0+	Age 0+	≥Age 1+
F1	21.6	0	10.8
F2	0	0	0
F4	0	0	6.0
F5	0	7.0	11.0
Mean F4 & F5	0.0	3.5	8.5

2.3.2 Tenas Creek

2.3.2.1 Habitat Description - Tenas Creek

Tenas Creek drains an area of 63 km^2 or approximately one-third of the total Goathorn Watershed. Significant fish spawning and rearing occurs upstream to a 20 m falls located approximately 16.5 km upstream (West Fork). The East Fork of Tenas is accessible for approximately 4 km. At this point it rises sharply at a series of chutes and cascades. Debris jams in the lower sections of the East Fork may be barriers to fish moving upstream during lower flows.

Most of the fish-producing sections of Tenas Creek are located in a confined gully with evidence of extensive valley-wall instability. Exposed fine-textured banks are prevalent, particularly on the east side of Reach 1 (Photo 5). Sediment inputs into Tenas Creek from these areas of instability may have been accelerated by logging to the edge of the escarpment area during the 1980's (Saimoto 1996), although studies conducted by the Ministry of Forests were unable to locate sediment inputs loading into Tenas Creek caused by logging activities (Beaudry et al. 1991).

All of the tributaries entering Tenas Creek from the east side (vicinity of Tenas West Pit) are small drainages that are not accessible beyond the steep embankment along Tenas Creek. The lower few hundred meters of a tributary entering from the west side of Tenas Creek in Reach 3 (TN18) offers some potential fish habitat before rising steeply.

More moderate streamflows and a narrower and lower gradient channel make the lower 9 km of Tenas Creek particularly suited for steelhead spawning and rearing (Photo 6). Large organic debris plays a more significant role in creating habitat diversity in Tenas Creek compared to the lower reaches of Goathorn Creek. Pool areas have formed

downstream from logs and root wads, and gravel has been deposited at the tail-outs from these pools creating more spawning areas. A lower discharge in Tenas Creek has also resulted in more low velocity sections suitable for fry rearing than in the large and fast-flowing Goathorn Creek.

Potential spawning habitat is also available in Reach 2 and the lower 2 km of Reach 3 (West Fork). Definite steelhead and bull trout redds were identified in this section during the 1997 ground surveys. Specific locations are shown on the 1:20000 aquatic map.

The channel slope steepens to 5-10% in Reach 4 of the West Fork and in most the East Fork, and the channel morphology becomes stepped-pool and cascade-pool through these sections. These areas are suspected to offer potential char habitat. The presence of bull trout fry in the lower section of the East Fork suggests that some bull trout spawning occurs in this system.

2.3.2.2 Juvenile Fish Sampling - Tenas Creek

Fish density estimates were conducted at six locations in Tenas Creek during the 1997 program (Figures 1.1 and 1.2). Three of these sites (T1 to T3) are index sites where sampling has also been conducted during the period 1983 to 1985. Site T4 has data for two years while the two additional sites in the upper watershed were added to better delineate fish distribution in the watershed, particularly for the char species. The detailed results for fish sampling at all sites in Tenas Creek are presented in Appendix 6, while habitat information is presented in Appendix 5.

A total of 1317 m^2 of habitat over a stream length of 194 m was sampled at the three key index sites in 1997 (Table 2.6). This is comparable to sample effort during the period 1983 to 1985. The results suggest that the species composition was similar in 1997 compared to catches in the mid-1980s with approximately 90% of the total catch at the three sites comprised of steelhead trout fry and parr.

Char fry and juveniles comprised between 2-3% and 4-8% of the overall catch in all four years of sampling. Sampling during 1997 indicated that only 5 of the 28 char juveniles (18%) sampled at the three index sites were bull trout. Whitefish have only been captured at index sites in Tenas Creek during 1984, when two were present.

Juvenile Steelhead - Tenas Creek

Figure 2.4a compares the estimated number of steelhead at the three index sites in Tenas Creek (T1 to T3) over the four years of sampling. Steelhead fry numbers have ranged from a high of nearly 700 in 1983 to a low of 232 in 1984. The 1997 results of 376 fry are in the mid-range compared to past years. These September fry estimates provide a

Table 2.6. Summary of fish species and age class composition at Tenas Creek index sites (Combined T1 to T3).

Species	Age	1983		1984		1985		1997	
		Number	%	Number	%	Number	%	Number	%
Steelhead	0+	701	76.8	232	56.3	452	74.1	392	76.1
	1+	99	10.8	104	25.2	25	4.1	30	5.8
	>=2+	45	4.9	35	8.5	75	12.3	51	9.9
Char	0+	30	3.3	7	1.7	15	2.5	14	2.7
Bull trout	>=1+	*ns		ns		ns		5	1.0
Dolly Varden	>=1+	38	4.2	32	7.8	43	7.0	23	4.5
Mountain whitefish	>=1+	0		2	0.5	0		0	
TOTAL		913	100	412	100	610	100	515	100
Area sampled (m^2)		1154		1201		1094		1317	
Length of stream sampled (m)		189		182		182		194	

*Bull trout and Dolly Varden were not separated as different species from 1983 to 1985.

reasonable measure of the strength of the previous year's spawner recruitment to this stream.

Fry densities combined for the three index sites have ranged from 14 to 48 fry/100m^2 during the four years of sampling (Table 2.7). The data suggests that fry densities have consistently been higher at the bottom two sites (T1 and T2) compared to the upper index site located in Reach 2 of Tenas Creek. The 1997 densities of both steelhead fry and parr were lower than the mean for the three years of sampling in the mid-1980s.

It is interesting to note that steelhead fry were distributed at higher densities farther upstream on Tenas Creek than in past years. Sampling at Site T4 (located 7.4 km upstream from Goathorn Creek) indicated that steelhead fry achieved relatively high densities up to at least the top section of Reach 1 in 1997 (Figure 2.5a). This reach was identified as the most suited for potential steelhead spawning during the habitat surveys. Sampling in 1984 indicated that in some years steelhead fry can be quite sparse above the lowest site (T1). Figure 2.5a illustrates the decline in steelhead fry at sample sites located in the upper reaches of Tenas Creek compared to lower sections based on 1997 sampling.

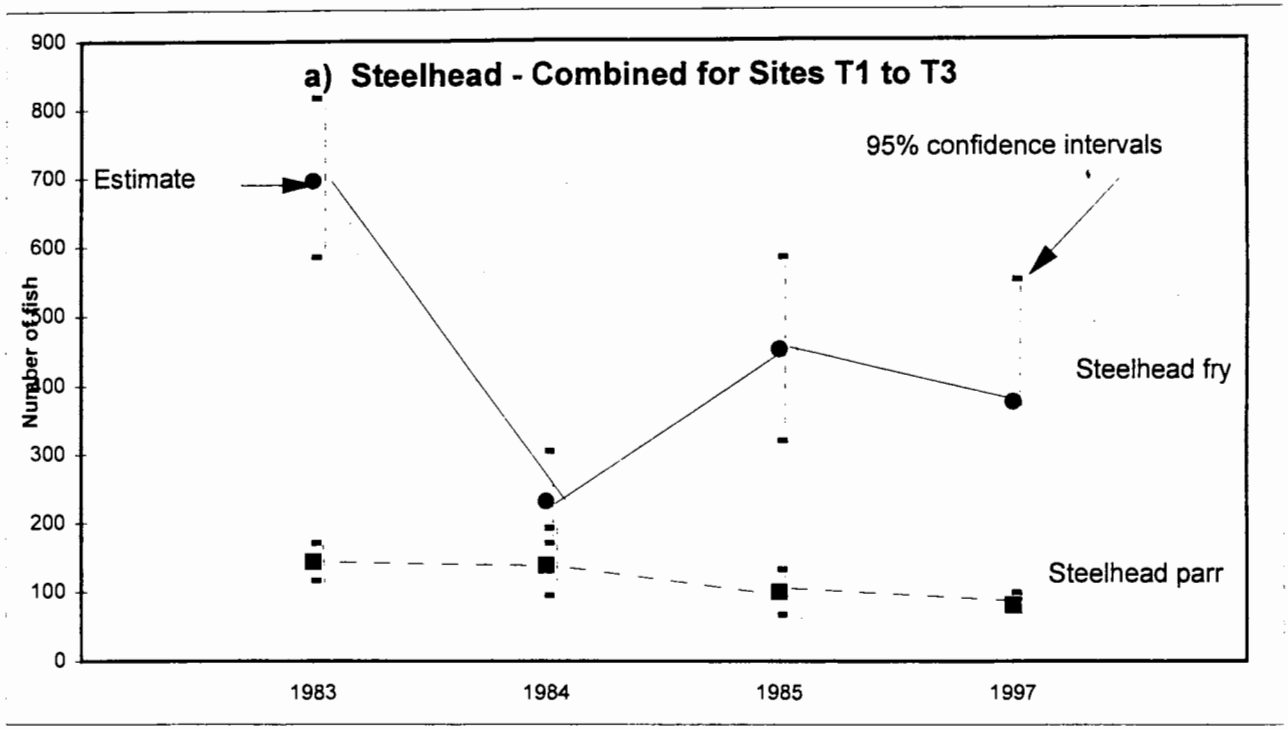
Table 2.7 Densities of steelhead fry and parr (fish/100m^2) at three index sites in Tenas Creek from 1983-85 and in 1997.

	Age 0+				Parr			
	T1	T2	T3	Mean	T1	T2	T3	Mean
1983	87.7	52.2	4.6	48.2	13.3	17.3	0.0	10.2
1984	36.6	4.4	0.5	13.8	8.0	21.1	2.9	10.7
1985	50.4	46.8	1.2	32.8	6.2	15.7	3.5	8.5
Mean 1983-85	58.2	34.5	2.1	31.6	9.2	18.0	2.1	9.8
1997	40.9	24.2	9.9	25.0	7.5	7.2	5.4	6.7

Steelhead parr densities (mean for three index sites) have ranged from 7 to 11 parr/100m^2 for the four years of sampling (Table 2.7). Densities have been highest at Site T2 in the mid-section of Reach 1 during most years. Sampling at Site T4 located 7.4 km upstream on Tenas Creek resulted in the highest parr densities in 1997 (Figure 2.5a). Steelhead parr were present up into the West Fork of Tenas Creek over 13 km upstream. A steelhead redd was identified in this section during the 1997 surveys.

Steelhead age 1+ parr numbers were very low during the 1997 sampling program. Only 30 yearlings were captured in the three sites combined. This pattern of low yearling numbers is similar to that observed in Goathorn Creek and suggests poor fry recruitment thoughout the watershed during 1996.

Figure 2.4. Estimated fish numbers and confidence intervals for steelhead and char at Tenas Creek index sites.



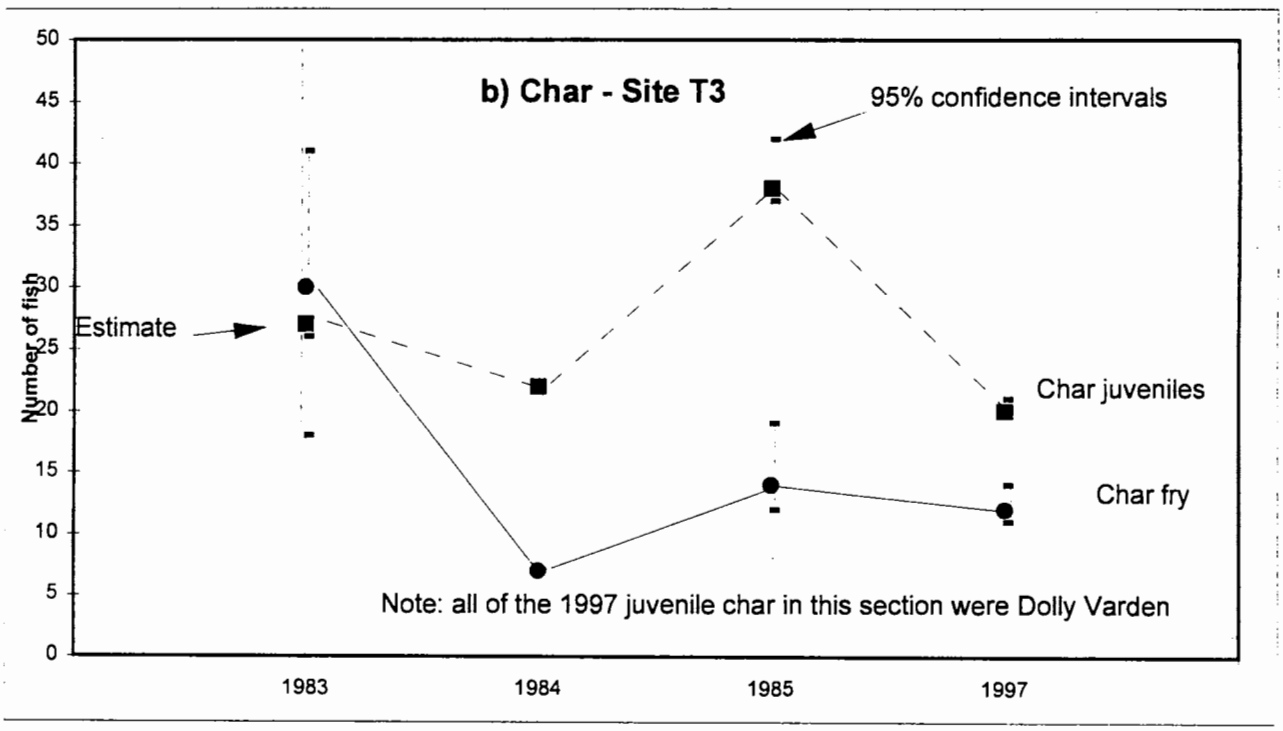


Photo 5. Naturally unstable silt banks were common along Tenas Creek. This site is located near the top end of Reach 1, the main steelhead spawning and rearing section of Tenas Creek.

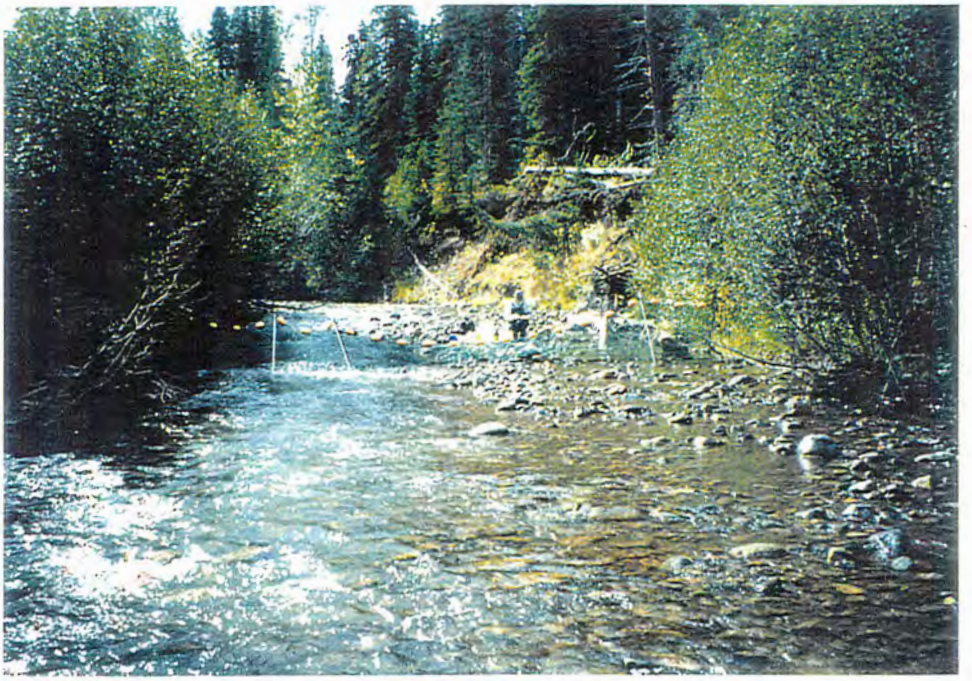
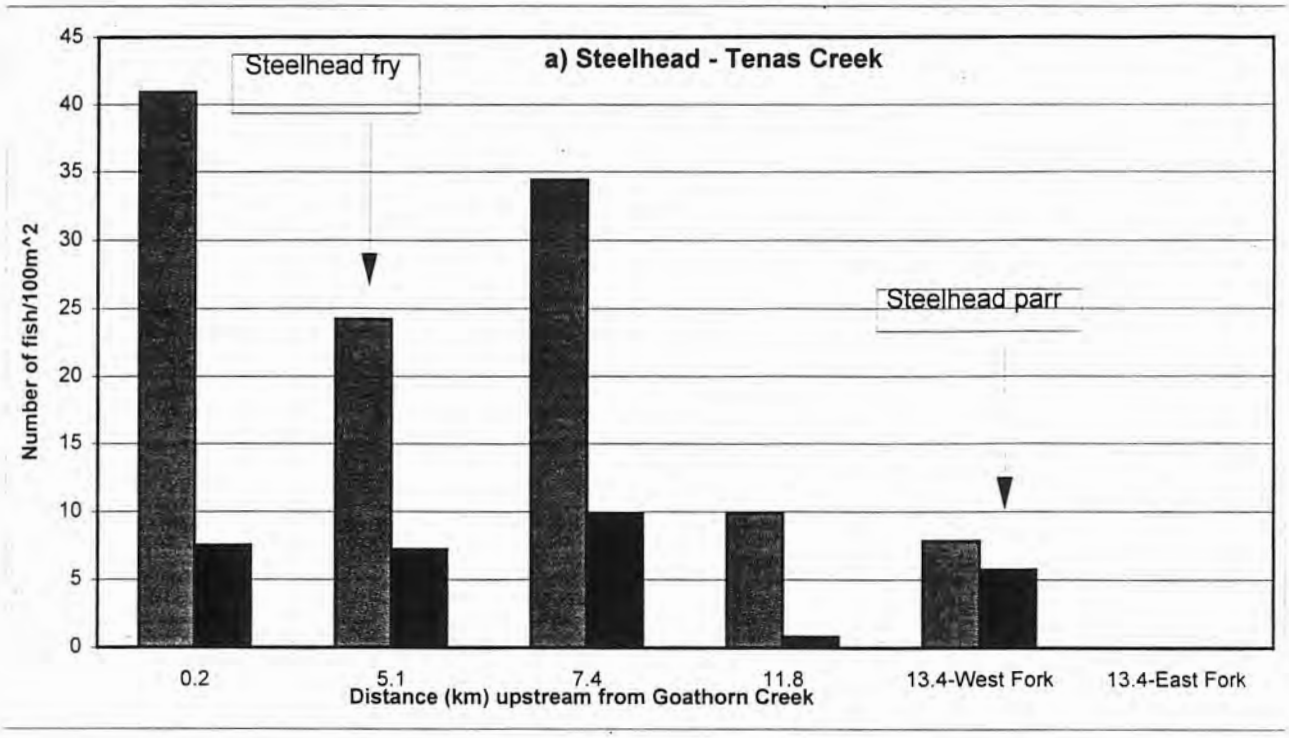
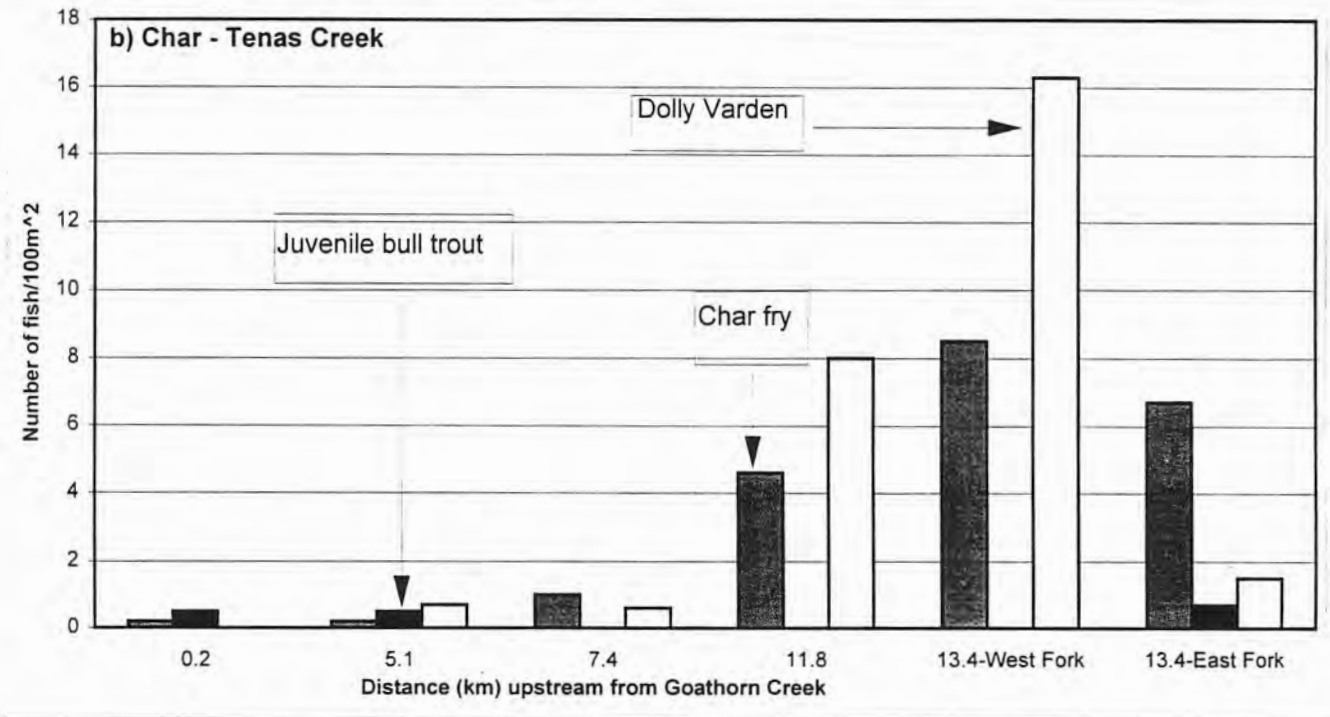


Photo 6. The lower 9 km of of Tenas Creek is heavily utilized by steelhead. The shallow cobble sections are ideal for steelhead fry and parr rearing.

Figure 2.5. Densities of juvenile steelhead and char in Tenas Creek with distance upstream from Goathorn Creek, 1997.





The mean fork length for steelhead fry for the three index sites combined was 38.7 mm (Appendix 8 Table 2). This is in the mid-range of past years results and is comparable to Goathorn Creek steelhead fry fork lengths. Yearling steelhead fork lengths were also comparable to previous years. There is considerable range in the mean length of older steelhead parr, presumably reflecting differences in the proportion of age 2+ and 3+ fish in the sample. The 1997 sample of steelhead parr was at the small end of the range. The length-frequency distribution of Tenas Creek steelhead is shown in Appendix 9 Figure 1.

Juvenile Char - Tenas Creek

The main char-rearing sections of Tenas Creek are in the upper reaches of this system (Figure 2.5b). In the main steelhead production areas, char are present at very low densities. This habitat segregation is more distinct in Tenas than in Goathorn Creek, where there were more extensive areas of species overlap between steelhead and bull trout.

Site T3 located in Reach 2 is the best index site for char abundance over the four sample years. Char fry densities at this site were highest in 1983 (Table 2.8).

Table 2.8. Densities of char fry and parr (fish/100m^2) at Site T3 in upper Tenas Creek from 1983-85 and in 1997.

	Char fry	Char juveniles
1983	**15.3**	**13.8**
1984	**3.3**	**10.5**
1985	**7.8**	**22.1**
Mean 1983-85	**8.8**	**15.5**
1997	**4.6**	**8.0**

Char fry achieve higher densities in the upper reaches of Tenas Creek, upstream from the T3 index site (Figure 2.4b). Estimates of char fry densities at these upper sites range from 4-8 fry/100m^2 of habitat in 1997. This is comparable to char fry densities at the sites in upper Goathorn and Cabinet creeks.

Char juvenile numbers at the T3 index site have ranged between 20 and 38 fish during the four sample years (Figure 2.5b) with the lowest number occurring during 1997. Densities of char juveniles in 1997 (8 char/100m^2) are lower than the past range for the period 1983-85 (10 to 22 char/100m^2). This is similar to the pattern of low juvenile char numbers noted in Goathorn Creek in 1997.

Very few bull trout juveniles were present at sites throughout Tenas Creek (six fish for all sites combined). Density estimates were below 1 bull trout/100m^2 of habitat. These results are surprising, given the presence of bull trout spawners in this system.

Dolly Varden juvenile[14] abundance increased with distance upstream with the highest densities (16 fish/100m^2) at Site T6 located in Reach 3 (Figure 2.5b). These are similar to the Dolly Varden densities achieved in the headwater areas of Goathorn Creek (Figure 2.3b).

Char fry mean fork lengths at the index sites were 47.3 mm (Appendix 8 Table 2). This is slightly larger than the means reported for past years. Juvenile char mean fork length of 103.7 mm were in the mid-range of past sampling. The length-frequency distribution for char captured in Tenas Creek is presented in Appendix 9 Figure 2.

2.3.2.3 Adult Fish Observations - Tenas Creek

Adult fish observations focused on delineating bull trout spawner distribution in Tenas Creek during early September. Incidental steelhead spawning information has been gathered during past years.

Bull Trout - Tenas Creek

Bull trout redd and spawner surveys were conducted throughout lower Tenas Creek and in the lower reaches of the West and East Forks in upper Tenas Creek. In total, just under 17 kms of stream channel were surveyed. Visibility was generally good in Tenas Creek during the spawner surveys.

A total of 10 bull trout spawners and 12 redd sites were observed during the September surveys (Table 2.9). The main area for bull trout redds was in the 1500 m section below the confluence of the East and West Forks of Tenas Creek and in the lower 1200 m of the West Fork. A single bull trout redd was located in lower Tenas Creek approximately 1000 m upstream from the Goathorn confluence. The upper extent of ground surveys and redd site locations are shown on the 1:20000 aquatic map.

Nine of the 10 bull trout spawners observed were holding in the vicinity of redds. The observations included a range of spawning sites from redd locations with no fish present to sites where digging had just been initiated (Appendix 11 Table 2). These observations suggest that the surveys were conducted mid-way through the period of bull trout spawning in Tenas Creek.

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[14] Those fish over approximately 120 mm maturing adults that may be spawning in the fall of 1997. See Appendix 9 Figure 2 for the length-frequency of Tenas Creek char.

Redd dimensions ranged from 0.6 to 1.4 m^2 based on five redd site measurements in Tenas Creek (Appendix 11 Table 2).

Dolly Varden - Tenas Creek

Similar to Goathorn Creek, no specific areas of concentrated Dolly Varden spawning were noted in Tenas Creek. The system does not include extensive areas of seepage or groundwater inflows that have been noted to be heavily used by Dolly Varden spawners elsewhere when they occur in sympatry with bull trout (e.g., Bustard 1997a and 1997c).

During the September surveys, maturing Dolly Varden (typically 12-20 cm fork length) were noted in Reach 2 of Tenas Creek and in the lower end of Reach 3 (West Fork). Based on these observations and the presence of fry at sample locations, it is likely that Dolly Varden spawning is scattered throughout these sections. Specific sites identified as suited for spawning included locations approximately 900 m and 1300 m (lower end of Tributary TN18) upstream on the West Fork (Appendix 11 Table 2).

Steelhead - Tenas Creek

Little specific data describing steelhead spawning are available for the Tenas Creek system. Steelhead spawning occurs during the high flow period in late May and early June making redd and spawner surveys impractical. Most steelhead information is derived from the distribution and abundance of fry and juveniles.

However, a single steelhead redd with stranded fry isolated from the mainstem creek was located during early September 1997 at a site approximately 500 m upstream in Reach 3 (West Fork of Tenas Creek).

A small scale radio-telemetry study conducted by MOELP in the 1981/82 season tagged three steelhead overwintering in the Telkwa River in the vicinity of Pine Creek. At least one of the three tagged fish subsequently spawned 5-7 km upstream in Tenas Creek[15].

Most Telkwa River steelhead appear to overwinter in the Bulkley River and move upstream into spawning tributaries during April and May.

[15] Mike Lough (personal communication) - former fisheries biologist with MOELP, Smithers.

Table 2.9. Summary of bull trout spawner and redd observations in Tenas Creek during September 3-5th, 1997.

Stream Section	Length (m)	Spawners	Redds	Comments
Tenas Creek - Reach 1	9100	0	1	One redd observed 1 km upstream from the Goathorn Creek confluence.
Tenas Creek - Reach 2	4200	7	6	6 of 7 redds and all bull trout spawners were observed in the upper 1500 m of this section.
Tenas Creek - West Fork	2100	3	5	Spawning bull trout observed to 1200 m.
Tenas Creek - East Fork	1300	0	0	Bull trout fry present in the juvenile sample site in this section suggests spawning upstream in this system.

Total Fish Biomass

Table 2.10 summarizes the total fish biomass at the four locations where periphyton and benthic invertebrate sampling was conducted. The pattern of higher periphyton and benthic invertebrate abundance at upper sites (G5 and T3) compared to lower sites (G2 and T3) did not translate into similarly higher fish biomass estimates at these upper sites.

Although there was little difference in biomass between the upstream and downstream sites, overall fish biomass at Tenas Creek locations were almost double the levels achieved at the two Goathorn Creek sites for the four years of surveys. Benthic invertebrate total abundance was also higher at the Tenas sites compared to Goathorn Creek locations (Figure 1.4). Periphyton accumulation rates, particularly at site T1, did not show the marked differences that were apparent between the two systems (Figure 1.3).

Table 2.10. Summary of total fish biomass at periphyton and benthic monitoring sites in Tenas and Goathorn creeks.

	Total Fish Biomass (g/100m^2)				
	1983	**1984**	**1985**	**1997**	**Mean**
T1	244	156	102	140	161
T3	181	140	214	133	167
G2	139	86	47	79	88
G5	113	108	97	51	92

2.3.3 Telkwa River

2.3.3.1 Habitat Description - Telkwa River

The Telkwa River from its confluence with Goathorn Creek to the Bulkley River has a low slope (<1%) and is complex and multi-channelled. Goathorn Creek is a major source of bed material to the Telkwa River, and channel widening and sidechannel development is markedly increased downstream from the Goathorn Creek confluence with the Telkwa River.

Measurements taken from air photos (Bustard 1985a) indicated approximately 18 km of sidechannel ranging from less than 200 m in length to over 2 km long were present in the lower 8 km section of the Telkwa River. Approximately two-thirds of these sidechannels (based on length) provided potentially productive juvenile salmonid habitat. Detailed typing and mapping of the different sidechannel habitat is presented in Bustard (1985a)[16]. The analysis indicated approximately 11 ha of potentially productive sidechannel habitat, and an equal amount of mainstem area. Measurements taken at fish sample sites during the 1980s suggest that most of the rearing occurs within 7 m of the river's edge during the late summer and fall period. Fry tend to occupy slow, shallow sites right along the stream margin.

The construction of a rock dyke just upstream from the village of Telkwa (Figure 2.1) since the earlier studies has introduced a significant change to the lower Telkwa River floodplain, and will influence future sidechannel development in the lower river.

Past fisheries studies in the Telkwa River indicate that the predominantly cobble bed material (10-30 cm diameter) provides good cover for fry and parr-sized fish, especially steelhead. Gravel areas suitable for spawning are interspersed along the lower Telkwa River, particularly in active sidechannels. These sections are utilized to a limited extent by pink salmon spawners (Bustard 1984b) and to some extent by juvenile coho.

[16] This report appears as Appendix 12 of the *Application for a Project Approval Certificate* submitted by Manalta Coal Ltd. (1997).

The complex sidechannel habitat in the lower Telkwa River provides important refuge areas for fish subject to high turbid flows in the mainstem river for much of the early summer period. Log jams and gravel bars tend to buffer these channels during high flows. These sites are also subject to dewatering during the low-flow winter period (Bustard 1986b).

The Telkwa River is a dynamic system and channel shifting is frequent in this lower reach. Not surprisingly, investigations during the 1997 juvenile fish sampling program, indicated that substantial changes to some of the sidechannels had occurred since they were last sampled in 1985. The old SC1 location was dry, and a new location across the river was established in 1997 (Figure 2.1). Although conditions at SC2 were still suited for fish use, the channel was smaller and had lower water velocities than in the 1980s. SC3 was in the same general location but was a larger and more productive sidechannel than the site sampled in earlier years.

2.3.3.2 Juvenile Fish Sampling - Telkwa River

Fish density estimates were conducted at 13 sites in the lower Telkwa River during the 1997 program. This included eight mainstem sites, four sidechannels and a wetland complex located just downstream from the Goathorn confluence (Figures 1.1 and 2.1). The detailed results of the fish sampling at all locations in the Telkwa River are presented in Appendix 6. Past index site sampling has been conducted at all of these sites except MS8, SC4, and MS9 (habitat card only). These sites are located in the vicinity of the proposed bridge crossing of the Telkwa River.

Due to changed habitat conditions, sidechannel fish densities over time are not as directly comparable as at the index sites in Goathorn and Tenas creeks. A total of 1722 m^2 of habitat was sampled over a combined length of 302 m of stream channel in 1997 (Table 2.11). Approximately 50% of the area and length of channel was at sidechannel sample sites.

Similar to past years, juvenile steelhead were the dominant fish species in the lower Telkwa River index sites (Table 2.11). Various age classes of juvenile steelhead together comprised more than 70% of the overall catch. While steelhead fry numbers were higher than past years, parr numbers were down.

Juvenile coho comprised a significantly higher proportion of the index site catches in 1997, and represented over 18% of the total catch. Nearly all of the coho were sampled in two sidechannel locations (Table 2.12). Habitat conditions in these two sites appeared to be more suited for coho rearing compared to earlier sampling periods (i.e., stable low-flow sites not directly connected to surface flows from the mainstem river during the late summer period).

Table 2.11. Summary of fish species and age class composition in the Telkwa River combined for main and sidechannels.

Species	Age	1983		1984		1985		1997	
		Number	%	Number	%	Number	%	Number	%
Steelhead	0+	535	66.7	255	38.6	489	68.6	744	65.7
	1+	75	9.4	213	32.3	67	9.4	59	5.2
	>=2+	42	5.2	56	8.5	52	7.3	19	1.7
Coho	0+	34	4.2	75	11.4	55	7.7	176	15.5
	1+							36	3.2
Chinook	0+	1	0.1	11	1.7	0	0.0	4	0.4
Char	0+	0	0.0	0	0.0	1	0.1	4	0.4
Bull trout	>=1+	*ns		ns		ns		6	0.5
Dolly Varden	>=1+	7	0.9	4	0.6	3	0.4	2	0.2
Mountain whitefish	0+	105	13.1	43	6.5	45	6.3	77	6.8
	>=1+	3	0.4	2	0.3	0	0	0	0.0
Longnose dace	all	0	0.0	1	0.2	0	0.0	6	0.5
Longnose sucker	all	0	0.0	0	0.0	1	0.1	0	0.0
TOTAL		802	100	660	100	713	100	1133	100
Area sampled (m^2)		1812		2089		1853		1722	
Length of stream sampled (m)		237		281		257		302	

*Bull trout and Dolly Varden were not separated as different species from 1983 to 1985.

Table 2.12. Summary of juvenile salmonid density estimates at sites in the mainstem and sidechannels of the Telkwa River, 1997.

Site	Telkwa Mainstem Densities (Fish/100m^2)										
	Steelhead			Char	Bull trout	DV	Coho		Chinook	M. Whitefish	
	0+	1+	>=2+	0+	>=1+	>=1+	0+	>=1+	0+	0+	>=1+
MS1	39.7	6.6	1.2	0	1.2	0	0	0	0	0	0
MS2	29.4	2.1	0	0	0	0	0	0	1	0	0
MS3	35.6	7.3	0.9	0.9	0	0	0	0	0	0	0
MS4	25.3	6.7	0.8	0	0.8	0	0.8	1.7	2.5	0.8	0
MS5	30.0	0.4	0.4	0	0.4	0	0	0	0	0.9	0
MS6	31.6	1.8	1.8	0.9	0	0	0	0	0	0	0
MS7	75.7	3.6	3.6	0.9	0	0	0	0	0	0.9	0
Mean 1-7	38.2	4.1	1.2	0.4	0.3	0.0	0.1	0.2	0.5	0.4	0.0
MS8	13.7	1.1	1.1	0	0	0	0	0	0	2.2	0

Site	Telkwa Sidechannel Densities (Fish/100 m^2)										
	Steelhead			Char	Bull trout	DV	Coho		LN dace	M. Whitefish	
	0+	1+	>=2+	0+	>=1+	>=1+	0+	>=1+	0+	0+	>=1+
SC1	14.3	4	0.9	0	0	0.3	31.3	7.1	2.2	11.4	0
SC2	73.2	0.7	0	0	0.4	0	26.3	4	0	11.4	2.2
SC3	67.2	5.5	2.4	0.4	0.8	0.4	0	0	0	1.5	0
Mean 1-3	51.6	3.4	1.1	0.1	0.4	0.2	19.2	3.7	0.7	8.1	0.7
SC4	28.8	6.4	8.5	0	2.7	1.1	2.7	0.5	0	0	0

Mountain whitefish fry comprised just under 7% of the total catch, again largely the result of sampling sidechannel locations (Table 2.12). Small numbers of juvenile chinook, bull trout, Dolly Varden, and longnose dace together comprised 2% of the overall catch.

Juvenile Steelhead - Telkwa River

Steelhead fry densities in Telkwa River sidechannels combined were 52 fry/100m^2 of channel, the highest recorded in the four years of sampling at these locations. These are nearly twice the densities measured at the Tenas and Goathorn creek index sites (Tables 2.2 and 2.7), and confirm the importance of Telkwa River sidechannels as rearing habitat for steelhead fry.

Mainstem Telkwa River steelhead fry densities were also high, averaging 38 fry/100m^2 of habitat. It is interesting to note that steelhead fry densities were consistent across the mainstem sites ranging from 25-40 fry/100m^2 at six of the seven index sites (Table 2.12).

Steelhead parr densities in both mainstem and sidechannel locations in the Telkwa River averaged approximately 5 parr/100m^2 (Table 2.13). These estimates are lower than mean estimates of 8 and 10 parr/100m^2 measured in sidechannels and mainstem sites in past years. The numbers of yearling and older age class steelhead parr were lower in 1997 compared to previous years (Table 2.11).

Table 2.13. Densities of steelhead fry and parr (fish/100m^2) at side and main channel sample locations in the lower Telkwa River from 1983-85 and in 1997.

	Age 0+		Parr	
	Side	**Main**	**Side**	**Main**
1983	27.0	32.0	7.0	7.0
1984	9.0	16.0	15.0	12.0
1985	16.0	44.0	3.0	11.0
Mean 1983-85	17.3	30.7	8.3	10.0
1997	51.6	38.2	4.5	5.3

It should be emphasized that direct comparisons between the 1997 results and the earlier data is limited due to changes in habitat characteristics over time. As a general observation, the sidechannel locations sampled in 1997, particularly SC2 and SC3, offered more suitable steelhead fry rearing habitat than at these locations in the mid-

1980s. At the same time, steelhead parr rearing potential was lower in both SC1 and SC2 compared to the earlier years, and this may account for some of the differences observed.

The method of sampling the Telkwa River mainstem (installing rebar and then completely enclosing the site with stopnets) probably underestimates older parr numbers utilizing these habitats due to site disturbance during net installation and the inability to sample some of the deeper faster habitats utilized by older steelhead parr in the Telkwa. The same method has been used in all years of sampling.

The mean fork length of steelhead fry in the lower Telkwa River combined for mainstem and sidechannel sites was 40.7 mm (Appendix 8 Table 3). This is in the mid-range of fork length measurements for past years. Yearling steelhead fork lengths (77.1 mm) were also similar to past measurements at these sites. The length frequency distribution for a sample of 440 steelhead juveniles from the lower Telkwa River is shown in Appendix 9 Figure 1. The ageing estimates shown in this figure are based on scale analysis of 49 juvenile steelhead in the lower Telkwa River during 1997 (Appendix 9 Table 3).

Juvenile Coho - Telkwa River

Table 2.14 summarizes the catch of coho in the lower Telkwa River at index sites in sidechannels and mainstem habitat. The data suggest coho use in mainstem areas of the lower Telkwa has been consistently low, ranging from <1 to 5 coho juveniles/100m^2 during the years of sampling.

Coho densities in sidechannels have ranged from 2-62 coho/100m^2 of habitat. During the period 1983-85, sampling at SC3 accounted for the high coho densities. This channel was dry in 1985, leading to the lowest densities for all years in sidechannels, despite higher mainstem use. The data indicate that specific sidechannels provide important rearing areas for coho in the lower Telkwa River, and that densities at these locations achieve much higher levels than in the mainstem river.

Table 2.14. Densities of coho juveniles (fish/100m^2) at sidechannel and mainstem locations in the lower Telkwa River from 1983-85 and in 1997.

	Sidechannel	Main
1983	9.0	1.8
1984	61.7	0.8
1985	2.0	5.3
Mean 1983-85	24.2	2.6
1997	22.9	0.4

Sampling at a sidechannel seepage complex in the project area located at WL1 (Figure 1.1), indicated coho use at this area for 500 m upstream from the mainstem Telkwa River. Minnow trapping indicated significant numbers of coho, including both fry and yearlings, were present at this site. A total of 107 coho juveniles were captured in 10 traps set in this channel (Appendix 5 Site Card WL1). There is evidence of flow throughout this channel during freshets.

Flows in this channel are suspected to be mainly derived from subsurface flows from the Telkwa River, although some surface flows may enter this area during the spring from the drainage area around the proposed tailings disposal area. Based on observations at the Km 1011 area located adjacent to the Telkwa River upstream from Pine Creek, coho fry likely move upstream into the seepage channel at WL1 during the high-flow period from late May through July, overwinter in this area, and leave as smolts after one or two years (Bustard 1997d).

The channel at WL1was sampled in 1984 (Bustard 1985a) and no fish were present. Coho fry were probably unable to access this channel in 1984 due to beaver dams in the lower section. These beaver dams had been washed out prior to the 1997 sampling, enabling fish to access upstream areas.

A second wetland complex located in the lower Telkwa project area (WL5 - Figure 1.1) was sampled in 1997 (Bustard 1997b), and similar to 1984, had no fish upstream from the first large beaver dam located near the outlet (Table 2.15).

Table 2.15. Summary of fish catches at two wetland areas in the lower Telkwa River.

Site	Location	Number of Traps	Coho		Rbt
			Age 0+	Age 1+	Age 1+
WL1	200 m upstream from outlet	5	43	52	1
	600 m upstream from outlet	5	6	6	0
WL5[17]	Below beaver dam at outlet	2	0	45	0
	Ponded area above lower beaver dam	8	0	0	0

[17] Sampled in June 1995 (Bustard 1997b).

Off-channel rearing areas provide important habitat for juvenile coho in the Telkwa River. A program to develop off-channel habitat in the Telkwa River has been underway since 1993 (Finnigan and Marshall 1997). As part of this project, considerable knowledge has been gained in terms of the timing and age structure of juvenile coho dispersal into off-channel areas and subsequent smolt movements out of these areas (Bustard 1997d). In addition to the main site at Km 1011, off-channel ponds have been constructed at two new location in the past two years (Km 1019 and Km 1010).

Juvenile Fish Sampling in Vicinity of Proposed Bridge Site - Lower Telkwa River

Fish sampling was conducted at the proposed bridge crossing site on the Telkwa River approximately 350 m downstream from the Goathorn Creek confluence. This site is located at the downstream end of a fast single-channel section confined on the left side by high banks (Photo 7). Below the proposed crossing, the channel widens and the flood plain broadens. The bed material at this site is dominated by cobbles and boulders, although some smaller gravel material is located at the tail-out from a pool located at the crossing site. It is unlikely that the mainstem channel in this section is utilized for spawning by any of the fish species present in the Telkwa River. A more detailed description of the habitat at this site is provided in Appendix 5 Site Card MS9.

A sidechannel is located at the crossing site (Photo 8), and a 33-m long section was sampled in this channel (SC4). The results indicate that this sidechannel provides significant steelhead fry and parr rearing habitat (Table 2.12). Steelhead parr densities (15 parr/100m^2) were the highest of the four sidechannels sampled in the lower Telkwa. Juvenile bull trout, Dolly Varden and coho were also present at this site.

Sampling conducted at MS8 located on the mainstem Telkwa just below the proposed bridge site, indicated that steelhead fry and parr were the main species present along this section, with densities lower than the mean for mainstem sites located downstream (Table 2.12).

Adult Fish Observations - Lower Telkwa River

Specific adult fish surveys were not undertaken in the lower Telkwa River during 1997. There have not been any broad-based adult steelhead projects undertaken in the Telkwa River to identify spawning locations for this species. Most of the spawning information is inferred from the presence of steelhead fry. Steelhead spawn during the spring snowmelt freshet in May and early June, and the only method of identifying specific spawning sites during this time would be with the use of radio-telemetry. Most steelhead appear to spawn in tributaries to the Telkwa River such as Tenas and Goathorn, as well as sidechannel locations not subject to the high and fast water conditions typical of the mainstem Telkwa River during the spawning period.

Past observations indicate that some pink salmon spawning does occur in sections of the lower Telkwa during high escapement years to the Bulkley River. The pink run in 1997 was weak, and a planned aerial survey to evaluate pink salmon use in the lower Telkwa was cancelled due to the low numbers in the system. The location of pink salmon spawning sites identified during 1983 are shown on the 1:20000 aquatic map and are described in more detail in Bustard (1984b). The specific sites will probably change from year-to-year, especially given the frequency of channel changes and range of flow conditions in the lower Telkwa River.

Bull trout probably do not spawn in the mainstem or sidechannels of the lower Telkwa River. Characteristically this species moves upstream into the cold headwater tributaries such as upper Goathorn and Tenas creeks. The lack of char fry at the mainstem and sidechannel locations in the Telkwa River (Table 2.12) supports this view. The lower Telkwa River is utilized by sub-adult and adult bull trout for rearing. Studies of fluvial bull trout elsewhere indicate that these fish may make major migrations between overwintering locations and spawning sites, sometimes for distances of 100 kms or more (e.g., Swanberg 1997).

Dolly Varden spawning tends to be most prevalent in the smaller tributaries and headwaters of larger tributary streams. Some Dolly Varden spawning may occur in the lower ends of small seepages and tributaries on the Telkwa floodplain, although no specific sites were identified. The lack of char fry in the catches suggests that spawning is minor in these areas.

Coho salmon spawning occurs predominantly in the upper reaches of the Telkwa River. Detailed surveys were conducted during 1982 and 1984 and are reported in Bustard (1985a). Much of the spawning occurs in the mainstem river between 30 and 47 kms upstream. Lower Elliott Creek also provides significant spawning habitat.

The lower sections of the Telkwa River in the project area are not generally utilized by coho spawners, possibly due to the more severe icing conditions prevalent during the winter in the lower river, and the greater abundance of groundwater inflows, smaller bed material, and excellent rearing areas prevalent in the upper river sections.

Table 2.16 summarizes the results of helicopter counts of coho spawners that have been conducted in the Telkwa River and lower Elliott Creek since 1982. Typically, these surveys have been conducted on at least two dates in early and late November, although they have only been done during some years. The summaries suggest that the coho escapement estimates to the Telkwa in 1997 were very low and comparable to the low estimates of 1988.

These aerial counts do not represent total numbers, since coho are widely dispersed and tend to hold in debris jams and under shelf ice making visibility difficult. As well, coho spawn over an extended period. Spawners were still present in the upper Telkwa on December 23 during the 1982 surveys (Bustard 1983). It is interesting to note that a

Photo 7. Telkwa River mainstem looking downstream at the proposed bridge crossing site. The crossing site is at the lower end of a confined section, just upstream from where the floodplain widens.

Photo 8. Sidechannel SC4 located at the proposed bridge crossing site. This channel was used by both steelhead fry and parr.

comparison was made between snorkel and helicopter counts in a section of the Telkwa River on November 14, 1994. The snorkel counts of 191 coho were more than twice the aerial count of 88 fish conducted in the same section.

Table 2.16 Summary of coho salmon spawner counts in the upper Telkwa River for selected years between 1982 and 1997.

Year	Maximum Count	Date of Survey
1982	104	Nov-18
1984	117	Nov-30
1988[18]	36	Nov-29
1994[19]	605	Nov-01
1995	178	Oct-31
1997	54	Nov-11

2.3.4 Bulkley River

Four sites along the mainstem edge of the Bulkley River were selected for sampling during the 1997 program. These sites were located in the general vicinity of the proposed loadout facility and are indicative of fish use along the Bulkley River in this reach. Comparable data is available from the 1984 sampling program.

The results indicate that juvenile steelhead and chinook salmon fry dominate the catches along this section of the Bulkley River (Table 2.17). Both steelhead and chinook fry densities (22 and 27 fry/100m^2 respectively) were considerably higher in 1997 than levels measured in 1984 (9 and 6 fry/100m^2 respectively).

[18] Data from Bustard (1988).

[19] Data from 1994 to 1997 provided by Barry Finnegan, Northern Coho Stock Assessment, Department of Fisheries and Oceans, Nanaimo, B.C.

Table 2.17 Densities of juvenile fish sampled along the mainstem Bulkley River in the vicinity of Hubert Creek and the proposed reload site.

Site	Bulkley River Mainstem Fish Densities (Fish/100m^2)					
	Steelhead			Chinook	Mt. Whitefish	LN Dace
	0+	1+	≥2+	0+	all	all
B1	36.4	2.9	0	45.8	0	1.0
B2	5.9	0	0	5.9	0	0
B3	13.7	1.3	0	20.4	0	0
B4	33.1	8.0	0	38.0	0	0
Mean 1-4	22.3	3.1	0.0	27.5	0.0	<1.0
1984	9.5	3.5	4.0	6.3	1.0	0

The sampling method used in this study is effective for sampling fry species utilizing the mainstem margin, but underestimates the abundance of larger fish using faster water areas, often just beyond the margin sites. Studies conducted in September 1982 using a boat shocker (Envirocon Ltd 1984 - Section F) indicated that this section of the Bulkley River provides important rearing habitat for larger steelhead parr (age 2+ and 3+). As well, other resident species common in the boat shocking catches but not effectively sampled at the margin sites included mountain whitefish, largescale suckers and longnose dace. Low numbers of char (probably bull trout) were also present in the boat shocking catches in this section during the 1982 program.

Major migrations of salmon and steelhead move through this section of the Bulkley River, but most spawning locations are upstream in the mainstem Morice River and the numerous tributary streams. Some scattered spawning of pink salmon occurs in the mainstem Bulkley in this reach and in the section downstream from the Telkwa River confluence. The bed material tends to be large and more suited for rearing than for spawning at most locations. See Section 2.4 for a description of the sport fishery on the Bulkley River.

2.3.5 Hubert Creek

Studies in Hubert Creek focused on assessing fish distribution and abundance information in this watershed relative to a proposed road corridor and loadout facility located in the lower reach. Considerable background information is available for the Hubert Watershed based on studies conducted in 1983 and 1984 (Bustard 1984a and 1985a) and supplemented by additional, more detailed assessments in 1986 focusing on the

headwater areas of Helps Creek (Bustard 1986a). The location of Hubert Creek relative to the Bulkley and Telkwa rivers, and of all of the sample site locations is shown in Figure 2.1.

The earlier assessments focused on a rail corridor and waste disposal area originally planned for the headwater sections of Helps Creek. The revised mine plan proposes a road crossing of lower Hubert and a location on the east side with crossings in the mid-reaches of Hubert and Helps creeks. Additional information was needed on the mid- and upper reaches of Hubert and Helps creeks to assess these proposed crossing sites.

2.3.5.1 Habitat Description - Hubert Creek

Hubert Creek drains a 44 km^2 watershed comprised of low to mid-elevation areas. This stream is approximately 12 km long and its one major tributary, Helps Creek, is an additional 8.5 km in length.

Hubert Creek is not subject to the same variations in flow regime characteristic of the other streams in the project area. The combination of extensive ponding and lack of high elevation snowfields within the watershed, results in a moderated flow regime and lower turbidity levels than in the other study streams in the project area. Land-use activities, particularly agricultural clearing and livestock grazing, have resulted in considerable habitat degradation in portions of this system.

The lower reach of Hubert Creek is less than 0.5% slope and is characterized by extensive ponds and wetland areas, largely the result of beaver activity. Beaver dams restrict the movement of salmon fry (coho and chinook) to the lower sections of Hubert Creek. The location of these barriers tends to vary from year-to-year. There are short sections of potential spawning habitat in lower Hubert Creek and some coho and steelhead spawning can occur in the lower system during high-flow years when fish can access these areas.

Resident cutthroat are present in the mid-sections of Hubert Creek and in Helps Lake. The upper creek system (both Helps and Hubert creeks) has more potential spawning areas, but extensive beaver dams restrict easy movements into these upper areas.

Specific habitat information was collected in conjunction with fish sampling at each of the sites shown in Figure 2.1 during the 1997 surveys and is presented in Appendix 5. This information, in conjunction with sampling conducted during the FRBC stream inventory program[20] has been used to delineate fish distribution in the upper watersheds of Hubert and Helps creeks (see 1:20000 aquatic map).

[20] Preliminary data provided by Triton Environmental Consultants Ltd.

2.3.5.2 Juvenile Fish Sampling - Hubert Creek

Lower Reach

The fish sampling that was undertaken in lower Hubert Creek was conducted using the same methods as in 1983 (Bustard 1984a) and in 1986 (Bustard 1986). This program involved extensive minnow trap sampling in the lower 1.5 km section of Hubert Creek.

Table 2.18 summarizes the upper extent of distribution of juvenile coho and chinook salmon and steelhead trout in lower Hubert Creek for the three years of sampling. The data indicate that coho fry (age 0+) were distributed farther upstream in 1997 compared to past years. They were present upstream to a beaver dam located 1.2 km upstream (see 1:20000 aquatic map for specific locations). Yearling coho have been present up to a series of beaver dams located at 1.5 km (just upstream from Lawson Road) for all years of sampling. This suggests that coho juveniles may re-distribute farther upstream during spring high-flow periods.

Sampling conducted 200 m and 1000 m upstream from Lawson Road during 1997 suggests that coho are not found upstream from the first beaver dam above the road crossing (Appendix 12 Table 1).

Figure 2.6 shows the catch per trap (CPUE) of coho fry and yearlings (combined) at the three accessible sites (HUB1 to HUB3) for the three years of sampling. This information indicates that juvenile coho abundance throughout lower Hubert Creek was very low in 1997, despite good access for fry for a greater distance than past years. Coho fry CPUE was very high in the lowest section of Hubert Creek during 1986 (16 coho/trap). Interestingly, juvenile chinook were more abundant in the lowest section of Hubert Creek during 1997 compared to past years, and were present upstream for nearly 1 km (Table 2.18). This is a very different pattern than observed in past years, when only a few chinook juveniles have been sampled in the lowest section of the creek. The habitat in lower Hubert Creek is not characteristic chinook rearing habitat. These chinook fry have probably moved upstream from the Bulkley River mainstem, and that they are the progeny from fish that spawn in the upper Morice River, the main chinook spawning area in the Bulkley system.

No steelhead fry were sampled in the lower Hubert sites in 1997, and a small number of yearlings were present up to approximately 1 km upstream (Table 2.18). CPUE in the traps was lower than during past years (Figure 2.6).

Fish information collected in lower Hubert Creek during the three years of sampling indicates that the abundance and distribution of juvenile salmon and steelhead is highly variable between years. Important factors include the location of impassable beaver dams on the lower creek and the abundance of salmon fry recruiting upstream from the Bulkley River into Hubert Creek.

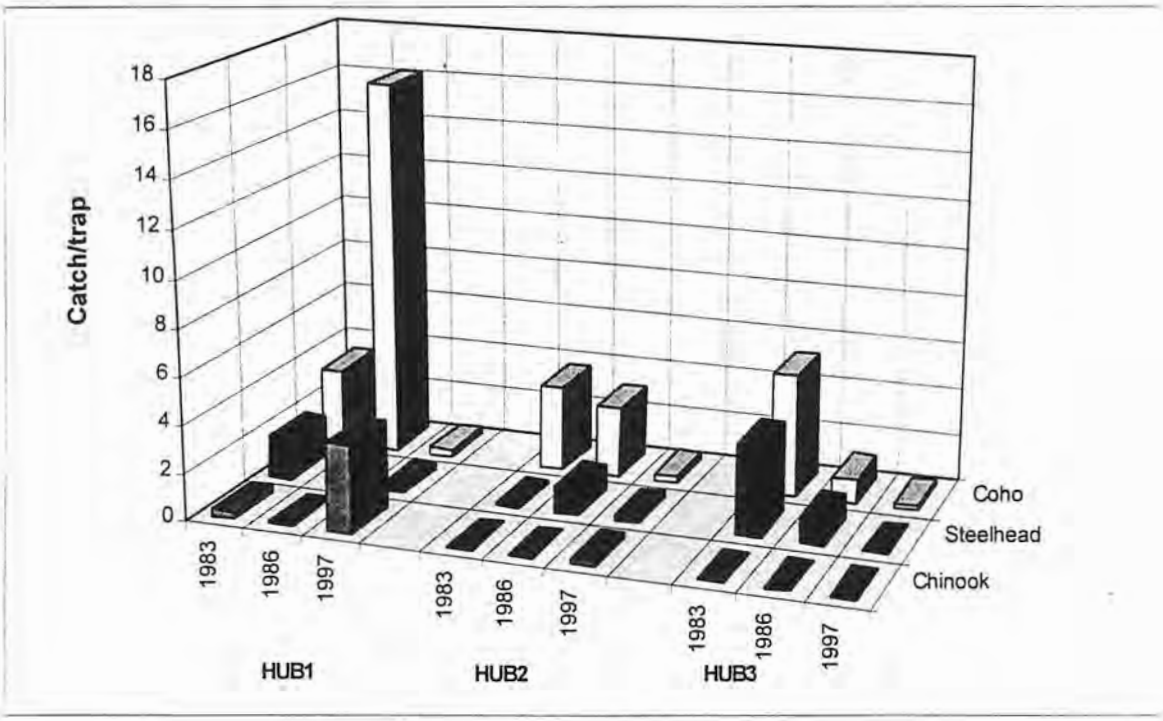
Table 2.18 Summary of the upstream distribution by species and age class of fish in lower Hubert Creek based on three years of sampling.

	Age	Year	Distance Upstream
Coho	**Age 0+**	**1983**	0.3 km
		1986	0.9 km
		1997	1.2 km
Coho	**Age 1+**	**1983-97**	1.5 km
Chinook	**Age 0+**	**1983**	<0.1 km
		1986	<0.1 km
		1997	0.9 km
Steelhead	**Age 0+**	**1983**	1.5 km
		1986	1.0 km
		1997	None present
Steelhead	**Age 1+**	**1983**	1.5 km
		1986	1.0 km
		1997	0.9 km

Other fish species present in the lower sections of Hubert Creek include longnose dace and longnose suckers (Appendix 12 Table 1). A few cutthroat trout and Dolly Varden have been sampled in lower Hubert Creek in past years (Bustard 1984a and 1986a). A small tributary entering lower Hubert Creek on the east side approximately 800 m upstream from the Bulkley River (Figure 2.1) was identified as having potential fish use on a seasonal basis upstream for 1500 m (see Appendix 5 Site Card HUB5). Locals report catching fish in this system during high spring flows.

Sampling was conducted in the ponded habitat towards the top end of Reach 1 for the first time in 1997 (HUB4 in Figure 2.1). No fish were captured in 20 minnow traps set in this section. These middle ponded sections of Hubert Creek likely offer low potential fish habitat as a result of poor access due to beaver dams and water quality limitations.

Figure 2.6 Summary of CPUE (fish/trap) at the three lower sample sections in Hubert Creek for three years.



Upper Reaches of Hubert Creek

The results of electrofishing at four location in the middle and upper reaches of Hubert Creek (Figure 2.1) indicate that the densities of both cutthroat trout and Dolly Varden were exceptionally low at all sites (Table 2.19). No cutthroat or Dolly Varden fry were captured at any of the sites.

Habitat suitability was high at the lower three sites, and it is likely that there is a recruitment problem in these systems, possibly linked to beaver dam activity in lower Hubert and Helps creeks preventing adults from moving upstream into these potential spawning and rearing sections of the creek. A limited amount of sampling conducted at one site (HUB7) using minnow traps in 1983 suggested that more cutthroat were present than in 1997.

All of the cutthroat captured in the four sites in upper Hubert Creek in 1997 ranged in size from 13-18 cm fork length. There was a complete absence of the younger age classes of cutthroat at any of the sites, further supporting the conclusion that spawners had not been able to recruit upstream into this section of stream for at least the previous three years. All of the Dolly Varden captured in the sites also exceeded 11 cm and were up to 16 cm fork length.

Table 2.19 Summary of fish densities (fish/100m^2) at electrofishing sites in the mid and upper reaches of Hubert Creek, 1997.

Site[21]	Cutthroat		Dolly Varden	
	0+	>1+	0+	>1+
HUB6	0	2.0	0	0
HUB8	0	1.0	0	0
HUB9	0	3.6	0	1.8
HUB10	0	0	0	6.0

The upper extent of fish distribution in Hubert Creek is shown on the 1:20000 aquatic map, while the detailed fish sampling information is presented in Appendix 6.

2.3.5.3 Juvenile Fish Sampling - Helps Creek

The results of electrofishing in Helps Creeks at some of the same locations as in 1986 is presented in Table 2.20 The data indicate that cutthroat fry densities have dropped to very low levels in 1997 (mean of 4.9 fry/100m^2) compared to sampling results for 1986 (mean of 49.3 fry/100m^2). Similar to Hubert Creek, there appears to be a cutthroat spawner recruitment problem into upper Helps Creek. Presumably this is related to beaver dams occurring between Helps Lake and the main spawning and rearing sections of Helps Creek located in Reaches 2 and 3 (Figure 2.1). Most larger resident fish probably move downstream into the deeper ponded sections of these creeks during the late summer and winter period.

A number of cutthroat parr were sampled in Helps Creek in 1997. These fish ranged in size from 8-12 cm fork length and were present at sites H1 and H4. No cutthroat parr were sampled in 1986, further suggesting that fish distribution in the upper reaches of this creek is highly dependent upon suitable access for spawners to move into these upper reaches during the spring high-flow period. Based on a sample of 38 cutthroat captured in Helps Lake, cutthroat trout can achieve a size of up to 30 cm in this system (Bustard 1984a).

Surveys in Helps Creek during 1986 identified the location of key cutthroat spawning areas based on direct observations of spawners and redds during late May and early June, as well as the presence of newly-emerged cutthroat fry during August (Bustard 1986). High water temperature problems along the creek sections where riparian vegetation has

[21] A total of 12 cutthroat and 1 Dolly Varden were sampled at HUB7 in 4 minnow traps during sampling in 1983.

been removed were identified in some of the spawning sections (Photos 9 and 10). These sites are shown on the 1:20000 aquatic map.

Table 2.20 Summary of fish densities (fish/100m^2) at electrofishing sites in Helps Creek in 1986 and 1997.

Site	1986	1997	1986	1997
	0+	0+	1+	1+
H1	0	0	0	16.3
H2	15.8	1.1	0	0
H3	33.6	1.3	0	0
H4	148.8	22.2	0	7.2
H7	48.1	0	0	0
Mean	49.3	4.9	0.0	4.7

Additional sampling effort was extended to other sites in Helps Creek to better delineate the upper extent of fish access on the mainstem creek and several of its tributaries during the 1997 program. Detailed fish sample site and habitat summaries for each site are presented in Appendices 5 and 6.

2.4 DISCUSSION

Steelhead

Juvenile steelhead were the dominant fish species present in lower Goathorn and Tenas creeks and the lower Telkwa River, comprising more than 70% of the overall catch. This is a similar pattern to catch results at these sites during three years of sampling from 1983 to 1985.

Figure 2.7 summarizes the results of fish sampling in Goathorn and Tenas creeks and the lower Telkwa River sidechannel and mainstem sites. The summary indicates that steelhead fry densities exceeded 20 fry/100m^2 of habitat in the main steelhead-producing sections of these systems. Fry abundance was highest in the sidechannels of the Telkwa River in 1997 where densities exceeded 50 steelhead fry/100m^2 based on sampling at three channels. These data indicate that the lower reaches of Goathorn and Tenas creeks, and the mainstem Telkwa River are important spawning and rearing areas for steelhead

Photo 9. Sections of Helps Creek have been severely degraded by agricultural clearing, diversions, and livestock use. The loss of a riparian zone along this section has resulted in channel widening and infilling, resulting in loss of surface flows and high water temperatures in a formerly productive stream section.

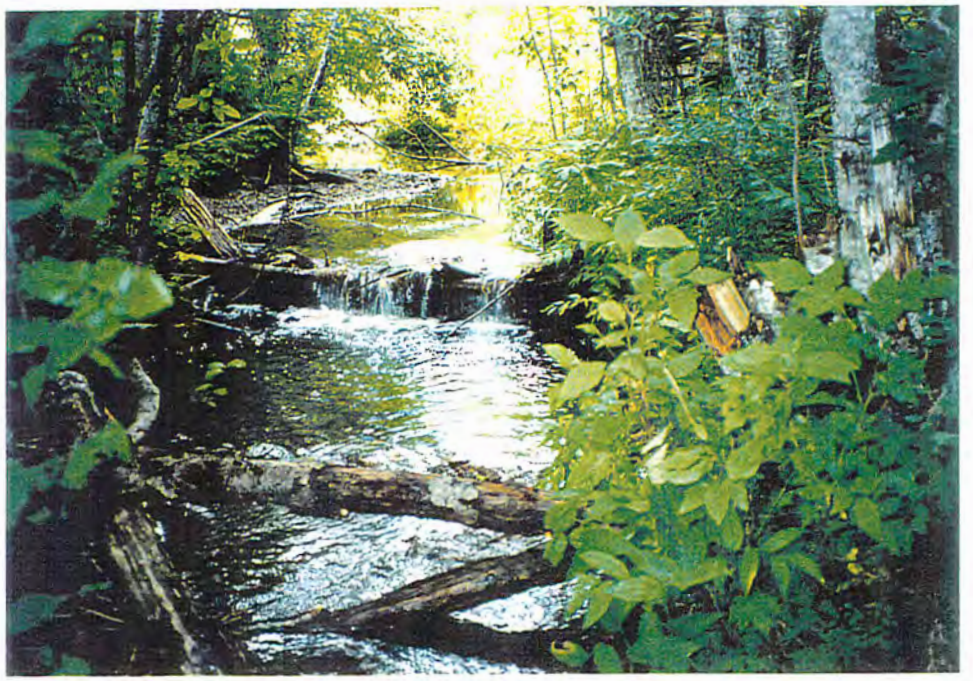


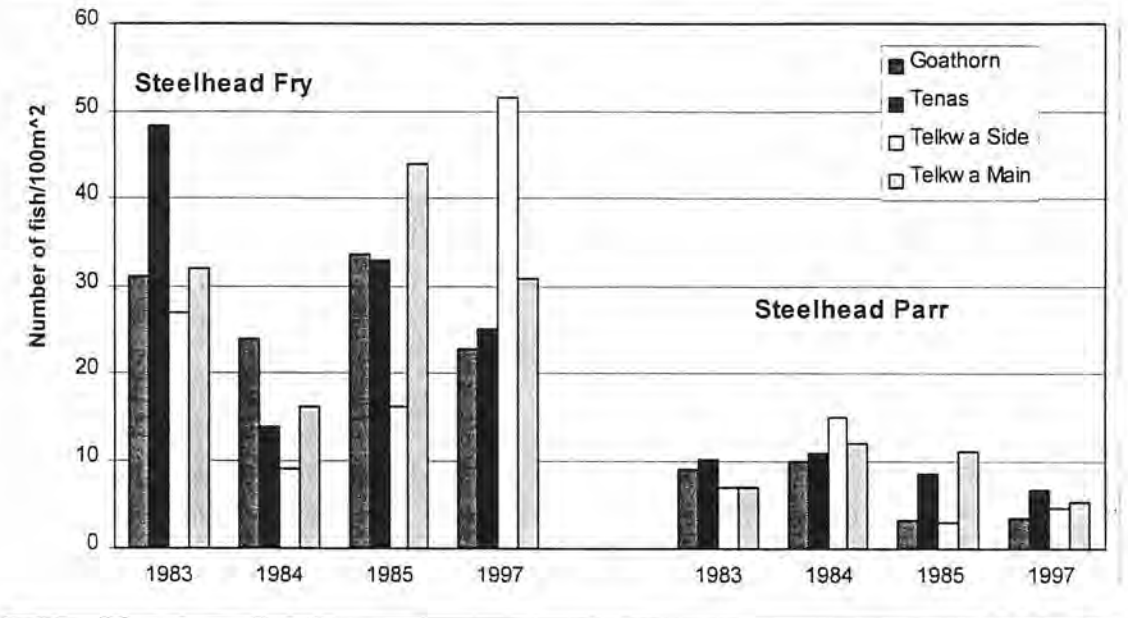
Photo 10. Helps Creek just upstream from the agricultural clearing. The riparian zone is intact and cutthroat trout spawn in this section. The proposed haul road must ensure fish passage at a crossing site in this general area.

trout, and are comparable to steelhead fry densities in known important steelhead tributaries in the Skeena Watershed[22].

Steelhead fry densities vary considerably between sites and years, reflecting the strength of the adult spawning escapement and habitat differences between years. The 1997 fry densities were in the mid-range of those measured at the same sites in the past, and were definitely stronger than the 1984 estimates. It is interesting to note that in 1997, steelhead fry were distributed upstream to Cabinet Creek in the Goathorn system, and had higher densities in the upper reaches of Tenas Creek than noted in past studies.

Appendix 13 Figure 1 summarizes the Tyee Test Fishery index for adult steelhead on the lower Skeena River for the period of record (1956 to 1997). The years highlighted in black are indicative of adult run strength for those years prior to the juvenile assessments. For example, the 1982 adult run would be responsible for the 1983 fry recruitment. This index suggests that 1983 was a poor year for adult steelhead recruitment compared to the years immediately before and after, likely accounting for the poor fry numbers throughout the Telkwa Watershed in 1984. The 1996 test fishery results were near the average for all years combined.

Figure 2.7 Summary of steelhead fry and parr densities at Goathorn and Tenas creeks and the lower Telkwa River sites from 1983 to 1997.



[22] Extensive juvenile steelhead index sampling was conducted by MOELP during the late 1970s to early 1990s. Data reports on file, MOELP, Fisheries Section, Smithers.

Steelhead parr remain in these systems for two or more years prior to smolting. The parr estimates obtained in 1997 were in the range of 3-7 parr/100m^2. In all cases, this was lower than estimates conducted in 1983-84 at these sites, and comparable to 1985 estimates. There was a distinct lack of age 1+ steelhead at all sample sites in 1997, either reflecting poor steelhead fry recruitment in 1996, or very poor survival from the fry to yearling stage in the past year.

Juvenile steelhead index surveys are no longer conducted in the Skeena drainage, so comparisons to most other steelhead systems for 1997 cannot be made. Studies in the Thautil River in 1996 indicated a relatively strong fry recruitment compared to previous years (Bustard 1997c). Skeena test fishery indices indicate that the 1995 steelhead escapement (leading to 1996 fry recruitment) was slightly below the long-term average[23].

Rough approximations of adult production derived from juvenile steelhead numbers in the lower Telkwa, Goathorn, and Tenas creeks combined ranged from 1000-1500 adults (before interception losses) or approximately 350-500 spawners combined (Bustard 1985a)[24].

Our observations suggest that Goathorn and Tenas creeks are the most productive steelhead tributaries in the Telkwa Watershed. Tenas Creek, in particular, stands out as an important system. It is utilized by steelhead for at least 13 km, with heavy use in the lower 9 km. Steelhead do use other Telkwa River tributaries such as Elliott, Howson and Pine creeks, but barriers are present within a few km of the mainstem river limiting access to relatively short sections of stream. Our data also indicates that the Telkwa River mainstem and sidechannels are very important steelhead rearing areas. Together, these systems probably account for much of the steelhead production in the Telkwa Watershed.

Although these tributaries themselves receive relatively minor angling use, it is likely that most steelhead that spawn in these systems hold in the Bulkley River during the fall and winter periods and comprise an important component of the summer steelhead fishery on this system.

The Bulkley River is one of the two most heavily fished steelhead systems in the Skeena Region. During the period 1994 to 1996, approximately 8000 steelhead angler days were reported for the Bulkley River representing 20-24% of the overall angling effort in the Skeena Region (Steelhead Harvest Analysis[25]). The section of the Bulkley River in the vicinity and downstream from the Telkwa River confluence is one of the most heavily fished sections of the Bulkley River for steehead (O'Neill and Whately 1984).

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[23] Steelhead Index at Skeena River Tyee Test Fishery; data on file, Fisheries Section, Ministry of Environment, Lands and Parks, Smithers.

[24] These estimates are based on 35% survival from parr to smolt and 12% survival from smolt to adult and a 2:1 interception loss. The parr and smolt survival figures are very similar to those presented in Koning and Keeley (1997).

[25] Steelhead Harvest Analysis; data on file, Minstry of Environment, Lands and Parks, Smithers.

Most steelhead angling occurs during a 10-week period from early September through mid-November. There are seven licensed guiding operations on the river. Nearly 70% of the anglers estimated to be present on the Bulkley on a given day during the peak of the steelhead fishery are non-residents of BC and two thirds of these are non-Canandian (MOELP draft 1997). The Bulkley River is one of 40 classified rivers (Class 2) in the province and special fees and guide restrictions are in place during the fall period.

Water clarity is an important feature of the Bulkley River steelhead fishery. During periods when the water clarity downstream from the Telkwa is poor (e.g., following a heavy rain event), anglers tend to concentrate on the clear section of river upstream from the Telkwa. During these periods, anglers from other major steelhead tributaries such as the Kispiox, Zymoetz, Suskwa and Skeena rivers tend to congregate in the clear sections of the Bulkley[26].

Land-use activities in the Telkwa Watershed that lead to reduced water clarity due to sediment would have a definite impact on the Bulkley steelhead fishery. A study conducted by the Ministry of Forests monitored sediment levels in the Telkwa Watershed during 1990. This study found that natural sediment sources from landslides, gully erosion, and streambank erosion dominated the sediment input in all of the major tributaries including Tenas and Goathorn creeks during the peak flow period. The study warned that "*small amounts of sediment introduced into the Telkwa River during the summer and fall period could substantially alter turbidity and thus recreational activity on the rivers ... and that an active program to prevent and mitigate erosion and sediment transport in the watershed is needed*" (Beaudry et al. 1991).

Other significant sport fisheries on the Bulkley River include chinook salmon from late June through early August primarily focused at Moricetown Canyon and the Bulkley-Morice confluence area. More recently, a smaller fishery has developed for pink salmon in August during good escapement years, and for hatchery coho in the vicinity of Trout Creek. There is no longer a sport fishery for wild coho in the Bulkley River due to low escapements for this species[27].

Bull Trout

The studies conducted in 1997 represent the first year that bull trout and Dolly Varden have been separated in the catches as two distinct species. The highest abundance of bull trout occurred in the mid-reaches of Goathorn Creek and in lower Cabinet Creek. Interestingly, bull trout juvenile densities did not exceed 3 fish/100m^2 at any of the

[26] From *Angling Use Plan - Bulkley River, 1997* (draft); on file, Fisheries Section, MOELP, Smithers.

[27] Coho conservation concerns in the upper Skeena (including the upper Bulkley) are so great that a Coho Response Team has been set up by the Department of Fisheries and Oceans to deal with concerns for run extinctions in some coho systems within the watershed. A sharp decline in 1997 coho escapements are thought to be a result of chronic over-fishing, poor marine survivals and increasing exploitation by the Alaska troll fishery (DFO 1998).

Goathorn Creek sites. The densities of char captured in the main bull trout section of Goathorn Creek were down significantly from levels recorded in the period 1983-85 (Table 2.3).

Although bull trout were present in Tenas Creek, their densities were also very low and did not exceed 1 fish/100m^2 at any sites except T6 in the uppermost reach. Densities were also in the range of 1 bull trout/100m^2 in the Telkwa River sidechannels.

Bull trout tend to achieve relatively low densities, often in specific habitat areas. McPhail and Baxter (1996), in their review of bull trout life history, indicated that densities of less than 2 juveniles/100m^2 was typical of studies conducted in Idaho and Washington streams where adult populations are quite low due to habitat degradation and over-exploitation. Goetz (1989) reported densities of 8 juveniles/100m^2 in the Flathead River, while Allan (1987) estimated 2-5 fish/100m^2 in Line Creek in the Kootenays. Data collected at sites in the Bulkley River tributaries in 1996 indicated densities of <4 fish/100m^2 in four systems[28]. Extensive sampling of a relatively unexploited bull trout population in the Thutade Watershed indicates bull trout achieve a mean density of 8 juvenile/100m^2 with upper estimates to 17 fish/100m^2 (Bustard 1997a).

These comparisons suggest that Goathorn and Tenas creeks are supporting small populations of bull trout at low densities. This is confirmed by the relatively low numbers of adult spawners and redd sites located in the two systems (16 adults in Goathorn Creek and 10 in Tenas Creek - Tables 2.4 and 2.9 respectively).

There is generally widespread agreement that recreational fishing can have a major impact on bull trout abundance, as the species is long-lived and easy to catch (McPahil and Baxter 1996). Bull trout are commonly captured in the Bulkley River, and liberal catch limits in conjunction with heavy fishing pressure for other species for many years has probably resulted in a relatively diminished population of bull trout in the system. This could account for the low abundance of bull trout in stream habitat that appears ideally suited for this species.

There is a lack of good regional data describing the status of bull trout populations in the Skeena Watershed. Factors that have played a major role in the decline of bull trout populations elsewhere such as angler overharvest and habitat degradation (e.g., Brewin 1997) have probably had a significant influence on many Skeena bull trout populations. However, insufficient data are available to compare the importance and status of the Telkwa River bull trout populations to those elsewhere in the Skeena Watershed. Bull trout management is receiving an increasing emphasis provincially, including a shift to catch-and-release fisheries in some regions.

McPhail and Baxter (1996) warn that juvenile bull trout are particularly vulnerable to land use activities that cause siltation and lead to cementing of stream substrate. Loose

[28] Denison/Canyon/Goathorn/Cumming creeks (Bustard 1996).

bed material is essential to juvenile bull trout as cover, and for the community of aquatic insects that provide the major food source for bull trout fry and juveniles.

Dolly Varden

Dolly Varden residents dominated the fish catches in the upper watersheds of Goathorn and Tenas creeks. These fish mature at a small size (<20 mm fork length), and can achieve high densities in the headwater areas, typically up to 15-20 fish/100m^2 in upper Goathorn Creek tributaries (Figure 2.3b) and somewhat lower in most upper Tenas Creek sites (Figure 2.5b).

There is a strong negative association between Dolly Varden and steelhead trout in these tributaries. Dolly Varden tend to achieve low densities where higher numbers of steelhead are present. It is likely that Dolly Varden cannot compete effectively with steelhead, and will occupy sites that are marginal for steelhead (smaller channels, higher gradients and colder water temperatures).

Dolly Varden also tend to dominate the catches in smaller tributary streams in the Goathorn and Tenas creek watersheds. Resident Dolly Varden were present in approximately 5 km of Four Creek at relatively low densities. They were also present in the lower sections of several smaller tributaries in Goathorn and Tenas creeks (1:20000 aquatic map) and in the headwater area of Hubert Creek.

Dolly Varden juveniles comprise a minor component of the Telkwa River mainstem and sidechannel catch, with only five fry captured in four years of sampling (Table 2.11).

Populations of resident Dolly Varden tend to be widespread in the smaller tributary streams in the Bulkley Watershed, especially cooler mountainous systems such as those found in the Telkwa Watershed. For example, Dolly Varden were the most widespread species found in the Thautil Watershed and were present at many more sites than anadromous species such as steelhead and coho, or fluvial populations of bull trout. Due to their small size (they rarely exceed 20 cm), resident Dolly Varden populations tend to not be exploited by angler harvests. They are also protected by Forest Practices Code regulations. As a result, resident Dolly Varden populations are not at risk compared to anadromous and fluvial species in the watershed.

Coho Salmon

Coho salmon juveniles were present in lower Hubert Creek and in two sidechannels and a wetland site in the lower Telkwa River. Coho abundance was very low throughout the lower reach of Hubert Creek in 1997 compared to sampling conducted during the 1980s. This was despite good access into the lower 1.2 km of Hubert Creek, and presumably

reflects poor fry recruitment into Hubert Creek from the Bulkley River. Adult coho escapements to the Bulkley River have been very poor for most of the past decade.

Interestingly, coho juveniles comprised a higher percentage of the catch in the lower Telkwa River (18%) than in past years. This is largely the result of sampling at two sidechannel locations that were well suited for coho rearing, and may be more a reflection of the dynamic and changing habitat conditions in the lower Telkwa rather than an improvement in overall population strength in this system.

Cutthroat

Cutthroat trout were present in the upper reaches of Helps and Hubert creeks in 1997. However, sampling at the same locations indicated that cutthroat fry had a 10-fold decline in abundance in the system. It is probable that there are access problems to the upper spawning sites, largely due to beaver dams located in the mid-reaches of Helps and Hubert creeks.

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Appendices 1-13:

Aquatic Resource Baseline Studies - Telkwa Coal Project

Appendix 1 Table 1. Chlorophyll *a* concentrations on styrofoam substrata in Goathorn and Tenas creeks, 1997 and 1984.

Date	Stream	Station	Repl.	Day	Temp	Depth (cm)	Velocity (m/s)	Chlorophyll (µg/cm^2)
05-Sep-97	Goathorn	G2	1	0		25	0.67	
05-Sep-97	Goathorn	G2	2	0		22	0.63	
05-Sep-97	Goathorn	G2	3	0		20	0.63	
05-Sep-97	Goathorn	G5	1	0		28	0.40	
05-Sep-97	Goathorn	G5	2	0		29	0.67	
05-Sep-97	Goathorn	G5	3	0		23	0.53	
05-Sep-97	Tenas	T1	1	0		24	0.55	
05-Sep-97	Tenas	T1	2	0		25	0.75	
05-Sep-97	Tenas	T1	3	0		23	0.62	
05-Sep-97	Tenas	T3	1	0	7.0	21	0.81	
05-Sep-97	Tenas	T3	2	0	7.0	23	0.64	
05-Sep-97	Tenas	T3	3	0	7.0	23	0.58	
12-Sep-97	Goathorn	G2	1	7	11.0	17	0.63	0.13
12-Sep-97	Goathorn	G2	2	7	11.0	16	0.85	0.10
12-Sep-97	Goathorn	G2	3	7	11.0	13	0.53	0.12
12-Sep-97	Goathorn	G5	1	7	11.0	18	0.39	0.12
12-Sep-97	Goathorn	G5	2	7	11.0	18	0.54	0.11
12-Sep-97	Goathorn	G5	3	7	11.0	13	0.45	0.11
12-Sep-97	Tenas	T1	1	7	10.0	14	0.56	0.31
12-Sep-97	Tenas	T1	2	7	10.0	17	0.77	0.19
12-Sep-97	Tenas	T1	3	7	10.0	14	0.52	0.34
12-Sep-97	Tenas	T3	1	7	8.5	14	0.77	0.11
12-Sep-97	Tenas	T3	2	7	8.5	15	0.70	0.14
12-Sep-97	Tenas	T3	3	7	8.5	16	0.43	0.18
19-Sep-97	Goathorn	G2	1	14	10.0	24		0.42
19-Sep-97	Goathorn	G2	2	14	10.0	21		0.43
19-Sep-97	Goathorn	G2	3	14	10.0	20		0.31
19-Sep-97	Goathorn	G5	1	14	9.0	29		0.35
19-Sep-97	Goathorn	G5	2	14	9.0	28		0.38
19-Sep-97	Goathorn	G5	3	14	9.0	26		0.28
19-Sep-97	Tenas	T1	1	14	9.5	20		0.61
19-Sep-97	Tenas	T1	2	14	9.5	22		0.50
19-Sep-97	Tenas	T1	3	14	9.5	20		0.77
19-Sep-97	Tenas	T3	1	14	6.5	23		0.30
19-Sep-97	Tenas	T3	2	14	6.5	24		0.33
19-Sep-97	Tenas	T3	3	14	6.5	23		0.31
26-Sep-97	Goathorn	G2	1	21	8.5	20		1.20
26-Sep-97	Goathorn	G2	2	21	8.5	19		1.18
26-Sep-97	Goathorn	G2	3	21	8.5	16		0.80
26-Sep-97	Goathorn	G5	1	21	8.0	22		0.86
26-Sep-97	Goathorn	G5	2	21	8.0	22		1.43
26-Sep-97	Goathorn	G5	3	21	8.0	18		1.13
26-Sep-97	Tenas	T1	1	21	9.0	15		1.12
26-Sep-97	Tenas	T1	2	21	9.0	20		0.95
26-Sep-97	Tenas	T1	3	21	9.0	17		1.15
26-Sep-97	Tenas	T3	1	21	7.5	20		1.27
26-Sep-97	Tenas	T3	2	21	7.5	19		1.30
26-Sep-97	Tenas	T3	3	21	7.5	19		0.90
03-Oct-97	Goathorn	G2	1	28	7.0	25		1.50
03-Oct-97	Goathorn	G2	2	28	7.0	24		1.20
03-Oct-97	Goathorn	G2	3	28	7.0	21		0.96
03-Oct-97	Goathorn	G5	1	28	6.5	28		1.15
03-Oct-97	Goathorn	G5	2	28	6.5	29		2.43
03-Oct-97	Goathorn	G5	3	28	6.5	26		1.41
03-Oct-97	Tenas	T1	1	28	5.0	20		1.45
03-Oct-97	Tenas	T1	2	28	5.0	23		0.92
03-Oct-97	Tenas	T1	3	28	5.0	22		0.94
03-Oct-97	Tenas	T3	1	28	4.5	21		2.22
03-Oct-97	Tenas	T3	2	28	4.5	24		1.69

Appendix 1 Table 1. Chlorophyll *a* concentrations on styrofoam substrata in Goathorn and Tenas creeks, 1997 and 1984.

Date	Stream	Station	Repl.	Day	Temp	Depth (cm)	Velocity (m/s)	Chlorophyll ($\mu g/cm^2$)
03-Oct-97	Tenas	T3	3	28	4.5	22		2.20
10-Oct-97	Goathorn	G2	1	35	3.0	18		2.30
10-Oct-97	Goathorn	G2	2	35	3.0	17		1.51
10-Oct-97	Goathorn	G2	3	35	3.0	14		0.90
10-Oct-97	Goathorn	G5	1	35	3.0	20		1.14
10-Oct-97	Goathorn	G5	2	35	3.0	20		2.31
10-Oct-97	Goathorn	G5	3	35	3.0	15		1.37
10-Oct-97	Tenas	T1	1	35	1.5	16		0.83
10-Oct-97	Tenas	T1	2	35	1.5	21		0.77
10-Oct-97	Tenas	T1	3	35	1.5	19		1.01
11-Oct-97	Tenas	T3	1	36	2.0	19		1.18
11-Oct-97	Tenas	T3	2	36	2.0	20		1.54
11-Oct-97	Tenas	T3	3	36	2.0	19		1.57
05-Sep-84	Goathorn	G2	1	0				
05-Sep-84	Goathorn	G2	2	0				
05-Sep-84	Goathorn	G2	3	0				
05-Sep-84	Goathorn	G2	4	0				
12-Sep-84	Goathorn	G2	1	7				0.63
12-Sep-84	Goathorn	G2	2	7				0.44
12-Sep-84	Goathorn	G2	3	7				0.73
12-Sep-84	Goathorn	G2	4	7				0.35
19-Sep-84	Goathorn	G2	1	14				0.74
19-Sep-84	Goathorn	G2	2	14				0.85
19-Sep-84	Goathorn	G2	3	14				0.23
19-Sep-84	Goathorn	G2	4	14				0.46
26-Sep-84	Goathorn	G2	1	21				0.89
26-Sep-84	Goathorn	G2	2	21				1.42
26-Sep-84	Goathorn	G2	3	21				1.26
26-Sep-84	Goathorn	G2	4	21				0.69
03-Oct-84	Goathorn	G2	1	28				1.73
03-Oct-84	Goathorn	G2	2	28				1.83
03-Oct-84	Goathorn	G2	3	28				1.64
03-Oct-84	Goathorn	G2	4	28				
10-Oct-84	Goathorn	G2	1	35				2.27
10-Oct-84	Goathorn	G2	2	35				1.75
10-Oct-84	Goathorn	G2	3	35				2.18
10-Oct-84	Goathorn	G2	4	35				
17-Oct-84	Goathorn	G2	1	42				2.1
17-Oct-84	Goathorn	G2	2	42				2.2
17-Oct-84	Goathorn	G2	3	42				1.8
17-Oct-84	Goathorn	G2	4	42				2.2
05-Sep-84	Goathorn	G5	1	0				
05-Sep-84	Goathorn	G5	2	0				
05-Sep-84	Goathorn	G5	3	0				
05-Sep-84	Goathorn	G5	4	0				
12-Sep-84	Goathorn	G5	1	7				1.28
12-Sep-84	Goathorn	G5	2	7				1.37
12-Sep-84	Goathorn	G5	3	7				1.74
12-Sep-84	Goathorn	G5	4	7				1.66
19-Sep-84	Goathorn	G5	1	14				1.74
19-Sep-84	Goathorn	G5	2	14				1.52
19-Sep-84	Goathorn	G5	3	14				2.18
19-Sep-84	Goathorn	G5	4	14				1.83
26-Sep-84	Goathorn	G5	1	21				1.85
26-Sep-84	Goathorn	G5	2	21				1.99
26-Sep-84	Goathorn	G5	3	21				2.61
26-Sep-84	Goathorn	G5	4	21				1.42
03-Oct-84	Goathorn	G5	1	28				
03-Oct-84	Goathorn	G5	2	28				

Appendix 1 Table 1. Chlorophyll *a* concentrations on styrofoam substrata in Goathorn and Tenas creeks, 1997 and 1984.

Date	Stream	Station	Repl.	Day	Temp	Depth (cm)	Velocity (m/s)	Chlorophyll ($\mu g/cm^2$)
03-Oct-84	Goathorn	G5	3	28				2.75
03-Oct-84	Goathorn	G5	4	28				
10-Oct-84	Goathorn	G5	1	35				
10-Oct-84	Goathorn	G5	2	35				3.08
10-Oct-84	Goathorn	G5	3	35				2.73
10-Oct-84	Goathorn	G5	4	35				1.66
17-Oct-84	Goathorn	G5	1	42				
17-Oct-84	Goathorn	G5	2	42				1.97
17-Oct-84	Goathorn	G5	3	42				2.8
17-Oct-84	Goathorn	G5	4	42				2.3

Appendix 1 Table 2. List of periphyton species found on styrofoam substrata in Goathorn and Tenas creeks, 1997 and 1984.

Division	Species		code
CYANOPHYTA	Oscillatoria sp.	/mm	1
CHLOROPHYTA	Closterium sp.		2
CHLOROPHYTA	Ulothrix sp.	/mm	3
CHRYSOPHYTA - DIATOMS	Achnanthes minutissima		4
CHRYSOPHYTA - DIATOMS	Achnanthes sp.		5
CHRYSOPHYTA - DIATOMS	Amphipleura pellucida		6
CHRYSOPHYTA - DIATOMS	Cocconeis placentula		7
CHRYSOPHYTA - DIATOMS	Cymbella caespitosa		8
CHRYSOPHYTA - DIATOMS	Cymbella cistula		9
CHRYSOPHYTA - DIATOMS	Cymbella ventricosa		10
CHRYSOPHYTA - DIATOMS	Diatoma hiemale		11
CHRYSOPHYTA - DIATOMS	Diatoma tenue v. elongatum		12
CHRYSOPHYTA - DIATOMS	Fragilaria sp.		13
CHRYSOPHYTA - DIATOMS	Fragilaria vaucheriae		14
CHRYSOPHYTA - DIATOMS	Gomphonema geminatum		15
CHRYSOPHYTA - DIATOMS	Gomphonema herculeanum		16
CHRYSOPHYTA - DIATOMS	Gomphonema olivaceum		17
CHRYSOPHYTA - DIATOMS	Gomphonema sp.		18
CHRYSOPHYTA - DIATOMS	Hannaea arcus		19
CHRYSOPHYTA - DIATOMS	Meridion circulare		20
CHRYSOPHYTA - DIATOMS	Nitzschia linearis		21
CHRYSOPHYTA - DIATOMS	Nitzschia palea		22
CHRYSOPHYTA - DIATOMS	Synedra ulna		23
CHRYSOPHYTA - DIATOMS	Diatom subtotal		24
TOTAL			25
TOTAL mm			26

Appendix 1 Table 3. Cell counts, bio-volume, and percent of total bio-volume by periphyton species code found in Goathorn and Tenas creeks in 1984 and 1997.

Explanation of species coding:

Numbers refer to the numeric code assigned to each species as listed in Appendix 1 Table 2.
N" refers to cell numbers in units of cells x $10^6/m^2$
V" refers to cell bio-volume in units of um^3 x $10^9/m^2$
PV" refers to percent of total periphyton bio-volume in units of %
Species codes number 1, 3 and 26 have cell numbers expressed as "mm" because they are filamentous forms in which free cells do not exist

			Species Coding														
Date	Site	Replicate	1N	2N	3N	4N	5N	6N	7N	8N	9N	10N	11N	12N	13N	14N	15N	16N
17-Oct-84	G2	1																
17-Oct-84	G2	2																
17-Oct-84	G2	3																
17-Oct-84	G2	4																
17-Oct-84	G5	2																
17-Oct-84	G5	3																
17-Oct-84	G5	4																
10-Oct-97	T1	1				20.53		3.73	1.87									5.60
10-Oct-97	T1	2				29.86		1.87	20.53				3.73		3.73			20.53
10-Oct-97	T1	3		1.87		7.47		3.73	14.93	1.87			1.87		3.73			11.20
11-Oct-97	T3	1				120.57			12.69	63.46		76.15	139.60		164.99	12.69		
11-Oct-97	T3	2			2.14	90.43			14.28	14.28		109.46	57.11		76.15			
11-Oct-97	T3	3				52.35	33.31		9.52	23.80		23.80	57.11		157.06			38.07
10-Oct-97	G2	1				959.17	43.93		21.97					219.66	51.25			
10-Oct-97	G2	2	1.09			404.54	66.63							475.93	19.04		4.76	
10-Oct-97	G2	3	0.64		1.26	389.14								120.38	2.80		2.80	
10-Oct-97	G5	1				894.74				9.52	4.76	52.35	28.56	33.31				
10-Oct-97	G5	2				2227.33						57.11		171.33	1028.00			
10-Oct-97	G5	3	8.02			1509.37				13.60		54.39	13.60	163.17	666.30			

Appendix 1 Table 3. Cell

Explanation of species co

Numbers refer to the numer
N" refers to cell numbers in
V" refers to cell bio-volume
PV" refers to percent of tota
Species codes number 1, 3

Date	Site	Replicate	17N	18N	19N	20N	21N	22N	23N	24N	25N	26N	1V	2V	3V	4V	5V	6V
17-Oct-84	G2	1																
17-Oct-84	G2	2																
17-Oct-84	G2	3																
17-Oct-84	G2	4																
17-Oct-84	G5	2																
17-Oct-84	G5	3																
17-Oct-84	G5	4																
10-Oct-97	T1	1	125.05		5.60	1.87	1.87	110.12	293.02	569.24	569.24					1.44		4.78
10-Oct-97	T1	2	141.84		1.87		3.73	149.31	237.03	614.04	614.04					2.09		2.39
10-Oct-97	T1	3	126.91				1.87	154.91	302.35	630.84	632.70			11.20		0.52		4.78
11-Oct-97	T3	1	583.80		647.26	6.35		76.15	317.28	2220.99	2220.99					8.44		
11-Oct-97	T3	2	371.22		509.24	14.28		90.43	185.61	1532.48	1532.48	2.14			128.50	6.33		
11-Oct-97	T3	3	490.20		409.30	14.28		42.83	157.06	1508.69	1508.69					3.66	2.00	
10-Oct-97	G2	1	234.30			7.32		43.93	754.16	2335.70	2335.70					67.14	2.64	
10-Oct-97	G2	2	176.09		4.76			9.52	280.80	1442.06	1442.06	1.09	10.95			28.32	4.00	
10-Oct-97	G2	3	148.38		11.20			11.20	226.76	912.66	912.66	1.90	6.44		75.59	27.24		
10-Oct-97	G5	1	685.33		14.28				80.91	1803.76	1803.76					62.63		
10-Oct-97	G5	2	1008.96	152.30	780.52			494.96	361.70	6282.22	6282.22					155.91		
10-Oct-97	G5	3	1210.21	149.58	244.76			203.97	81.59	4310.53	4310.53	8.02	80.23			105.66		

Appendix 1 Table 3. Cell

Explanation of species co

Numbers refer to the numer
N" refers to cell numbers in
V" refers to cell bio-volume
PV" refers to percent of tota
Species codes number 1, 3

Date	Site	Replicate	7V	8V	9V	10V	11V	12V	13V	14V	15V	16V	17V	18V	19V	20V	21V	22V	23V
17-Oct-84	G2	1																	
17-Oct-84	G2	2																	
17-Oct-84	G2	3																	
17-Oct-84	G2	4																	
17-Oct-84	G5	2																	
17-Oct-84	G5	3																	
17-Oct-84	G5	4																	
10-Oct-97	T1	1	1.68									22.40	60.02		10.64	0.91	6.07	121.13	873.20
10-Oct-97	T1	2	18.48				2.39		1.87			82.12	68.09		3.55		12.13	164.24	706.35
10-Oct-97	T1	3	13.44	2.26			1.19		1.87			44.79	60.92				6.07	170.40	901.01
11-Oct-97	T3	1	11.42	76.78		37.31	89.35		82.49	4.32			280.23		1229.79	3.11		83.76	945.51
11-Oct-97	T3	2	12.85	17.28		53.64	36.55		38.07				178.19		967.56	7.00		99.47	553.12
11-Oct-97	T3	3	8.57	28.79		11.66	36.55		78.53			152.30	235.30		777.66	7.00		47.12	468.03
10-Oct-97	G2	1	19.77					39.54	25.63				112.46			3.59		48.32	2247.40
10-Oct-97	G2	2						85.67	9.52		109.46		84.52		9.04			10.47	836.77
10-Oct-97	G2	3						21.67	1.40		64.39		71.22		21.28			12.32	675.76
10-Oct-97	G5	1		11.52	30.32	25.65	18.28	6.00					328.96		27.13				241.10
10-Oct-97	G5	2				27.98		30.84	514.00				484.30	152.30	1482.99			544.46	1077.88
10-Oct-97	G5	3		16.45		26.65	8.70	29.37	333.15				580.90	149.58	465.05			224.37	243.13

Appendix 1 Table 3. Cell

Explanation of species co

Numbers refer to the numer
N" refers to cell numbers in
V" refers to cell bio-volume
PV" refers to percent of tota
Species codes number 1, 3

Date	Site	Replicate	24V	25V	26V	1PV	2PV	3PV	4PV	5PV	6PV	7PV	8PV	9PV	10PV	11PV	12PV	13PV	14PV
17-Oct-84	G2	1								10						trace	30	25	
17-Oct-84	G2	2							10								25	20	
17-Oct-84	G2	3								5							25	20	
17-Oct-84	G2	4														trace	25	15	
17-Oct-84	G5	2								10							25	20	
17-Oct-84	G5	3								10							25	20	
17-Oct-84	G5	4								5						trace	25	20	
10-Oct-97	T1	1	1102.26	1102.26					0		0	0							
10-Oct-97	T1	2	1063.69	1063.69					0		0	2				0		0	
10-Oct-97	T1	3	1207.25	1218.45			1		0		0	1	0			0		0	
11-Oct-97	T3	1	2852.51	2852.51					0			0	3		1	3		3	0
11-Oct-97	T3	2	1970.05	1970.05	128.50			6	0			1	1		3	2		2	
11-Oct-97	T3	3	1857.16	1857.16					0	0		0	2		1	2		4	
10-Oct-97	G2	1	2566.49	2566.49					3	0		1					2	1	
10-Oct-97	G2	2	1177.77	1177.77	10.95	1			2	0							7	1	
10-Oct-97	G2	3	895.27	895.27	82.03	1		8	3								2	0	
10-Oct-97	G5	1	751.58	751.58					8				2	4	3	2	1		
10-Oct-97	G5	2	4470.66	4470.66					3						1		1	11	
10-Oct-97	G5	3	2183.00	2183.00	80.23	4			5				1		1	0	1	15	

Appendix 1 Table 3. Cell

Explanation of species co

Numbers refer to the numer
N" refers to cell numbers in
V" refers to cell bio-volume
PV" refers to percent of tota
Species codes number 1, 3

Date	Site	Replicate	15PV	16PV	17PV	18PV	19PV	20PV	21PV	22PV	23PV	24PV	25PV	26PV
17-Oct-84	G2	1					20				15	100	100	0
17-Oct-84	G2	2				20					25	100	100	0
17-Oct-84	G2	3				15	15				20	100	100	0
17-Oct-84	G2	4				15	20				25	100	100	0
17-Oct-84	G5	2				5	20				20	100	100	0
17-Oct-84	G5	3				5	25				15	100	100	0
17-Oct-84	G5	4				10	15				25	100	100	0
10-Oct-97	T1	1		2	5		1	0	1	11	79	100	100	0
10-Oct-97	T1	2		8	6		0		1	15	66	100	100	0
10-Oct-97	T1	3		4	5				0	14	74	99	100	0
11-Oct-97	T3	1			10		43	0		3	33	100	100	0
11-Oct-97	T3	2			8		46	0		5	26	94	94	6
11-Oct-97	T3	3		8	13		42	0		3	25	100	100	0
10-Oct-97	G2	1			4			0		2	88	100	100	0
10-Oct-97	G2	2	9		7		1			1	70	99	99	1
10-Oct-97	G2	3	7		7		2			1	69	92	92	8
10-Oct-97	G5	1			44		4				32	100	100	0
10-Oct-97	G5	2			11	3	33			12	24	100	100	0
10-Oct-97	G5	3			26	7	21			10	11	96	96	4

Appendix 2 Table 1. List of benthic invertebrate species and assigned species codes found in Goathorn and Tenas creeks in 1983, 1984, and 1997.

Division	Order	Family	Species	Stage	Species Code
Insecta	Ephemeroptera		Ephemeroptera A	adult	1
Insecta	Ephemeroptera	Baetidae	Baetis sp		2
Insecta	Ephemeroptera	Siphlonuridae	Ameletus sp		3
Insecta	Ephemeroptera	Ephemerellidae	Ephemerella doddsi		4
Insecta	Ephemeroptera	Ephemerellidae	Ephemerella flavilinea		5
Insecta	Ephemeroptera	Ephemerellidae	Ephemerella spinifera		6
Insecta	Ephemeroptera	Ephemerellidae	Ephemerella sp		7
Insecta	Ephemeroptera	Heptageneidae	Rhithrogena sp		8
Insecta	Ephemeroptera	Heptageneidae	Epeorus (Iron) sp		9
Insecta	Ephemeroptera	Heptageneidae	Cinygmula sp		10
Insecta	Ephemeroptera	Leptophlebiidae	Paraleptophlebia sp		11
Insecta	Ephemeroptera		Ephemeroptera subtotal		12
Insecta	Plecoptera		Kathroperla sp		13
Insecta	Plecoptera	Perlodidae	Diura sp		14
Insecta	Plecoptera	Perlodidae	Isogenus sp		15
Insecta	Plecoptera	Perlodidae	Arcynopteryx sp		16
Insecta	Plecoptera	Perlodidae	Isoperla sp		17
Insecta	Plecoptera	Perlodidae	Megarcys sp		18
Insecta	Plecoptera	Perlodidae	Skwala (curvata)		19
Insecta	Plecoptera	Perlodidae	Skwala (paralella)		20
Insecta	Plecoptera	Chloroperlidae	Chloroperla sp		21
Insecta	Plecoptera	Chloroperlidae	Hastaperla sp		22
Insecta	Plecoptera	Chloroperlidae	Suwalia sp		23
Insecta	Plecoptera	Chloroperlidae	Sweltsa sp group		24
Insecta	Plecoptera	Leuctridae	Leuctra sp		25
Insecta	Plecoptera	Nemouridae	Nemoura sp1		26
Insecta	Plecoptera	Nemouridae	Nemoura sp2		27
Insecta	Plecoptera	Nemouridae	Malenka sp		28
Insecta	Plecoptera	Nemouridae	Podmosta sp		29
Insecta	Plecoptera	Nemouridae	Visoka cataractae		30
Insecta	Plecoptera	Nemouridae	Zapada sp		31
Insecta	Plecoptera	Capniidae	Capnia sp		32
Insecta	Plecoptera	Taeniopterygidae	Taenionema sp		33
Insecta	Plecoptera		Plecoptera subtotal		34
Insecta	Megaloptera	Corydalidae			35
Insecta	Trichoptera		Sericostoma sp.		36
Insecta	Trichoptera	Psychomyiidae	Tinodes sp. larva	larva	37
Insecta	Trichoptera	Psychomyiidae	Tinodes sp. pupa	pupa	38
Insecta	Trichoptera		Trichoptera Unid J	juvenile	39
Insecta	Trichoptera	Hydropsychidae	Arctopsyche sp		40
Insecta	Trichoptera	Hydropsychidae	Parapsyche sp		41
Insecta	Trichoptera	Leptoceridae	Leptocella sp		42
Insecta	Trichoptera	Brachycentridae	Brachycentrus sp		43
Insecta	Trichoptera	Limnephilidae	Unid Juv	juvenile	44
Insecta	Trichoptera	Limnephilidae	Ecclisomyia sp		45
Insecta	Trichoptera	Rhyacophilidae	Rhyacophila acropedes or vao		46
Insecta	Trichoptera	Rhyacophilidae	Rhyacophila angelita		47
Insecta	Trichoptera	Rhyacophilidae	Rhyacophila vaccua		48
Insecta	Trichoptera	Rhyacophilidae	Rhyacophila sp		49
Insecta	Trichoptera	Glossosomatidae	Glossosoma sp		50
Insecta	Trichoptera		Trichoptera subtotal		51
Insecta	Diptera	Chironomidae	L	larva	52
Insecta	Diptera	Chironomidae	P	pupa	53
Insecta	Diptera	Chironomidae	A	adult	54
Insecta	Diptera	Chironomidae	Chironomid subtotal		55
Insecta	Diptera		Diptera Unid L	Larva	56
Insecta	Diptera		Diptera Unid A	adult	57
Insecta	Diptera		Brillia sp		58
Insecta	Diptera		Cardiocladius sp		59
Insecta	Diptera		Corynoneura sp		60
Insecta	Diptera		Cricotopus sp		61
Insecta	Diptera		Epoicocladius sp		62
Insecta	Diptera		Eukiefferiella sp		63
Insecta	Diptera		Euryhapsis sp		64
Insecta	Diptera		Parorthocladius sp		65
Insecta	Diptera		Psectrocladius sp		66
Insecta	Diptera		Rheotanytarsus sp		67
Insecta	Diptera		Synorthocladius sp		68
Insecta	Diptera		Thienemanniella sp		69
Insecta	Diptera		Thienemannimyia sp		70
Insecta	Diptera	Simulidae L	Prosimulium sp	larva	71
Insecta	Diptera	Simulidae P	Simulium sp	pupa	72

Appendix 2 Table 1. List of benthic invertebrate species and assigned species codes found in Goathorn and Tenas creeks in 1983, 1984, and 1997.

Division	Order	Family	Species	Stage	Species Code
Insecta	Diptera	Simulidae A	Simulium sp	adult	73
Insecta	Diptera	Simulidae	Simulium sp		74
Insecta	Diptera	Empididae	Empididae	larva	75
Insecta	Diptera	Empididae	Empididae	pupa	76
Insecta	Diptera	Empididae L	Chelifera sp		77
Insecta	Diptera	Empididae	Weidemannia sp		78
Insecta	Diptera	Ephydridae	Ephydridae	larva	79
Insecta	Diptera	Ephydridae	Ephydridae	pupa	80
Insecta	Diptera	Muscidae	Muscidae		81
Insecta	Diptera	Ceccidomylidae	Ceccidomylidae		82
Insecta	Diptera	Blephariceridae	Agathon sp		83
Insecta	Diptera	Blephariceridae	Blephariceridae		84
Insecta	Diptera	Blephariceridae	Philorus sp.		85
Insecta	Diptera	Ceratopogonidae	Culicoides sp		86
Insecta	Diptera	Ceratopogonidae	Palpomyia sp		87
Insecta	Diptera	Tipulidae	Tipula sp		88
Insecta	Diptera	Tipulidae	Antocha sp		89
Insecta	Diptera	Tipulidae	Dicranota sp		90
Insecta	Diptera	Tipulidae	Hexatoma sp		91
Insecta	Diptera	Rhagionidae	Atherix sp		92
Insecta	Diptera	Rhagionidae	Undescribed athericid		93
Insecta	Diptera	Psychodidae	Pericoma sp		94
Insecta	Diptera	Deuterophlebiid	Deuterophlebia sp		95
Insecta	Diptera	Cyclorrhapha	Cyclorrhapha		96
Insecta	Diptera		Diptera others subtotal	larva	97
	Lepidoptera		Lepidoptera Unid L		98
	Coleoptera	Hydrophilidae			99
	Coleoptera	Psephenidae			100
	Homoptera	Aphidae (terrestrial)			101
	Homoptera	Ceropidae (terrestrial)			102
	Homoptera		Homoptera subtotal		103
	Hymenoptera	Braconidae (terr)	Braconidae (terr)		104
	Hymenoptera	Formicidae	Formicidae		105
	Hymenoptera		Hymenoptera subtotal		106
	Collembola		Bourletiella spinata		107
	Collembola		Hypogastrura sp		108
	Collembola		Isotomurus sp		109
	Collembola	Sminthuridae	Sminthurides		110
	Ostracoda	Ostracoda	Candona sp		111
	Hirudina				112
	Oligochaeta				113
	Oligochaeta		Enchytraeidae		114
	Acarina		Acarina Unid J/D		115
	Acarina		Lebertia sp		116
	Acarina		Neumannia sp		117
	Acarina		Sperchon sp		118
	Acarina		Wandesia sp		119
	Acarina		Orbibatei		120
	Aranaea		Aranaea (terr.)		121
	Sphaeridae				122
	Turbellaria		Polycelis coronata		123
	Nematoda		Nematoda		124

Appendix 2 Table 2. Sample counts of all benthic invertebrates listed by species code in Goathorn and Tenas creeks in 1983, 1984 and 1997.
Species codes are described in Appendix 2 Table 1.

Date	Site	Replicate	SPECIES CODE 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
16-Sep-83	T1	1		27		3				31	2			63	3	11		19		
16-Sep-83	T1	2		34		2				3				39		2		26		
16-Sep-83	T1	3		51		4				44				99	1			40		
16-Sep-83	T1	4		33		9				19	1		3	65	2	1		32		
16-Sep-83	T1	5		3	4	3				16			9	35	7			13		
16-Sep-83	T1	6		3	11	1				44		2	3	64	9			47		
23-Sep-83	T2	1		27	6					9	1		4	47	1	1		17		
23-Sep-83	T2	2		293		5				57	3		4	362	13	3		41		
23-Sep-83	T2	3		278		6				22	7		5	318	13	6		28		
23-Sep-83	T2	4		147		7				24	9			187	9	4		54		
23-Sep-83	T2	5		127	2	5				91	4		4	233	11	4		43		
23-Sep-83	T2	6		69						19	2			90	6	2		35		
16-Sep-83	G2	1		1	18					2				21				13		
16-Sep-83	G2	2		6		7				26	1			40	5			12		
16-Sep-83	G2	3		8		1				9				18	1			11		
16-Sep-83	G2	4		5		7				22				34	12	1		13		
16-Sep-83	G2	5		5	1	3				4				13	10			7		
16-Sep-83	G2	6			5							2		7				3		
16-Sep-83	G5	1		32		3		6		58	2			101	6	6		49		
16-Sep-83	G5	2		16	2	4				47	3		1	73	11	3		45		
16-Sep-83	G5	3		63		14		3		111	5			196	3	1		81		
16-Sep-83	G5	4		29	3	7		6		103	8		3	159	10	1		79		
16-Sep-83	G5	5		23	1	3				13				40	11	4		21		
16-Sep-83	G5	6		18	20	2				49	2			91	29			37		
12-Sep-84	T1	1		24	3			1		2	4		3	37		8		10		
12-Sep-84	T1	2		7		2				4	1		1	15		2		5		
12-Sep-84	T1	3		8	1	2		1		5	7			24		1		2		
12-Sep-84	T1	4		5		2				13	12	2		34		1		3		
12-Sep-84	T1	5		10	2	2				7	17		3	41		12		8		
12-Sep-84	T1	6		4		6				13	8	2		33		6		13		
28-Sep-84	T2	1		75		6				31	12		6	130		7		28		
28-Sep-84	T2	2		19		5				15	1			40				8		
28-Sep-84	T2	3		5		2				18	4	1		30				4		
28-Sep-84	T2	4		93		6				18	6		1	124				14		
28-Sep-84	T2	5		72		7				23	29		1	132		23		19		
28-Sep-84	T2	6		23		1				19	21		2	66		7		4		
28-Sep-84	G2	1		7		8				6				21				2		
28-Sep-84	G2	2		12		10		1		21	2			46				3		
28-Sep-84	G2	3		3		4				23	1			31		6		5		
28-Sep-84	G2	4		3		2		2		10	7			24		5		16		
28-Sep-84	G2	5		9	1	11				25	2	2		50		3		2		
28-Sep-84	G2	6		11	1	3				6	2			23				3		
20-Sep-84	G5	1		33	1	5				72	3			114		3		4		
20-Sep-84	G5	2		12		3		2		31	1	6		55		8		5		
20-Sep-84	G5	3		14		7				38		1		60		2		7		
20-Sep-84	G5	4		16		9		3		41	5	5		79		6		12		
20-Sep-84	G5	5		12	3	3		2		29	6	4		59		6		10		
20-Sep-84	G5	6		33	1	6		1		31	4	2		78		8		7		
18-Sep-97	G2	1			5		1		1	2	1	2		12						
18-Sep-97	G2	2		3	4	2			3	8	1	3		24						
18-Sep-97	G2	3		2		5			8	23	3	2		43						
18-Sep-97	G2	4		21	2	3			2	35	15	18		96						
18-Sep-97	G2	5		7	3	4	1		2	17	7	4		45						
18-Sep-97	G2	6		3		4				6	2	1		16						
19-Sep-97	G5	1		11	1					1		2		15						
19-Sep-97	G5	2		12	17					3	2	7		41						
19-Sep-97	G5	3		21	4	1	1		7	19	2	12		67						
19-Sep-97	G5	4		8	2	2			6	12	4	11		45						
19-Sep-97	G5	5		8	19				9	10	6	36		88						
19-Sep-97	G5	6		2	21				2		5	9		39					1	
16-Sep-97	T1	1		2						4				6						
16-Sep-97	T1	2		12		1			2	9	3	1		28						
16-Sep-97	T1	3		21		1	1		1	19	8	5		56						
16-Sep-97	T1	4		11		4				10	8		1	34				1		
16-Sep-97	T1	5		33		1			1	41	19	8		103						
16-Sep-97	T1	6	1	2	1	8			1	3	1	2	1	20						
19-Sep-97	T2	1		200	8	1			5	7	6	40		267					5	1
19-Sep-97	T2	2		307	5	5			6	9	10	34		376					1	
19-Sep-97	T2	3		256	5	1			1	2	12	14		291						
19-Sep-97	T2	4		188		5			2	5	3	9		212					1	
19-Sep-97	T2	5		53	2				3	1	1	19		79						
19-Sep-97	T2	6		300	1	2			7	21	7	47		385						

Appendix 2 Table 2. Sample coun

Species codes are de

Date	Site	Replicate	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
16-Sep-83	T1	1			4					18	6							61		
16-Sep-83	T1	2			1					6	6							41		
16-Sep-83	T1	3			4					14	5							64		
16-Sep-83	T1	4			3					9	15							62		
16-Sep-83	T1	5			5					29	6							58		2
16-Sep-83	T1	6			4					24	7							92		2
23-Sep-83	T2	1			11					7	3							33		
23-Sep-83	T2	2			22					10	15							93		
23-Sep-83	T2	3			8					38	43							150		1
23-Sep-83	T2	4			7					24	15							114		1
23-Sep-83	T2	5			3					18	18							101		1
23-Sep-83	T2	6			15					12	29							87		7
16-Sep-83	G2	1			12					5								33	1	4
16-Sep-83	G2	2			3					1								30		2
16-Sep-83	G2	3			6													15		
16-Sep-83	G2	4			3					1	11							44		
16-Sep-83	G2	5			6					3	2							25		
16-Sep-83	G2	6			3					18	3							27		
16-Sep-83	G5	1			3					3	7							77		
16-Sep-83	G5	2			6					7	5							75		
16-Sep-83	G5	3			4					5	10							111		
16-Sep-83	G5	4			11					8	1							127		
16-Sep-83	G5	5			28					9	3							57		
16-Sep-83	G5	6			9					21	5							112		
12-Sep-84	T1	1			20					1					2			21		
12-Sep-84	T1	2						4		1					2			15		
12-Sep-84	T1	3								1	1				3			7		
12-Sep-84	T1	4						22							2			29		
12-Sep-84	T1	5								4	1				7			32		
12-Sep-84	T1	6								3	2				2			24		
28-Sep-84	T2	1					5			11					27			79		
28-Sep-84	T2	2					3			2					5			18		
28-Sep-84	T2	3					4								24			32		
28-Sep-84	T2	4					4			3					11			32		
28-Sep-84	T2	5					16								22			32		
28-Sep-84	G2	6					13			3					2			128		
28-Sep-84	G2	1					5			48					3			30		
28-Sep-84	G2	2					3			4					5			10		
28-Sep-84	G2	3					11								14			13		
28-Sep-84	G2	4					10			2					15			36		
28-Sep-84	G2	5					5								5			54		
20-Sep-84	G5	6								8					2			18		
20-Sep-84	G5	1					19			3					10			5		
20-Sep-84	G5	2					12								26			41		
20-Sep-84	G5	3					9			4	1				8			32		
20-Sep-84	G5	4					4			1					18			29		
20-Sep-84	G5	5					8			3					48			43		
20-Sep-84	G5	6					13			3					31			80		
18-Sep-97	G2	1								7	1				31			62		
18-Sep-97	G2	2		2				1		1					8			44		
18-Sep-97	G2	3							1	4					9			26		
18-Sep-97	G2	4	1						3						29			78		
18-Sep-97	G2	5							1	1					30			72		
19-Sep-97	G5	6	2				1		4						28			16		
19-Sep-97	G5	1					1		1						45			40		
19-Sep-97	G5	2	1						1						17			65		
19-Sep-97	G5	3	1	1					1						11			50		
19-Sep-97	G5	4	1						2						68			27		
19-Sep-97	G5	5	2				1								229			447		
16-Sep-97	T1	6							2						69			106		
16-Sep-97	T1	1					1								9			21		
16-Sep-97	T1	2	1						1						19			40		
16-Sep-97	T1	3							1						38			111		
16-Sep-97	T1	4					2	2							53			98		
16-Sep-97	T1	5					1	1							142			180		
19-Sep-97	T2	6	5				3								60			93		
19-Sep-97	T2	1	1				1	3							110			439		
19-Sep-97	T2	2	1	1			2	1	1						36			434		
19-Sep-97	T2	3	2					1	1						34			217		
19-Sep-97	T2	4	1				1	2	1						9			192		
19-Sep-97	T2	5						1	2						14			73		
19-Sep-97	T2	6		1			2	3	1	9					61			495		

Appendix 2 Table 2. Sample coun

Species codes are de

Date	Site	Replicate	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
16-Sep-83	T1	1	3													3	6	82	2	
16-Sep-83	T1	2	1				1								1	1	4			
16-Sep-83	T1	3	2												1	3	6	3		
16-Sep-83	T1	4	2				4								1	2	11	48	3	
16-Sep-83	T1	5	2				1	1							2		8	35		
16-Sep-83	T1	6	1					1							1	1	4	23	2	
23-Sep-83	T2	1															0	2	3	
23-Sep-83	T2	2	4				1									2	8			
23-Sep-83	T2	3	2				10										13	4	1	
23-Sep-83	T2	4	5				8								2	2	18	5		
23-Sep-83	T2	5	3				11									20	41	5	3	
23-Sep-83	T2	6	6				2									1	13	6	1	
16-Sep-83	G2	1	1														3	67	1	
16-Sep-83	G2	2	5													1	6	11		
16-Sep-83	G2	3														1	1	16		
16-Sep-83	G2	4	3													1	4	13	1	
16-Sep-83	G2	5	6												1	2	9	84	3	
16-Sep-83	G2	6	3													1	4	100	1	
16-Sep-83	G5	1	4				1									3	8	19	2	
16-Sep-83	G5	2	2														2	22	2	
16-Sep-83	G5	3	6													2	8	12		
16-Sep-83	G5	4	5													2	7	14	7	
16-Sep-83	G5	5	2				1									2	5	17		
16-Sep-83	G5	6	3													1	4	29	2	
12-Sep-84	T1	1													3	4	7	180	1	1
12-Sep-84	T1	2	2												2	1	5	57		
12-Sep-84	T1	3													1		1	7		
12-Sep-84	T1	4	2				5									6	13	8	1	
12-Sep-84	T1	5	1					1							2	8	12	17		
12-Sep-84	T1	6	1					1								2	4	12	1	
28-Sep-84	T2	1	3				3										6	2		
28-Sep-84	T2	2	1				3									1	5	2		
28-Sep-84	T2	3	1				2										3	2		
28-Sep-84	T2	4	1				2										2	2		
28-Sep-84	T2	5	4				29									3	6	2	1	
28-Sep-84	T2	6	6				14								1	5	36	6	2	
28-Sep-84	G2	1		1												2	26		1	
28-Sep-84	G2	2	2				4									1	2	6		
28-Sep-84	G2	3	2													2	7	2		
28-Sep-84	G2	4	6				4								2	1	4	4		
28-Sep-84	G2	5	3														13	1	2	
28-Sep-84	G2	6	1				1									3	3	1		
20-Sep-84	G5	1	6				3	1								3	5	3	1	
20-Sep-84	G5	2	4														13	5		
20-Sep-84	G5	3	1														4	4	1	
20-Sep-84	G5	4	4														1	1		
20-Sep-84	G5	5	1												1	2	7	5	1	
20-Sep-84	G5	6	1													1	2	10	1	
18-Sep-97	G2	1														2	3	3	1	
18-Sep-97	G2	2										1	2				0	1		
18-Sep-97	G2	3										1	4				3	1		
18-Sep-97	G2	4				3				1			2				5			
18-Sep-97	G2	5				2				1							6	1	1	1
18-Sep-97	G2	6															3	1	1	1
19-Sep-97	G5	1				1							3				3	1		
19-Sep-97	G5	2															1		5	
19-Sep-97	G5	3								2			3				0		2	
19-Sep-97	G5	4									1		3				5		2	
19-Sep-97	G5	5								1	2		3				4		3	
19-Sep-97	G5	6										1	1				6	34	14	
16-Sep-97	T1	1								1							2	3	4	
16-Sep-97	T1	2				1							1				1	1		
16-Sep-97	T1	3				3							3				2		2	
16-Sep-97	T1	4			1	5				3	1		4				6		1	1
16-Sep-97	T1	5		1		11				10	1	2	10	1			14	1	2	
16-Sep-97	T1	6				1				2			4				36	7	25	
19-Sep-97	T2	1			1	3				5				4			7	1	3	
19-Sep-97	T2	2				10							6	1			13	3	9	
19-Sep-97	T2	3				2						1		1			17	2	1	
19-Sep-97	T2	4				10								1			4	2		
19-Sep-97	T2	5				1											11		3	
19-Sep-97	T2	6				6						1	5	2			1	3		
																	14	1	3	

Appendix 2 Table 2. Sample coun

Species codes are de

Date	Site	Replicate	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
16-Sep-83	T1	1	84																	1
16-Sep-83	T1	2	0																	
16-Sep-83	T1	3	3																	
16-Sep-83	T1	4	51																2	
16-Sep-83	T1	5	35																	
16-Sep-83	T1	6	25																	
23-Sep-83	T2	1	5																	
23-Sep-83	T2	2	0																	
23-Sep-83	T2	3	5																3	
23-Sep-83	T2	4	5																4	
23-Sep-83	T2	5	8																	
23-Sep-83	T2	6	7																1	
16-Sep-83	G2	1	68																	
16-Sep-83	G2	2	11																	
16-Sep-83	G2	3	16																	
16-Sep-83	G2	4	14																	
16-Sep-83	G2	5	87																	
16-Sep-83	G2	6	101																	
16-Sep-83	G5	1	21																	
16-Sep-83	G5	2	24																	
16-Sep-83	G5	3	12																	
16-Sep-83	G5	4	21																	
16-Sep-83	G5	5	17																	
16-Sep-83	G5	6	31																	
12-Sep-84	T1	1	182																	
12-Sep-84	T1	2	57																	
12-Sep-84	T1	3	7																	
12-Sep-84	T1	4	9																	
12-Sep-84	T1	5	17																	
12-Sep-84	T1	6	13																	
28-Sep-84	T2	1	2																	
28-Sep-84	T2	2	2																	
28-Sep-84	T2	3	2																1	
28-Sep-84	T2	4	3																	
28-Sep-84	T2	5	8																1	
28-Sep-84	T2	6	1																	
28-Sep-84	G2	1	6																	
28-Sep-84	G2	2	2																	
28-Sep-84	G2	3	4																	
28-Sep-84	G2	4	3																1	
28-Sep-84	G2	5	1																	
28-Sep-84	G2	6	4																	
20-Sep-84	G5	1	5																	
20-Sep-84	G5	2	5																	1
20-Sep-84	G5	3	1																	
20-Sep-84	G5	4	6																	1
20-Sep-84	G5	5	11																	
20-Sep-84	G5	6	4																	1
18-Sep-97	G2	1	1	1		1		1	1						1					
18-Sep-97	G2	2	1																	
18-Sep-97	G2	3	0						3											
18-Sep-97	G2	4	3			1			1		1									1
18-Sep-97	G2	5	3						1		6									
18-Sep-97	G2	6	1			1			3											
19-Sep-97	G5	1	5				1	2	1		11			1	7					
19-Sep-97	G5	2	2			1					2									
19-Sep-97	G5	3	2						2											
19-Sep-97	G5	4	3								2								1	
19-Sep-97	G5	5	48			5		5	13	1	19	1	1		11					
19-Sep-97	G5	6	7					1	4	1	3	2			2					
16-Sep-97	T1	1	1						2		1				1					
16-Sep-97	T1	2	2						2		1						1			
16-Sep-97	T1	3	2						1		4				2					
16-Sep-97	T1	4	3			6			5		8									
16-Sep-97	T1	5	32	1		2		1	7		27				1				2	1
16-Sep-97	T1	6	4			1		1	2		2				1	4		1		
19-Sep-97	T2	1	12					1	6		24				1	1		3		
19-Sep-97	T2	2	3					1	1		11				5				2	
19-Sep-97	T2	3	2						2		2									
19-Sep-97	T2	4	3								12					1				
19-Sep-97	T2	5	3						1											
19-Sep-97	T2	6	4								1				2	2			1	

Appendix 2 Table 2. Sample coun

Species codes are de

Date	Site	Replicate	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
16-Sep-83	T1	1							2											
16-Sep-83	T1	2																		
16-Sep-83	T1	3																		
16-Sep-83	T1	4							2		2									
16-Sep-83	T1	5			2				2		1									
16-Sep-83	T1	6																		
23-Sep-83	T2	1			1															
23-Sep-83	T2	2			3				2											
23-Sep-83	T2	3			2															
23-Sep-83	T2	4			1															
23-Sep-83	T2	5			1							1								
23-Sep-83	T2	6																		
16-Sep-83	G2	1			3													6		
16-Sep-83	G2	2			1				2									1		
16-Sep-83	G2	3																		
16-Sep-83	G2	4																1		
16-Sep-83	G2	5			1				1											
16-Sep-83	G2	6																		
16-Sep-83	G5	1			4															
16-Sep-83	G5	2			5				1											
16-Sep-83	G5	3			4															
16-Sep-83	G5	4			4				1									3		
16-Sep-83	G5	5			4															
16-Sep-83	G5	6	1		5															
12-Sep-84	T1	1							1											
12-Sep-84	T1	2							1										1	
12-Sep-84	T1	3																		
12-Sep-84	T1	4																		
12-Sep-84	T1	5							1											
12-Sep-84	T1	6																		
28-Sep-84	T2	1																		
28-Sep-84	T2	2																		
28-Sep-84	T2	3							5											
28-Sep-84	T2	4																		
28-Sep-84	T2	5																		
28-Sep-84	T2	6																		
28-Sep-84	G2	1																		
28-Sep-84	G2	2																		
28-Sep-84	G2	3																		
28-Sep-84	G2	4																		
28-Sep-84	G2	5																		
28-Sep-84	G2	6																		
20-Sep-84	G5	1			2													1		
20-Sep-84	G5	2			1															
20-Sep-84	G5	3			2															
20-Sep-84	G5	4														1				
20-Sep-84	G5	5																		
20-Sep-84	G5	6	1						2											
18-Sep-97	G2	1																		
18-Sep-97	G2	2																		
18-Sep-97	G2	3																		
18-Sep-97	G2	4		1																
18-Sep-97	G2	5						1					1							
18-Sep-97	G2	6																	7	
19-Sep-97	G5	1						1												
19-Sep-97	G5	2																		1
19-Sep-97	G5	3																		
19-Sep-97	G5	4						1												
19-Sep-97	G5	5																		1
19-Sep-97	G5	6																		1
16-Sep-97	T1	1															1			
16-Sep-97	T1	2																		
16-Sep-97	T1	3																		1
16-Sep-97	T1	4						2												
16-Sep-97	T1	5		4																1
16-Sep-97	T1	6		1				1										-		
19-Sep-97	T2	1		3				1												2
19-Sep-97	T2	2																		1
19-Sep-97	T2	3																		
19-Sep-97	T2	4																		
19-Sep-97	T2	5																		
19-Sep-97	T2	6					1													

Appendix 2 Table 2. Sample coun

Species codes are de

Date	Site	Replicate	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108
16-Sep-83	T1	1							2											
16-Sep-83	T1	2																		
16-Sep-83	T1	3																		
16-Sep-83	T1	4																		
16-Sep-83	T1	5		1																
23-Sep-83	T2	6		1			1													
23-Sep-83	T2	1						2	8											
23-Sep-83	T2	2						1	8											
23-Sep-83	T2	3		1					1											
23-Sep-83	T2	4							1											
23-Sep-83	T2	5							6											
16-Sep-83	G2	6							5											
16-Sep-83	G2	1							5											
16-Sep-83	G2	2		2					2											
16-Sep-83	G2	3							1											
16-Sep-83	G2	4							11											
16-Sep-83	G2	5		1					4											
16-Sep-83	G5	6															1			
16-Sep-83	G5	1							2									1		
16-Sep-83	G5	2							2											
16-Sep-83	G5	3		1									1							
16-Sep-83	G5	4							4						1					
16-Sep-83	G5	5		1					7											
12-Sep-84	T1	6							4											
12-Sep-84	T1	1		2					9											
12-Sep-84	T1	2							4											
12-Sep-84	T1	3						1	7											
12-Sep-84	T1	4						1	2											
12-Sep-84	T1	5							3											
28-Sep-84	T2	6		2																
28-Sep-84	T2	1																		
28-Sep-84	T2	2							3											
28-Sep-84	T2	3		1																
28-Sep-84	T2	4		2																
28-Sep-84	T2	5		1																
28-Sep-84	G2	6						1	1											
28-Sep-84	G2	1							9											
28-Sep-84	G2	2							1											
28-Sep-84	G2	3							1											
28-Sep-84	G2	4					3													
28-Sep-84	G2	5							3											
28-Sep-84	G2	6						1	1											
20-Sep-84	G5	1					1		2			2								
20-Sep-84	G5	2																		
20-Sep-84	G5	3																		
20-Sep-84	G5	4		3					3											
20-Sep-84	G5	5							1											
18-Sep-97	G2	6		1					5				1							
18-Sep-97	G2	1	1						1					1						
18-Sep-97	G2	2							1											
18-Sep-97	G2	3							2	2										
18-Sep-97	G2	4		1					6											
18-Sep-97	G2	5		2																
19-Sep-97	G5	6		5					4											
19-Sep-97	G5	1							6											
19-Sep-97	G5	2							14											
19-Sep-97	G5	3		1					11											
19-Sep-97	G5	4							24											
19-Sep-97	G5	5	1	2					5											
19-Sep-97	G5	6							2											
16-Sep-97	T1	1							6											
16-Sep-97	T1	2							58											
16-Sep-97	T1	3		1					14						1					
16-Sep-97	T1	4		4					5								1			
16-Sep-97	T1	5							5				1							
19-Sep-97	T2	6			1				12											
19-Sep-97	T2	1			5				22									1		
19-Sep-97	T2	2			3				51											
19-Sep-97	T2	3							17											
19-Sep-97	T2	4							42										1	
19-Sep-97	T2	5							21											
19-Sep-97	T2	6							4											
									13										1	
									1									1		
									7											

Appendix 2 Table 2. Sample coun

Species codes are de

Date	Site	Replicate	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124
16-Sep-83	T1	1						1										
16-Sep-83	T1	2				1												
16-Sep-83	T1	3				1												
16-Sep-83	T1	4				5		1										
16-Sep-83	T1	5				3		1										
16-Sep-83	T1	6														1		
23-Sep-83	T2	1																
23-Sep-83	T2	2																
23-Sep-83	T2	3														1		
23-Sep-83	T2	4																
23-Sep-83	T2	5				2										1		
23-Sep-83	T2	6																
16-Sep-83	G2	1						1								3		
16-Sep-83	G2	2				3												
16-Sep-83	G2	3																
16-Sep-83	G2	4				3												
16-Sep-83	G2	5						3										
16-Sep-83	G2	6				1												
16-Sep-83	G5	1				5												
16-Sep-83	G5	2				2												
16-Sep-83	G5	3				3		2										
16-Sep-83	G5	4				7												
16-Sep-83	G5	5																
16-Sep-83	G5	6												2				
12-Sep-84	T1	1				1		1										
12-Sep-84	T1	2																
12-Sep-84	T1	3				1		1										
12-Sep-84	T1	4				4		1										
12-Sep-84	T1	5				6		1										
12-Sep-84	T1	6				4												
28-Sep-84	T2	1																
28-Sep-84	T2	2				4												
28-Sep-84	T2	3						1										
28-Sep-84	T2	4				5												
28-Sep-84	T2	5																
28-Sep-84	T2	6				5		2										
28-Sep-84	G2	1				2		2										
28-Sep-84	G2	2				2		1										
28-Sep-84	G2	3				1												
28-Sep-84	G2	4				6		1										
28-Sep-84	G2	5				1		1										
28-Sep-84	G2	6				2		3										
20-Sep-84	G5	1						5										
20-Sep-84	G5	2		1		10												
20-Sep-84	G5	3				2												
20-Sep-84	G5	4				11												
20-Sep-84	G5	5				17												
20-Sep-84	G5	6				6												
18-Sep-97	G2	1																
18-Sep-97	G2	2															1	
18-Sep-97	G2	3															2	
18-Sep-97	G2	4							3								5	
18-Sep-97	G2	5			2				1						1			1
18-Sep-97	G2	6															1	
19-Sep-97	G5	1	1		2			2									2	
19-Sep-97	G5	2															2	
19-Sep-97	G5	3						1				1					11	
19-Sep-97	G5	4																
19-Sep-97	G5	5			2				2	1	1				1		4	
19-Sep-97	G5	6			1												1	
16-Sep-97	T1	1															1	2
16-Sep-97	T1	2															2	
16-Sep-97	T1	3										1					5	
16-Sep-97	T1	4															1	
16-Sep-97	T1	5	1							2		3					13	1
16-Sep-97	T1	6						1		1							1	
19-Sep-97	T2	1			3			1	2	2		1	1				3	1
19-Sep-97	T2	2							1			1					8	2
19-Sep-97	T2	3		1													1	
19-Sep-97	T2	4							2									1
19-Sep-97	T2	5							1									
19-Sep-97	T2	6			1												3	4

Appendix 3 Table 1. Site locations, length sampled, method and date of sampling, 1997.

SYSTEM	SITE	LENGTH (m)	REACH	METHOD	DATE
TENAS	T1	83	1	3-pass	Sep-16
	T2	67	1	3-pass	Sep-20
	T4	33	1	2-pass	Sep-19
	T3	44	2	2-pass	Sep-17
West Fork	T6	24	3	2-pass	Sep-18
East Fork	T5	33	1	2-pass	Sep-18
Trib TN31	T7	70	2	1-pass	Oct-14
GOATHORN	G1	62	1	3-pass	Sep-22
	G2	70	2	2-pass	Sep-15
	G3	45	2	3-pass	Oct-30
	G4	68	2	3-pass	Sep-27
Crossing site	G4a	45	2	1-pass	Nov-04
Crossing site	G4b		2	Habitat card only.	Nov-03
	G5	53	2	3-pass	Oct-24
	G8	37	3	2-pass	Sep-24
Cabinet	G6a	25	1	2-pass	Sep-24
	G7	28	1	2-pass	Sep-25
	G9	23	2	2-pass	Sep-25
Webster	G10	21	1	2-pass	Sep-27
Four	F1	15	2	2-pass	Sep-29
	F2	20	2	2-pass	Sep-29
	F3		2	Habitat card only.	Oct-14
	F4	10	3	1-pass, spot shocked.	Oct-01
	F5	30	4	2-pass	Oct-08
	F6		5	Habitat card only.	Oct-14
	F7	75	6	1-pass, spot shocked.	Oct-08
Four Trib FT1	F8	45	2	1-pass	Oct-22
Four Trib FT2	F9		1	Habitat card only.	Oct-14
	F10	70	1	1-pass, spot shocked.	Oct-08
TELKWA	SC1	76	1	2-pass	Sep-30
	SC2	54	1	3-pass	Oct-01
	SC3	25	1	2-pass	Oct-03
Bridge Site	SC4	33	1	3-pass	Oct-21
	MS1	23	1	2-pass	Oct-09
	MS2	20	1	2-pass	Oct-09
	MS3	16	1	2-pass	Oct-09
	MS4	21	1	2-pass	Oct-09
	MS5	33	1	2-pass	Oct-03
	MS6	17	1	2-pass	Oct-03
	MS7	22	1	2-pass	Oct-03
Bridge Site	MS8	19	1	2-pass	Oct-21
Bridge Site	MS9		1	Habitat card only.	Nov-01
	WL1		1	Minnow Trap - 10	Nov-3-4
BULKLEY R.	B1	20	6	2-pass	Oct-02
	B2	23	6	2-pass	Oct-02
	B3	22	6	2-pass	Oct-02
	B4	21	6	2-pass	Oct-02

Appendix 3 Table 1. Site locations, length sampled, method and date of sampling, 1997.

HUBERT	HUB1		1	Minnow Trap - 12	Aug 12-14
	HUB2		1	Minnow Trap - 12	Aug 12-14
	HUB3		1	Minnow Trap - 12	Aug 12-14
	HUB4		1	Minnow Trap - 20	Oct 15-16
	HUB6	38	2	2-pass	Aug-09
	HUB8	30	3	2-pass	Sep-22
	HUB9	30	4	2-pass	Aug-07
	HUB10	35	4	2-pass	Sep-07
Trib HT1	HUB5		1	Habitat card only.	Nov-13
HELPS	H1	30	2	2-pass	Aug-17
	H2	33	2	2-pass	Aug-07
	H3	33	2	2-pass	Aug-07
	H4	37	3	2-pass	Aug-07
	H7	33	3	2-pass	Aug-09
	H9	35	4	2-pass	Aug-07
Trib HP1	H3a	30	1	2-pass	Aug-07
Trib HP3	H6a		1	Habitat card only.	Aug-08
Trib HP4	H11a		1	Habitat card only.	Aug-09
Trib HP4	H11	40	2	1-pass	Aug-07

Appendix 4 Table 1. Summary of habitat features for Goathorn and Tenas creek reaches.

Reach	Slope	Length	Width (m)		Area	Bed Material (cm)		Comment
	(%)	(m)	Wetted	Channel	Wetted	D50	D90	
Mainstem Goathorn								
1	2.8	1140	10.5	20.1	11970	11	28	Riffle-pool $_c$
2	2.5	9130	12.3	33.4	112299	11	26	Cascade-pool $_c$
3	2.2	3186	5.6	10.2	17842	9	18	Cascade-pool $_c$
4	5.6	3000	4.7	6.9	14100		66	Step-pool $_b$
5	1.3	2330						Riffle-pool $_g$
Cabinet Creek								
1	2.2	3360	8.6	19.2	28896	15	40	Riffle-pool $_c$
2	7.8	1500	5.5	6.7	8250	15	33	Step-pool $_b$
3&4	13.7	2000						
Webster Creek								
1	2.8	3500	7.8	8.4	27300	12	40	Cascade-pool $_b$
2	3.4	4.2	12.6				35	Riffle-pool $_c$
Tenas Creek								
1	1.8	9000	7.8	9.8	70200	16	29	Riffle-pool $_c$
2	3	4400	5.7	10.8	25080	24	40	Riffle-pool $_c$
West Fork 3	3	2100	4.4	8.4	9240	7	28	Riffle-pool $_c$
4	7.8	1800						Step-pool $_b$
East Fork 1	4.5	2000	4.5	12.5	9000	16	40	Cascade-pool $_b$
2	10	1000						Step-pool $_r$

Appendix 5. DFO/MOE Stream Summary Forms for all 1997 sample sites.

DFO / MOE
STREAM SURVEY FORM

Stream Name	(gaz) Goathorn Creek	(local) Goathorn Creek		Access	V2 Method
Watershed Code	460-4227-096	ReachNo.	1	Lngth(km)	1.2
Location	Upper net 110 m below PNG crossing.	Map # 093L065	SiteNo. G1	LthSurv(m)	62
		U.T.M.	FishCard (Y) N	Field X	Hist.
Date Y.M.D	970922	Time 1000	Agency C87	Crew RD/CP/GM	Photos B3/15, 16 AirPhotos

PARAMETER	VALUE	METH	SPECIFIC DATA
Ave. Chan. Width (m)	20.1		24.9, 17.1, 16.9, 18.4, 20.5, 22.5
Ave. Wet. Width (m)	10.5		12.0, 10.7, 9.5, 9.8, 10.0, 10.9
Ave.Max.Riffle Depth (cm)	54		42, 85, 35
Ave.Max.Pool Depth (cm)	45		41, 48, 47
Gradient %	1.5-2.0		
% Pool 5, Riffle 40, Run 45, Other 10		FLATS	
Side Chan.%	0 X, 0-10, 10-40, >40		
Debris Area%	0, 0-5, 5-15 X, >15		
Debris Stable%	15		
COVER: Total%	70		
Comp. sum 100	Dp.Pool 10, L.O.D. 10, Boulder 80, InVeg, OverVeg, Cutbank		
Crown Closure %	5	Aspect	

BED MATERIAL		%
Fines	clay,silt,sand (<2mm)	5
Gravels	small (2-16mm)	10
	large (16-64mm)	10
Larges	sm. cobble (64-128mm)	15
	lge. cobble (128-256mm)	25
	boulder(>256mm)	35
Bedrock		
D90(cm) 50	Compaction	L (M) H
/50	18	

BANKS	
Height(m)	1.7
%Unstable	0
Texture	(F) (G) L R
Confinement	EN CO FC OC (UC) N/A
Valley:Channel Ratio	0-2 2-5 5-10 (10+) N/A
Stage	Dry L (M) (H) Flood
Flood Signs Ht(m)	1.2
Braided	Y (N)
Bars (%)	30
pH	7.5
O_2 (ppm)	
WaterTemp(C)	6.0
Turb(cm)	cl
Cond(25C)	100

OBSTRUCTIONS C	Ht(m)	Type	Loc'n

DISCHARGE

Parameter	Value	Method	Specific Data
Wetted Width (m)			Creek discharge is at medium to high flows.
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL (Fish)

(Width Valley/Channel, Slope) BedMaterial

FISH SUMMARY

C	Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
	SST	139	28-53	F	R	EF
	SST	24	75-143	J	R	EF
	CHAR	6	47-53	F	R	EF
	BT	3	103-200	J	R	EF
	DV	1	113	J	R	EF
	MW	13	108-178	J	R	EF

All char fry were identified as BT with the exception of 2 which were DV.

STREAM/VALLEY CROSS-SECTION
(Looking Downstream)
L R

PLANIMETRIC VIEW

COMMENTS

Channel Stability ☐ Debris ☐ Management Concerns ☐ Obstructions ☐ Riparian Zone ☐ Valley Wall Processes ☐ Etc.

Site consists of riffle-run habitat with some flats along the margins. Bed material is mainly boulder and cobble.

Difficult to hold nets in due to high flows and the large number of leaves flowing into the net.

Edited by: CP
Date Y M D 97/11/26

DFO / MOE
STREAM SURVEY FORM

Stream Name	(gaz) Goathorn Creek	(local) Goathorn Creek	Access	V2	Method
Watershed Code	460-4227-096	ReachNo.	2	Lngth(km)	9.1
Location	Above lower crossing; lower net at Water Survey Site.	Map # 093L065	SiteNo. G2	LthSurv(m)	70
		U.T.M.	FishCard (Y) N	Field X	Hist.
Date Y.M.D	9 7 0 9 1 5	Time 1020	Agency C87	Crew DB/CP/GM	Photos B3/1, 2
AirPhotos					

PARAMETER	VALUE	METH	SPECIFIC DATA
Ave. Chan. Width (m)	14.8		12.7, 12.5, 13.4, 15.2, 16.7, 17.1, 16.2
Ave. Wet. Width (m)	13.3		12.7, 12.0, 13.4, 14.2, 13.0, 13.5, 14.0
Ave.Max.Riffle Depth (cm)	47		50, 40, 45, 45, 65, 45, 40
Ave.Max.Pool Depth (cm)	na		
Gradient %	2.5		
% Pool — Riffle 95, Run 5, Other			
Side Chan.%	0 ☐ 0-10 ☒ 10-40 ☐ >40 ☐		
Area%	0 ☐ 0-5 ☒ 5-15 ☐ >15 ☐		
Debris — Stable%	50		
COVER: Total%	50		
Crown Closure %	<5		Aspect

Comp. sum 100	Dp.Pool	L.O.D.	Boulder	InVeg	OverVeg	Cutbank
	0	0	80	5	0	5

BED MATERIAL		%
Fines	clay,silt,sand (<2mm)	
Gravels	small (2-16mm)	10
	large (16-64mm)	10
Larges	sm. cobble (64-128mm)	30
	lge. cobble (128-256mm)	30
	boulder(>256mm)	20
Bedrock		
D90(cm)	40	Compaction L (M) H

BANKS			
Height(m)	4.0	%Unstable	25
Texture	F (G) (L) R		
Confinement	EN CO (FC) OC UC N/A		
Valley:Channel Ratio	(0-2) 2-5 5-10 10+ N/A		
Stage	Dry L (M) (H) Flood		
Flood Signs Ht(m)	1.5	Braided	Y (N)
Bars (%)	10	pH 7.6	O_2 (ppm)
WaterTemp(C)	7.0	Turb(cm) ~35	Cond(25C) 100

OBSTRUCTIONS: Ht(m) | Type | Loc'n — (none recorded)

DISCHARGE
/50 10

Parameter	Value	Method	Specific Data
Wetted Width (m)			Estimated 8-10 m^3/s discharge.
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL (Fish)

(Width Valley/Channel,Slope) BedMaterial

FISH SUMMARY

Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
SST	118	30-44	F	R	EF
SST	24	73-146	J	R	EF
CHAR	4	50-55	F	R	EF
BT	5	84-146	J	R	EF
DV	1	105	J	R	EF

STREAM/VALLEY CROSS-SECTION (Looking Downstream) ☐

PLANIMETRIC VIEW ☐

L R

COMMENTS

Channel Stability ☐ Debris ☐ Management Concerns ☐ Obstructions ☐ Riparian Zone ☐ Valley Wall Processes ☐ Etc.

Difficult to hold in nets due to the high flows. Upper net partially blew out at the end of the 2nd pass. Difficult to remove fish in fast water.

Heavy rain for 2-3 days prior to sampling resulted in medium to high flows.

Edited by: CP
Date Y M D 97/11/26

DFO / MOE
STREAM SURVEY FORM

Stream Name	(gaz) Goathorn Creek	(local) Goathorn Creek	Access: ATV	Method
Watershed Code	460-4227-096	ReachNo. 2	Lngth(km) 9.1
Location	Drove down old road to Goathorn C. Top of site located at the end of the road.	Map # 093L065	SiteNo. G3	LthSurv(m) 44.5
		U.T.M.	FishCard (Y) N	C	Field X	Hist.
Date Y.M.D	9 7 1 0 3 0	Time 1000	Agency C87	Crew RD/CP/DA	Photos A5/11, 12	AirPhotos

PARAMETER	VALUE	METH	SPECIFIC DATA
Ave. Chan. Width (m)	50		
Ave. Wet. Width (m)	12.4		14.0, 13.7, 13.5, 11.7, 9.2
Ave.Max.Riffle Depth (cm)	40		40, 44, 35
Ave.Max.Pool Depth (cm)	na		
Gradient %	2		
% Pool: — Riffle: 90 Run: 10 Other: —			
Side Chan.%	0 X 0-10 ☐ 10-40 ☐ >40 ☐		
Debris Area%	0 ☐ 0-5 X 5-15 ☐ >15 ☐		
Debris Stable%	40		
COVER: Total%	70		
Crown Closure %	<5		Aspect

Cover Composition (sum 100)

Dp.Pool	L.O.D.	Boulder	InVeg	OverVeg	Cutbank
0	5	80	0	5	10

BED MATERIAL

Class	Size	%
Fines	clay,silt,sand (<2mm)	5
Gravels	small (2-16mm)	15
Gravels	large (16-64mm)	
Larges	sm. cobble (64-128mm)	15
Larges	lge. cobble (128-256mm)	30
Larges	boulder(>256mm)	35
Bedrock		
D90(cm)	32	Compaction L (M) H
D/50	14	

BANKS

Height(m)	3.0
%Unstable	0
Texture	(F) (G) L R
Confinement	EN CO FC (OC) UC N/A
Valley:Channel Ratio	0-2 2-5 (5-10) 10+ N/A
Stage	Dry L (M) H Flood
Flood Signs Ht(m)	1.4
Braided	Y (N)
Bars (%)	40
pH	nr
O_2 (ppm)	
WaterTemp(C)	3.0
Turb(cm)	ta
Cond(25C)	nr

OBSTRUCTIONS

C	Ht(m)	Type	Loc'n

DISCHARGE

Parameter	Value	Method	Specific Data
Wetted Width (m)			Water levels are moderate.
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL (Fish)

(Width:Valley/Channel,Slope) BedMaterial

FISH SUMMARY

C	Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
	SST	18	39-51	F	R	EF
	SST	9	100-132	J	R	EF
	CHAR	20	46-58	F	R	EF
	BT	7	92-124	J	R	EF
	DV	2	77-103	J	R	EF

Char fry were identified as BT with the exception of 5 fry which were DV.

STREAM/VALLEY CROSS-SECTION (Looking Downstream)

L R

PLANIMETRIC VIEW

COMMENTS

Channel Stability ☐ Debris ☐ Management Concerns ☐ Obstructions ☐ Riparian Zone ☐ Valley Wall Processes ☐ Etc.

Water is slightly tannic in colour.

Primarily fast boulder-riffle habitat - good for parr rearing. Some good fry habitat is present along the margins.

Difficult site to sample. Nets had to be constantly cleaned due to the continual build up of leaves.

Edited by: CP

Date Y M D 97/11/26

DFO / MOE
STREAM SURVEY FORM

Stream Name	(gaz) Goathorn Creek	(local) Goathorn Creek		Access	V2 Method
Watershed Code	460-4227-096		ReachNo. 2	Lngth(km)	9.1
Location	~400 m u/s from old coal mine site.	Map # 093L065	SiteNo. G4	LthSurv(m)	68
		U.T.M.	FishCard (Y) N	Field X	Hist. ☐
Date Y.M.D	9 7 0 9 2 7	Time 1000	Agency C87	Crew DB/CP/IF	Photos B4/3, 4 AirPhotos

PARAMETER	VALUE	METH	SPECIFIC DATA
Ave. Chan. Width (m)	26.1		31.6, 31.0, 25.9, 19.3, 20.2, 28.5
Ave. Wet. Width (m)	12.1		11.0, 16.9, 15.8, 5.8, 10.9, 11.9
Ave.Max.Riffle Depth (cm)	35		34, 35, 36
Ave.Max.Pool Depth (cm)	50		33, 67
Gradient %	3		
% Pool 5 / Riffle 75 / Run 20 / Other			
Side Chan.%	0 ☐ 0-10 ☐ 10-40 X >40 ☐		
Debris Area%	0 ☐ 0-5 ☐ 5-15 X >15 ☐		
Debris Stable%	20		
COVER: Total%	70		
Comp. sum 100	Dp.Pool 15, L.O.D. 20, Boulder 60, InVeg, OverVeg 5, Cutbank		
Crown Closure %	<2		Aspect

OBSTRUCTIONS

Ht(m)	Type	Loc'n

BED MATERIAL

		%
Fines	clay,silt,sand (<2mm)	
Gravels	small (2-16mm)	5
	large (16-64mm)	5
Larges	sm. cobble (64-128mm)	25
	lge. cobble (128-256mm)	40
	boulder(>256mm)	25
Bedrock		
D90(cm)	35	Compaction L (M) H

BANKS

Height(m)	1.5 %Unstable 35
Texture	(F) (G) L R
Confinement	EN CO (FC) OC UC N/A
Valley:Channel Ratio	(0-2) 2-5 5-10 10+ N/A
Stage	Dry L (M) H Flood
Flood Signs Ht(m)	1.4 Braided Y (N)
Bars (%)	40 pH 7.2 O_2(ppm)
WaterTemp(C)	6.0 Turb(cm) cl Cond(25C) 90

DISCHARGE

Parameter	Value	Method	Specific Data
Wetted Width (m)			Estimated 20 c.f.s. discharge.
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL (Fish)

(Width:Valley/Channel,Slope) BedMaterial

FISH SUMMARY

Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
SST	67	32-51	F	R	EF
SST	9	101-141	J	R	EF
CHAR	51	38-62	F	R	EF
BT	17	80-126	J	R	EF
DV	6	73-126	J	R	EF

All char fry were identified as BT with the exception of 5 fry which were DV.

STREAM/VALLEY CROSS-SECTION ☐ (Looking Downstream)

L R

PLANIMETRIC VIEW ☐

COMMENTS

Channel Stability X Debris X Management Concerns ☐ Obstructions ☐ Riparian Zone ☐ Valley Wall Processes ☐ Etc.

Dynamic creek; LOD within channel.

Complex site: good fry rearing along the margins, boulder/cobble and run/pool areas provide good cover for parr.

Unstable bank on R. left at the top of the site.

Same site as 1984.

Difficult to sample due to the build up of leaves in the net; nets had to be continually cleaned to prevent them from blowing out.

Edited by CP

Date Y M D 97/11/26

DFO / MOE
STREAM SURVEY FORM

Stream Name	(gaz) Goathorn Creek	(local) Goathorn Creek		Access	V2 Method
Watershed Code	460-4227-096		ReachNo. 2	Lngth(km)	9.1
Location	Goathorn Creek river right side channel at proposed bridge crossing.	Map # 093L065	SiteNo. G4a	LthSurv(m)	45
		U.T.M.	FishCard Y (N)	C	Field X Hist.
Date Y.M.D	9 7 1 1 0 4	Time 1212	Agency C87	Crew RD/DA	Photos A5/22, 23 AirPhotos

C	PARAMETER	VALUE	METH	SPECIFIC DATA
	Ave. Chan. Width (m)	6.8		6.8, 4.2, 8.3, 7.9
	Ave. Wet. Width (m)	2.5		2.3, 3.7, 1.1, 2.7
	Ave.Max.Riffle Depth (cm)	<5		
	Ave.Max.Pool Depth (cm)	35		
	Gradient %	1.5		
	% Pool 90	Riffle 10	Run	Other
	Side Chan.%	0 ☐ 0-10 ☐ 10-40 ☐ >40 ☐		
	Debris Area%	0 ☐ 0-5 ☐ 5-15 X >15 ☐		
	Debris Stable%	50		
	COVER: Total%	20		
	Crown Closure %	5		Aspect

Comp. sum 100	Dp.Pool	L.O.D.	Boulder	InVeg	OverVeg	Cutbank
	80	0	15	0	5	0

BED MATERIAL

C			%
	Fines	clay,silt,sand (<2mm)	20
	Gravels	small (2-16mm)	15
		large (16-64mm)	20
		sm. cobble (64-128mm)	25
	Larges	lge. cobble (128-256mm)	15
		boulder(>256mm)	5
	Bedrock		
	D90(cm) 22	C Compaction	L (M) H
	/50	10	

BANKS

C		
	Height(m) 0.5	%Unstable 30
	Texture	(F) G L R
	Confinement	EN CO FC OC (UC) N/A
	Valley:Channel Ratio	0-2 2-5 5-10 (10+) N/A
	Stage	(Dry) (L) M H Flood
	Flood Signs Ht(m)	Braided Y (N)
	Bars (%) nr	pH nr O$_2$(ppm)
	WaterTemp(C) 2.0	Turb(cm) cl Cond(25C) nr

OBSTRUCTIONS

C	Ht(m)	Type	Loc'n

DISCHARGE

Parameter	Value	Method	Specific Data
Wetted Width (m)			Estimated 0.5 c.f.s. discharge.
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL
(Fish)

(Width:Valley/Channel,Slope) BedMaterial

FISH SUMMARY

C	Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
	Sampled upper 45 m of a 420 m long side channel at					
	proposed bridge crossing.					
			NO CATCH.			

STREAM/VALLEY CROSS-SECTION
(Looking Downstream)

L R

PLANIMETRIC VIEW

COMMENTS

Channel Stability ☐ Debris X Management Concerns ☐ Obstructions X Riparian Zone ☐ Valley Wall Processes ☐ Etc.

Below 45 m section sampled, channel is dewatered; suspect this side channel is seasonally wetted.

Numerous old beaver dams are present d/s of sample site and discharge is a trickle flow in the lower 20 m of channel flowing into m/s Goathorn C.

Edited by: CP
Date Y M D 97/11/26

DFO / MOE
STREAM SURVEY FORM

Stream Name	(gaz) Goathorn Creek	(local) Goathorn Creek		Access	FT	Method
Watershed Code	460-4227-096		ReachNo. 2	Lngth(km)	9.1
Location	Proposed bridge crossing site. ~100 m d/s from Four C. confluence.	Map # 093L065	SiteNo. G4b	LthSurv(m)	100
		U.T.M.	FishCard Y (N)	C	Field ☒ Hist. ☐
Date Y.M.D	9 7 1 1 0 3	Time 1300	Agency C87	Crew RD	Photos A5/13-17	AirPhotos

C	PARAMETER	VALUE	METH	SPECIFIC DATA
	Ave. Chan. Width (m)	40		34, 42, 45
	Ave. Wet. Width (m)	11.5		11, 12
	Ave.Max.Riffle Depth (cm)	30		
	Ave.Max.Pool Depth (cm)	70		
	Gradient %	2		
	% Pool 25	Riffle 60	Run 15	Other
	Side Chan.%	0 ☐ 0-10 ☒ 10-40 ☐ >40 ☐		
	Debris Area%	0 ☐ 0-5 ☒ 5-15 ☐ >15 ☐		
	Debris Stable%	40		
	COVER: Total%	60		
	Comp. sum 100	Dp.Pool 30	L.O.D. 15	Boulder 50 · InVeg · OverVeg · Cutbank 5
	Crown Closure %	<5		C Aspect

OBSTRUCTIONS

C	Ht(m)	Type	Loc'n

C	BED MATERIAL		%
	Fines	clay,silt,sand (<2mm)	10
	Gravels	small (2-16mm)	15
		large (16-64mm)	
		sm. cobble (64-128mm)	35
	Larges	lge. cobble (128-256mm)	25
		boulder(>256mm)	15
	Bedrock		
	D90(cm) 28	C Compaction	L (M) H

C	BANKS			
	Height(m)	1.5	%Unstable	10
	Texture	(F) (G) L R		
	Confinement	EN CO FC (OC) UC N/A		
	Valley:Channel Ratio	0-2 2-5 5-(10) 10+ N/A		
	Stage	Dry (L) M H Flood		
	Flood Signs Ht(m)	1.1	Braided	Y (N)
	Bars (%)	70	pH nr	O_2(ppm)
	WaterTemp(C)	nr	Turb(cm) cl	Cond(25C) nr

DISCHARGE /50 8

Parameter	Value	Method	Specific Data
Wetted Width (m)			Creek at moderate flows.
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL
(Fish)
(Width Valley/Channel,Slope) BedMaterial

FISH SUMMARY

C	Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
			NOT SAMPLED.			

STREAM/VALLEY CROSS-SECTION ☐
(Looking Downstream)
L R

PLANIMETRIC VIEW ☐

SEE HAND DRAWN MAP.

COMMENTS

Channel Stability ☒ Debris ☐ Management Concerns ☒ Obstructions ☐ Riparian Zone ☐ Valley Wall Processes ☐ Etc.

Photos: A5/ 15 - river left unstable bank (50 m long, 20-25 m high) at lower end of bridge crossing site.
16 - river left flood channel at bridge crossing site.
17 - river right seepage channel at bridge crossing site.

There are 2 flood channels on river left bridge crossing site with channel widths of 2 m and 3 m respectively. Both were dry at the time of survey.

The river right seepage channel has a channel width of 4-5 m with a gravel bed and trickle flow discharge.

Proposed crossing site appears to be an active area of lateral channel movement.

Edited by CP
Date Y M D 97/11/26

DFO / MOE
STREAM SURVEY FORM

Stream Name	(gaz) Goathorn Creek	(local) Goathorn Creek		Access	V2	Method
Watershed Code	460-4227-096		ReachNo.	2	Lngth(km)	9.1
Location	Upper Goathorn Creek, ~1 km u/s from upper bridge site.	Map # 093L065	SiteNo.	G5	LthSurv(m)	52.6
		U.T.M.	FishCard	(Y) N	C	Field X Hist.
Date Y.M.D	9 7 1 0 2 4	Time 1000 / Agency C87 / Crew RD/CP/DA / Photos A4/9-12	AirPhotos			

C	PARAMETER	VALUE	METH	SPECIFIC DATA
	Ave. Chan. Width (m)	43		40, 38, 50
	Ave. Wet. Width (m)	11.6		13.3, 11.4, 8.6, 12.0, 11.4, 12.9
	Ave.Max.Riffle Depth (cm)	36		
	Ave.Max.Pool Depth (cm)	na		
	Gradient %	2		
	% Pool / Riffle 75 / Run 20 / Other 5		FLATS	
	Side Chan.%	0 ☐ 0-10 ☐ 10-40 ☐ >40 ☐		
	Debris Area%	0 ☐ 0-5 ☒ 5-15 ☐ >15 ☐		
	Debris Stable%	95		
	COVER: Total%	75		
	Comp. sum 100%: Dp.Pool — / L.O.D. 5 / Boulder 90 / InVeg — / OverVeg — / Cutbank 5			
	Crown Closure %	<5		Aspect

C	BED MATERIAL		%
	Fines	clay,silt,sand (<2mm)	5
	Gravels	small (2-16mm)	5
		large (16-64mm)	10
		sm. cobble (64-128mm)	10
	Larges	lge. cobble (128-256mm)	30
		boulder(>256mm)	40
	Bedrock		
	D90(cm)	85	Compaction L M (H)
	/50	19	

C	BANKS			
	Height(m)	2.5	%Unstable	0
	Texture	(F) (G) L R		
	Confinement	EN CO (FC) OC UC N/A		
	Valley:Channel Ratio	0-2 (2-5) 5-10 10+ N/A		
	Stage	Dry L (M) (H) Flood		
	Flood Signs Ht(m)	1.2	Braided	Y (N)
	Bars (%)	60	pH 8	O₂(ppm)
	WaterTemp(C)	2.0	Turb(cm) cl	Cond(25C)

OBSTRUCTIONS C	Ht(m)	Type	Loc'n

DISCHARGE

Parameter	Value	Method	Specific Data
Wetted Width (m)			Creek at moderate to high flows.
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL (Fish)

(Width:Valley/Channel,Slope) BedMaterial

FISH SUMMARY

C	Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
	SST	18	34-46	F	R	EF
	SST	5	95-126	J	R	EF
	CHAR	28	33-61	F	R	EF
	BT	12	68-114	J	R	EF
	DV	8	77-127	J	R	EF

STREAM/VALLEY CROSS-SECTION (Looking Downstream) L R

PLANIMETRIC VIEW

COMMENTS

Channel Stability ☐ Debris ☐ Management Concerns ☐ Obstructions ☐ Riparian Zone ☐ Valley Wall Processes ☐ Etc.

Nets were not long enough to span this site so the side channel and mainstem were sampled separately but consecutively. The data was then combined.

Creek at moderate to high flows.

Immature Western Spotted Frog was caught in the side channel.

Mainstem: large boulder/cobble with riffle habitat; poor fish habitat due to high flows.

Side channel: smaller bed material and consisting of 60% riffle and 40% run.

Edited by: CP

Date Y M D 97/11/26

DFO / MOE
STREAM SURVEY FORM

Stream Name	(gaz) Upper Goathorn Creek	(local) Upper Goathorn Creek		Access	FT	Method
Watershed Code	460-4227-096		ReachNo. 3	Lngth(km)	3.1
Location	~80 m u/s from confluence with Cabinet Creek.	Map # 093L055	SiteNo. G8	LthSurv(m)	37
		U.T.M.	FishCard (Y) N		Field X Hist.
Date Y.M.D 970924	Time 1500	Agency C87	Crew CP/RD/GM	Photos B3/19, 21	AirPhotos

PARAMETER	VALUE	METH	SPECIFIC DATA
Ave. Chan. Width (m)	10.2		9.4, 7.8, 10.4, 13.1
Ave. Wet. Width (m)	5.6		6.3, 4.3, 5.7, 6.0
Ave.Max.Riffle Depth (cm)	18		16, 18, 19
Ave.Max.Pool Depth (cm)	40		30, 38, 49, 43
Gradient %	2		
% Pool 15	Riffle 70	Run 15	Other
Side Chan.%	0 ☐ 0-10 ☒ 10-40 ☐ >40 ☐		
Debris Area%	0 ☐ 0-5 ☐ 5-15 ☐ >15 ☒		
Debris Stable%	20		
COVER: Total%	75		
Crown Closure %	20	Aspect	

Comp. sum 100	Dp.Pool	L.O.D.	Boulder	InVeg	OverVeg	Cutbank
	15	20	50	0	5	10

BED MATERIAL		%
Fines	clay,silt,sand (<2mm)	
Gravels	small (2-16mm)	5
	large (16-64mm)	10
	sm. cobble (64-128mm)	50
Larges	lge. cobble (128-256mm)	35
	boulder(>256mm)	
Bedrock		
D90(cm)	18	Compaction (L) M H

BANKS		
Height(m)	0.5	%Unstable 0
Texture	(F) G L R	
Confinement	EN CO FC (OC) UC N/A	
Valley:Channel Ratio	0-2 2-5 5-(10) 10+ N/A	
Stage	Dry (L) (M) H Flood	
Flood Signs Ht(m)	0.3	Braided Y (N)
Bars (%)	40	pH 7.2, O_2(ppm)
WaterTemp(C)	8.5	Turb(cm) cl, Cond(25C) 60

OBSTRUCTIONS: C | Ht(m) | Type | Loc'n

DISCHARGE
/50 9

Parameter	Value	Method	Specific Data
Wetted Width (m)			Estimated 8-10 c.f.s. discharge.
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL (Fish)

(Width:Valley/Channel,Slope) BedMaterial

FISH SUMMARY

C	Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
	SST	4	116-126	J	R	EF
	CHAR	21	49-62	F	R	EF
	DV	36	71-171	J	R	EF

The char fry were visually identified as a mix of BT and DV.
171 mm DV was a maturing female.
164 mm DV was a ripe male.

STREAM/VALLEY CROSS-SECTION
(Looking Downstream)

L R

PLANIMETRIC VIEW

COMMENTS

Channel Stability ☒ Debris ☒ Management Concerns ☐ Obstructions ☐ Riparian Zone ☐ Valley Wall Processes ☐ Etc.

Excellent site; good fry habitat along the margin. Unembedded cobbles, cutbank, LOD, and pools provide good cover.
Dynamic, unstable creek; observed several sediment wedges and massive debris jams u/s.

Edited by CP
Date Y M D 97/11/26

DFO / MOE
STREAM SURVEY FORM

Stream Name	(gaz) Cabinet Creek	(local) Cabinet Creek		Access	FT Method
Watershed Code	460-4227-096-485		ReachNo. 1	Lngth(km)	3.5
Location	Lower Cabinet C. fan, 100 m u/s from Cabinet - Goathorn	Map # 093L055	SiteNo. G6a	LthSurv(m)	25
	confluence. Sampled a large side channel.	U.T.M.	FishCard (Y) N	C	Field X Hist.
Date Y.M.D	9 7 0 9 2 4	Time 1130	Agency C87	Crew RD/GM/CP	Photos B3/17, 18 AirPhotos

C	PARAMETER	VALUE	METH	SPECIFIC DATA
	Ave. Chan. Width (m)	26.6		25.0, 27.8, 27.0
	Ave. Wet. Width (m)	6.7		6.8, 5.4, 6.4, 8.3
	Ave.Max.Riffle Depth (cm)	25		26, 25, 27
	Ave.Max.Pool Depth (cm)	65		
	Gradient %	2.5		
	% Pool 10, Riffle 50, Run 30, Other 10		FLATS	
	Side Chan.%	0 ☐ 0-10 ☐ 10-40 ☒ >40 ☐		
	Debris Area%	0 ☐ 0-5 ☒ 5-15 ☐ >15 ☐		
	Debris Stable%	10		
	COVER: Total%	60		
	Comp. sum 100: Dp Pool 20, L.O.D. 5, Boulder 75, InVeg, OverVeg, Cutbank			
	Crown Closure %	<5	C Aspect	

C	BED MATERIAL		%
	Fines	clay,silt,sand (<2mm)	5
	Gravels	small (2-16mm)	10
		large (16-64mm)	
		sm. cobble (64-128mm)	10
	Larges	lge. cobble (128-256mm)	45
		boulder(>256mm)	30
	Bedrock		
	D90(cm) 40	C Compaction	L (M) H

C	BANKS	
	Height(m)	2.5 %Unstable 0
	Texture	(F) (G) L R
	Confinement	EN CO (FC) OC UC N/A
	Valley:Channel Ratio	0-2 (2-5) 5-10 10+ N/A
	Stage	Dry L (M) H Flood
	Flood Signs Ht(m)	1.0 Braided (Y) N
	Bars (%)	40 pH 7.0 O₂ (ppm)
	WaterTemp(C)	7.0 Turb(cm) cl Cond(25C) 70

OBSTRUCTIONS: C | Ht(m) | Type | Loc'n

DISCHARGE /50 17

Parameter	Value	Method	Specific Data
Wetted Width (m)			Estimated 20 c.f.s. discharge in sample channel.
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL (Fish)

(Width Valley/Channel,Slope) BedMaterial

FISH SUMMARY

C	Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
	SST	1	106	J	R	EF
	CHAR	1	escaped through net			EF
	BT	4	73-138	J	R	EF
	DV	4	74-147	J	R	EF
	DV	2	168-170	A	S/M	EF
	170 mm DV was a ripe male.					
	168 mm DV was a maturing female.					

STREAM/VALLEY CROSS-SECTION
(Looking Downstream)
L R

PLANIMETRIC VIEW

COMMENTS

Channel Stability ☒ Debris ☐ Management Concerns ☐ Obstructions ☐ Riparian Zone ☐ Valley Wall Processes ☐ Etc.

Mainly boulder-riffle habitat with one pool within the site.
Good fry habitat present along the margins.
Wide, unstable channel in the lower 25 m of this creek.

Edited by: CP
Date Y M D 97/11/26

DFO / MOE
STREAM SURVEY FORM

Stream Name	(gaz) Cabinet Creek	(local) Cabinet Creek	Access	V2	Method	
Watershed Code	460-4227-096-485		ReachNo.	1	Lngth(km)	3.5
Location	Upper net 20 m below main Cabinet C. bridge.	Map # 093L055	SiteNo.	G7	LthSurv(m)	27.6
		U.T.M.	FishCard	(Y) N	Field X	Hist. ☐
Date Y.M.D 9 7 0 9 2 5	Time 1200	Agency C87	Crew DB/CP	Photos B3/22,23	AirPhotos	

C	PARAMETER	VALUE	METH	SPECIFIC DATA
	Ave. Chan. Width (m)	11.9		13.7, 12.6, 11.5, 10.2, 11.0, 12.4
	Ave. Wet. Width (m)	10.5		13.1, 11.2, 9.3, 8.9, 9.6, 10.8
	Ave.Max.Riffle Depth (cm)	34		28, 36, 38
	Ave.Max.Pool Depth (cm)	na		
	Gradient %	2		
	% Pool ; Riffle 95 ; Run 5 ; Other			
	Side Chan.%	0 X 0-10 ☐ 10-40 ☐ >40 ☐		
	Debris Area%	0 X 0-5 ☐ 5-15 ☐ >15 ☐		
	Debris Stable%	na		
	COVER: Total%	75		
	Comp. sum 100%: Dp.Pool ; L.O.D. ; Boulder 90 ; InVeg ; OverVeg 10 ; Cutbank			
	Crown Closure %	5		Aspect

OBSTRUCTIONS

C	Ht(m)	Type	Loc'n

BED MATERIAL

		%
Fines	clay,silt,sand (<2mm)	
Gravels	small (2-16mm)	
	large (16-64mm)	5
Larges	sm. cobble (64-128mm)	30
	lge. cobble (128-256mm)	40
	boulder(>256mm)	25
Bedrock		
D90(cm)	40	Compaction (L) M H

BANKS

Height(m)	3.5 ; %Unstable 10
Texture	F (G) (L) R
Confinement	EN (CO) FC OC UC N/A
Valley:Channel Ratio	(0-2) 2-5 5-10 10+ N/A
Stage	Dry (L) (M) H Flood
Flood Signs Ht(m)	1.5 ; Braided Y (N)
Bars (%)	5 ; pH 7.0 ; O_2(ppm)
WaterTemp(C)	6.5 ; Turb(cm) cl ; Cond(25C) 70

DISCHARGE /50 15

Parameter	Value	Method	Specific Data
Wetted Width (m)			Estimated 1 m^3/s discharge.
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL (Fish)

(Width:Valley/Channel,Slope) BedMaterial

FISH SUMMARY

C	Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
	CHAR	10	31-45	F	R	EF
	DV	46	53-129	J	R	EF
	BT	1	65	J	R	EF

STREAM/VALLEY CROSS-SECTION (Looking Downstream) ☐

L R

PLANIMETRIC VIEW ☐

COMMENTS

Channel Stability ☐ Debris ☐ Management Concerns ☐ Obstructions ☐ Riparian Zone ☐ Valley Wall Processes ☐ Etc.

Good clarity and no net problems i.e. no wind/leaves.

Low BT numbers caught at this site.

Edited by CP

Date Y M D 97/11/26

DFO / MOE

STREAM SURVEY FORM

Stream Name	(gaz) Cabinet Creek	(local) Cabinet Creek	Access: V2 / Method
Watershed Code	460-4227-096-485	ReachNo. 2	Lngth(km) 1.6
Location	Approximately 400 m u/s from Webster C. confluence. Map # 093L055	SiteNo. G9	LthSurv(m) 23
	U.T.M.	FishCard (Y) N	Field X Hist.
Date Y.M.D	9 7 0 9 2 5 Time 1600 Agency C87 Crew DB/CP Photos B3/24, 25	AirPhotos	

C	PARAMETER	VALUE	METH	SPECIFIC DATA
	Ave. Chan. Width (m)	6.7		5.2, 5.8, 6.4, 8.1, 7.9
	Ave. Wet. Width (m)	5.5		3.3, 4.2, 5.4, 8.1, 6.3
	Ave.Max.Riffle Depth (cm)	22		30, 15, 20
	Ave.Max.Pool Depth (cm)	43		41, 42, 46
	Gradient %	7		
	% Pool 3 / Riffle 97 / Run / Other			
	Side Chan.%	0 X / 0-10 / 10-40 / >40		
	Debris Area%	0 / 0-5 X / 5-15 / >15		
	Debris Stable%	50		
	COVER: Total%	75		
	Comp. sum 100%: Dp.Pool / L.O.D. 5 / Boulder 90 / InVeg / OverVeg / Cutbank 5			
	Crown Closure %	<1		Aspect

C	BED MATERIAL		%
	Fines	clay,silt,sand (<2mm)	
	Gravels	small (2-16mm)	
		large (16-64mm)	
	Larges	sm. cobble (64-128mm)	10
		lge. cobble (128-256mm)	30
		boulder(>256mm)	60
	Bedrock		
	D90(cm)	33	Compaction (L) M H
	/50	15	

C	BANKS			
	Height(m)	2.0	%Unstable	0
	Texture	F G (L) R		
	Confinement	EN (CO) FC OC UC N/A		
	Valley:Channel Ratio	(0-2) 2-5 5-10 10+ N/A		
	Stage	Dry (L) (M) H Flood		
	Flood Signs Ht(m)	1.0	Braided	Y (N)
	Bars (%)	20	pH 7.1	O_2 (ppm)
	WaterTemp(C)	7.0	Turb(cm) cl	Cond(25C) 90

OBSTRUCTIONS C	Ht(m)	Type	Loc'n

DISCHARGE Parameter	Value	Method	Specific Data
Wetted Width (m)			Estimated 10-15 c.f.s. discharge.
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL (Fish)

(Width:Valley/Channel,Slope) BedMaterial

FISH SUMMARY

C	Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
	DV	23	63-130	J	R	EF
	CHAR	3	35-44	F	R	EF

STREAM/VALLEY CROSS-SECTION (Looking Downstream) L R

PLANIMETRIC VIEW

COMMENTS

Channel Stability ☐ Debris X Management Concerns ☐ Obstructions ☐ Riparian Zone ☐ Valley Wall Processes ☐ Etc.

Only DV were caught at this site.

Lower net located on d/s side of bridge. No upper net; used log drop (40 cm) as upper barrier.

No leaf problems with this creek.

Edited by: CP

Date Y M D 97/11/26

DFO / MOE
STREAM SURVEY FORM

Stream Name	(gaz) Webster Creek	(local) Webster Creek	Access: V2 / Method
Watershed Code	460-4227-096-485-346	ReachNo.: 1	Lngth(km): 3.2
Location	1.4 km u/s from main road spur 120G.	Map #: 093L055 / SiteNo.: G10	LthSurv(m): 21
		U.T.M. / FishCard: (Y) N	Field X / Hist.
Date Y.M.D	9 7 0 9 2 7 / Time 1200 / Agency C87	Crew DB/CP / Photos B4/1, 2	AirPhotos

C	PARAMETER	VALUE	METH	SPECIFIC DATA
	Ave. Chan. Width (m)	8.4		10.5, 9.0, 7.7, 7.6, 7.2
	Ave. Wet. Width (m)	7.8		9.5, 9.0, 7.7, 6.7, 6.1
	Ave.Max.Riffle Depth (cm)	25		23, 23, 30
	Ave.Max.Run Depth (cm)	53		60, 50, 50
	Gradient %	2		
	% Pool / Riffle 60 / Run 40 / Other			
	Side Chan.%	0 X / 0-10 / 10-40 / >40		
	Debris Area%	0 / 0-5 X / 5-15 / >15		
	Debris Stable%	75		
	COVER: Total%	70		
	Comp. sum 100%: Dp.Pool / L.O.D. 5 / Boulder 65 / InVeg / OverVeg 20 / Cutbank 10			
	Crown Closure %	10		Aspect

OBSTRUCTIONS: C	Ht(m)	Type	Loc'n

C	BED MATERIAL		%
	Fines	clay,silt,sand (<2mm)	
	Gravels	small (2-16mm)	
		large (16-64mm)	10
		sm. cobble (64-128mm)	20
	Larges	lge. cobble (128-256mm)	40
		boulder(>256mm)	30
	Bedrock		
	D90(cm)	40	Compaction: (L) M H
	D/50	12	

C	BANKS		
	Height(m)	1.5	%Unstable 0
	Texture	F (G) (L) R	
	Confinement	EN (CO) FC OC UC N/A	
	Valley:Channel Ratio	(0-2) 2-5 5-10 10+ N/A	
	Stage	Dry (L) (M) H Flood	
	Flood Signs Ht(m)	0.7	Braided Y (N)
	Bars (%)	0	pH 7.5 / O_2(ppm)
	WaterTemp(C)	5.0	Turb(cm) cl / Cond(25C) 80

DISCHARGE

Parameter	Value	Method	Specific Data
Wetted Width (m)			Estimated 30 c.f.s. discharge.
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL
(Fish)

(Width:Valley/Channel,Slope) BedMaterial

FISH SUMMARY

C	Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
	DV	25	54-137	J	R	EF
	BT	2	100-109	J	R	EF
	CHAR	2	30-32	F	R	EF

STREAM/VALLEY CROSS-SECTION
(Looking Downstream)

L R

PLANIMETRIC VIEW

COMMENTS

Channel Stability / Debris / Management Concerns / Obstructions / Riparian Zone / Valley Wall Processes / Etc.

Climbed down short hill off new road into setting. Route was marked with pink ribbon.

Good site; lower 30' net was ~2' too short. Should use 50' net next time.

No potential spawning in this section.

No potential landing site further u/s.

Edited by: CP

Date Y M D: 97/11/26

DFO / MOE
STREAM SURVEY FORM

Stream Name	(gaz) Tenas Creek	(local) Tenas Creek		Access	V2 Method
Watershed Code	460-4227-096-049		ReachNo. 1	Lngth(km)	9.1
Location	~30 m u/s from old bridge site.	Map # 093L065	SiteNo. T1	LthSurv(m)	83
		U.T.M.	FishCard (Y) N	C	Field X Hist. ☐
Date Y.M.D 9 7 0 9 1 6	Time 900	Agency C87 Crew RD/CP/GM	Photos B3/3, 4	AirPhotos	

C	PARAMETER	VALUE	METH	SPECIFIC DATA
	Ave. Chan. Width (m)	10.0		7.9, 10.3, 12.7, 10.9, 8.8, 9.3
	Ave. Wet. Width (m)	7.8		7.5, 9.2, 7.6, 8.4, 8.3, 5.7
	Ave.Max.Riffle Depth (cm)	14		17, 12, 13
	Ave.Max.Run Depth (cm)	35		
	Gradient %	1.5		
	% Pool 20 / Riffle 70 / Run 10 / Other			
	Side Chan.%	0 ☐ 0-10 X 10-40 ☐ >40 ☐		
	Debris Area%	0 ☐ 0-5 X 5-15 ☐ >15 ☐		
	Debris Stable%	30		
	COVER: Total%	70		
	Comp. sum 100: Dp.Pool 20 / L.O.D. 10 / Boulder 60 / InVeg 0 / OverVeg 5 / Cutbank 5			
	Crown Closure %	15		Aspect

C	BED MATERIAL		%
	Fines	clay,silt,sand (<2mm)	5
	Gravels	small (2-16mm)	20
		large (16-64mm)	
		sm. cobble (64-128mm)	35
	Larges	lge. cobble (128-256mm)	30
		boulder(>256mm)	10
	Bedrock		
	D90(cm)	30	Compaction L M (H)

C	BANKS	
	Height(m)	1.3 %Unstable 0
	Texture	(F) (G) L R
	Confinement	EN CO FC (OC) UC N/A
	Valley:Channel Ratio	0-2 2-5 (5-10) 10+ N/A
	Stage	Dry L (M) H Flood
	Flood Signs Ht(m)	0.4 Braided Y (N)
	Bars (%)	12 pH 7.7 O_2(ppm)
	WaterTemp(C)	8.0 Turb(cm) 100 Cond(25C) 120

OBSTRUCTIONS C	Ht(m)	Type	Loc'n

DISCHARGE

Parameter	Value	Method	Specific Data
Wetted Width (m)			Tenas C. at moderate flows.
Mean Depth (m)			Slight colour in water from heavy rains.
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL (Fish)

(Width Valley/Channel,Slope) BedMaterial

FISH SUMMARY

C	Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
	SST	232	29-52	F	R	EF
	SST	46	66-152	J	R	EF
	CHAR	1	42	F	R	EF
	BT	3	106-127	J	R	EF

STREAM/VALLEY CROSS-SECTION (Looking Downstream) ☐

L R

PLANIMETRIC VIEW ☐

COMMENTS

Channel Stability ☐ Debris X Management Concerns ☐ Obstructions ☐ Riparian Zone X Valley Wall Processes ☐ Etc.

Good SST parr rearing in the cobble-riffle sections and moderate fry rearing along the margins.

Flows are moderate and water is slightly coloured due to heavy rain.

A large debris jam and a side channel are present within the site.

Same site location as 1984.

A lot of debris collecting in the net due to heavy alder overstory within the site.

Edited by: CP

Date Y M D 97/11/26

DFO / MOE
STREAM SURVEY FORM

Stream Name	(gaz) Tenas Creek	(local) Tenas Creek	Access: FT / Method
Watershed Code	460-4227-096-049	ReachNo. 1	Lngth(km) 9.1
Location	Lower Tenas C., hiked in from edge of block. Map # 093L065	SiteNo. T2	LthSurv(m) 67
	U.T.M.	FishCard (Y) N	Field X Hist. ☐
Date Y.M.D 9 7 0 9 2 0	Time 930 Agency C87 Crew RD/GM/IF	Photos B3/13, 14	AirPhotos

C	PARAMETER	VALUE	METH	SPECIFIC DATA
	Ave. Chan. Width (m)	7.6		8.4, 6.9, 8.3, 6.8, 7.7
	Ave. Wet. Width (m)	6.3		7.1, 6.4, 6.9, 5.6, 5.3
	Ave.Max.Riffle Depth (cm)	25		22, 28, 24
	Ave.Max.Pool Depth (cm)	52		55, 48
	Gradient %	1.5		
	% Pool 10 / Riffle 50 / Run 30 / Other 10		FLATS	
	Side Chan.%	0 X 0-10 ☐ 10-40 ☐ >40 ☐		
	Debris Area%	0 ☐ 0-5 X 5-15 ☐ >15 ☐		
	Debris Stable%	75		
	COVER: Total%	60		
	Comp. sum 100: Dp.Pool 10, L.O.D. 10, Boulder 65, InVeg, OverVeg 10, Cutbank 5			
	Crown Closure %		C Aspect	

OBSTRUCTIONS

C	Ht(m)	Type	Loc'n

BED MATERIAL

C			%
	Fines	clay,silt,sand (<2mm)	5
	Gravels	small (2-16mm)	10
		large (16-64mm)	
	Larges	sm. cobble (64-128mm)	15
		lge. cobble (128-256mm)	40
		boulder(>256mm)	30
	Bedrock		
	D90(cm)	32	C Compaction L M (H)

BANKS

C		
	Height(m)	1.3 %Unstable
	Texture	(F) (G) L R
	Confinement	EN CO FC (OC) UC N/A
	Valley:Channel Ratio	0-2 2-5 5 (10) 10+ N/A
	Stage	Dry L (M) H Flood
	Flood Signs Ht(m) 1.0	Braided Y (N)
	Bars (%) 10	pH 7.3 O₂(ppm)
	WaterTemp(C) 5.5	Turb(cm) 80 Cond(25C) 90

DISCHARGE /50 19

Parameter	Value	Method	Specific Data
Wetted Width (m)			Lower Tenas C. at moderate flows.
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL (Fish)

(Width Valley/Channel,Slope) BedMaterial

FISH SUMMARY

C	Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
	SST	100	31-49	F	R	EF
	SST	30	69-146	J	R	EF
	CHAR	1	50	F	R	EF
	BT	2	102-132	J	R	EF
	DV	3	90-113	J	R	EF
	DV	1	152	A	S	EF
	Suspect char fry was a DV.					

STREAM/VALLEY CROSS-SECTION (Looking Downstream) ☐

L R

PLANIMETRIC VIEW ☐

COMMENTS

Channel Stability ☐ Debris X Management Concerns ☐ Obstructions ☐ Riparian Zone ☐ Valley Wall Processes ☐ Etc.

Hiked into site from old block; trail ribboned with pink flagging tape.
The 152 mm long DV was identified as a spent male.
Site mainly cobble-riffle with some run and flats along the margin.
Two pools in site associated with LOD.

Edited by CP
Date Y M D 97/11/26

DFO / MOE
STREAM SURVEY FORM

Stream Name	(gaz) Tenas Creek	(local) Tenas Creek		Access	ATV/FT	Method
Watershed Code	460-4227-096-049		ReachNo.	1	Lngth(km)	9.1
Location	Mid section of Tenas C. at outlet of small beaver pond.	Map # 093L065	SiteNo.	T4	LthSurv(m)	33
		U.T.M.	FishCard	(Y) N	Field X	Hist.
Date Y.M.D	9 7 0 9 1 9	Time 1300	Agency C87	Crew RD/GM	Photos B3/11, 12	AirPhotos

PARAMETER	VALUE	METH	SPECIFIC DATA
Ave. Chan. Width (m)	11.9		10.9, 12.7, 11.1, 13.0
Ave. Wet. Width (m)	9.3		9.0, 9.8, 9.4, 9.1 + a 1 m^2 alcove area.
Ave.Max.Riffle Depth (cm)	24		24, 23, 24
Ave.Max.Pool Depth (cm)	30		28, 32
Gradient %	2.5		
% Pool 5, Riffle 70, Run 15, Other 10		FLATS	
Side Chan.%	0 ☐ 0-10 X 10-40 ☐ >40 ☐		
Debris Area%	0 ☐ 0-5 X 5-15 ☐ >15 ☐		
Debris Stable%	60		
COVER: Total%	65		
Comp. sum 100%	Dp.Pool: ; L.O.D.: 10; Boulder: 80; InVeg: ; OverVeg: 5; Cutbank: 5		
Crown Closure %			Aspect

OBSTRUCTIONS

Ht(m)	Type	Loc'n

BED MATERIAL

		%
Fines	clay,silt,sand (<2mm)	5
Gravels	small (2-16mm)	10
	large (16-64mm)	
Larges	sm. cobble (64-128mm)	25
	lge. cobble (128-256mm)	50
	boulder(>256mm)	10
Bedrock		
D90(cm)	25	Compaction L M (H)

BANKS

Height(m)	1.2 %Unstable
Texture	(F) (G) L R
Confinement	EN CO (FC) OC UC N/A
Valley:Channel Ratio	0-2 (-5) 5-10 10+ N/A
Stage	Dry L (M) H Flood
Flood Signs Ht(m)	0.6 Braided Y (N)
Bars (%)	10 pH 7.2 O_2(ppm)
WaterTemp(C)	7.5 Turb(cm) cl Cond(25C) 100

DISCHARGE /50 13

Parameter	Value	Method	Specific Data
Wetted Width (m)			Estimated 20 c.f.s. discharge.
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL
(Fish)

(Width:Valley/Channel,Slope) BedMaterial

FISH SUMMARY

Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
SST	101	32-44	F	R	EF
SST	30	67-157	J	R	EF
CHAR	3	44-51	F	R	EF
DV	2	62-73	J	R	EF
The char fry were a mix of DV and BT.					

STREAM/VALLEY CROSS-SECTION
(Looking Downstream)

L R

PLANIMETRIC VIEW

COMMENTS

Channel Stability ☐ Debris ☐ Management Concerns ☐ Obstructions ☐ Riparian Zone ☐ Valley Wall Processes ☐ Etc.

Hiked in from ATV road on old cutblock. ATV could not be used due to the abundance of trees/shrubs on the block.
Mainly boulder-riffle habitat with some run and 2 small edge pools.
Alcove at base of seepage outlet from the beaver pond was also sampled.
Excellent fry habitat section in the side channel.

Edited by: CP
Date Y M D 97/11/26

DFO / MOE
STREAM SURVEY FORM

Stream Name	(gaz) Tenas Creek	(local) Tenas Creek	Access: FT; Method:
Watershed Code	460-4227-096-049	ReachNo. 2	Lngth(km) 4.2
Location	Upper Tenas C.; hiked down from block. Just u/s from 1997 periphyton site.	Map # 093L054; U.T.M.	SiteNo. T3; LthSurv(m) 44.1; FishCard (Y) N; Field X Hist.
Date Y.M.D	9 7 0 9 1 7	Time 1100; Agency C87; Crew RD/GM/CP; Photos B3/5, 6	AirPhotos

PARAMETER	VALUE	METH	SPECIFIC DATA
Ave. Chan. Width (m)	10.8		12.3, 12.2, 10.5, 9.8, 9.1
Ave. Wet. Width (m)	5.7		6.2, 5.5, 5.9, 5.8, 5.1
Ave.Max.Riffle Depth (cm)	30		30, 28, 31
Ave.Max.Run Depth (cm)	33		33, 32, 34
Gradient %	3		
% Pool: ; Riffle 90; Run 10; Other			
Side Chan.%	0 X 0-10 10-40 >40		
Debris Area%	0 0-5 X 5-15 >15		
Debris Stable%	nr		
COVER: Total%	70		
Comp. sum 100%: Dp.Pool ; L.O.D. 5; Boulder 90; InVeg ; OverVeg 5; Cutbank			
Crown Closure %	5		Aspect

BED MATERIAL		%
Fines	clay,silt,sand (<2mm)	5
Gravels	small (2-16mm)	10
	large (16-64mm)	10
	sm. cobble (64-128mm)	20
Larges	lge. cobble (128-256mm)	35
	boulder(>256mm)	20
Bedrock		
D90(cm) 40	Compaction L M (H)	
/50 24		

BANKS	
Height(m)	2.5 %Unstable
Texture	(F) (G) L R
Confinement	EN CO (FC) OC UC N/A
Valley:Channel Ratio	0-2 (2-5) 5-10 10+ N/A
Stage	Dry L (M) H Flood
Flood Signs Ht(m)	1.0 Braided Y (N)
Bars (%)	20; pH 7.7; O_2(ppm)
WaterTemp(C)	6.0; Turb(cm) 40; Cond(25C) 90

OBSTRUCTIONS: Ht(m) | Type | Loc'n

DISCHARGE Parameter	Value	Method	Specific Data
Wetted Width (m)			Upper Tenas C. at moderate flows.
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL (Fish)

(Width:Valley/Channel,Slope) BedMaterial

FISH SUMMARY

C	Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
	SST	9	28-36	F	R	EF
	SST	2	98-183	J	R	EF
	CHAR	11	41-53	F	R	EF
	DV	19	67-122	J	R	EF
	DV	1	171	A	S	EF

The 171 mm long DV was identified as a ripe male.

All but 3 char fry were identified as BT.

STREAM/VALLEY CROSS-SECTION (Looking Downstream) L R

PLANIMETRIC VIEW

COMMENTS

Channel Stability Debris Management Concerns Obstructions Riparian Zone Valley Wall Processes Etc.

In same general area as 1984 site but at a new location.

Heavy rain caused flow/turbidity to increase during sampling.

Site mainly riffle with a small section (~5-10%) of run. Pools were to deep/turbid to sample.

Edited by CP

Date Y M D 97/11/26

DFO / MOE
STREAM SURVEY FORM

Stream Name	(gaz) Tenas Creek	(local) Tenas Creek	Access: FT · Method:
Watershed Code	460-4227-096-049	ReachNo. 3	Lngth(km) 2.6
Location	Upper Tenas C.; ~70 m u/s in the West fork.	Map # 093L054 · SiteNo. T6	LthSurv(m) 24
	U.T.M.	FishCard (Y) N	Field X Hist.
Date Y.M.D	9 7 0 9 1 8 · Time 1100 · Agency C87 · Crew RD/CP/GM · Photos B3/7, 8	AirPhotos	

PARAMETER	VALUE	METH	SPECIFIC DATA
Ave. Chan. Width (m)	8.4		12.3, 7.3, 7.7, 6.3
Ave. Wet. Width (m)	4.4		3.0, 3.4, 5.8, 5.5
Ave.Max.Riffle Depth (cm)	14		15, 18, 9
Ave.Max.Pool Depth (cm)	46		31, 56, 50
Gradient %	3		
% Pool 15 · Riffle 80 · Run 5 · Other			
Side Chan.%	0 ☐ 0-10 ☒ 10-40 ☐ >40 ☐		
Debris Area%	0 ☐ 0-5 ☐ 5-15 ☒ >15 ☐		
Debris Stable%	70		
COVER: Total%	90		
Comp. sum 100%: Dp.Pool · L.O.D. 10 · Boulder 60 · InVeg · OverVeg 30 · Cutbank			
Crown Closure % 15	Aspect		

BED MATERIAL		%
Fines	clay,silt,sand (<2mm)	5
Gravels	small (2-16mm)	5
	large (16-64mm)	20
Larges	sm. cobble (64-128mm)	40
	lge. cobble (128-256mm)	20
	boulder(>256mm)	10
Bedrock		
D90(cm) 28	Compaction L (M) H	

BANKS	
Height(m)	0.5 · %Unstable 0
Texture	(F) (G) L R
Confinement	EN CO FC (OC) UC N/A
Valley:Channel Ratio	0-2 2-5 5-(10) 10+ N/A
Stage	Dry L (M) H Flood
Flood Signs Ht(m)	0.3 · Braided Y (N)
Bars (%)	20 · pH 7.5 · O_2(ppm)
WaterTemp(C)	4.5 · Turb(cm) 80 · Cond(25C) 90

OBSTRUCTIONS: Ht(m) | Type | Loc'n

DISCHARGE /50 7

Parameter	Value	Method	Specific Data
Wetted Width (m)			Tenas C. at moderate to low flows.
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL (Fish)

(Width Valley/Channel,Slope) BedMaterial

FISH SUMMARY

Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
RB	7	33-36	F	R	EF
RB	5	89-98	J	R	EF
CHAR	5	36-49	F	R	EF
DV	15	70-143	J	R	EF

Char fry were identified as DV except the largest fry which was a BT.

STREAM/VALLEY CROSS-SECTION (Looking Downstream) L R

PLANIMETRIC VIEW

COMMENTS

Channel Stability ☐ Debris ☒ Management Concerns ☐ Obstructions ☐ Riparian Zone ☐ Valley Wall Processes ☐ Etc.

Complex site consisting of riffle, 2 pools, small debris along the margins, and a small trickle side channel suitable for fry.

Bed material is primarily cobble; very limited potential spawning in lower 100 m.

Edited by: CP
Date Y M D 97/11/26

DFO / MOE
STREAM SURVEY FORM

Stream Name	(gaz) Tenas Creek	(local) Tenas Creek	Access: FT / Method
Watershed Code	460-4227-096-049	ReachNo. 1	Lngth(km) 2.5
Location	Upper Tenas Creek, ~100 m u/s in the East fork. Map # 093L054	SiteNo. T5	LthSurv(m) 33
	U.T.M.	FishCard (Y) N	Field X Hist.
Date Y.M.D 9 7 0 9 1 8	Time 1130 Agency C87 Crew RD/GM/CP Photos B3/9, 10	AirPhotos	

PARAMETER	VALUE	METH	SPECIFIC DATA
Ave. Chan. Width (m)	12.5		17.8, 12.1, 12.4, 10.8, 9.5
Ave. Wet. Width (m)	4.1		5.5, 3.9, 4.1, 3.3, 3.5
Ave.Max.Riffle Depth (cm)	24		27, 25, 19
Ave.Max.Pool Depth (cm)	41		52, 29
Gradient %	4-5		
% Pool 20 / Riffle 75 / Run 5 / Other			
Side Chan.%	0-10 X		
Debris Area%	0-5 X		
Debris Stable%	20		
COVER: Total%	70		
Comp. sum 100: Dp.Pool 15, L.O.D. 20, Boulder 65, InVeg, OverVeg, Cutbank			
Crown Closure %			Aspect

OBSTRUCTIONS Ht(m)	Type	Loc'n
1.0	X	0
Located at the mouth of the East fork.		

BED MATERIAL		%
Fines	clay,silt,sand (<2mm)	5
Gravels	small (2-16mm)	15
	large (16-64mm)	
Larges	sm. cobble (64-128mm)	20
	lge. cobble (128-256mm)	40
	boulder(>256mm)	20
Bedrock		
D90(cm) 40	Compaction L (M) H	
/50 16		

BANKS	
Height(m)	1.5 %Unstable
Texture	(F) (G) (C) (L) R
Confinement	EN CO FC (OC) UC N/A
Valley:Channel Ratio	0-2 2-5 (5-10) 10+ N/A
Stage	Dry L (M) H Flood
Flood Signs Ht(m) 0.8	Braided Y (N)
Bars (%) 30	pH 7.4 O2(ppm)
WaterTemp(C) 6.0	Turb(cm) cl Cond(25C) 120

DISCHARGE

Parameter	Value	Method	Specific Data
Wetted Width (m)			Estimated 5-6 c.f.s. discharge.
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL (Fish)
(Width:Valley/Channel,Slope) BedMaterial

FISH SUMMARY

C	Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
	CHAR	5	31-51	F	R	EF
	DV	2	77-144	J	R	EF
	BT	1	197	J	R	EF

The 3 largest fry were identified as BT.

STREAM/VALLEY CROSS-SECTION (Looking Downstream) L R

PLANIMETRIC VIEW

COMMENTS

Channel Stability X Debris ☐ Management Concerns ☐ Obstructions X Riparian Zone X Valley Wall Processes ☐ Etc.

Large gravel slump present along river left side of site.
Mainly boulder-riffle with some pool/LOD habitat. Creek quite steep for good fish habitat.
Dynamic creek with potential to move debris.
Drops over debris up to 1 m high present d/s; access is restricted to high flow periods.

Edited by CP
Date Y M D 97/11/26

DFO / MOE

STREAM SURVEY FORM

Stream Name	(gaz) Tenas Creek Tributary TN31	(local) Tenas Creek Tributary TN31		Access	V2	Method
Watershed Code	460-4227-096-049		ReachNo.	2	Lngth(km)	1.8
Location	Site located in upper reach of Tributary TN31 along cutblock.	Map # 093L055	SiteNo.	T7	LthSurv(m)	100
		U.T.M.	FishCard	Y (N)		Field X Hist. ☐
Date Y.M.D	9 7 1 0 1 4	Time 1200 Agency C87 Crew RD/DA	Photos A3/13, 14	AirPhotos		

PARAMETER	VALUE	METH	SPECIFIC DATA
Ave. Chan. Width (m)	0.6		0.6, 0.8, 0.4
Ave. Wet. Width (m)	0.6		0.6, 0.8, 0.4
Ave.Max.Riffle Depth (cm)	12		
Ave.Max.Pool Depth (cm)	35		
Gradient %	1.5		
% Pool 15, Riffle 5, Run 80, Other			
Side Chan.%	0 X 0-10 ☐ 10-40 ☐ >40 ☐		
Debris Area%	0 ☐ 0-5 X 5-15 ☐ >15 ☐		
Debris Stable%	99		
COVER: Total%	40		
Comp. sum 100: Dp.Pool 20, L.O.D. 20, Boulder, InVeg, OverVeg 10, Cutbank 50			
Crown Closure %			Aspect

OBSTRUCTIONS Ht(m)	Type	Loc'n

BED MATERIAL		%
Fines	clay,silt,sand (<2mm)	80
Gravels	small (2-16mm)	10
	large (16-64mm)	10
Larges	sm. cobble (64-128mm)	
	lge. cobble (128-256mm)	
	boulder(>256mm)	
Bedrock		
D90(cm) 3	Compaction (L) M H	

BANKS	
Height(m)	0.3
%Unstable	0
Texture	(F) G L R
Confinement	EN CO FC OC (UC) N/A
Valley:Channel Ratio	0-2 2-5 5-10 (10+) N/A
Stage	Dry L (M) H Flood
Flood Signs Ht(m)	0.1
Braided	Y (N)
Bars (%)	
pH	7.4
O_2 (ppm)	
WaterTemp(C)	3.0
Turb(cm)	cl
Cond(25C)	50

DISCHARGE

Parameter	Value	Method	Specific Data
Wetted Width (m)			Estimated 1.5 c.f.s. discharge.
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL (Fish)

(Width:Valley/Channel,Slope) BedMaterial

FISH SUMMARY

Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
		NO CATCH.			

STREAM/VALLEY CROSS-SECTION ☐ (Looking Downstream)

L R

PLANIMETRIC VIEW ☐

COMMENTS

Channel Stability X Debris ☐ Management Concerns ☐ Obstructions ☐ Riparian Zone X Valley Wall Processes ☐ Etc.

Small, stable, low gradient, meandering creek with moss-covered banks.
No spawning potential present in this section. Bed material consists of sand/silt.
Creek is buffered on each side from new cutblocks.

Edited by. CP
Date Y M D 97/11/26

DFO / MOE
STREAM SURVEY FORM

Stream Name	(gaz) Bulkley River	(local) Bulkley River		Access	BOAT	Method	
Watershed Code	460		ReachNo.	6	Lngth(km)	
Location	Bulkley River margin site, ~ 100 m d/s from Hubert Creek mouth.	Map # 093L065	SiteNo.	B1	LthSurv(m)	20
		U.T.M.	FishCard	(Y) N	Field [X]	Hist. [ ]
Date Y.M.D	9 7 1 0 0 2	Time 1100	Agency C87	Crew RD/CP/DA	Photos B4/15, 16	AirPhotos

C	PARAMETER	VALUE	METH	SPECIFIC DATA
	Ave. Chan. Width (m)	100		80, 120, 100, 100 - CW's calculated from air photo.
	Ave. Wet. Width (m)	5.3		2.4, 4.6, 6.5, 6.7, 7.2, 4.1 (Enclosed site only.)
	Ave.Max.Run Depth (cm)	44		45, 52, 36
	Ave.Max.Pool Depth (cm)	na		
	Gradient %	1		
	% Pool / Riffle / Run 100 / Other			
	Side Chan.%	0 [X] 0-10 [ ] 10-40 [ ] >40 [ ]		
	Area%	0 [X] 0-5 [ ] 5-15 [ ] >15 [ ]		
	Debris Stable%	na		
	COVER: Total%	40		
	Comp. sum 100%: Dp.Pool / L.O.D. / Boulder 100 / InVeg / OverVeg / Cutbank			
	Crown Closure %	0		Aspect

C	BED MATERIAL		%
	Fines	clay,silt,sand (<2mm)	5
	Gravels	small (2-16mm)	15
		large (16-64mm)	
	Larges	sm. cobble (64-128mm)	30
		lge. cobble (128-256mm)	40
		boulder(>256mm)	10
	Bedrock		
	D90(cm) 30	Compaction	L (M) H
	/50	12	

C	BANKS		
	Height(m)	3.0	%Unstable 0
	Texture	(F) (G) L R	
	Confinement	EN CO (FC) OC UC N/A	
	Valley:Channel Ratio	0-2 (2-5) 5-10 10+ N/A	
	Stage	Dry (L) M H Flood	
	Flood Signs Ht(m)	2.0	Braided Y (N)
	Bars (%)	5	pH 7.4	O_2 (ppm)
	WaterTemp(C)	8.0	Turb(cm) cl	Cond(25C) 110

OBSTRUCTIONS C	Ht(m)	Type	Loc'n

DISCHARGE

Parameter	Value	Method	Specific Data
Wetted Width (m)			
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL (Fish)

(Width:Valley/Channel,Slope) BedMaterial

FISH SUMMARY

C	Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
	SST	36	33-59	F	R	EF
	SST	3	71-74	J	R	EF
	CH	46	44-70	F	R	EF
	LNC	1	37	F	R	EF

STREAM/VALLEY CROSS-SECTION (Looking Downstream)

L R

PLANIMETRIC VIEW

COMMENTS

Channel Stability [ ] Debris [ ] Management Concerns [ ] Obstructions [ ] Riparian Zone [ ] Valley Wall Processes [ ] Etc.

Similar location to 1984; directions described 1984 site to be 100 m d/s from Hubert Creek mouth, but rock outcrop (site description) is ~1 km d/s.

Slow, flat, run habitat with cobble bed material.

Edited by CP

Date Y M D 97/11/

DFO / MOE

STREAM SURVEY FORM

Stream Name	(gaz) Bulkley River	(local) Bulkley River			Access	BOAT	Method
Watershed Code	460		ReachNo.	6	Lngth(km)		
Location	Bulkley River margin site, 100 m d/s from rock outcrop	Map # 093L065	SiteNo.	B2	LthSurv(m)	23	
	along CNR rip-rap.	U.T.M.	FishCard	Y (N)	C	Field X	Hist.
Date Y.M.D	9 7 1 0 0 2	Time 1300	Agency C87	Crew RD/CP/DA	Photos B4/17	AirPhotos	

PARAMETER	VALUE	METH	SPECIFIC DATA
Ave. Chan. Width (m)	100		80, 120, 100, 100 - CW's calculated from air photo.
Ave. Wet. Width (m)	3.0		2.6, 3.4, 4.2, 4.4, 2.2, 1.0 (Enclosed site only.)
Ave.Max.Run Depth (cm)	60		60, 54, 66
Ave.Max.Pool Depth (cm)	na		
Gradient %	1		
% Pool / Riffle / Run 100 / Other			
Side Chan.%	0 X 0-10 ☐ 10-40 ☐ >40 ☐		
Debris Area%	0 X 0-5 ☐ 5-15 ☐ >15 ☐		
Debris Stable%	na		
COVER: Total%	65		
Comp. sum 100%: Dp.Pool / L.O.D. / Boulder 100 / InVeg / OverVeg / Cutbank			
Crown Closure %	0		Aspect

BED MATERIAL		%
Fines	clay,silt,sand (<2mm)	5
Gravels	small (2-16mm)	15
	large (16-64mm)	
Larges	sm. cobble (64-128mm)	25
	lge. cobble (128-256mm)	45
	boulder(>256mm)	10
Bedrock		
D90(cm)	28	Compaction L (M) H

BANKS			
Height(m)	3.6	%Unstable	0
Texture	(F) (G) L R		
Confinement	EN CO (FC) OC UC N/A		
Valley:Channel Ratio	0-2 (2-5) 5-10 10+ N/A		
Stage	Dry (L) M H Flood		
Flood Signs Ht(m)	2.0	Braided	Y (N)
Bars (%)	5	pH 7.4	O_2 (ppm)
WaterTemp(C)	8.0	Turb(cm) cl	Cond(25C) 50

OBSTRUCTIONS			
C	Ht(m)	Type	Loc'n

DISCHARGE /50 15

Parameter	Value	Method	Specific Data
Wetted Width (m)			
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL (Fish)

(Width:Valley/Channel,Slope) BedMaterial

FISH SUMMARY

C	Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
	SST	4	40-47	F	R	EF
	CH	3	57-58	F	R	EF

STREAM/VALLEY CROSS-SECTION ☐

(Looking Downstream)

L R

PLANIMETRIC VIEW ☐

COMMENTS

Channel Stability ☐ Debris ☐ Management Concerns ☐ Obstructions ☐ Riparian Zone ☐ Valley Wall Processes ☐ Etc.

Same location as 1984. Fish habitat not as good as that found at site B1.

Fast and deep along outer edge of margin site and moderate flows within margin site.

Bed material consists of cobble.

Edited by: CP

Date Y M D 97/11/

DFO / MOE
STREAM SURVEY FORM

Stream Name	(gaz) Bulkley River	(local) Bulkley River	Access	BOAT	Method
Watershed Code	460	ReachNo. 6	Lngth(km)		
Location	Bulkley River margin site.	Map # 093L065	SiteNo. B3	LthSurv(m)	21.5
		U.T.M.	FishCard (Y) N	Field X	Hist.
Date Y.M.D	9 7 1 0 0 2	Time 1400	Agency C87	Crew RD/CP/DA	Photos B4/18, 19 AirPhotos

PARAMETER	VALUE	METH	SPECIFIC DATA
Ave. Chan. Width (m)	100		80, 120, 100, 100 - CW's calculated from air photo.
Ave. Wet. Width (m)	3.5		2.7, 4.3, 4.5, 3.6, 3.4, 2.2 (Enclosed site only.)
Ave.Max.Run Depth (cm)	55		45, 57, 64
Ave.Max.Pool Depth (cm)	na		
Gradient %	1		
% Pool / Riffle / Run / Other	Run 100		
Side Chan.%	0 X 0-10 10-40 >40		
Debris Area%	0 X 0-5 5-15 >15		
Debris Stable%	na		
COVER: Total%	70		
Comp. sum 100%: Dp.Pool 20; L.O.D. ; Boulder 80; InVeg ; OverVeg ; Cutbank			
Crown Closure %	0	Aspect	

BED MATERIAL		%
Fines	clay,silt,sand (<2mm)	5
Gravels	small (2-16mm)	5
	large (16-64mm)	10
	sm. cobble (64-128mm)	30
Larges	lge. cobble (128-256mm)	40
	boulder(>256mm)	10
Bedrock		
D90(cm)	27	Compaction L (M) H
/50	12	

BANKS	
Height(m)	2.5 %Unstable 0
Texture	(F) (G) L R
Confinement	EN CO (FC) OC UC N/A
Valley:Channel Ratio	0-2 (2-5) 5-10 10+ N/A
Stage	Dry (L) M H Flood
Flood Signs Ht(m)	2.0 Braided Y (N)
Bars (%)	5 pH 7.4 O_2(ppm)
WaterTemp(C)	8.5 Turb(cm) cl Cond(25C) 50

OBSTRUCTIONS: Ht(m) | Type | Loc'n

DISCHARGE

Parameter	Value	Method	Specific Data
Wetted Width (m)			
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL (Fish)

(Width:Valley/Channel,Slope) BedMaterial

FISH SUMMARY

C	Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
	SST	10	37-54	F	R	EF
	SST	1	70	J	R	EF
	CH	14	45-66	F	R	EF

STREAM/VALLEY CROSS-SECTION (Looking Downstream)

L R

PLANIMETRIC VIEW

COMMENTS

Channel Stability Debris Management Concerns Obstructions Riparian Zone Valley Wall Processes Etc.

Approximately same location as 1984.

Cobble bed material in a slow run section.

Edited by CP

Date Y M D 97/11/

DFO / MOE
STREAM SURVEY FORM

Stream Name	(gaz) Bulkley River	(local) Bulkley River	Access	BOAT	Method	
Watershed Code	460		ReachNo.	6	Lngth(km)	
Location	Bulkley River margin site, 50 m d/s from Site B3.	Map # 093L065	SiteNo.	B4	LthSurv(m)	21
		U.T.M.	FishCard	(Y) N	Field X	Hist. ☐
Date Y.M.D	9 7 1 0 0 2	Time 1600	Agency C87	Crew RD/CP/DA	Photos B4/20, 21	AirPhotos

PARAMETER	VALUE	METH	SPECIFIC DATA
Ave. Chan. Width (m)	100		80, 120, 100, 100 - CW's calculated from air photo.
Ave. Wet. Width (m)	3.6		3.0, 4.3, 4.6, 4.3, 3.4, 1.9 (Enclosed site only.)
Ave.Max.Riffle Depth (cm)	29		25, 33
Ave.Max.Run Depth (cm)	41		40, 38, 46
Gradient %	<1		
% Pool	Riffle 5	Run 95	Other
Side Chan.%	0 X 0-10 ☐ 10-40 ☐ >40 ☐		
Debris Area%	0 X 0-5 ☐ 5-15 ☐ >15 ☐		
Debris Stable%	na		
COVER: Total%	75		
Comp. sum 100%	Dp.Pool:	L.O.D.:	Boulder: 100; InVeg: ; OverVeg: ; Cutbank:
Crown Closure %	0	Aspect	

OBSTRUCTIONS

Ht(m)	Type	Loc'n

BED MATERIAL

		%
Fines	clay,silt,sand (<2mm)	5
Gravels	small (2-16mm)	5
Gravels	large (16-64mm)	
Larges	sm. cobble (64-128mm)	30
Larges	lge. cobble (128-256mm)	45
Larges	boulder(>256mm)	15
Bedrock		
D90(cm)	30	Compaction L (M) H

BANKS

Height(m)	2.5	%Unstable	0
Texture	(F) (G) L R		
Confinement	EN CO (FC) OC UC N/A		
Valley:Channel Ratio	0-2 (2-5) 5-10 10+ N/A		
Stage	Dry (L) M H Flood		
Flood Signs Ht(m)	2.0	Braided	Y (N)
Bars (%)	5	pH	7.4
O₂ (ppm)			
WaterTemp(C)	8.5	Turb(cm)	cl
Cond(25C)	50		

DISCHARGE /50 17

Parameter	Value	Method	Specific Data
Wetted Width (m)			
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL
(Fish)
(Width:Valley/Channel,Slope) BedMaterial

FISH SUMMARY

Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
SST	23	32-53	F	R	EF
SST	6	71-82	J	R	EF
CH	26	39-69	F	R	EF

STREAM/VALLEY CROSS-SECTION ☐
(Looking Downstream)
L R

PLANIMETRIC VIEW ☐

COMMENTS

Channel Stability ☐ Debris ☐ Management Concerns ☐ Obstructions ☐ Riparian Zone ☐ Valley Wall Processes ☐ Etc.

Approximately same location as 1984.
Slow, run habitat.
Cobble bed material.
Good CH and SST parr rearing habitat. Moderate habitat for large parr.
Good fry habitat within 1 m of margin.

Edited by: CP
Date Y M D 97/11/

DFO / MOE
STREAM SURVEY FORM

Stream Name	(gaz) Four Creek	(local) Four Creek			Access	V2	Method
Watershed Code	460-4227-096-256		ReachNo.	2	Lngth(km)	2.0	
Location	Four Creek, ~30-40 m d/s from Telkwa Coal Mine Road.	Map # 093L065	SiteNo.	F1	LthSurv(m)	15.0	
		U.T.M.	FishCard	Y (N)		Field X	Hist.
Date Y.M.D	9 7 0 9 2 9	Time 1130	Agency C87	Crew CP/DA	Photos A2/2-4; B4/5-7	AirPhotos	

PARAMETER	VALUE	METH	SPECIFIC DATA
Ave. Chan. Width (m)	4.5		3.0, 3.9, 6.9, 5.9, 4.2, 3.0
Ave. Wet. Width (m)	1.2		0.5, 1.7, 1.5
Ave.Max.Riffle Depth (cm)	14		15, 14, 12
Ave.Max.Pool Depth (cm)	25		32, 20, 23
Gradient %	8		
% Pool 15 / Riffle 85 / Run / Other			
Side Chan.%	0 X / 0-10 / 10-40 / >40		
Debris Area%	0 / 0-5 X / 5-15 / >15		
Debris Stable%	10		
COVER: Total%	65		

Comp. sum 100%	Dp.Pool	L.O.D.	Boulder	InVeg	OverVeg	Cutbank
	5	5	65		10	15

Crown Closure %	40	Aspect	

BED MATERIAL		%
Fines	clay,silt,sand (<2mm)	5
Gravels	small (2-16mm)	5
	large (16-64mm)	10
	sm. cobble (64-128mm)	20
Larges	lge. cobble (128-256mm)	35
	boulder(>256mm)	25
Bedrock		
D90(cm)	35	Compaction L (M) H

BANKS			
Height(m)	1.5	%Unstable	0
Texture	F G (L) R		
Confinement	EN (CO) FC OC UC N/A		
Valley:Channel Ratio	(0-2) 2-5 5-10 10+ N/A		
Stage	Dry (L) M H Flood		
Flood Signs Ht(m)	0.4	Braided	Y (N)
Bars (%)	50	pH	nr
O_2 (ppm)			
WaterTemp(C)	5.0	Turb(cm)	cl
Cond(25C)	180		

OBSTRUCTIONS: Ht(m) | Type | Loc'n

DISCHARGE

Parameter	Value	Method	Specific Data
Wetted Width (m)			
Mean Depth (m)			Estimated 1 c.f.s. discharge.
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL (Fish)

(Width:Valley/Channel.Slope) BedMaterial

FISH SUMMARY

C	Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
	SST	4	45-52	F	R	EF
	DV	2	166-201	A	S/M	EF

201 mm DV was a mature female.

166 mm DV was a mature male.

STREAM/VALLEY CROSS-SECTION (Looking Downstream)

L R

PLANIMETRIC VIEW

COMMENTS

Channel Stability ☐ Debris ☒ Management Concerns ☐ Obstructions ☒ Riparian Zone ☐ Valley Wall Processes ☐ Etc.

1.5 m high drop over debris (remnants of old bridge) is present just d/s from road culvert: fish barrier.

Sample site was 30-40 m below the road - below the barrier. Several fry were visually observed just below the barrier.

Good cobble-boulder fry cover.

Small pockets of potential DV spawning.

Culvert dimensions: 1.9 m diameter by 17.3 m long with ~5% gradient.

Edited by: CP

Date Y M D 97/11/

DFO / MOE
STREAM SURVEY FORM

Stream Name	(gaz) Four Creek	(local) Four Creek			Access	V2	Method
Watershed Code	460-4227-096-256		ReachNo.	2	Lngth(km)	2.0
Location	Four Creek, ~25 m u/s from Telkwa Coal Mine Road.	Map # 093L065	SiteNo.	F2	LthSurv(m)	19.5
		U.T.M.	FishCard	Y (N)	Field [X]	Hist [ ]
Date Y.M.D 9 7 0 9 2 9	Time 1130	Agency C87	Crew CP/DA	Photos na	AirPhotos	

PARAMETER	VALUE	METH	SPECIFIC DATA
Ave. Chan. Width (m)	4.1		3.7, 5.2, 3.7, 3.6, 4.3
Ave. Wet. Width (m)	2.7		2.3, 2.3, 2.9, 3.6, 2.5
Ave.Max.Riffle Depth (cm)	25		23, 27, 26
Ave.Max.Pool Depth (cm)	33		42, 20, 29
Gradient %	9		
% Pool 50	Riffle 50	Run	Other
Side Chan.%	0 [X] 0-10 [ ] 10-40 [ ] >40 [ ]		
Debris Area%	0 [ ] 0-5 [ ] 5-15 [ ] >15 [X]		
Debris Stable%	70		
COVER: Total%	70		

Comp.	Dp.Pool	L.O.D.	Boulder	InVeg	OverVeg	Cutbank
sum 100%	10	10	70		5	5

Crown Closure %	60	Aspect	

OBSTRUCTIONS

Ht(m)	Type	Loc'n
1.5	X	
located d/s of road culvert.		

BED MATERIAL

		%
Fines	clay,silt,sand (<2mm)	5
Gravels	small (2-16mm)	5
	large (16-64mm)	5
Larges	sm. cobble (64-128mm)	10
	lge. cobble (128-256mm)	30
	boulder(>256mm)	45
Bedrock		
D90(cm) 55	Compaction	L (M) H

BANKS

Height(m)	1.0 %Unstable 5
Texture	(F) (G) L R
Confinement	EN (CO) FC OC UC N/A
Valley:Channel Ratio	(0-2) 2-5 5-10 10+ N/A
Stage	Dry (L) (M) H Flood
Flood Signs Ht(m)	0.6 Braided Y (N)
Bars (%)	5 pH 7.4 O_2(ppm)
WaterTemp(C)	5.0 Turb(cm) cl Cond(25C) 180

DISCHARGE /50 20

Parameter	Value	Method	Specific Data
Wetted Width (m)			
Mean Depth (m)			Estimated 1-2 c.f.s. discharge.
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL
(Fish)
(Width:Valley/Channel,Slope) BedMaterial

FISH SUMMARY

Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
		NO CATCH.			

STREAM/VALLEY CROSS-SECTION [ ]
(Looking Downstream)
L R
PLANIMETRIC VIEW [ ]

COMMENTS

Channel Stability [ ] Debris [X] Management Concerns [ ] Obstructions [X] Riparian Zone [ ] Valley Wall Processes [ ] Etc.

No fish were caught in site F2. ~15 m below and ~15 m above the site was spot shocked; no fish were caught or observed.
The ~1.5 m high drop present d/s from the road culvert is a barrier to fish.
Boulder-pool habitat with some log stepping; although steep, appears to be good for parr rearing.
Little potential spawning in this section of creek.

Edited by: CP
Date Y M D 97/11/

DFO / MOE
STREAM SURVEY FORM

Stream Name	(gaz) Four Creek	(local) Four Creek		Access	FT	Method	
Watershed Code	460-4227-096-256		ReachNo.	2	Lngth(km)	2.0	
Location	Site card just u/s from Tributary 1, ~600 m u/s from Telkwa Coal Mine Road.	Map #	093L065	SiteNo.	F3	LthSurv(m)	2000
		U.T.M.		FishCard	Y (N) circled	Field X	Hist.
Date Y.M.D	9 7 1 0 1 4	Time 1600	Agency C87	Crew RD/DA	Photos A3/15, 16	AirPhotos	

PARAMETER	VALUE	METH	SPECIFIC DATA
Ave. Chan. Width (m)	2.3		1.9, 2.7, 2.4
Ave. Wet. Width (m)	nr		
Ave.Max.Riffle Depth (cm)	15		
Ave.Max.Pool Depth (cm)	45		NOTE: BED MATERIAL WAS NOT RECORDED DUE TO WATER TURBIDITY.
Gradient %	4-5		
% Pool 30, Riffle 60, Run 10, Other			
Side Chan.%	0 X, 0-10, 10-40, >40		
Debris Area%	0, 0-5 X, 5-15, >15		
Debris Stable%	50		
COVER: Total%	60		
Comp. sum 100%: Dp.Pool 10, L.O.D. 20, Boulder 70, InVeg, OverVeg, Cutbank			
Crown Closure %		Aspect	

OBSTRUCTIONS

Ht(m)	Type	Loc'n
	Steep d/s.	

BED MATERIAL

		%
Fines	clay,silt,sand (<2mm)	
Gravels	small (2-16mm)	
	large (16-64mm)	
Larges	sm. cobble (64-128mm)	
	lge. cobble (128-256mm)	
	boulder(>256mm)	
Bedrock		
D90(cm)	nr	Compaction L M (H)

BANKS

Height(m)	1.0	%Unstable	25
Texture	(F) (G) L R		
Confinement	(EN) CO FC OC UC N/A		
Valley:Channel Ratio	(0-2) 2-5 5-10 10+ N/A		
Stage	Dry L (M) H Flood		
Flood Signs Ht(m)	0.3	Braided	Y (N)
Bars (%)	nr	pH nr	O₂(ppm)
WaterTemp(C)	nr	Turb(cm) 20	Cond(25C) nr

DISCHARGE

Parameter	Value	Method	Specific Data
Wetted Width (m)			
Mean Depth (m)			Estimated 6-7 c.f.s. discharge.
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL (Fish)

(Width:Valley/Channel,Slope) BedMaterial

FISH SUMMARY

Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
		NOT SAMPLED.			

STREAM/VALLEY CROSS-SECTION (Looking Downstream)

L R

PLANIMETRIC VIEW

COMMENTS

Channel Stability X Debris Management Concerns Obstructions Riparian Zone Valley Wall Processes Etc.

A lot of instability along banks.

Gradient of 4-5% at 400 m u/s from road; gravel-cobble and some potential SST spawning is present.

Tributary 1 enters Four C. at 525 m.

Gradient increases to 11% at 900 m and then decreases to 4% at 1000 m; bed material is gravel and continues u/s with the same gradient.

Edited by CP

Date Y M D 97/11/

DFO / MOE
STREAM SURVEY FORM

Stream Name	(gaz) Four Creek	(local) Four Creek	Access	V2	Method
Watershed Code	460-4227-096-256		ReachNo. 3	Lngth(km)	1.8
Location	Four Creek, at second road crossing.	Map # 093L055	SiteNo. F4	LthSurv(m)	25
		U.T.M.	FishCard (Y) N	Field ☒	Hist. ☐
Date Y.M.D 9 7 1 0 0 1	Time 1600	Agency C87	Crew RD/DA	Photos B4/12, 13	AirPhotos

PARAMETER	VALUE	METH	SPECIFIC DATA
Ave. Chan. Width (m)	2.4		3.1, 2.0, 2.1, 2.2
Ave. Wet. Width (m)	2.2		2.9, 2.0, 2.0, 2.0
Ave.Max.Riffle Depth (cm)	9		8, 10, 10
Ave.Max.Pool Depth (cm)	15		14, 12, 18
Gradient %	1-2		
% Pool 10 / Riffle 75 / Run 5 / Other			
Side Chan.%	0 ☒ 0-10 ☐ 10-40 ☐ >40 ☐		
Debris Area%	0 ☐ 0-5 ☒ 5-15 ☐ >15 ☐		
Debris Stable%	90		
COVER: Total%	50		
Comp. sum 100%	Dp.Pool 10, L.O.D. 20, Boulder 60, InVeg, OverVeg 10, Cutbank		
Crown Closure %			Aspect

OBSTRUCTIONS Ht(m)	Type	Loc'n

BED MATERIAL		%
Fines	clay,silt,sand (<2mm)	5
Gravels	small (2-16mm)	10
	large (16-64mm)	15
Larges	sm. cobble (64-128mm)	30
	lge. cobble (128-256mm)	25
	boulder(>256mm)	15
Bedrock		
D90(cm)	28	Compaction L (M) H

BANKS			
Height(m)	1.5	%Unstable	
Texture	(F) (G) L R		
Confinement	EN (CO) FC OC UC N/A		
Valley:Channel Ratio	0-2 (2-5) 5-10 10+ N/A		
Stage	Dry (L) M H Flood		
Flood Signs Ht(m)	0.3	Braided	Y (N)
Bars (%)	5	pH 7.5	O_2 (ppm)
WaterTemp(C)	5.5	Turb(cm) cl	Cond(25C) 150

DISCHARGE

/50 10

Parameter	Value	Method	Specific Data
Wetted Width (m)			
Mean Depth (m)			Estimated 2 c.f.s. discharge.
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL
(Fish)

(Width:Valley/Channel,Slope) BedMaterial

FISH SUMMARY

Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
DV	6	57-115	J	R	EF

NOTE: The fish data is the combined data for sites above and below the road; two of the six fish were caught in the enclosed site above the road.

STREAM/VALLEY CROSS-SECTION ☐
(Looking Downstream)

L R

PLANIMETRIC VIEW ☐

COMMENTS

Channel Stability ☐ Debris ☒ Management Concerns ☒ Obstructions ☒ Riparian Zone ☐ Valley Wall Processes ☐ Etc.

Spot shocked 10 m section below the road. Sampled a 15 m enclosed site above the road.
Heavy debris across the channel prevented a larger site from being sampled.
Low gradient, cobble-bedded stream with limited potential DV spawning.
Block was logged beside R. left bank; when the block was burned, the small buffer zone was burned also, causing trees to fall across the creek and changing the LOD composition.
Culverts at the road are impassable: 1 m x 19 m and 0.7 m x 19 m (Photo B4/14).

Edited by: CP
Date Y M D 97/11/

DFO / MOE
STREAM SURVEY FORM

Stream Name	(gaz) Four Creek	(local) Four Creek		Access	FT	Method
Watershed Code	460-4227-096-256		ReachNo. 4	Lngth(km)	1.1
Location	Upper Four Creek, just d/s of fork.	Map # 093L055	SiteNo. F5	LthSurv(m)	30
		U.T.M.	FishCard (Y) N	Field X	Hist.
Date Y.M.D 9 7 1 0 0 8	Time 1600	Agency C87	Crew CP/RD/DA	Photos A3/1, 2	AirPhotos

PARAMETER	VALUE	METH	SPECIFIC DATA
Ave. Chan. Width (m)	2.1		2.1, 2.7, 1.9, 1.7, 2.0
Ave. Wet. Width (m)	1.9		2.0, 2.4, 1.6, 1.5, 2.0
Ave.Max.Riffle Depth (cm)	6		
Ave.Max.Pool Depth (cm)	25		
Gradient %	4		
% Pool 20 / Riffle 60 / Run 20 / Other			
Side Chan.%	0 X / 0-10 / 10-40 / >40		
Debris Area%	0 / 0-5 X / 5-15 / >15		
Debris Stable%	95		
COVER: Total%	60		
Comp. sum 100%: Dp.Pool 10, L.O.D. 10, Boulder 75, InVeg, OverVeg, Cutbank 5			
Crown Closure %	15		Aspect

BED MATERIAL		%
Fines	clay,silt,sand (<2mm)	10
Gravels	small (2-16mm)	30
	large (16-64mm)	
Larges	sm. cobble (64-128mm)	40
	lge. cobble (128-256mm)	20
	boulder(>256mm)	
Bedrock		
D90(cm) 18	Compaction L (M) H	

BANKS	
Height(m)	3.0 %Unstable 0
Texture	(F) (G) L R
Confinement	EN (CO) FC OC UC N/A
Valley:Channel Ratio	0-2 (2-5) 5-10 10+ N/A
Stage	Dry (L) M H Flood
Flood Signs Ht(m)	0.2 Braided Y (N)
Bars (%)	10 pH 7.6 O_2(ppm)
WaterTemp(C)	1.0 Turb(cm) cl Cond(25C) 130

OBSTRUCTIONS: Ht(m) | Type | Loc'n

DISCHARGE /50 7

Parameter	Value	Method	Specific Data
Wetted Width (m)			
Mean Depth (m)			Estimated 2 c.f.s. discharge.
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL (Fish) (Width:Valley/Channel,Slope) BedMaterial

FISH SUMMARY

Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
CHAR	4	39-43	F	R	EF
DV	6	91-122	J	R	EF
All char fry were visually identified as DV.					

STREAM/VALLEY CROSS-SECTION (Looking Downstream) L R
PLANIMETRIC VIEW

COMMENTS

Channel Stability X Debris X Management Concerns Obstructions Riparian Zone X Valley Wall Processes Etc.

Hiked down to site from old block.
Small, stable creek in confined gully.
Some boulder/LOD habitat and pockets of potential spawning are present.
Moderate to low gradient in this section of creek (steeper u/s).

Edited by CP
Date Y M D 97/11/

DFO / MOE

STREAM SURVEY FORM

Stream Name	(gaz) Four Creek	(local) Four Creek		Access	FT	Method	
Watershed Code	460-4227-096-256		ReachNo.	5	Lngth(km)	0.3	
Location	Upper Four Creek.	Map #	093L055	SiteNo.	F6	LthSurv(m)	400
		U.T.M.		FishCard	Y (N)	Field X	Hist.
Date Y.M.D	9 7 1 0 1 4	Time nr	Agency C87	Crew RD/DA	Photos na	AirPhotos	

PARAMETER	VALUE	METH	SPECIFIC DATA
Ave. Chan. Width (m)	2.2		2.9, 1.7, 2.1
Ave. Wet. Width (m)	2.2		2.9, 1.7, 2.1
Ave.Max.Riffle Depth (cm)	8		
Ave.Max.Pool Depth (cm)	25		
Gradient %	8-11		
% Pool 30 / Riffle 60 / Run 10 / Other			
Side Chan.%	0 X / 0-10 / 10-40 / >40		
Debris Area%	0 / 0-5 X / 5-15 / >15		
Debris Stable%	75		
COVER: Total%	60		
Comp. sum 100%	Dp.Pool 10 / L.O.D. 15 / Boulder 70 / InVeg / OverVeg / Cutbank 5		
Crown Closure %	nr		Aspect

BED MATERIAL		%
Fines	clay,silt,sand (<2mm)	5
Gravels	small (2-16mm)	10
	large (16-64mm)	
Larges	sm. cobble (64-128mm)	20
	lge. cobble (128-256mm)	60
	boulder(>256mm)	5
Bedrock		
D90(cm)	18	Compaction L (M) H

BANKS			
Height(m)	0.8	%Unstable	0
Texture	(F) (G) L R		
Confinement	EN (CO) FC OC UC N/A		
Valley:Channel Ratio	(0-2) 2-5 5-10 10+ N/A		
Stage	Dry L (M) H Flood		
Flood Signs Ht(m)	0.4	Braided	Y (N)
Bars (%)	0	pH	nr
O_2(ppm)			
WaterTemp(C)	1.5	Turb(cm)	35
Cond(25C)	nr		

OBSTRUCTIONS Ht(m)	Type	Loc'n

DISCHARGE /50 12

Parameter	Value	Method	Specific Data
Wetted Width (m)			
Mean Depth (m)			Estimated 3 c.f.s. discharge.
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL (Fish)

(Width:Valley/Channel,Slope) BedMaterial

FISH SUMMARY

Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
		NOT SAMPLED.			

STREAM/VALLEY CROSS-SECTION (Looking Downstream) L R

PLANIMETRIC VIEW

COMMENTS

Channel Stability ☐ Debris ☐ Management Concerns ☐ Obstructions ☐ Riparian Zone ☐ Valley Wall Processes ☐ Etc.

Hiked lower section of south fork (upper Four C. mainstem) to determine upper extent of fish.
Moderate, low gradient creek from fork.
Good potential fish habitat in lower 30 m of stream.
8% gradient with pockets of potential DV spawning.
Gradient 11% at 50 m; riffle-pool cobble habitat.
Channel becomes more confined u/s and at 270 m is entrenched with bedrock and 19% gradient; end of fish habitat.
Further u/s the creek forks again. Although 19% gradient and marginal fish habitat, Triton caught 1 fish in a 300 m section of stream in the upper right fork. The upper left fork has a gradient of 25% and no fish potential (sampled u/s and no fish were caught).

Edited by: CP

Date Y M D 97/11/

DFO / MOE
STREAM SURVEY FORM

Stream Name	(gaz) Four Creek	(local) Four Creek		Access	V2	Method
Watershed Code	460-4227-096-256		ReachNo. 6	Lngth(km)	2.1
Location	Upper Four Creek; sampled below road culvert.	Map # 093L055	SiteNo. F7	LthSurv(m)	75
		U.T.M.	FishCard Y (N)	Field ☒	Hist. ☐
Date Y.M.D 9 7 1 0 0 8	Time 1700	Agency C87	Crew RD/CP/DA	Photos A3/5, 6	AirPhotos

C	PARAMETER	VALUE	METH	SPECIFIC DATA
	Ave. Chan. Width (m)	0.9		0.9, 0.7, 0.8, 1.1
	Ave. Wet. Width (m)	0.9		0.9, 0.7, 0.8, 1.1
	Ave.Max.Riffle Depth (cm)	3		
	Ave.Max.Pool Depth (cm)	11		12, 10, 13
	Gradient %	17		
	% Pool 15	Riffle 75	Run 10	Other
	Side Chan.%	0 ☒ 0-10 ☐ 10-40 ☐ >40 ☐		
	Debris Area%	0 ☐ 0-5 ☒ 5-15 ☐ >15 ☐		
	Debris Stable%	95		
	COVER: Total%	50		

Comp. sum 100%	Dp.Pool	L.O.D.	Boulder	InVeg	OverVeg	Cutbank
	30	15	30		5	20

Crown Closure %	nr	Aspect	

C	BED MATERIAL		%
	Fines	clay,silt,sand (<2mm)	5
	Gravels	small (2-16mm)	20
		large (16-64mm)	
	Larges	sm. cobble (64-128mm)	25
		lge. cobble (128-256mm)	40
		boulder(>256mm)	10
	Bedrock		
	D90(cm)	30	Compaction (L) M H
	/50	11	

C	BANKS			
	Height(m)	1.2	%Unstable	0
	Texture	(F) (G) L R		
	Confinement	EN (CO) FC OC UC N/A		
	Valley:Channel Ratio	0-2 (2-5) 5-10 10+ N/A		
	Stage	Dry (L) M H Flood		
	Flood Signs Ht(m)	0.2	Braided	Y (N)
	Bars (%)	<5	pH	7.6	O₂(ppm)
	WaterTemp(C)	1.5	Turb(cm) cl	Cond(25C) 110

OBSTRUCTIONS C	Ht(m)	Type	Loc'n
	Steep.		

DISCHARGE

Parameter	Value	Method	Specific Data
Wetted Width (m)			
Mean Depth (m)			Trickle flow discharge.
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL
(Fish)

(Width:Valley/Channel,Slope) BedMaterial

FISH SUMMARY

C	Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
	Spot shocked below road for 75 m length of					
	stream; No fish were caught/observed.					

STREAM/VALLEY CROSS-SECTION
(Looking Downstream)

L R

PLANIMETRIC VIEW

COMMENTS

Channel Stability ☐ Debris ☐ Management Concerns ☐ Obstructions ☒ Riparian Zone ☐ Valley Wall Processes ☐ Etc.

Creek too small and steep; no potential fish use.

Edited by CP

Date Y M D 97/11/

DFO / MOE
STREAM SURVEY FORM

Stream Name	(gaz) Four Creek Tributary 1	(local) Four Creek Tributary 1		Access	FT	Method
Watershed Code	460-4227-096-256		ReachNo. 2	Lngth(km)	1.3
Location	Four Creek Tributary 1, at spur road crossing.	Map # 093L065	SiteNo. F8	LthSurv(m)	45
		U.T.M.	FishCard Y (N) C	Field X	Hist. ☐
Date Y.M.D 9 7 1 0 2 2	Time 1400	Agency C87	Crew RD/DA	Photos A4/7, 8	AirPhotos

C	PARAMETER	VALUE	METH	SPECIFIC DATA
	Ave. Chan. Width (m)	3.2		4.1, 2.9, 3.1, 2.8
	Ave. Wet. Width (m)	3.2		4.1, 2.9, 3.1, 2.8
	Ave.Max.Riffle Depth (cm)	7		
	Ave.Max.Pool Depth (cm)	25		
	Gradient %	2		
	% Pool 20 / Riffle 10 / Run 70 / Other			
	Side Chan.%	0 X 0-10 ☐ 10-40 ☐ >40 ☐		
	Debris Area%	0 ☐ 0-5 X 5-15 ☐ >15 ☐		
	Debris Stable%	95		
	COVER: Total%	30		
	Comp. sum 100%	Dp.Pool 30, L.O.D. 20, Boulder, InVeg 10, OverVeg 20, Cutbank 20		
	Crown Closure %		Aspect	

OBSTRUCTIONS

C	Ht(m)	Type	Loc'n

C	BED MATERIAL		%
	Fines	clay,silt,sand (<2mm)	100
	Gravels	small (2-16mm)	
		large (16-64mm)	
	Larges	sm. cobble (64-128mm)	
		lge. cobble (128-256mm)	
		boulder(>256mm)	
	Bedrock		
	D90(cm)	<1	C Compaction (L) M H

C	BANKS	
	Height(m)	0.3 %Unstable 0
	Texture	(F) (G) L R
	Confinement	EN CO (FC) OC UC N/A
	Valley:Channel Ratio	0-2 (2-5) 5-10 10+ N/A
	Stage	Dry (L) M H Flood
	Flood Signs Ht(m)	nr Braided Y (N)
	Bars (%)	0 pH 7.3 O_2(ppm)
	WaterTemp(C)	2.5 Turb(cm) 35 Cond(25C) nr

DISCHARGE

Parameter	Value	Method	Specific Data
Wetted Width (m)			
Mean Depth (m)			Estimated 2 c.f.s. discharge.
Mean Velocity (m/s)			Water turbid with ~35 cm visibility.
Discharge (m3/s)			

REACH SYMBOL (Fish)

(Width:Valley/Channel,Slope) BedMaterial

FISH SUMMARY

C	Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
			NO CATCH.			

STREAM/VALLEY CROSS-SECTION (Looking Downstream)

L R

PLANIMETRIC VIEW

COMMENTS

Channel Stability ☐ Debris ☐ Management Concerns ☐ Obstructions ☐ Riparian Zone X Valley Wall Processes ☐ Etc.

Small, low gradient creek with heavy alder overstory and sand/silt bed material.
No potential spawning present in this section.
May dewater in summer/winter.
D/S at mouth, steep (12-15%), cobble, ~1 c.f.s. and 1 m wide; suspect no fish use.

Edited by: CP
Date Y M D 97/11/

DFO / MOE
STREAM SURVEY FORM

Stream Name	(gaz) Four Creek Tributary 2	(local) Four Creek Tributary 2		Access	FT	Method
Watershed Code	460-4227-096-256		ReachNo. 1	Lngth(km)	2.3
Location	Four Creek Tributary 2, the lower 120 m.	Map # 093L055	SiteNo. F9	LthSurv(m)	120
		U.T.M.	FishCard Y (N)	Field X	Hist.
Date Y.M.D	9 7 1 0 1 4	Time 1000	Agency C87	Crew RD/DA	Photos na	AirPhotos

PARAMETER	VALUE	METH	SPECIFIC DATA
Ave. Chan. Width (m)	1.9		1.9, 2.1, 1.7
Ave. Wet. Width (m)	1.9		1.9, 2.1, 1.7
Ave.Max.Riffle Depth (cm)	12		
Ave.Max.Pool Depth (cm)	30		
Gradient %	11-14		
% Pool 20, Riffle 60, Run 20, Other			
Side Chan.%	0 X, 0-10 ☐, 10-40 ☐, >40 ☐		
Debris Area%	0 ☐, 0-5 X, 5-15 ☐, >15 ☐		
Debris Stable%	90		
COVER: Total%	60		
Comp. sum 100%: Dp.Pool 20, L.O.D. 5, Boulder 70, InVeg, OverVeg, Cutbank 5			
Crown Closure %	5		Aspect

BED MATERIAL		%
Fines	clay,silt,sand (<2mm)	5
Gravels	small (2-16mm)	10
	large (16-64mm)	
Larges	sm. cobble (64-128mm)	20
	lge. cobble (128-256mm)	50
	boulder(>256mm)	15
Bedrock		
D90(cm) 27	Compaction	L (M) H
D50 10		

BANKS	
Height(m)	0.8 — %Unstable 0
Texture	(F) (G) L R
Confinement	EN (CO) FC OC UC N/A
Valley:Channel Ratio	0-2 (2-5) 5-10 10+ N/A
Stage	Dry L (M) H Flood
Flood Signs Ht(m)	nr — Braided Y (N)
Bars (%)	<5 — pH nr — O_2(ppm)
WaterTemp(C)	1.5 — Turb(cm) cl — Cond(25C) nr

OBSTRUCTIONS Ht(m)	Type	Loc'n

DISCHARGE Parameter	Value	Method	Specific Data
Wetted Width (m)			
Mean Depth (m)			Estimated 2-3 c.f.s. discharge.
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL (Fish)
(Width:Valley/Channel,Slope) BedMaterial

FISH SUMMARY Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
		NOT SAMPLED.			

STREAM/VALLEY CROSS-SECTION (Looking Downstream) L R
PLANIMETRIC VIEW

COMMENTS

Channel Stability ☐ Debris ☐ Management Concerns ☐ Obstructions ☐ Riparian Zone ☐ Valley Wall Processes ☐ Etc.

Lower 20 m of Tributary 2 has a gradient of 11% with cobble-boulder bed material.
Gradient continually steepens: 14% at 70 m and 19% at 100 m.
End of potential fish use at 100 m. (Sampled further u/s below the road crossing; no fish were caught.)

Edited by: CP
Date Y M D 97/11/

DFO / MOE
STREAM SURVEY FORM

Stream Name	(gaz) Four Creek Tributary 2	(local) Four Creek Tributary 2	Access V2	Method
Watershed Code	460-4227-096-256	ReachNo. 1	Lngth(km) 2.3	
Location	Four Creek Tributary 2, d/s from road culvert.	Map # 093L055	SiteNo. F10	LthSurv(m) 70
		U.T.M.	FishCard Y (N)	Field X Hist. ☐
Date Y.M.D 9 7 1 0 0 8	Time 1630	Agency C87	Crew RD/CP/DA	Photos A3/3, 4 AirPhotos

PARAMETER	VALUE	METH	SPECIFIC DATA
Ave. Chan. Width (m)	1.1		0.9, 1.1, 1.4, 0.7, 0.9, 1.3
Ave. Wet. Width (m)	1.1		0.9, 1.1, 1.4, 0.7, 0.9, 1.3
Ave.Max.Riffle Depth (cm)	3		
Ave.Max.Pool Depth (cm)	15		
Gradient %	18		
% Pool 5 Riffle 95 Run Other			
Side Chan.%	0 X 0-10 ☐ 10-40 ☐ >40 ☐		
Debris Area%	0 ☐ 0-5 X 5-15 ☐ >15 ☐		
Debris Stable%	90		
COVER: Total%	30		
Comp. sum 100%	Dp.Pool 20, L.O.D. 20, Boulder 60, InVeg, OverVeg, Cutbank		
Crown Closure %	nr		Aspect

BED MATERIAL		%
Fines	clay,silt,sand (<2mm)	5
Gravels	small (2-16mm)	5
	large (16-64mm)	30
Larges	sm. cobble (64-128mm)	30
	lge. cobble (128-256mm)	20
	boulder(>256mm)	10
Bedrock		
D90(cm) 25	Compaction L (M) H	

BANKS	
Height(m)	1.5 %Unstable 0
Texture	(F) (G) L R
Confinement	EN (CO) FC OC UC N/A
Valley:Channel Ratio	0-2 (2-5) 5-10 10+ N/A
Stage	Dry (L) M H Flood
Flood Signs Ht(m)	0.2 Braided Y (N)
Bars (%)	0 pH 7.7 O_2(ppm)
WaterTemp(C)	1.5 Turb(cm) cl Cond(25C) 130

OBSTRUCTIONS		
Ht(m)	Type	Loc'n
	Steep.	

DISCHARGE

Parameter	Value	Method	Specific Data
Wetted Width (m)			
Mean Depth (m)			Trickle flow discharge.
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL
(Fish)
(Width:Valley/Channel,Slope) BedMaterial

FISH SUMMARY

Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
Spot shocked 70 m length of stream d/s from					
road. No fish were caught/observed.					

STREAM/VALLEY CROSS-SECTION ☐
(Looking Downstream)
L R
PLANIMETRIC VIEW ☐

COMMENTS

Channel Stability ☐ Debris ☐ Management Concerns ☐ Obstructions ☐ Riparian Zone ☐ Valley Wall Processes ☐ Etc.

Creek too small and steep; no potential fish use.

Edited by: CP
Date Y M D 97/11/

DFO / MOE
STREAM SURVEY FORM

Stream Name	(gaz) Telkwa River	(local) Telkwa River	Access	V2	Method
Watershed Code	460-4227	ReachNo. 1	Lngth(km)	8.0	
Location	Lower Telkwa River side channel; near Bulkley River confluence.	Map # 093L065	SiteNo. SC1	LthSurv(m)	76
		U.T.M.	FishCard (Y) N	Field [X]	Hist. [ ]
Date Y.M.D	9 7 0 9 3 0	Time 1500	Agency C87	Crew RD/DA	Photos B4/8, 9
AirPhotos					

C	PARAMETER	VALUE	METH	SPECIFIC DATA
	Ave. Chan. Width (m)	~240		-calculated from air photo.
	Ave. Wet. Width (m)	4.3		1.6, 1.8, 1.6, 8.9, 7.2, 5.1, 4.9, 3.3 - ww's of side channel sampled.
	Ave.Max.Riffle Depth (cm)	15		
	Ave.Max.Pool Depth (cm)	35		
	Gradient %	<1		
	% Pool	Riffle 5	Run	Other 95 FLATS
	Side Chan.%	0 [X] 0-10 [ ] 10-40 [ ] >40 [ ]		
	Debris Area%	0 [ ] 0-5 [X] 5-15 [ ] >15 [ ]		
	Debris Stable%	10		
	COVER: Total%	20		
	Comp. sum 100%	Dp.Pool 30, L.O.D. 10, Boulder 20, InVeg –, OverVeg 10, Cutbank 30		
	Crown Closure %	5	Aspect	

BED MATERIAL		%
Fines	clay,silt,sand (<2mm)	10
Gravels	small (2-16mm)	30
	large (16-64mm)	
Larges	sm. cobble (64-128mm)	25
	lge. cobble (128-256mm)	30
	boulder(>256mm)	5
Bedrock		
D90(cm)	20	Compaction (L) M H

BANKS	
Height(m)	3.0
%Unstable	0
Texture	(F) (G) L R
Confinement	EN CO FC (OC) UC N/A
Valley:Channel Ratio	0-2 2-5 5-(10) 10+ N/A
Stage	Dry (L) M H Flood
Flood Signs Ht(m)	1.5
Braided	(Y) N
Bars (%)	70
pH	7.4
O_2 (ppm)	
WaterTemp(C)	9.0
Turb(cm)	cl
Cond(25C)	80

OBSTRUCTIONS			
C	Ht(m)	Type	Loc'n

DISCHARGE /50 7

Parameter	Value	Method	Specific Data
Wetted Width (m)			
Mean Depth (m)			Estimated <1 c.f.s. discharge.
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL (Fish)

(Width:Valley/Channel.Slope) BedMaterial

FISH SUMMARY

C	Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
	SST	40	37-63	F	R	EF
	SST	16	69--160	J	R	EF
	DV	1	103	J	R	EF
	CO	101	47-76	F	R	EF
	CO	23	77-104	J	R	EF
	MW	35	47-63	F	R	EF

STREAM/VALLEY CROSS-SECTION [ ]
(Looking Downstream)

L R

PLANIMETRIC VIEW [ ]

COMMENTS

Channel Stability [ ] Debris [ ] Management Concerns [ ] Obstructions [ ] Riparian Zone [X] Valley Wall Processes [ ] Etc.

Sampled a very small side channel.

Section is slow and flat with cutbank and alder overstory providing good cover.

Nice fry habitat along the cobble margins.

Many fish present in this site; may be survival problems in the winter?

Edited by CP

Date Y M D 97/11/

DFO / MOE
STREAM SURVEY FORM

Stream Name	(gaz) Telkwa River	(local) Telkwa River	Access	V2	Method
Watershed Code	460-4227	ReachNo. 1	Lngth(km)	8.0	
Location	Telkwa River side channel.	Map # 093L065	SiteNo. SC2	LthSurv(m)	50
		U.T.M.	FishCard (Y) N	Field X	Hist. ☐
Date Y.M.D	9 7 1 0 0 1	Time 1200	Agency C87	Crew RD/DA	Photos B4/10, 11 AirPhotos

PARAMETER	VALUE	METH	SPECIFIC DATA
Ave. Chan. Width (m)	~230		- calculated from air photos.
Ave. Wet. Width (m)	5.1		5.3, 5.0, 2.8, 4.1, 7.4, 6.3, 5.2, 5.0
Ave.Max.Riffle Depth (cm)	10		
Ave.Max.Pool Depth (cm)	35		
Gradient %	1		
% Pool 10, Riffle 30, Run 60, Other			
Side Chan.%	0 X 0-10 ☐ 10-40 ☐ >40 ☐		
Debris Area%	0 X 0-5 ☐ 5-15 ☐ >15 ☐		
Debris Stable%	na		
COVER: Total%	30		

Comp.	Dp.Pool	L.O.D.	Boulder	Algae	OverVeg	Cutbank
sum 100%	10		50	40		

Crown Closure %		Aspect	

OBSTRUCTIONS	Ht(m)	Type	Loc'n

BED MATERIAL		%
Fines	clay,silt,sand (<2mm)	15
Gravels	small (2-16mm)	20
	large (16-64mm)	20
Larges	sm. cobble (64-128mm)	10
	lge. cobble (128-256mm)	25
	boulder(>256mm)	10
Bedrock		
D90(cm)	30	Compaction (L) M H

BANKS	
Height(m)	3.0
%Unstable	0
Texture	(F) (G) L R
Confinement	EN CO FC OC (UC) N/A
Valley:Channel Ratio	0-2 2-5 5-10 (10+) N/A
Stage	Dry (L) M H Flood
Flood Signs Ht(m)	1.5
Braided	Y (N)
Bars (%)	70
pH	7.4
O_2 (ppm)	
WaterTemp(C)	8.0
Turb(cm)	cl
Cond(25C)	130

DISCHARGE /50 7

Parameter	Value	Method	Specific Data
Wetted Width (m)			
Mean Depth (m)			Estimated 2 c.f.s. discharge.
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL
(Fish)
(Width:Valley/Channel,Slope) BedMaterial

FISH SUMMARY

Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
SST	198	30-59	F	R	EF
SST	2	72-78	J	R	EF
BT	1	157	J	R	EF
CO	26	51-76	F	R	EF
CO	11	77-103	J	R	EF
MW	31	35-63	F	R	EF
LNC	6	27-32	F	R	EF

STREAM/VALLEY CROSS-SECTION
(Looking Downstream)
L R

PLANIMETRIC VIEW

COMMENTS

Channel Stability X Debris ☐ Management Concerns ☐ Obstructions ☐ Riparian Zone ☐ Valley Wall Processes ☐ Etc.

Sampled a slow, wide flat section with cobble margin along one side of the site.

Good fry cover despite the sandy bed material due to the extensive amount of brown algae growing within the channel.

Edited by: CP
Date Y M D 97/11/

DFO / MOE
STREAM SURVEY FORM

Stream Name	(gaz) Telkwa River	(local) Telkwa River	Access: FT	Method
Watershed Code	460-4227	ReachNo. 1	Lngth(km) 8.0
Location	Telkwa River side channel; located between margin sites MS6 and MS7.	Map # 093L065	SiteNo. SC3	LthSurv(m) 25
		U.T.M.	FishCard (Y) N	Field [X] Hist. [ ]
Date Y.M.D	9 7 1 0 0 3	Time 1300	Agency C87	Crew RD/DB/CP	Photos B5/6, 7	AirPhotos

PARAMETER	VALUE	METH	SPECIFIC DATA
Ave. Chan. Width (m)	168		200, 164, 140, 168 - CW's calculated from air photo.
Ave. Wet. Width (m)	10.6		8.0, 7.7, 8.9, 11.3, 12.9, 14.5
Ave.Max.Riffle Depth (cm)	12		
Ave.Max.Pool Depth (cm)	na		
Gradient %	1		
% Pool: — Riffle: 80 Run: — Other: 20 FLATS			
Side Chan.%	0 [X] 0-10 [ ] 10-40 [ ] >40 [ ]		
Debris Area%	0 [X] 0-5 [ ] 5-15 [ ] >15 [ ]		
Debris Stable%	na		
COVER: Total%	65		
Comp. sum 100%: Dp.Pool — L.O.D. — Boulder 100 InVeg — OverVeg — Cutbank —			
Crown Closure %			Aspect

OBSTRUCTIONS: Ht(m) | Type | Loc'n — (none recorded)

BED MATERIAL		%
Fines	clay,silt,sand (<2mm)	
Gravels	small (2-16mm)	10
	large (16-64mm)	
Larges	sm. cobble (64-128mm)	15
	lge. cobble (128-256mm)	45
	boulder(>256mm)	30
Bedrock		
D90(cm)	33	Compaction L (M) H
D50	20	

BANKS			
Height(m)	3.0	%Unstable	0
Texture	(F) (G) L R		
Confinement	EN CO FC (OC) UC N/A		
Valley:Channel Ratio	0-2 2-5 5-(10) 10+ N/A		
Stage	Dry (L) M H Flood		
Flood Signs Ht(m)	2.0	Braided	Y (N)
Bars (%)	0	pH	7.3	O_2 (ppm)
WaterTemp(C)	4.5	Turb(cm)	cl	Cond(25C) 60

DISCHARGE

Parameter	Value	Method	Specific Data
Wetted Width (m)			
Mean Depth (m)			Estimated 10 c.f.s. discharge.
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL (Fish)

(Width:Valley/Channel,Slope) BedMaterial

FISH SUMMARY

Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
SST	172	31-48	F	R	EF
SST	20	63-122	J	R	EF
CHAR	1	57	F	R	EF
DV	1	82	J	R	EF
BT	2	71-107	J	R	EF
MW	4	59-61	F	R	EF

The char fry was visually identified as a BT.

STREAM/VALLEY CROSS-SECTION (Looking Downstream) L R

PLANIMETRIC VIEW

COMMENTS

Channel Stability [ ] Debris [ ] Management Concerns [ ] Obstructions [ ] Riparian Zone [ ] Valley Wall Processes [ ] Etc.

Hiked in from private property; sampled a side channel on river right.

Habitat consists mainly of wide, fast cobble-riffle with some flats along the margin areas.

Bed material is covered with brown algae.

Edited by CP

Date Y M D 97/11/

DFO / MOE
STREAM SURVEY FORM

Stream Name	(gaz) Telkwa River	(local) Telkwa River				Access	V2 / Method
Watershed Code	460-4227			ReachNo.	1	Lngth(km)	8.0
Location	Telkwa River side channel, at proposed bridge crossing.	Map #	093L065	SiteNo.	SC4	LthSurv(m)	33
		U.T.M.		FishCard	(Y) N	Field X	Hist. ☐
Date Y.M.D	9 7 1 0 2 1	Time 1130	Agency C87	Crew RD/DA	Photos A4/1, 2	AirPhotos	

PARAMETER	VALUE	METH	SPECIFIC DATA
Ave. Chan. Width (m)	120		- CW calculated from air photo.
Ave. Wet. Width (m)	5.7		6.4, 5.4, 5.5, 6.7, 5.8, 4.5 (Enclosed site only.)
Ave.Max.Riffle Depth (cm)	16		17, 15, 18
Ave.Max.Pool Depth (cm)	75		75
Gradient %	1.5		
% Pool 20	Riffle 35	Run 30	Other 15 FLATS
Side Chan.%	0 X 0-10 ☐ 10-40 ☐ >40 ☐		
Debris Area%	0 ☐ 0-5 ☐ 5-15 X >15 ☐		
Debris Stable%	90		
COVER: Total%	60		
Comp. sum 100%	Dp.Pool 15	L.O.D. 25	Boulder 60 / InVeg / OverVeg / Cutbank
Crown Closure %	0		Aspect

OBSTRUCTIONS

Ht(m)	Type	Loc'n

BED MATERIAL

		%
Fines	clay,silt,sand (<2mm)	5
Gravels	small (2-16mm)	10
Gravels	large (16-64mm)	
Larges	sm. cobble (64-128mm)	30
Larges	lge. cobble (128-256mm)	40
Larges	boulder(>256mm)	15
Bedrock		
D90(cm) 36	Compaction	L M (H)

BANKS

Height(m)	3.5 / %Unstable 0
Texture	(F) (G) L R
Confinement	EN (CO) FC OC UC N/A
Valley:Channel Ratio	(0-2) 2-5 5-10 10+ N/A
Stage	Dry (L) M H Flood
Flood Signs Ht(m)	1.5 / Braided Y (N)
Bars (%)	30 / pH 7.4 / O_2(ppm)
WaterTemp(C)	4.5 / Turb(cm) cl / Cond(25C) nr

DISCHARGE /50 12

Parameter	Value	Method	Specific Data
Wetted Width (m)			
Mean Depth (m)			Estimated 10 c.f.s. discharge.
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL (Fish)

(Width:Valley/Channel,Slope) BedMaterial

FISH SUMMARY

Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
SST	53	34-58	F	R	EF
SST	28	66-153	J	R	EF
BT	5	88-219	J	R	EF
DV	2	117-124	J	R	EF
CO	5	62-72	F	R	EF
CO	1	78	J	R	EF

STREAM/VALLEY CROSS-SECTION ☐
(Looking Downstream)

L R

PLANIMETRIC VIEW ☐

COMMENTS

Channel Stability ☐ Debris X Management Concerns ☐ Obstructions ☐ Riparian Zone ☐ Valley Wall Processes ☐ Etc.

Best site this season for good fish habitat and complexity.
Excellent small side channel complex of habitat types (riffle, pool, run, flats).
Cobble bed material with some debris along R. left margin.
Excellent parr/juv. char habitat for 75% of this site.
Good fry habitat along the slower flat areas.

Edited by: CP
Date Y M D 97/11/

DFO / MOE
STREAM SURVEY FORM

Stream Name	(gaz) Telkwa River	(local) Telkwa River				Access V2	Method
Watershed Code	460-4227		ReachNo.	1	Lngth(km)	8.0	
Location	Lower Telkwa River margin site; at end of Cottonwood St. in Telkwa.	Map # 093L065	SiteNo.	MS1	LthSurv(m)	22.8	
		U.T.M.	FishCard	(Y) N	C	Field X	Hist. ☐
Date Y.M.D	9 7 1 0 0 9	Time 1000	Agency C87	Crew RD/CP/DA	Photos A3/7	AirPhotos	

C	PARAMETER	VALUE	METH	SPECIFIC DATA
	Ave. Chan. Width (m)	201		172, 208, 240, 184 - CW's calculated from air photo.
	Ave. Wet. Width (m)	3.5		2.0, 3.8, 4.2, 4.3, 3.8, 3.1 (Enclosed site only.)
	Ave.Max.Riffle Depth (cm)	38		
	Ave.Max.Pool Depth (cm)	na		
	Gradient %	1		
	% Pool / Riffle 60 / Run 40 / Other			
	Side Chan.%	0 X 0-10 ☐ 10-40 ☐ >40 ☐		
	Debris Area%	0 X 0-5 ☐ 5-15 ☐ >15 ☐		
	Debris Stable%	na		
	COVER: Total%	70		
	Comp. sum 100%: Dp.Pool / L.O.D. / Boulder 100 / InVeg / OverVeg / Cutbank			
	Crown Closure %	0		Aspect

OBSTRUCTIONS

C	Ht(m)	Type	Loc'n

BED MATERIAL

C			%
	Fines	clay,silt,sand (<2mm)	5
	Gravels	small (2-16mm)	
		large (16-64mm)	10
		sm. cobble (64-128mm)	15
	Larges	lge. cobble (128-256mm)	30
		boulder(>256mm)	40
	Bedrock		
	D90(cm) 35	Compaction	L (M) H
	/50	18	

BANKS

C		
	Height(m)	2.0 %Unstable 0
	Texture	(F) (G) L R
	Confinement	EN CO FC (OC) UC N/A
	Valley:Channel Ratio	0-2 2-5 5 (10) 10+ N/A
	Stage	Dry (L) M H Flood
	Flood Signs Ht(m)	2.0 Braided Y (N)
	Bars (%)	0 pH 7.4 O_2(ppm)
	WaterTemp(C)	1.9 Turb(cm) cl Cond(25C) 60

DISCHARGE

Parameter	Value	Method	Specific Data
Wetted Width (m)			
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL
(Fish)

(Width Valley/Channel,Slope) BedMaterial

FISH SUMMARY

C	Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
	SST	30	32-47	F	R	EF
	SST	6	64-108	J	R	EF
	BT	1	152	J	R	EF

STREAM/VALLEY CROSS-SECTION
(Looking Downstream)

L R

PLANIMETRIC VIEW

COMMENTS

Channel Stability ☐ Debris ☐ Management Concerns ☐ Obstructions ☐ Riparian Zone ☐ Valley Wall Processes ☐ Etc.

Site consists mainly of boulder and cobble with high flows on the edge of the site and some slow flats within ~1.5 m of the margin.

Edited by: CP
Date Y M D 97/11/

DFO / MOE
STREAM SURVEY FORM

Stream Name	(gaz) Telkwa River	(local) Telkwa River	Access	V2	Method	
Watershed Code	460-4227		ReachNo.	1	Lngth(km)	8.0
Location	Telkwa River margin site, ~60 m u/s from Site MS1.	Map # 093L065	SiteNo.	MS2	LthSurv(m)	20.2
		U.T.M.	FishCard	(Y) N	Field X	Hist.
Date Y.M.D	9 7 1 0 0 9	Time 1200	Agency C87	Crew RD/DA/CP	Photos A3/8	AirPhotos

PARAMETER	VALUE	METH	SPECIFIC DATA
Ave. Chan. Width (m)	201		172, 208, 240, 184 - CW's calculated from air photo.
Ave. Wet. Width (m)	4.8		3.3, 5.3, 6.7, 6.0, 4.3, 2.9 (Enclosed site only.)
Ave.Max.Riffle Depth (cm)	20		
Ave.Max.Run Depth (cm)	58		
Gradient %	1		
% Pool	Riffle 20	Run 80	Other
Side Chan.%	0 X 0-10 ☐ 10-40 ☐ >40 ☐		
Debris Area%	0 X 0-5 ☐ 5-15 ☐ >15 ☐		
Debris Stable%	na		
COVER: Total%	60		
Comp. sum 100%: Dp.Pool / L.O.D. / Boulder / InVeg / OverVeg / Cutbank	Boulder 100		
Crown Closure %	0		Aspect

BED MATERIAL		%
Fines	clay,silt,sand (<2mm)	5
Gravels	small (2-16mm)	15
	large (16-64mm)	
Larges	sm. cobble (64-128mm)	20
	lge. cobble (128-256mm)	40
	boulder(>256mm)	20
Bedrock		
D90(cm)	28	Compaction L (M) H
/50	14	

BANKS			
Height(m)	2.0	%Unstable	0
Texture	(F) (G) L R		
Confinement	EN CO FC (OC) UC N/A		
Valley:Channel Ratio	0-2 2-5 5-(10) 10+ N/A		
Stage	Dry (L) M H Flood		
Flood Signs Ht(m)	2.0	Braided	Y (N)
Bars (%)	0	pH	7.4
O₂ (ppm)			
WaterTemp(C)	1.9	Turb(cm)	cl
Cond(25C)	70		

OBSTRUCTIONS	Ht(m)	Type	Loc'n

DISCHARGE Parameter	Value	Method	Specific Data
Wetted Width (m)			
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL (Fish)

(Width:Valley/Channel,Slope) BedMaterial

FISH SUMMARY

Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
SST	28	33-51	F	R	EF
SST	2	67-86	J	R	EF
CH	1	58	F	R	EF

STREAM/VALLEY CROSS-SECTION (Looking Downstream)

L R

PLANIMETRIC VIEW

COMMENTS

Channel Stability ☐ Debris ☐ Management Concerns ☐ Obstructions ☐ Riparian Zone ☐ Valley Wall Processes ☐ Etc.

Cobble margin site with primarily run habitat and a bit of riffle.

Edited by: CP

Date Y M D 97/11/

DFO / MOE
STREAM SURVEY FORM

Stream Name	(gaz) Telkwa River	(local) Telkwa River			Access	V2 Method
Watershed Code	460-4227		ReachNo.	1	Lngth(km)	8.0
Location	Telkwa River margin site, u/s from Site MS2.	Map # 093L065	SiteNo.	MS3	LthSurv(m)	15.6
		U.T.M.	FishCard	(Y) N	C	Field ☒ Hist. ☐
Date Y.M.D	9 7 1 0 0 9	Time 1400	Agency C87	Crew RD/CP/DA	Photos A3/9, 10	AirPhotos

C	PARAMETER	VALUE	METH	SPECIFIC DATA
	Ave. Chan. Width (m)	201		172, 208, 240, 184 - CW's calculated from air photo.
	Ave. Wet. Width (m)	7.1		4.1, 7.3, 9.4, 10.3, 9.5, 5.7, 3.1 (Enclosed site only.)
	Ave.Max.Riffle Depth (cm)	25		
	Ave.Max.Pool Depth (cm)	na		
	Gradient %	1		
	% Pool — Riffle 60 — Run 40 — Other			
	Side Chan.%	0 ☒ 0-10 ☐ 10-40 ☐ >40 ☐		
	Debris Area%	0 ☒ 0-5 ☐ 5-15 ☐ >15 ☐		
	Debris Stable%	na		
	COVER: Total%	70		
	Comp. sum 100%: Dp.Pool — L.O.D. — Boulder 100 — InVeg — OverVeg — Cutbank			
	Crown Closure %	0		C Aspect

OBSTRUCTIONS C	Ht(m)	Type	Loc'n

C	BED MATERIAL		%
	Fines	clay,silt,sand (<2mm)	5
	Gravels	small (2-16mm)	10
		large (16-64mm)	
		sm. cobble (64-128mm)	15
	Larges	lge. cobble (128-256mm)	30
		boulder(>256mm)	40
	Bedrock		
	D90(cm)	36	C Compaction L (M) H
	/50	19	

C	BANKS			
	Height(m)	2.0	%Unstable	0
	Texture	(F) (G) L R		
	Confinement	EN CO FC (OC) UC N/A		
	Valley:Channel Ratio	0-2 2-5 5 (10) 10+ N/A		
	Stage	Dry (L) M H Flood		
	Flood Signs Ht(m)	2.0	Braided	Y (N)
	Bars (%)	0	pH 7.6	O_2 (ppm)
	WaterTemp(C)	2.0	Turb(cm) cl	Cond(25C) 60

DISCHARGE

Parameter	Value	Method	Specific Data
Wetted Width (m)			
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL (Fish)

(Width Valley/Channel Slope) — BedMaterial

FISH SUMMARY

C	Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
	SST	36	32-58	F	R	EF
	SST	9	64-103	J	R	EF
	CHAR	1	53	F	R	EF

The char fry was visually identified as a DV.

STREAM/VALLEY CROSS-SECTION
(Looking Downstream)

L — R

PLANIMETRIC VIEW

COMMENTS

Channel Stability ☐ Debris ☐ Management Concerns ☐ Obstructions ☐ Riparian Zone ☐ Valley Wall Processes ☐ Etc.

Sampled a short, wide, cobble-riffle section.

Excellent parr habitat for outer half of site.

Good fry and small juv. habitat along margin section of site.

Edited by CP

Date Y M D 97/11/

DFO / MOE
STREAM SURVEY FORM

Stream Name	(gaz) Telkwa River	(local) Telkwa River			Access	V2	Method
Watershed Code	460-4227		ReachNo.	1	Lngth(km)	8.0
Location	Telkwa River margin site, just u/s from Site MS3.	Map # 093L065	SiteNo.	MS4	LthSurv(m)	20.7
		U.T.M.	FishCard	(Y) N	Field X	Hist.
Date Y.M.D	9 7 1 0 0 9	Time 1600	Agency C87	Crew RD/CP/DA	Photos A3/11, 12	AirPhotos

PARAMETER	VALUE	METH	SPECIFIC DATA
Ave. Chan. Width (m)	201		172, 208, 240, 184 - CW's calculated from air photo.
Ave. Wet. Width (m)	5.7		4.7, 6.6, 7.6, 7.4, 6.0, 5.6, 2.3 (Enclosed site only.)
Ave.Max.Riffle Depth (cm)	20		
Ave.Max.Run Depth (cm)	32		
Gradient %	1		
% Pool / Riffle 10 / Run 90 / Other			
Side Chan.%	0 X 0-10 ☐ 10-40 ☐ >40 ☐		
Area%	0 ☐ 0-5 X 5-15 ☐ >15 ☐		
Debris Stable%	95		
COVER: Total%	60		
Comp. sum 100%	Dp.Pool: ; L.O.D.: 5; Boulder: 95; InVeg: ; OverVeg: ; Cutbank:		
Crown Closure %	0		Aspect

BED MATERIAL		%
Fines	clay,silt,sand (<2mm)	10
Gravels	small (2-16mm)	5
	large (16-64mm)	10
	sm. cobble (64-128mm)	30
Larges	lge. cobble (128-256mm)	35
	boulder(>256mm)	10
Bedrock		
D90(cm)	27	Compaction L (M) H
D50	11	

BANKS	
Height(m)	2.0
%Unstable	0
Texture	(F) (G) L R
Confinement	EN CO FC (OC) UC N/A
Valley:Channel Ratio	0-2 2-5 5-(10) 10+ N/A
Stage	Dry (L) M H Flood
Flood Signs Ht(m)	2.0
Braided	Y (N)
Bars (%)	
pH	7.6
O_2 (ppm)	
WaterTemp(C)	1.9
Turb(cm)	cl
Cond(25C)	60

OBSTRUCTIONS

C	Ht(m)	Type	Loc'n

DISCHARGE

Parameter	Value	Method	Specific Data
Wetted Width (m)			
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL
(Fish)
(Width:Valley/Channel,Slope) BedMaterial

FISH SUMMARY

C	Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
	SST	26	32-49	F	R	EF
	SST	9	68-102	J	R	EF
	CH	3	60-67	F	R	EF
	BT	1	225	J	R	EF
	CO	1	69	F	R	EF
	CO	2	70-85	J	R	EF
	MW	1	60	F	R	EF

STREAM/VALLEY CROSS-SECTION
(Looking Downstream)
L R

PLANIMETRIC VIEW

COMMENTS

Channel Stability ☐ Debris X Management Concerns ☐ Obstructions ☐ Riparian Zone ☐ Valley Wall Processes ☐ Etc.

Primarily run habitat within site.
Debris along margin with most of it dewatered.
Fines/cobbles within 2 m of the margin.

Edited by: CP
Date Y M D 97/11/

DFO / MOE

STREAM SURVEY FORM

Stream Name	(gaz) Telkwa River	(local) Telkwa River		Access	FT	Method	
Watershed Code	460-4227			ReachNo.	1	Lngth(km)	8.0
Location	Telkwa River, bay area just off the German carver's property.	Map #	093L065	SiteNo.	MS5	LthSurv(m)	33
		U.T.M.		FishCard	(Y) N	Field [X]	Hist. [ ]
Date Y.M.D	9 7 1 0 0 3	Time 1000	Agency C87	Crew RD/DA/CP	Photos B4/22, 23	AirPhotos	

PARAMETER	VALUE	METH	SPECIFIC DATA
Ave. Chan. Width (m)	168		200, 164, 140, 168 - CW's calculated from air photo.
Ave. Wet. Width (m)	6.7		8.5, 8.9, 8.2, 8.1, 3.1, 7.1, 2.8 - plus bay area of 4.6 m x 1.3 m
Ave.Max.Riffle Depth (cm)	10		(Enclosed site only.)
Ave.Max.Run Depth (cm)	45		
Gradient %	1		
% Pool: — Riffle: 10 Run: — Other: 90	FLATS		
Side Chan.%	0 [X] 0-10 [ ] 10-40 [ ] >40 [ ]		
Debris Area%	0 [ ] 0-5 [X] 5-15 [ ] >15 [ ]		
Debris Stable%	90		
COVER: Total%	25		
Comp. sum 100%: Dp.Pool 10, L.O.D. —, Boulder 80, Algae 10, OverVeg —, Cutbank —			
Crown Closure %	0		Aspect

BED MATERIAL		%
Fines	clay,silt,sand (<2mm)	10
Gravels	small (2-16mm)	30
	large (16-64mm)	
Larges	sm. cobble (64-128mm)	45
	lge. cobble (128-256mm)	5
	boulder(>256mm)	10
Bedrock		
D90(cm) 32	Compaction	L (M) H
D50	9	

BANKS			
Height(m)	3.0	%Unstable	0
Texture	(F) (G) L R		
Confinement	EN CO FC (OC) UC N/A		
Valley:Channel Ratio	0-2 2-5 5-(10) 10+ N/A		
Stage	Dry (L) M H Flood		
Flood Signs Ht(m)	1.5	Braided	Y (N)
Bars (%)	nr	pH 7.4	O$_2$(ppm)
WaterTemp(C)	4.0	Turb(cm) cl	Cond(25C) 60

OBSTRUCTIONS Ht(m)	Type	Loc'n

DISCHARGE

Parameter	Value	Method	Specific Data
Wetted Width (m)			
Mean Depth (m)			Trickle flow discharge entering top of bay.
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL (Fish)

(Width Valley/Channel,Slope) BedMaterial

FISH SUMMARY

Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
SST	67	31-61	F	R	EF
SST	2	71-108	J	R	EF
BT	1	180	J	R	EF
MW	2	54-68	F	R	EF

STREAM/VALLEY CROSS-SECTION (Looking Downstream)

L R

PLANIMETRIC VIEW

COMMENTS

Channel Stability [ ] Debris [ ] Management Concerns [ ] Obstructions [ ] Riparian Zone [ ] Valley Wall Processes [ ] Etc.

Sampled a bay area off the mainstem of the Telkwa River.

Edited by CP

Date Y M D 97/11/

DFO / MOE
STREAM SURVEY FORM

Stream Name	(gaz) Telkwa River	(local) Telkwa River	Access FT / Method
Watershed Code	460-4227	ReachNo. 1	Lngth(km) 8.0
Location	Telkwa River margin site, 50 m u/s from Site MS5. Map # 093L065	SiteNo. MS6	LthSurv(m) 16.5
	U.T.M.	FishCard (Y) N	Field [X] Hist. [ ]
Date Y.M.D 9 7 1 0 0 3	Time 1130 Agency C87 Crew RD/DA/DB Photos B5/2, 3	AirPhotos	

PARAMETER	VALUE	METH	SPECIFIC DATA
Ave. Chan. Width (m)	168		200, 164, 140, 168 - CW's calculated from air photo.
Ave. Wet. Width (m)	6.7		5.5, 7.2, 7.7, 7.9, 5.0 (Enclosed site only.)
Ave.Max.Riffle Depth (cm)	na		
Ave.Max.Run Depth (cm)	39		35, 37, 46
Gradient %	1		
% Pool / Riffle / Run 100 / Other			
Side Chan.%	0 [X] 0-10 [ ] 10-40 [ ] >40 [ ]		
Debris Area%	0 [X] 0-5 [ ] 5-15 [ ] >15 [ ]		
Debris Stable%	na		
COVER: Total%	75		
Comp. sum 100%: Dp.Pool / L.O.D. / Boulder 100 / InVeg / OverVeg / Cutbank			
Crown Closure %	0		Aspect ·

OBSTRUCTIONS

Ht(m)	Type	Loc'n

BED MATERIAL		%
Fines	clay,silt,sand (<2mm)	5
Gravels	small (2-16mm)	10
	large (16-64mm)	
Larges	sm. cobble (64-128mm)	20
	lge. cobble (128-256mm)	40
	boulder(>256mm)	25
Bedrock		
D90(cm)	32	Compaction L (M) H

BANKS			
Height(m)	3.0	%Unstable	0
Texture	(F) (G) L R		
Confinement	EN CO FC (OC) UC N/A		
Valley:Channel Ratio	0-2 2-5 5-(10) 10+ N/A		
Stage	Dry (L) M H Flood		
Flood Signs Ht(m)	1.5	Braided	Y (N)
Bars (%)	nr	pH	7.3
O2 (ppm)			
WaterTemp(C)	4.0	Turb(cm)	cl
Cond(25C)	60		

DISCHARGE /50 17

Parameter	Value	Method	Specific Data
Wetted Width (m)			
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL
(Fish)
(Width:Valley/Channel,Slope) BedMaterial

FISH SUMMARY

Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
SST	32	31-48	F	R	EF
SST	4	70-109	J	R	EF
CHAR	1	51	F	R	EF
The char fry was visually identified as a BT.					

STREAM/VALLEY CROSS-SECTION
(Looking Downstream)
L R
PLANIMETRIC VIEW

COMMENTS
Channel Stability [ ] Debris [ ] Management Concerns [ ] Obstructions [ ] Riparian Zone [ ] Valley Wall Processes [ ] Etc.

Sampled a slow run section with large cobble and boulder bed material.
Excellent fry habitat for ~1.5 m along the margin.
Good parr habitat throughout site.

Edited by: CP
Date Y M D 97/11/

DFO / MOE

STREAM SURVEY FORM

Stream Name	(gaz) Telkwa River	(local) Telkwa River	Access	FT	Method	
Watershed Code	460-4227		ReachNo.	1	Lngth(km)	8.0
Location	Telkwa River margin site, 150 m u/s from Site MS6.	Map # 093L065	SiteNo.	MS7	LthSurv(m)	22
		U.T.M.	FishCard	(Y) N	Field X	Hist. ☐
Date Y.M.D	9 7 1 0 0 3	Time 1200	Agency C87	Crew RD/DB/DA	Photos B5/4, 5	AirPhotos

PARAMETER	VALUE	METH	SPECIFIC DATA
Ave. Chan. Width (m)	168		200, 164, 140, 168 - CW's calculated from air photo.
Ave. Wet. Width (m)	5.1		2.8, 5.7, 7.4, 6.6, 2.9 (Enclosed site only.)
Ave.Max.Riffle Depth (cm)	25		18, 36, 21
Ave.Max.Pool Depth (cm)	na		
Gradient %	1		
% Pool / Riffle / Run / Other	Riffle 90; Other 10 (FLATS)		
Side Chan.%	0 X 0-10 ☐ 10-40 ☐ >40 ☐		
Debris Area%	0 X 0-5 ☐ 5-15 ☐ >15 ☐		
Debris Stable%	na		
COVER: Total%	80		
Comp. sum 100%	Dp.Pool: ; L.O.D.: ; Boulder: 100; InVeg: ; OverVeg: ; Cutbank:		
Crown Closure %	0		Aspect

BED MATERIAL		%
Fines	clay,silt,sand (<2mm)	5
Gravels	small (2-16mm)	10
	large (16-64mm)	
Larges	sm. cobble (64-128mm)	10
	lge. cobble (128-256mm)	45
	boulder(>256mm)	30
Bedrock		
D90(cm)	35	Compaction L (M) H
/50	18	

BANKS	
Height(m)	3.0
%Unstable	0
Texture	(F) (G) L R
Confinement	EN CO FC (OC) UC N/A
Valley:Channel Ratio	0-2 2-5 (5-10) 10+ N/A
Stage	Dry (L) M H Flood
Flood Signs Ht(m)	2.0
Braided	Y (N)
Bars (%)	nr
pH	7.3
O₂ (ppm)	
WaterTemp(C)	4.5
Turb(cm)	cl
Cond(25C)	60

OBSTRUCTIONS Ht(m)	Type	Loc'n

DISCHARGE

Parameter	Value	Method	Specific Data
Wetted Width (m)			
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL (Fish)

(Width:Valley/Channel,Slope) BedMaterial

FISH SUMMARY

C	Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
	SST	78	31-45	F	R	EF
	SST	8	78-127	J	R	EF
	CHAR	1	56	F	R	EF
	MW	1	60	F	R	EF

The char fry was visually identified as a BT.

STREAM/VALLEY CROSS-SECTION ☐ (Looking Downstream)

L R

PLANIMETRIC VIEW ☐

COMMENTS

Channel Stability ☐ Debris ☐ Management Concerns ☐ Obstructions ☐ Riparian Zone ☐ Valley Wall Processes ☐ Etc.

Sampled a very fast boulder-riffle section.

Excellent fry habitat for 1-2 m along the margin.

Good parr habitat throughout most of the site.

Poor fish habitat along the outer edge of net due to high water velocities.

Edited by: CP

Date Y M D 97/11/

DFO / MOE

STREAM SURVEY FORM

Stream Name	(gaz) Telkwa River	(local) Telkwa River			Access	V2	Method
Watershed Code	460-4227		ReachNo.	1	Lngth(km)	8.0	
Location	Telkwa River margin site, just d/s from proposed bridge crossing, 30 m d/s from Site SC4.	Map # 093L065 / U.T.M.	SiteNo.	MS8	LthSurv(m)	19.3	
			FishCard	(Y) N	Field X	Hist. ☐	
Date Y.M.D	9 7 1 0 2 1	Time 1400	Agency C87	Crew RD/DA	Photos A4/3, 4	AirPhotos	

PARAMETER	VALUE	METH	SPECIFIC DATA
Ave. Chan. Width (m)	120		- CW calculated from air photo.
Ave. Wet. Width (m)	4.7		4.3, 5.7, 6.4, 4.7, 2.5 (Sample site only.)
Ave.Max.Run Depth (cm)	45		
Ave.Max.Pool Depth (cm)	na		
Gradient %	1		
% Pool / Riffle / Run 100 / Other			
Side Chan.%	0 X 0-10 ☐ 10-40 ☐ >40 ☐		
Debris Area%	0 X 0-5 ☐ 5-15 ☐ >15 ☐		
Debris Stable%	na		
COVER: Total%	75		
Crown Closure %	0		Aspect

Comp. sum 100%	Dp.Pool	L.O.D.	Boulder	InVeg	OverVeg	Cutbank
			100			

OBSTRUCTIONS

Ht(m)	Type	Loc'n

BED MATERIAL

		%
Fines	clay,silt,sand (<2mm)	
Gravels	small (2-16mm)	10
	large (16-64mm)	
Larges	sm. cobble (64-128mm)	10
	lge. cobble (128-256mm)	25
	boulder(>256mm)	55
Bedrock		
D90(cm)	60	Compaction L M (H)

BANKS

Height(m)	2.5
%Unstable	0
Texture	(F) (G) L R
Confinement	EN (CO) FC OC UC N/A
Valley:Channel Ratio	(0-2) 2-5 5-10 10+ N/A
Stage	Dry L (M) H Flood
Flood Signs Ht(m)	1.5
Braided	Y (N)
Bars (%)	30
pH	7.6
O2 (ppm)	
WaterTemp(C)	4.5
Turb(cm)	cl
Cond(25C)	nr

DISCHARGE /50 20

Parameter	Value	Method	Specific Data
Wetted Width (m)			
Mean Depth (m)			Telkwa River at moderate flows.
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL (Fish)

(Width:Valley/Channel,Slope) BedMaterial

FISH SUMMARY

Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
SST	12	38-52	F	R	EF
SST	2	68-98	J	R	EF
MW	2	60	F	R	EF

STREAM/VALLEY CROSS-SECTION (Looking Downstream)

L R

PLANIMETRIC VIEW

COMMENTS

Channel Stability ☐ Debris ☐ Management Concerns ☐ Obstructions ☐ Riparian Zone ☐ Valley Wall Processes ☐ Etc.

Boulder/cobble margin site consisting primarily of run habitat.

Good parr rearing habitat despite the low catch.

Edited by: CP

Date Y M D 97/11/

DFO / MOE
STREAM SURVEY FORM

Stream Name	(gaz) Telkwa River	(local) Telkwa River	Access	FT	Method	
Watershed Code	460-4227		ReachNo.	1	Lngth(km)	8.0
Location	350 m below Goathorn Creek confluence; at proposed bridge crossing site.	Map # 093L065	SiteNo.	MS9	LthSurv(m)	~100
		U.T.M.	FishCard	Y (N)	Field X	Hist. ☐
Date Y.M.D	9 7 1 1 0 1	Time nr	Agency C87	Crew RD	Photos A3/19-25	AirPhotos

PARAMETER	VALUE	METH	SPECIFIC DATA
Ave. Chan. Width (m)	est. ~60 m		
Ave. Wet. Width (m)	nr		
Ave.Max.Riffle Depth (cm)	100		
Ave.Max.Pool Depth (cm)	350		
Gradient %	1-2		
% Pool 15 / Riffle 70 / Run 10 / Other			
Side Chan.%	0 ☐ 0-10 X 10-40 ☐ >40 ☐		
Area%	0 ☐ 0-5 X 5-15 ☐ >15 ☐		
Debris Stable%	10		
COVER: Total%	70		
Comp. sum 100%	Dp.Pool 15, L.O.D. 5, Boulder 80, InVeg, OverVeg, Cutbank		
Crown Closure %		Aspect	

BED MATERIAL		%
Fines	clay,silt,sand (<2mm)	5
Gravels	small (2-16mm)	15
	large (16-64mm)	
	sm. cobble (64-128mm)	20
Larges	lge. cobble (128-256mm)	40
	boulder(>256mm)	20
Bedrock		
D90(cm)	30	Compaction L (M) H

BANKS			
Height(m)		%Unstable	
Texture	F (G) L (R)		
Confinement	EN CO (FC) OC UC N/A		
Valley:Channel Ratio	0-2 (2-5) 5-10 10+ N/A		
Stage	Dry L (M) H Flood		
Flood Signs Ht(m)	2.5	Braided	Y (N)
Bars (%)	10	pH	7.7
O₂ (ppm)			
WaterTemp(C)	3.0	Turb(cm)	cl
Cond(25C)			

OBSTRUCTIONS: Ht(m) | Type | Loc'n

DISCHARGE /50 14

Parameter	Value	Method	Specific Data
Wetted Width (m)			
Mean Depth (m)			Telkwa River at moderate flows. Water slightly
Mean Velocity (m/s)			tannic in colour.
Discharge (m3/s)			

REACH SYMBOL (Fish)

(Width:Valley/Channel,Slope) BedMaterial

FISH SUMMARY

C	Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
			NOT SAMPLED.			

STREAM/VALLEY CROSS-SECTION
(Looking Downstream)

L R

PLANIMETRIC VIEW

COMMENTS

Channel Stability ☐ Debris X Management Concerns ☐ Obstructions ☐ Riparian Zone X Valley Wall Processes ☐ Etc.

Banks: R. left bank consists of 20 m high bedrock with a flat bench on top.

R. right bank consists of a 2.5-3.0 m high cobble-gravel bank.

A small cobble bar island is present in the center of the river at the crossing site. The R. right channel consists of 100% riffle. The R. left channel consists of deep pool habitat.

U/S of crossing very confined single channel; d/s of crossing channel is wider and less confined.

Boulder-cobble bed; substrate is smaller at pool outlets and slow flow sections - suitable for salmon spawning, but makes up only a small percentage of the channel area.

Potential sampling sections: R. right side channel is too large for sampling.

Some good cobble margin is present below pool on R. left.

U/S from site habitat is a slow run; water is too deep along the shoreline to sample.

Nice channel for sampling is present between the debris jams on R. left.

Edited by CP

Date Y M D 97/11/

DFO / MOE
STREAM SURVEY FORM

Stream Name	(gaz) Telkwa River	(local) Telkwa River	Access: V2 / Method
Watershed Code	460-4227	ReachNo. 1	Lngth(km) 8.0
Location	Lower 300 m of Telkwa River flood channel located below road at PNG crossing.	Map # 093L065 / U.T.M.	SiteNo. WL1 / LthSurv(m) 1200
FishCard	(Y) N	Field X	Hist.
Date Y.M.D	9 7 1 1 0 4	Time 900	Agency C87
Crew	RD/DA	Photos A5/18, 19	AirPhotos

PARAMETER	VALUE	METH	SPECIFIC DATA
Ave. Chan. Width (m)	4.0		2.5, 4.8, 4.0, 4.7
Ave. Wet. Width (m)	2.5		1.8, 2.3, 3.8, 3.5
Ave.Max.Riffle Depth (cm)	3		
Ave.Max.Pool Depth (cm)	38		
Gradient %	2		
% Pool 10 / Riffle 60 / Run 30 / Other			
Side Chan.%	0 ☐ 0-10 ☒ 10-40 ☐ >40 ☐		
Debris Area%	0 ☐ 0-5 ☒ 5-15 ☐ >15 ☐		
Debris Stable%	75		
COVER: Total%	50		
Comp. sum 100%	Dp.Pool 65 / L.O.D. 15 / Boulder 20 / InVeg / OverVeg / Cutbank		
Crown Closure %	0		Aspect

BED MATERIAL		%
Fines	clay,silt,sand (<2mm)	55
Gravels	small (2-16mm)	10
	large (16-64mm)	
Larges	sm. cobble (64-128mm)	20
	lge. cobble (128-256mm)	15
	boulder(>256mm)	
Bedrock		
D90(cm) 13	Compaction	L (M) H

BANKS			
Height(m)	1.6	%Unstable	0
Texture	(F) G L R		
Confinement	EN CO FC OC (UC) N/A		
Valley:Channel Ratio	0-2 2-5 5-10 (10+) N/A		
Stage	Dry (L) M H Flood		
Flood Signs Ht(m)	1.6	Braided	Y (N)
Bars (%)	50	pH	nr
O2 (ppm)			
WaterTemp(C)	4.0	Turb(cm)	cl
Cond(25C)	nr		

OBSTRUCTIONS: Ht(m) | Type | Loc'n

DISCHARGE

Parameter	Value	Method	Specific Data
Wetted Width (m)			
Mean Depth (m)			Estimated 1 c.f.s. discharge.
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL (Fish)
(Width:Valley/Channel,Slope) BedMaterial

FISH SUMMARY

Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
SST	1	83	J	R	MT
CO	107	49-76	F	R	MT
		77-99	J	R	MT

Set 10 traps in flood channel for 24 h. period.

STREAM/VALLEY CROSS-SECTION
(Looking Downstream)
L R
PLANIMETRIC VIEW

COMMENTS

Channel Stability ☐ Debris ☒ Management Concerns ☐ Obstructions ☐ Riparian Zone ☐ Valley Wall Processes ☐ Etc.

Nice, low gradient, seepage-fed channel.
Evidence of high flows - flood waters had blown out old beaver dams and left debris above the banks.
Sand/silt bed material with some cobble in riffle areas.
Good coho rearing and potential coho enhancement area.
No potential spawning in this section of channel.

Edited by: CP
Date Y M D 97/11/

DFO / MOE
STREAM SURVEY FORM

Stream Name	(gaz) Hubert Creek	(local) Lower Hubert Creek	Access: V2 / Method
Watershed Code	460-4370	ReachNo. 1	Lngth(km) 3.7
Location	~80 m d/s from CNR culverts. Map # 093L065	SiteNo. HUB1	LthSurv(m) 800 m
	U.T.M.	FishCard (Y) N	Field X Hist.
Date Y.M.D	9 7 0 8 1 4 Time 930 Agency C87 Crew CP Photos na	AirPhotos	

PARAMETER	VALUE	METH	SPECIFIC DATA
Ave. Chan. Width (m)	10.5		12.0, 10.9, 8.8, 11.6, 9.1, 10.6
Ave. Wet. Width (m)	7.6		7.7, 8.3, 6.9, 8.7, 6.6, 7.3
Ave.Max.Riffle Depth (cm)			n/a
Ave.Max.Pool Depth (cm)	1.0		1.2, 0.8, 0.9
Gradient %	1.5		
% Pool 95 / Riffle / Run 5 / Other			
Side Chan.%	0–10 X		
Debris Area%	5–15 X		
Debris Stable%	100		
COVER: Total%	95		
Comp. sum 100: Dp.Pool 30, L.O.D. 15, Boulder, InVeg 40, OverVeg 10, Cutbank 5			
Crown Closure %	10		Aspect

OBSTRUCTIONS: Ht(m) | Type | Loc'n (none recorded)

BED MATERIAL		%
Fines	clay,silt,sand (<2mm)	95
Gravels	small (2-16mm)	5
	large (16-64mm)	
Larges	sm. cobble (64-128mm)	
	lge. cobble (128-256mm)	
	boulder(>256mm)	
Bedrock		
D90(cm)	<1	Compaction (L) M H

BANKS			
Height(m)	0.5	%Unstable	0
Texture	(F) G L R		
Confinement	EN CO FC OC (UC) N/A		
Valley:Channel Ratio	0-2 2-5 5-10 (10+) N/A		
Stage	Dry L (M) H Flood		
Flood Signs Ht(m)	0.2	Braided	Y (N)
Bars (%)	5	pH	7.8
O2(ppm)			
WaterTemp(C)	15.5	Turb(cm)	cl
Cond(25C)	250		

DISCHARGE

Parameter	Value	Method	Specific Data
Wetted Width (m)			
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL (Fish)
(Width:Valley/Channel,Slope) BedMaterial

FISH SUMMARY

C	Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
	SST	4	87-125	J	R	MT
	CO	2	50	F	R	MT
	CO	2	75-89	J	R	MT
	CH	44	41-58	F	R	MT
	LSU	2	57-89	F/J	R	MT
	LNC	10	42-72	F/J	R	MT

12 traps were set for 24 h. period from Hubert C. mouth to the CNR culverts.

STREAM/VALLEY CROSS-SECTION (Looking Downstream) L R

PLANIMETRIC VIEW

COMMENTS

Channel Stability X Debris Management Concerns Obstructions X Riparian Zone Valley Wall Processes Etc.

Site card was filled out ~10 m d/s from breached BD. Channel was ponded with 1 m+ pools u/s of the BD - unable to wade across to record the channel widths in this section.
Instream grasses and mosses are abundant and make up the majority of cover.
Habitat primarily pool with some ponded areas and sections of glide.
Mud/silt bed material with small pockets of fine gravels are present.
All BD's d/s of CNR crossing are old and are not a barrier to fish.
There is no site card for HUB2. 12 traps were set for 24 h. period from the CNR culverts to the Hydro line (the HUB 2 section). The catch consisted of: - 3 coho - 3 longnose sucker
- 2 steelhead - 114 longnose dace
- 2 chinook

Edited by: CP
Date Y M D: 97/11/26

DFO / MOE
STREAM SURVEY FORM

Stream Name	(gaz) Hubert Creek	(local) Lower Hubert Creek			Access	V2 Method
Watershed Code	460-4370		ReachNo.	1	Lngth(km)	3.7
Location	Site card ~70 m d/s from Lawson Road.	Map # 093L065	SiteNo.	HUB3	LthSurv(m)	100m
		U.T.M.	FishCard	(Y) N	Field X	Hist.
Date Y.M.D 9 7 0 8 1 4	Time 1030	Agency C87	Crew CP	Photos B1/18-20	AirPhotos	

PARAMETER	VALUE	METH	SPECIFIC DATA
Ave. Chan. Width (m)	3.4		3.5, 2.9, 2.5, 4.5, 3.2, 3.9
Ave. Wet. Width (m)	2.9		3.1, 2.5, 2.0, 3.6, 2.6, 3.3
Ave.Max.Riffle Depth (cm)	nr		
Ave.Max.Pool Depth (cm)	47		55, 50, 35
Gradient %	1		
% Pool 70 / Riffle 30 / Run / Other			
Side Chan.%	0 ☐ 0-10 ☐ 10-40 X >40 ☐		
Debris Area%	0 ☐ 0-5 ☐ 5-15 ☐ >15 X		
Debris Stable%	100		
COVER: Total%	80		
Comp. sum 100: Dp.Pool 25 / L.O.D. 40 / Boulder / InVeg / OverVeg 35 / Cutbank			
Crown Closure %	50		Aspect

OBSTRUCTIONS

Ht(m)	Type	Loc'n

BED MATERIAL

		%
Fines	clay,silt,sand (<2mm)	85
Gravels	small (2-16mm)	5
	large (16-64mm)	10
Larges	sm. cobble (64-128mm)	
	lge. cobble (128-256mm)	
	boulder(>256mm)	
Bedrock		
D90(cm)	<1	Compaction (L) M H

BANKS

Height(m)	0.4
%Unstable	0
Texture	(F) G L R
Confinement	EN CO FC OC (UC) N/A
Valley:Channel Ratio	0-2 2-5 5-10 (10+) N/A
Stage	Dry L (M) H Flood
Flood Signs Ht(m)	0.3
Braided	Y (N)
Bars (%)	5
pH	7.7
O2(ppm)	
WaterTemp(C)	16.5
Turb(cm)	cl
Cond(25C)	240

DISCHARGE

Parameter	Value	Method	Specific Data
Wetted Width (m)			Estimated 0.5 c.f.s. discharge.
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL (Fish)

(Width:Valley/Channel,Slope) BedMaterial

FISH SUMMARY

Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
CO	1	111	J	R	MT
LNC	5	66-87	J	R	MT
LSU	1	62	J	R	MT

12 traps were set for 24 h. period from the Hydro line to 200 m u/s from Lawson Road.

STREAM/VALLEY CROSS-SECTION (Looking Downstream)

L R

PLANIMETRIC VIEW

COMMENTS

Channel Stability ☐ Debris ☐ Management Concerns X Obstructions X Riparian Zone ☐ Valley Wall Processes ☐ Etc.

Some gravels are present but bed material is primarily silt.

Heavy alder/willow overstory.

5 traps were set overnight in a BD-ponded area 200 m u/s from Lawson Road. (Photo B1/20). Longnose dace were caught.

150 m u/s from powerline, large 1.6 m high BD is present. Numerous salmon juveniles were visible d/s of this BD.

Restriction to fish but not a barrier during some years with very high flows. (A large juvenile coho was trapped ~30 m u/s from Lawson Road crossing.)

Edited by: CP

Date Y M D 97/11/26

DFO / MOE
STREAM SURVEY FORM

Stream Name	(gaz) Hubert Creek	(local) Lower Hubert Creek			Access	FT	Method
Watershed Code	460-4370		ReachNo.	1	Lngth(km)	3.7	
Location	Lower Hubert Creek in beaver dam swamp area in wide meadow.	Map #	093L065	SiteNo. HUB4	LthSurv(m)	50 m	
		U.T.M.		FishCard	Y (N)	Field X	Hist.
Date Y.M.D	9 7 1 0 1 6	Time nr	Agency C87	Crew RD/DA	Photos A3/17, 18	AirPhotos	

PARAMETER	VALUE	METH	SPECIFIC DATA
Ave. Chan. Width (m)	nr		
Ave. Wet. Width (m)	6-8		
Ave.Max.Riffle Depth (cm)	na		Est. run depth of 3-4 m.
Ave.Max.Pool Depth (cm)	na		
Gradient %	<1		
% Pool / Riffle / Run 100 / Other			
Side Chan.%	0 X 0-10 / 10-40 / >40		
Debris Area%	0 X 0-5 / 5-15 / >15		
Debris Stable%	na		
COVER: Total%	40		
Comp. sum 100: Dp.Pool 30; L.O.D. ; Boulder ; InVeg 50; OverVeg ; Cutbank			
Crown Closure %	0		Aspect

OBSTRUCTIONS		
Ht(m)	Type	Loc'n
Beaver dams present d/s.		

BED MATERIAL		%
Fines	clay,silt,sand (<2mm)	100
Gravels	small (2-16mm)	
	large (16-64mm)	
Larges	sm. cobble (64-128mm)	
	lge. cobble (128-256mm)	
	boulder(>256mm)	
Bedrock		
D90(cm)	<1	Compaction (L) M H

BANKS			
Height(m)	1.0	%Unstable	0
Texture	(F) G L R		
Confinement	EN CO FC OC (UC) N/A		
Valley:Channel Ratio	0-2 2-5 5-10 (10+) N/A		
Stage	Dry (L) M H Flood		
Flood Signs Ht(m)		Braided	Y (N)
Bars (%)	0	pH	7.2
O_2(ppm)			
WaterTemp(C)	4.5	Turb(cm)	ta
Cond(25C)	130		

DISCHARGE

Parameter	Value	Method	Specific Data
Wetted Width (m)			Long ponded section; appears to be very stagnant.
Mean Depth (m)			Water is tannic in colour.
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL
(Fish)

(Width:Valley/Channel.Slope) BedMaterial

FISH SUMMARY

Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
Set 20 traps in meadow for 24 hours.					
		NO CATCH.			

STREAM/VALLEY CROSS-SECTION
(Looking Downstream)

L R

PLANIMETRIC VIEW

COMMENTS

Channel Stability ☐ Debris ☐ Management Concerns X Obstructions X Riparian Zone ☐ Valley Wall Processes ☐ Etc.

No fish were observed within the large ponded channel.
Suspect this section of creek may have water quality problems i.e. low D.O. levels and hot summer temperatures.
Access into this section of creek is poor due to BD's d/s.
No potential spawning habitat was observed.
Generally poor fish habitat.

Edited by CP
Date Y M D 97/11/26

DFO / MOE

STREAM SURVEY FORM

Stream Name	(gaz) Hubert Creek Tributary HT1	(local) Hubert Creek Tributary HT1			Access	FT	Method
Watershed Code	460-4370		ReachNo.	1	Lngth(km)	1.8	
Location	Located mid-way u/s on seepage bog area.	Map # 093L065	SiteNo.	HUB5	LthSurv(m)	1800	
		U.T.M.	FishCard	Y (N)		Field X	Hist.
Date Y.M.D 9 7 1 1 1 3	Time 1300	Agency C87	Crew RD	Photos A6/1, 2	AirPhotos		

PARAMETER	VALUE	METH	SPECIFIC DATA
Ave. Chan. Width (m)	29		22, 28, 36
Ave. Wet. Width (m)	25		17, 25, 32
Ave.Max.Riffle Depth (cm)	na		
Ave.Max.Pool Depth (cm)	est. ~30 cm		Pool sections were iced over at the time of survey.
Gradient %	<1		
% Pool / Riffle / Run / Other	Other 100	FLATS	
Side Chan.%	0 X 0-10 ☐ 10-40 ☐ >40 ☐		
Debris Area%	0 X 0-5 ☐ 5-15 ☐ >15 ☐		
Debris Stable%	na		
COVER: Total%	75		

Comp.	Dp.Pool	L.O.D.	Boulder	InVeg	OverVeg	Cutbank
sum 100	20	5		70	5	

Crown Closure %		Aspect	

BED MATERIAL		%
Fines	clay,silt,sand (<2mm)	100
Gravels	small (2-16mm)	
	large (16-64mm)	
Larges	sm. cobble (64-128mm)	
	lge. cobble (128-256mm)	
	boulder(>256mm)	
Bedrock		
D90(cm)	nr	Compaction (L) M H

BANKS			
Height(m)		%Unstable	0
Texture	(F) G L R		
Confinement	EN (CO) FC OC UC N/A		
Valley:Channel Ratio	(0-2) 2-5 5-10 10+ N/A		
Stage	(Dry) (L) M H Flood		
Flood Signs Ht(m)		Braided	(Y) N
Bars (%)	0	pH	O2(ppm)
WaterTemp(C)	nr	Turb(cm) cl	Cond(25C) nr

OBSTRUCTIONS		
Ht(m)	Type	Loc'n
Channel is dewatered in sections.		

DISCHARGE

Parameter	Value	Method	Specific Data
Wetted Width (m)			Stagnant, ponded slough.
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL

(Fish)

(Width:Valley/Channel,Slope) BedMaterial

FISH SUMMARY

Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
		NOT SAMPLED.			
SUGGEST AREA BE TRAPPED IN THE SPRING.					

STREAM/VALLEY CROSS-SECTION

(Looking Downstream)

L R

PLANIMETRIC VIEW

COMMENTS

Channel Stability X Debris ☐ Management Concerns ☐ Obstructions X Riparian Zone ☐ Valley Wall Processes ☐ Etc.

Shallow, weeded bog with no visible flow. Maximum depth ~30 cm with some dewatered sections of channel.

Instream brush/grass is abundant.

Easy fish access during high flow in the spring. Channel is dewatered u/s from just below the culvert at the landowner's house.

Gradient is very low d/s of the culvert.

Landowner said the previous owner had caught fish in the spring at this location; there is flow for ~3 weeks as a large stream which forms

a lake above the culvert. Some years it stays wet enough to prevent hay crops.

Suspect some use by CO, SST, LSU, LNC.

Edited by: CP

Date Y M D 97/11/26

DFO / MOE
STREAM SURVEY FORM

Stream Name	(gaz) Hubert Creek	(local) Hubert Creek				Access	V2	Method
Watershed Code	460-4370			ReachNo.	2	Lngth(km)	1.6
Location	Immediately u/s from PNG crossing of Hubert C. Access via fields at Help's Farm.	Map #	093L065	SiteNo.	HUB6	LthSurv(m)	38
		U.T.M.		FishCard	Y (N)	Field X	Hist.
Date Y.M.D	9 7 0 8 0 9	Time 1420	Agency C87	Crew DB/CP	Photos A1/14-16	AirPhotos	

PARAMETER	VALUE	METH	SPECIFIC DATA
Ave. Chan. Width (m)	3.4		6.3, 2.8, 2.5, 2.5, 2.6, 3.8
Ave. Wet. Width (m)	2.3		3.0, 2.3, 2.5, 2.5, 1.7, 1.5
Ave.Max.Riffle Depth (cm)	10		10, 10, 10
Ave.Max.Pool Depth (cm)	27		25, 25, 30
Gradient %	2		
% Pool 20 / Riffle 60 / Run 20 / Other			
Side Chan.%	0 X		0-10 ☐ 10-40 ☐ >40 ☐
Debris Area%	0 ☐ 0-5 X 5-15 ☐ >15 ☐		
Debris Stable%	50		
COVER: Total%	60		
Comp. sum 100%	Dp.Pool: ; L.O.D.: 5; Boulder: 75; InVeg: ; OverVeg: 10; Cutbank: 10		
Crown Closure %	95		Aspect

BED MATERIAL		%
Fines	clay,silt,sand (<2mm)	
Gravels	small (2-16mm)	
	large (16-64mm)	40
Larges	sm. cobble (64-128mm)	40
	lge. cobble (128-256mm)	20
	boulder(>256mm)	
Bedrock		
D90(cm)	20	Compaction (L) M H

BANKS	
Height(m)	0.8
%Unstable	50
Texture	(F) (G) L R
Confinement	EN CO FC OC (UC) N/A
Valley:Channel Ratio	0-2 2-5 5-(10) 10+ N/A
Stage	Dry L (M) H Flood
Flood Signs Ht(m)	0.4
Braided	Y (N)
Bars (%)	30
pH	8.7
O_2(ppm)	
WaterTemp(C)	11.0
Turb(cm)	cl
Cond(25C)	110

OBSTRUCTIONS Ht(m)	Type	Loc'n

DISCHARGE /50 5

Parameter	Value	Method	Specific Data
Wetted Width (m)			Estimated 3-4 c.f.s. discharge.
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL (Fish)

(Width:Valley/Channel,Slope) BedMaterial

FISH SUMMARY

Species	No	Size Range(mm)	Life Phase	Use	Method/Ref
CT	2	135-179	J	R	EF

STREAM/VALLEY CROSS-SECTION (Looking Downstream)

L R

PLANIMETRIC VIEW

COMMENTS

Channel Stability ☐ Debris ☐ Management Concerns X Obstructions ☐ Riparian Zone X Valley Wall Processes ☐ Etc.

Evidence of cattle causing bank erosion just d/s. Photo A1/16: cattle in the creek.
Appears to be excellent rearing habitat - especially for fry.
Surprised at low fish abundance in this section. Access problems from lower area - beaver?
Hiked 400 m d/s from site: some spawning potential in this section. 3% slope and thick brush cover. Several 0.5 m high drops over debris - not fish barriers.
The two fish caught at this site appeared to be residents.

Edited by CP
Date Y M D 97/11/26

DFO / MOE

STREAM SURVEY FORM

Stream Name	(gaz) Hubert Creek	(local) Hubert Creek	Access: ATV; Method
Watershed Code	460-4370	ReachNo. 3	Lngth(km) 1.0
Location	Between PNG crossing and Hydro line.	Map # 093L065; SiteNo. HUB8	LthSurv(m) 30
		U.T.M.; FishCard Y (N)	Field X Hist.
Date Y.M.D	9 7 1 0 2 2; Time 1130; Agency C87; Crew RD/DA	Photos A4/5, 6	AirPhotos

PARAMETER	VALUE	METH	SPECIFIC DATA
Ave. Chan. Width (m)	5.4		5.1, 4.6, 5.9, 6.5, 4.8
Ave. Wet. Width (m)	2.9		1.9, 2.3, 2.8, 3.2, 4.3
Ave.Max.Riffle Depth (cm)	11		11, 11, 12
Ave.Max.Pool Depth (cm)	30		35, 30, 25
Gradient %	3-4		
% Pool 20; Riffle 60; Run 15; Other 5			
Side Chan.%	0 ☐ 0-10 ☒ 10-40 ☐ >40 ☐		
Debris Area%	0 ☐ 0-5 ☒ 5-15 ☐ >15 ☐		
Debris Stable%	90		
COVER: Total%	50		
Comp. sum 100: Dp.Pool 30; L.O.D. 10; Boulder 20; InVeg; OverVeg 20; Cutbank 20			
Crown Closure %			Aspect

OBSTRUCTIONS (Ht(m), Type, Loc'n): Beaver ponds below.

BED MATERIAL		%
Fines	clay,silt,sand (<2mm)	10
Gravels	small (2-16mm)	10
	large (16-64mm)	20
Larges	sm. cobble (64-128mm)	50
	lge. cobble (128-256mm)	10
	boulder(>256mm)	
Bedrock		
D90(cm) 11	Compaction L (M) H	

BANKS	
Height(m)	1.0; %Unstable 0
Texture	(F) (G) L R
Confinement	EN CO FC (OC) UC N/A
Valley:Channel Ratio	0-2 (2-5) 5-10 10+ N/A
Stage	Dry (L) M H Flood
Flood Signs Ht(m)	0.4; Braided Y (N)
Bars (%)	40; pH 7.5; O_2 (ppm)
WaterTemp(C)	4.0; Turb(cm) cl; Cond(25C) nr

DISCHARGE /50 6

Parameter	Value	Method	Specific Data
Wetted Width (m)			Estimated 3-4 c.f.s. discharge.
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL (Fish)

(Width:Valley/Channel,Slope) BedMaterial

FISH SUMMARY

Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
CT	1	150-177	J	R	EF

Site was 30 m in length. 1 CT was captured (FL= 150 mm).

Also spot sampled d/s for 60 m length of stream (270 sec.). 1 CT was captured (FL=177 mm).

STREAM/VALLEY CROSS-SECTION (Looking Downstream) L R

PLANIMETRIC VIEW

COMMENTS

Channel Stability ☐ Debris ☐ Management Concerns ☐ Obstructions ☒ Riparian Zone ☐ Valley Wall Processes ☐ Etc.

Limited potential for spawning in this section - mainly large gravel/small cobble bed material.

Surprisingly low fish densities. Suspect access problems from d/s areas.

Suspect two fish sampled were stream residents.

Edited by: CP

Date Y M D 97/11/26

DFO / MOE
STREAM SURVEY FORM

Stream Name	(gaz) Hubert Creek	(local) Hubert Creek		Access: ATV	Method
Watershed Code	460-4370		ReachNo. 4	Lngth(km)	1.8
Location	Sampled at Hydro line crossing.	Map # 093L065	SiteNo. HUB9	LthSurv(m)	30
		U.T.M.	FishCard Y (N)	Field X	Hist.
Date Y.M.D 9 7 0 8 0 7	Time 1430	Agency C87	Crew RD	Photos B1/1, 2	AirPhotos

C	PARAMETER	VALUE	METH	SPECIFIC DATA
	Ave. Chan. Width (m)	2.5		1.8, 2.1, 2.3, 1.7, 2.7, 4.5
	Ave. Wet. Width (m)	1.9		1.8, 1.9, 1.9
	Ave.Max.Riffle Depth (cm)	12		12
	Ave.Max.Pool Depth (cm)	27		27
	Gradient %	4-5		
	% Pool 20, Riffle 70, Run 10, Other			
	Side Chan.%	0 ☐ 0-10 ☒ 10-40 ☐ >40 ☐		
	Debris Area%	0 ☐ 0-5 ☒ 5-15 ☐ >15 ☐		
	Debris Stable%	70		
	COVER: Total%	60		
	Comp. sum 100: Dp.Pool 20, L.O.D. 20, Boulder 40, InVeg, OverVeg 10, Cutbank 10			
	Crown Closure %	50		Aspect

C	BED MATERIAL		%
	Fines	clay,silt,sand (<2mm)	10
	Gravels	small (2-16mm)	15
		large (16-64mm)	10
	Larges	sm. cobble (64-128mm)	50
		lge. cobble (128-256mm)	15
		boulder(>256mm)	
	Bedrock		
	D90(cm) 17	Compaction L (M) H	

C	BANKS	
	Height(m) 0.8	%Unstable 0
	Texture	(F) (G) L R
	Confinement	EN CO FC (OC) UC N/A
	Valley:Channel Ratio	0-2 2-5 5-(10) 10+ N/A
	Stage	Dry (L) M H Flood
	Flood Signs Ht(m) 0.4	Braided Y (N)
	Bars (%) 20	pH nr, O_2 (ppm)
	WaterTemp(C) nr	Turb(cm) cl, Cond(25C) nr

OBSTRUCTIONS C	Ht(m)	Type	Loc'n

DISCHARGE

Parameter	Value	Method	Specific Data
Wetted Width (m)			Estimated 3-4 c.f.s. discharge.
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL (Fish)

(Width:Valley/Channel,Slope) BedMaterial

FISH SUMMARY

C	Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
	CT	1	140	J	R	EF
	DV	1	162	J/A	R	EF

STREAM/VALLEY CROSS-SECTION ☐
(Looking Downstream)
L R

PLANIMETRIC VIEW ☐

COMMENTS

Channel Stability ☒ Debris ☐ Management Concerns ☐ Obstructions ☒ Riparian Zone ☐ Valley Wall Processes ☐ Etc.

Small cobble - limited potential spawning.

Good trout parr habitat in cobble/riffle areas. No fry or small juveniles present in this section.

Edited by: CP
Date Y M D 97/11/26

DFO / MOE

STREAM SURVEY FORM

Stream Name	(gaz) Hubert Creek	(local) Hubert Creek	Access: ATV; Method
Watershed Code	460-4370	ReachNo. 4	Lngth(km) 1.8
Location	Upstream from Hydro line. Sampled just u/s from upper road crossing.	Map # 093L065; SiteNo. HUB10	LthSurv(m) 35
		U.T.M.; FishCard Y (N)	Field X; Hist.
Date Y.M.D 970807	Time 1300	Agency C87; Crew RD; Photos B1/3, 4	AirPhotos

PARAMETER	VALUE	METH	SPECIFIC DATA
Ave. Chan. Width (m)	2.8		2.8, 2.6, 2.7, 3.1, 2.9
Ave. Wet. Width (m)	1.9		1.6, 2.3, 1.7, 1.5, 2.4
Ave.Max.Riffle Depth (cm)	12		10, 14
Ave.Max.Pool Depth (cm)	24		23, 25
Gradient %	6		
% Pool 15; Riffle 80; Run 5; Other			
Side Chan.%	0 [X] 0-10 [ ] 10-40 [ ] >40 [ ]		
Debris Area%	0 [ ] 0-5 [X] 5-15 [ ] >15 [ ]		
Debris Stable%	50		
COVER: Total%	75		
Comp. sum 100	Dp.Pool 20; L.O.D. 10; Boulder 60; InVeg; OverVeg 5; Cutbank 5		
Crown Closure %	15		Aspect

OBSTRUCTIONS

Ht(m)	Type	Loc'n
See d/s.		

BED MATERIAL

		%
Fines	clay,silt,sand (<2mm)	10
Gravels	small (2-16mm)	15
	large (16-64mm)	15
Larges	sm. cobble (64-128mm)	35
	lge. cobble (128-256mm)	25
	boulder(>256mm)	10
Bedrock		
D90(cm)	28	Compaction L M (H)

BANKS

Height(m)	2.0
%Unstable	
Texture	(F) (G) L R
Confinement	EN CO (FC) OC UC N/A
Valley:Channel Ratio	0-2 (2-5) 5-10 10+ N/A
Stage	Dry (L) M H Flood
Flood Signs Ht(m)	0.4
Braided	Y (N)
Bars (%)	25
pH	nr
O_2(ppm)	
WaterTemp(C)	nr
Turb(cm)	cl
Cond(25C)	nr

DISCHARGE

Parameter	Value	Method	Specific Data
Wetted Width (m)			Estimated 4 c.f.s. discharge.
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL (Fish)

(Width:Valley/Channel,Slope) BedMaterial

FISH SUMMARY

Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
DV	3	110-153	J	R	EF

STREAM/VALLEY CROSS-SECTION (Looking Downstream)

L R

PLANIMETRIC VIEW

COMMENTS

Channel Stability [ ] Debris [ ] Management Concerns [ ] Obstructions [ ] Riparian Zone [ ] Valley Wall Processes [ ] Etc.

Limited pockets of spawning potential. Mainly confined channel with cobble/boulder bed.

Marginal upper end of DV habitat at this location.

Edited by: CP

Date Y M D 97/11/26

DFO / MOE
STREAM SURVEY FORM

Stream Name	(gaz) Helps Creek	(local) Helps Creek				Access	V2	Method
Watershed Code	460-4370-227			ReachNo.	2	Lngth(km)	2.3	
Location	Mid-way between the cattleguard and the old bridge site.	Map #	093L065	SiteNo.	H1	LthSurv(m)	30	
		U.T.M.		FishCard	Y (N)		Field X	Hist. ☐
Date Y.M.D	9 7 0 8 1 7	Time 1115	Agency C87	Crew DB/CP	Photos A1/1, 2	AirPhotos		

C	PARAMETER	VALUE	METH	SPECIFIC DATA
	Ave. Chan. Width (m)	1.6		1.3, 2.2, 2.2, 1.7, 1.3, 1.1
	Ave. Wet. Width (m)	1.6		ww=cw
	Ave.Max.Riffle Depth (cm)	12		10, 15, 10
	Ave.Max.Pool Depth (cm)	32		30, 35, 35
	Gradient %	1		
	% Pool 10	Riffle 60	Run 30	Other
	Side Chan.%	0 X 0-10 ☐ 10-40 ☐ >40 ☐		
	Debris Area%	0 X 0-5 ☐ 5-15 ☐ >15 ☐		
	Debris Stable%	na		
	COVER: Total%	100		
	Comp. sum 100%	Dp.Pool: ; L.O.D.: ; Boulder: 50; InVeg: ; OverVeg: 50; Cutbank:		
	Crown Closure %	25		Aspect

OBSTRUCTIONS			
C	Ht(m)	Type	Loc'n

C	BED MATERIAL		%
	Fines	clay,silt,sand (<2mm)	30
	Gravels	small (2-16mm)	
		large (16-64mm)	10
	Larges	sm. cobble (64-128mm)	20
		lge. cobble (128-256mm)	40
		boulder(>256mm)	
	Bedrock		
	D90(cm)	25	Compaction (L) M H

C	BANKS			
	Height(m)	1.0	%Unstable	25
	Texture	(F) G L R		
	Confinement	EN CO FC OC (UC) N/A		
	Valley:Channel Ratio	0-2 2-5 5-10 (10+) N/A		
	Stage	Dry L (M) H Flood		
	Flood Signs Ht(m)	0.5	Braided	Y (N)
	Bars (%)	<5	pH	7.3
	O2 (ppm)			
	WaterTemp(C)	12.0	Turb(cm) 40	Cond(25C) 180

(DECID.) DISCHARGE

Parameter	Value	Method	Specific Data
Wetted Width (m)			Estimated 2 c.f.s. discharge.
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL
(Fish)
(Width:Valley/Channel.Slope) BedMaterial

FISH SUMMARY

C	Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
	CT	8	98-117	J	R	EF

STREAM/VALLEY CROSS-SECTION
(Looking Downstream)
L R
PLANIMETRIC VIEW

COMMENTS

Channel Stability X Debris ☐ Management Concerns X Obstructions ☐ Riparian Zone X Valley Wall Processes ☐ Etc.

Creek has been diverted through this section and runs along a ditch. Fencing is on one side of the creek.
No spawning potential. Banks sloughing in this section - some clay.
Willow/alder overstory.

Edited by CP
Date Y M D 97/11/26

DFO / MOE
STREAM SURVEY FORM

Stream Name	(gaz) Helps Creek (local) Helps Creek			Access	V2	Method
Watershed Code	460-4370-227	ReachNo.	2	Lngth(km)	2.3
Location	Immediately u/s from culvert. Old bridge site. Map # 093L065	SiteNo.	H2	LthSurv(m)	33
	U.T.M.	FishCard	Y N (N circled)	Field X	Hist.
Date Y.M.D 9 7 0 8 0 7	Time 1215 Agency C87 Crew DB/CP Photos A1/3, 4	AirPhotos			

PARAMETER	VALUE	METH	SPECIFIC DATA
Ave. Chan. Width (m)	8.5		6.2, 8.3, 9.0, 10.6, 9.5, 7.5
Ave. Wet. Width (m)	2.7		3.4, 3.2, 1.5, 3.9, 2.6, 1.8
Ave.Max.Riffle Depth (cm)	11		10, 8, 14
Ave.Max.Pool Depth (cm)	na		
Gradient %	2		
% Pool — Riffle 95 — Run 5 — Other			
Side Chan.%	0 X 0-10 ☐ 10-40 ☐ >40 ☐		
Debris Area%	0 X 0-5 ☐ 5-15 ☐ >15 ☐		
Debris Stable%	na		
COVER: Total%	0		
Comp. sum 100%	Dp.Pool / L.O.D. / Boulder / InVeg / OverVeg / Cutbank		
Crown Closure %	0	Aspect	

OBSTRUCTIONS

C	Ht(m)	Type	Loc'n

BED MATERIAL

		%
Fines	clay,silt,sand (<2mm)	85
Gravels	small (2-16mm)	15
	large (16-64mm)	
Larges	sm. cobble (64-128mm)	
	lge. cobble (128-256mm)	
	boulder(>256mm)	
Bedrock		
D90(cm)	4	Compaction **L** M H

BANKS

Height(m)	1.0	%Unstable	100
Texture	**F** G L R		
Confinement	EN CO FC OC **UC** N/A		
Valley:Channel Ratio	0-2 2-5 5-10 **10+** N/A		
Stage	Dry **L** M H Flood		
Flood Signs Ht(m)	0.6	Braided	Y **N**
Bars (%)	70	pH	na	O₂ (ppm)	
WaterTemp(C)	12.0	Turb(cm)	cl	Cond(25C)	180

DISCHARGE /50 1

Parameter	Value	Method	Specific Data
Wetted Width (m)			Estimated 2 c.f.s. discharge.
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL
(Fish)
(Width:Valley/Channel.Slope) BedMaterial

FISH SUMMARY

C	Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
	CT	1	43	F	R	EF

STREAM/VALLEY CROSS-SECTION
(Looking Downstream)
L R
PLANIMETRIC VIEW

COMMENTS

Channel Stability X Debris ☐ Management Concerns X Obstructions X Riparian Zone X Valley Wall Processes ☐ Etc.

Very poor fish habitat - cattle have eroded the banks and the channel is very wide (Photo A1/17).
Sands and pea-gravels abundant within site. No cover from adjacent vegetation.
Suspect this site dewaters in most summers and winters due to excess bed material.
Old bridge site has been replaced with 4' cuvlert - installation is acceptable.
Temp. is cool due to cool day.

Edited by CP
Date Y M D 97/11/26

DFO / MOE
STREAM SURVEY FORM

Stream Name	(gaz) Helps Creek	(local) Helps Creek	Access: V2 / Method:
Watershed Code	460-4370-227	ReachNo. 2	Lngth(km) 2.3
Location	South side of field - 150 m u/s from Trib HP1 confluence.	Map # 093L065 / SiteNo. H3	LthSurv(m) 33
		U.T.M. / FishCard Y (N)	Field X Hist. ☐
Date Y.M.D	9 7 0 8 0 7	Time 1400 / Agency C87 / Crew DB/CP / Photos A1/7, 8	AirPhotos

PARAMETER	VALUE	METH	SPECIFIC DATA
Ave. Chan. Width (m)	3.4		2.6, 3.0, 2.4, 3.4, 4.6, 4.1
Ave. Wet. Width (m)	2.4		2.1, 2.7, 1.7, 1.9, 3.0, 2.8
Ave.Max.Riffle Depth (cm)	12		10, 10, 15
Ave.Max.Pool Depth (cm)	22		20, 25
Gradient %	3		
% Pool 15 / Riffle 80 / Run 5 / Other			
Side Chan.%	0 X 0-10 ☐ 10-40 ☐ >40 ☐		
Debris Area%	0 X 0-5 ☐ 5-15 ☐ >15 ☐		
Debris Stable%	na		
COVER: Total%	75		
Comp. sum 100	Dp.Pool 5 / L.O.D. / Boulder 65 / InVeg / OverVeg 25 / Cutbank 5		
Crown Closure %	25		Aspect

BED MATERIAL		%
Fines	clay,silt,sand (<2mm)	15
Gravels	small (2-16mm)	10
	large (16-64mm)	20
Larges	sm. cobble (64-128mm)	40
	lge. cobble (128-256mm)	15
	boulder(>256mm)	
Bedrock		
D90(cm)	15	Compaction (L) M H

BANKS	
Height(m)	2.5
%Unstable	20
Texture	(F) G L R
Confinement	EN CO FC OC (UC) N/A
Valley:Channel Ratio	0-2 2-5 5-10 (10+) N/A
Stage	Dry (L) M H Flood
Flood Signs Ht(m)	0.4
Braided	Y (N)
Bars (%)	10
pH	8.9
O_2 (ppm)	
WaterTemp(C)	11.5
Turb(cm)	cl
Cond(25C)	170

OBSTRUCTIONS C	Ht(m)	Type	Loc'n

DISCHARGE

Parameter	Value	Method	Specific Data
Wetted Width (m)			Estimated 3 c.f.s. discharge.
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL (Fish)

(Width:Valley/Channel,Slope) BedMaterial

FISH SUMMARY

C	Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
	CT	1	46	F	R	EF

STREAM/VALLEY CROSS-SECTION
(Looking Downstream)

L R

PLANIMETRIC VIEW

COMMENTS

Channel Stability X Debris ☐ Management Concerns ☐ Obstructions ☐ Riparian Zone X Valley Wall Processes ☐ Etc.

Good rearing habitat with cobble cover and brush overstory.

Pockets of potential spawning.

Banks have some unstable clay/silt sections.

Edited by CP

Date Y M D 97/11/26

DFO / MOE
STREAM SURVEY FORM

Stream Name	(gaz) Helps Creek	(local) Helps Creek			Access	V2	Method
Watershed Code	460-4370-227		ReachNo.	3	Lngth(km)	0.7
Location	Upper net 8 m below culvert at top end of field.	Map # 093L065	SiteNo.	H4	LthSurv(m)	37
		U.T.M.	FishCard	Y (N)		Field X Hist.
Date Y.M.D 970807	Time 1500	Agency C87	Crew DB/CP	Photos A1/9, 10	AirPhotos	

PARAMETER	VALUE	METH	SPECIFIC DATA
Ave. Chan. Width (m)	3.1		2.4, 3.3, 3.4, 2.7, 3.4, 3.1
Ave. Wet. Width (m)	1.9		2.3, 1.0, 1.8, 2.0, 1.2, 2.9
Ave.Max.Riffle Depth (cm)	10		
Ave.Max.Pool Depth (cm)	60		
Gradient %	4		
% Pool 50, Riffle 50, Run, Other			
Side Chan.%	0 X, 0-10, 10-40, >40		
Debris Area%	0, 0-5, 5-15, >15 X		
Debris Stable%	75		
COVER: Total%	75		

Comp. sum 100%	Dp.Pool	L.O.D.	Boulder	InVeg	OverVeg	Cutbank
		40		30	30	

Crown Closure % 90 | Aspect

OBSTRUCTIONS

Ht(m)	Type	Loc'n

BED MATERIAL

		%
Fines	clay,silt,sand (<2mm)	20
Gravels	small (2-16mm)	80
	large (16-64mm)	
Larges	sm. cobble (64-128mm)	
	lge. cobble (128-256mm)	
	boulder(>256mm)	
Bedrock		
D90(cm) 5	Compaction (L) M H	

BANKS

Height(m)	2.0
%Unstable	0
Texture	(F) G L R
Confinement	EN CO FC (OC) UC N/A
Valley:Channel Ratio	0-2 2-5 (5-10) 10+ N/A
Stage	Dry L (M) H Flood
Flood Signs Ht(m)	0.3
Braided	Y (N)
Bars (%)	15
pH	8.8
O_2 (ppm)	
WaterTemp(C)	11.0
Turb(cm)	cl
Cond(25C)	170

DISCHARGE /50 3

Parameter	Value	Method	Specific Data
Wetted Width (m)			Estimated 3-4 c.f.s. discharge.
Mean Depth (m)			More flow than d/s.
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL
(Fish)
(Width:Valley/Channel,Slope) BedMaterial

FISH SUMMARY

Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
CT	15	29-47	F	R	EF
CT	5	95-116	J	R	EF

STREAM/VALLEY CROSS-SECTION
(Looking Downstream)
L R

PLANIMETRIC VIEW

COMMENTS

Channel Stability ☐ Debris ☐ Management Concerns ☐ Obstructions ☐ Riparian Zone X Valley Wall Processes ☐ Etc.

Good potential spawning in this section.
LOD forming stepped pools.
Extensive alder overstory.

Edited by: CP
Date Y M D 97/11/26

DFO / MOE

STREAM SURVEY FORM

Stream Name	(gaz) Helps Creek	(local) Helps Creek			Access	V2	Method	
Watershed Code	460-4370-227		ReachNo.	3	Lngth(km)	0.7		
Location	Just u/s from road crossing in brushy area. Access from clearing on west side of field.	Map # 093L065	SiteNo.	H7	LthSurv(m)	33		
		U.T.M.	FishCard	Y (N)		Field X	Hist.	
Date Y.M.D	9 7 0 8 0 9	Time 1145	Agency C87	Crew DB/CP	Photos A1/11, 12	AirPhotos		

PARAMETER	VALUE	METH	SPECIFIC DATA
Ave. Chan. Width (m)	1.6		1.8, 1.6, 2.0, 1.1, 1.6, 1.4
Ave. Wet. Width (m)	1.4		1.3, 1.6, 1.7, 0.8, 1.5, 1.3
Ave.Max.Riffle Depth (cm)	5		5, 5, 5
Ave.Max.Pool Depth (cm)	17		15, 20, 15
Gradient %	1.5		
% Pool 10	Riffle 60	Run 30	Other
Side Chan.%	0 X		0-10 / 10-40 / >40
Debris Area%			0 / 0-5 / 5-15 / >15 X
Debris Stable%	100		
COVER: Total%	80		

Comp.	Dp.Pool	L.O.D.	Boulder	InVeg	OverVeg	Cutbank
sum 100%	50				50	

Crown Closure %	90	Aspect	

BED MATERIAL		%
Fines	clay,silt,sand (<2mm)	60
Gravels	small (2-16mm)	40
	large (16-64mm)	
Larges	sm. cobble (64-128mm)	
	lge. cobble (128-256mm)	
	boulder(>256mm)	
Bedrock		
D90(cm)	4	Compaction (L) M H

BANKS			
Height(m)	0.5	%Unstable	0
Texture	(F) G L R		
Confinement	EN CO (FC) OC UC N/A		
Valley:Channel Ratio	0-2 (2-5) 5-10 10+ N/A		
Stage	Dry (L) M H Flood		
Flood Signs Ht(m)	0.2	Braided	Y (N)
Bars (%)	10	pH	8.8
O2 (ppm)			
WaterTemp(C)	11.0	Turb(cm)	cl
Cond(25C)	170		

OBSTRUCTIONS	Ht(m)	Type	Loc'n

DISCHARGE /50 1

Parameter	Value	Method	Specific Data
Wetted Width (m)			Estimated 1-2 c.f.s. discharge.
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL (Fish)

(Width:Valley/Channel.Slope) BedMaterial

FISH SUMMARY

C	Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
			NO FISH CAUGHT.			

Numerous fry were observed u/s to fork, ~180 m above site.

STREAM/VALLEY CROSS-SECTION (Looking Downstream)

L R

PLANIMETRIC VIEW

COMMENTS

Channel Stability Debris Management Concerns Obstructions Riparian Zone Valley Wall Processes Etc.

Surprised no fish were caught at this site; numerous fry were observed just u/s.

Edited by CP

Date Y M D 97/11/26

DFO / MOE

STREAM SURVEY FORM

Stream Name	(gaz) Helps Creek	(local) Helps Creek	Access	ATV	Method	
Watershed Code	460-4370-227		ReachNo.	4	Lngth(km)	2.8
Location	Helps Creek mainstem below culvert at B.C. Hydro line crossing.	Map # 093L065	SiteNo.	H9	LthSurv(m)	35
		U.T.M.	FishCard	Y (N)	Field X	Hist.
Date Y.M.D	9 7 0 8 0 7	Time 1600	Agency C87	Crew RD	Photos B1/7, 8	AirPhotos

PARAMETER	VALUE	METH	SPECIFIC DATA
Ave. Chan. Width (m)	2.2		2.1, 2.4, 1.2, 3.0
Ave. Wet. Width (m)	1.3		1.4, 1.3, 1.0, 1.4
Ave.Max.Riffle Depth (cm)	8		7, 9, 7
Ave.Max.Pool Depth (cm)	20		18, 26, 15
Gradient %	8-10		
% Pool 30 / Riffle 50 / Run 20 / Other			
Side Chan.%	0 ☐ 0-10 ☐ 10-40 X >40 ☐		
Debris Area%	0 ☐ 0-5 ☐ 5-15 X >15 ☐		
Debris Stable%	90		
COVER: Total%	50		
Crown Closure %	70		Aspect

Comp.	Dp.Pool	L.O.D.	Boulder	InVeg	OverVeg	Cutbank
sum 100	30	30	10		15	15

OBSTRUCTIONS

Ht(m)	Type	Loc'n

BED MATERIAL		%
Fines	clay,silt,sand (<2mm)	10
Gravels	small (2-16mm)	30
	large (16-64mm)	40
Larges	sm. cobble (64-128mm)	10
	lge. cobble (128-256mm)	10
	boulder(>256mm)	
Bedrock		
D90(cm)	11	Compaction (L) M H

BANKS			
Height(m)	1.8	%Unstable	0
Texture	(F) (G) L R		
Confinement	EN CO (FC) OC UC N/A		
Valley:Channel Ratio	0-2 (2-5) 5-10 10+ N/A		
Stage	Dry (L) M H Flood		
Flood Signs Ht(m)	0.3	Braided	Y (N)
Bars (%)	15	pH	nr
O₂(ppm)			
WaterTemp(C)	11.0	Turb(cm)	cl
Cond(25C)	190		

DISCHARGE

Parameter	Value	Method	Specific Data
Wetted Width (m)			Estimated 1.5 c.f.s. discharge.
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL (Fish)

(Width Valley/Channel,Slope) BedMaterial

FISH SUMMARY

Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
CT	8	29-33	F	R	EF
CT	2	83-100	J	R	EF

STREAM/VALLEY CROSS-SECTION (Looking Downstream)

L R

PLANIMETRIC VIEW

COMMENTS

Channel Stability X Debris ☐ Management Concerns X Obstructions X Riparian Zone X Valley Wall Processes ☐ Etc.

Small, stable creek with lots of LOD and brush cover. Some potential spawning in this area.

Culvert (0.4 m) - 10 m in length; no drop at outlet. May be passable to adults.

Triton caught CT above the culvert.

Suspect creek is mismapped u/s and this is the main Helps C. channel.

Edited by: CP

Date Y M D 97/11/26

DFO / MOE
STREAM SURVEY FORM

Stream Name	(gaz) Helps Creek Tributary HP1	(local) Helps Creek Tributary HP1		Access	V2	Method	
Watershed Code	460-4370-227		ReachNo.	1	Lngth(km)	1.0	
Location	Tributary HP1, immediately d/s from road crossing/culvert.	Map #	093L065	SiteNo.	H3a	LthSurv(m)	30
		U.T.M.		FishCard	Y (N)	Field X	Hist.
Date Y.M.D	9 7 0 8 0 7	Time 1300	Agency C87	Crew DB/CP	Photos A1/5, 6	AirPhotos	

PARAMETER	VALUE	METH	SPECIFIC DATA
Ave. Chan. Width (m)	3.4		3.1, 3.8, 4.0, 3.1, 2.6, 3.8
Ave. Wet. Width (m)	0.6		0.5, 0.7, 0.6, 0.6, 0.7, 0.2
Ave.Max.Riffle Depth (cm)	5		
Ave.Max.Pool Depth (cm)	10		
Gradient %	5		
% Pool 10 / Riffle 90 / Run / Other			
Side Chan.%	0 X / 0-10 / 10-40 / >40		
Debris Area%	0 / 0-5 X / 5-15 / >15		
Debris Stable%	50		
COVER: Total%	100		
Comp. sum 100%: Dp.Pool / L.O.D. 10 / Boulder 90 / InVeg / OverVeg / Cutbank			
Crown Closure %	25		Aspect

BED MATERIAL		%
Fines	clay,silt,sand (<2mm)	
Gravels	small (2-16mm)	25
	large (16-64mm)	25
Larges	sm. cobble (64-128mm)	25
	lge. cobble (128-256mm)	25
	boulder(>256mm)	
Bedrock		
D90(cm)	40	Compaction (L) M H

BANKS			
Height(m)	2.5	%Unstable	50
Texture	F (G) L R		
Confinement	EN CO (FC) OC UC N/A		
Valley:Channel Ratio	0-2 (2-5) 5-10 10+ N/A		
Stage	(Dry) (L) M H Flood		
Flood Signs Ht(m)	0.3	Braided	Y (N)
Bars (%)	98	pH	8.3
O₂ (ppm)			
WaterTemp(C)	14.5	Turb(cm)	cl
Cond(25C)	170		

OBSTRUCTIONS	Ht(m)	Type	Loc'n

DISCHARGE /50 6

Parameter	Value	Method	Specific Data
Wetted Width (m)			Trickle flow discharge. Channel is mainly
Mean Depth (m)			dewatered with a few pools wetted.
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL (Fish) (Width Valley/Channel,Slope) BedMaterial

FISH SUMMARY					
Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
	Electrofished culvert pool.				
	NO FISH .				
	CT fry was observed here in 1985.				

STREAM/VALLEY CROSS-SECTION (Looking Downstream) L R

PLANIMETRIC VIEW

COMMENTS

Channel Stability — Debris — Management Concerns — Obstructions X — Riparian Zone — Valley Wall Processes — Etc.

This creek dries up for much of the summer. CT fry was observed in 1985.
Walked 100 m u/s from culvert; few isolated pools wetted. Must dry up in late summer/winter.
Observed Western Spotted Frog near tributary mouth.
Tributary HP1 was observed at the powerline; channel was dry - no fish potential.

Edited by: CP
Date Y M D: 97/11/26

DFO / MOE
STREAM SURVEY FORM

Stream Name	(gaz) Helps Creek Tributary HP3	(local) Helps Creek Tributary HP3	Access	FT	Method
Watershed Code	460-4370-227	ReachNo. 1	Lngth(km)	0.5	
Location	100 m u/s from mouth, 140 m d/s from road on Helps C. mainstem.	Map # 093L065	SiteNo. H6a	LthSurv(m) 240	
		U.T.M.	FishCard Y (N)	Field X	Hist.
Date Y.M.D 9 7 0 8 0 8	Time 1245	Agency C87	Crew CP	Photos na	AirPhotos

PARAMETER	VALUE	METH	SPECIFIC DATA
Ave. Chan. Width (m)	1.9		2.1, 2.4, 2.3, 1.8, 1.3, 1.6
Ave. Wet. Width (m)	1.5		2.3, 1.2, 2.3, 0.7, 1.3, 1.4
Ave.Max.Riffle Depth (cm)	6		5, 7
Ave.Max.Pool Depth (cm)	11		10, 12
Gradient %	3-4		
% Pool 20, Riffle 60, Run 20, Other			
Side Chan.%	0 X, 0-10, 10-40, >40		
Debris Area%	0, 0-5, 5-15 X, >15		
Debris Stable%	80		
COVER: Total%	90		
Crown Closure %	80		Aspect

Comp. (sum 100)	Dp.Pool	L.O.D.	Boulder	InVeg	OverVeg	Cutbank
	10	15	20		50	5

BED MATERIAL		%
Fines	clay,silt,sand (<2mm)	10
Gravels	small (2-16mm)	25
	large (16-64mm)	35
Larges	sm. cobble (64-128mm)	20
	lge. cobble (128-256mm)	10
	boulder(>256mm)	
Bedrock		
D90(cm)	12	Compaction L M (H)

BANKS			
Height(m)	0.5	%Unstable	0
Texture	(F) G L R		
Confinement	EN CO (FC) OC UC N/A		
Valley:Channel Ratio	0-2 (-5) 5-10 10+ N/A		
Stage	Dry L (M) H Flood		
Flood Signs Ht(m)	0.3	Braided	Y (N)
Bars (%)	10	pH nr	O_2 (ppm)
WaterTemp(C)	10.5	Turb(cm) cl	Cond(25C) nr

OBSTRUCTIONS	Ht(m)	Type	Loc'n

(ALDER)

DISCHARGE

Parameter	Value	Method	Specific Data
Wetted Width (m)			Estimated 2 c.f.s. discharge.
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL (Fish)

(Width:Valley/Channel,Slope) BedMaterial

FISH SUMMARY

Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
	NOT SAMPLED.				

STREAM/VALLEY CROSS-SECTION
(Looking Downstream)

L R

PLANIMETRIC VIEW

COMMENTS

Channel Stability X Debris Management Concerns Obstructions X Riparian Zone X Valley Wall Processes Etc.

Sections of good potential spawning.
Observed some debris jams/log steps.
Excellent overstory (alder) cover.
Stable creek with moss-covered banks and instream boulders.
Western Toad was observed in creek during ground survey.

Hiked d/s for 380 m to locate Trib.'s HP3a and HP3b but they were not found. Suspect the tributaries enter futher d/s.
A small seepage with a channel width of 30 cm and a trickle flow discharge enters Trib. HP3 ~30 m d/s from road; inaccessible due to the 25 cm high drop at the mouth.

Edited by: CP
Date Y M D 97/11/26

DFO / MOE
STREAM SURVEY FORM

Stream Name	(gaz) Helps Creek Tributary HP4	(local) Helps Creek Tributary HP4	Access: FT; Method
Watershed Code	460-4370-227	ReachNo. 1	Lngth(km) 0.3
Location	100 m u/s from mouth. Map # 093L065	SiteNo. H11a	LthSurv(m) 100
	U.T.M.	FishCard Y (N)	Field X Hist.
Date Y.M.D 9 7 0 8 0 9	Time 1250; Agency C87; Crew DB; Photos A1/13	AirPhotos	

PARAMETER	VALUE	METH	SPECIFIC DATA
Ave. Chan. Width (m)	1.2		1.2, 0.9, 1.5, 1.0
Ave. Wet. Width (m)	1.0		1.1, 0.9, 0.9, 1.0
Ave.Max.Riffle Depth (cm)	5		4, 5, 7
Ave.Max.Pool Depth (cm)	17		20, 15, 15
Gradient %	1.5		
% Pool 60; Riffle 30; Run 10; Other			
Side Chan.%	0 [X] 0-10 [ ] 10-40 [ ] >40 [ ]		
Debris Area%	0 [ ] 0-5 [ ] 5-15 [ ] >15 [X]		
Debris Stable%	100		
COVER: Total%	100		
Comp.: Dp.Pool; L.O.D.; Boulder; InVeg; OverVeg; Cutbank			
sum 100%	OverVeg 100		
Crown Closure %	95	Aspect	

OBSTRUCTIONS: Ht(m) | Type | Loc'n — (none recorded)

BED MATERIAL		%
Fines	clay,silt,sand (<2mm)	70
Gravels	small (2-16mm)	30
	large (16-64mm)	
Larges	sm. cobble (64-128mm)	
	lge. cobble (128-256mm)	
	boulder(>256mm)	
Bedrock		
D90(cm) 3	Compaction (L) M H	

BANKS	
Height(m)	0.3; %Unstable 0
Texture	(F) G L R
Confinement	EN CO (FC) OC UC N/A
Valley:Channel Ratio	0-2 (2-5) 5-10 10+ N/A
Stage	Dry L (M) H Flood
Flood Signs Ht(m)	0.2; Braided Y (N)
Bars (%)	0; pH nr; O₂ (ppm)
WaterTemp(C)	12.0; Turb(cm) cl; Cond(25C) 100

DISCHARGE 50/ 1

Parameter	Value	Method	Specific Data
Wetted Width (m)			Estimated 0.7 c.f.s. discharge.
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL (Fish)

(Width:Valley/Channel,Slope) BedMaterial

FISH SUMMARY

C	Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
			NOT SAMPLED.			

STREAM/VALLEY CROSS-SECTION
(Looking Downstream)

L R

PLANIMETRIC VIEW

COMMENTS

Channel Stability [ ] Debris [ ] Management Concerns [ ] Obstructions [X] Riparian Zone [X] Valley Wall Processes [ ] Etc.

No fry were observed; appears to be upper limit of fish distribution based on gradient.
Very thick bush along banks; difficult for walking.
Few ~20 cm high drops are present; accessible to fish at high flows.
Small pockets of potential spawning were observed.

Edited by CP
Date Y M D 97/11/26

DFO / MOE
STREAM SURVEY FORM

Stream Name	(gaz) Helps Creek Tributary HP4	(local) Helps Creek Tributary HP4		Access	ATV	Method
Watershed Code	460-4370-227		ReachNo. 2	Lngth(km)	0.9
Location	Tributary HP4 at Hydro line crossing.	Map # 093L065	SiteNo. H11	LthSurv(m)	40
		U.T.M.	FishCard Y (N)	Field X	Hist.
Date Y.M.D	9 7 0 8 0 7	Time 1400	Agency C87	Crew RD	Photos B1/5, 6	AirPhotos

PARAMETER	VALUE	METH	SPECIFIC DATA
Ave. Chan. Width (m)	1.0		0.7, 0.8, 0.8, 1.2, 0.7, 1.5
Ave. Wet. Width (m)	0.5		0.4, 0.7, 0.5, 0.4, 0.5, 0.3
Ave.Max.Riffle Depth (cm)	9		7, 11, 9
Ave.Max.Pool Depth (cm)	23		23, 27, 19
Gradient %	15		
% Pool 15 / Riffle 80 / Run 5 / Other			
Side Chan.%	0 ☐ 0-10 ☒ 10-40 ☐ >40 ☐		
Debris Area%	0 ☐ 0-5 ☒ 5-15 ☐ >15 ☐		
Debris Stable%	90		
COVER: Total%	30		
Comp. sum 100	Dp.Pool 40, L.O.D. 30, Boulder 5, InVeg, OverVeg 10, Cutbank 5		
Crown Closure %	70		Aspect

OBSTRUCTIONS

Ht(m)	Type	Loc'n
Steep d/s.		
Road cv is		
also steep.		

BED MATERIAL

		%
Fines	clay,silt,sand (<2mm)	5
Gravels	small (2-16mm)	10
	large (16-64mm)	10
Larges	sm. cobble (64-128mm)	30
	lge. cobble (128-256mm)	30
	boulder(>256mm)	15
Bedrock		
D90(cm)	37	Compaction L M (H)

BANKS

Height(m)	1.2
%Unstable	0
Texture	(F) (G) L R
Confinement	EN CO FC (OC) UC N/A
Valley:Channel Ratio	0-2 2-5 (5-10) 10+ N/A
Stage	Dry (L) M H Flood
Flood Signs Ht(m)	0.1
Braided	Y (N)
Bars (%)	25
pH	nr
O2 (ppm)	
WaterTemp(C)	11.0
Turb(cm)	cl
Cond(25C)	110

DISCHARGE

Parameter	Value	Method	Specific Data
Wetted Width (m)			Estimated 1 c.f.s. discharge.
Mean Depth (m)			
Mean Velocity (m/s)			
Discharge (m3/s)			

REACH SYMBOL
(Fish)
(Width:Valley/Channel,Slope) BedMaterial

FISH SUMMARY

Species	No.	Size Range(mm)	Life Phase	Use	Method/Ref
Shocked 40 m length of stream, 1 pass with a lower net.					
		NO FISH CAUGHT.			

STREAM/VALLEY CROSS-SECTION
(Looking Downstream)
L R
PLANIMETRIC VIEW

COMMENTS

Channel Stability ☐ Debris ☒ Management Concerns ☒ Obstructions ☒ Riparian Zone ☒ Valley Wall Processes ☐ Etc.

Small, confined, single channel creek. Heavy brush covering steep creek.
~5 m road fill over small (70 cm wide by 30 m long), steep (8%) culvert. Creek is very steep further d/s with ~2.5' high drops over debris and rock.
Not suitable fish habitat.

Edited by: CP
Date Y M D 97/11/26

Appendix 6. Detailed results of fish sampling at all 1997 electrofishing sites

GOATHORN CREEK ELECTROFISHING SITE 1997

SITE:	G1	REACH:	1	DATE:	Sep-22	PHOTO:	B3/15, 16

SITE LOCATION: Goathorn Creek, upper net 110 m below PNG gas line crossing.

ACCESS: V2

EFFORT: (sec)		
	PASS 1	3425
	PASS 2	2937
	PASS 3	3079

MARGIN = 1 FULL=2: 2

S = SIDE / M = MAIN: M SLOPE (%): 1.5

TEMP (C):	6.0
TIME:	10:00
COND.(uS):	100.0

SAMPLING COMMENTS: Difficult to hold the nets in due to high flows and the large number of leaves flowing into the net.

POPULATION ESTIMATES:

SPECIES	AGE	FL RANGE	FL MEAN	MEAN WT (g)	PASS 1	PASS 2	PASS 3	EST. NUMB	95% C.I. LCI	95% C.I. UCI	N/M*M	N/100M	BIO-MASS (g/m*m)
Sthd	0+	28-53	38.3	0.7	76	41	22	162	147	196	0.250	261.9	0.175
Sthd	1+	75-79	82.0	7.1	1	1	0	2	2	na	0.003	3.2	0.022
Sthd	>1+	97-143	110.0	15.4	13	7	2	23	23	32	0.035	36.3	0.533
Char fry	0+	47-53	50.3	1.3	4	2	0	6	6	9	0.009	9.7	0.012
Bull trout	>=1+	103-200	151.0	41.0	1	2	0	3	3	na	0.005	4.8	0.189
D Varden	>=1+	113	113.0	16.5	0	1	0	1	1	na	0.002	1.6	0.025
MW	>=1+	108-178	136.8	26.3	2	8	3	13	14	na	0.020	21.0	0.526
TOTAL								210			0.323	338.5	1.483

DIST (m)	WET WIDTH (m)	CHAN WIDTH (m)
0	12.0	24.9
5	10.7	17.1
10	9.5	16.9
15	9.8	18.4
20	10.0	20.5
25	10.9	22.5
30		
35		
40		
	10.5	20.1
AREA	650.0	MARGIN (M)

SITE COVER (%)		
LOD	10	
COBBLE	80	
IN VEG		
OVER VEG		
CUTBANK		
DEEP POOL	10	
TOTAL	70	
	62.0	

SITE WATER TYPE (%)		DEPTH (cm)
POOL	5	45
RIFFLE	40	54
RUN	45	
OTHER	10	
D90	50	
D50	18	
(cm)		

HABITAT COMMENTS: Creek discharge is at medium to high flows. Site consists of riffle-run habitat with some flats along the margins. Bed material is mainly boulder and cobble.
All char fry were identified as BT with the exception of 2 which were DV.

GOATHORN CREEK ELECTROFISHING SITE 1997

SITE:	G2	REACH:	2	DATE:	Sep-15	PHOTO:	B3/1, 2

SITE LOCATION: Goathorn Creek above lower crossing; lower net at old Water Survey Site.

ACCESS: V2

EFFORT: (sec)	PASS 1	3144
	PASS 2	2916
	PASS 3	na

MARGIN = 1 FULL=2: 2

S = SIDE / M = MAIN: M SLOPE (%): 2.5

TEMP (C):	7.0
TIME:	10:20
COND.(uS):	100.0

SAMPLING COMMENTS: Difficult to hold in nets due to the high flows. Upper net partially blew out at the end of the 2nd pass; therefore, no 3rd pass. Difficult to remove fish in the fast water.

POPULATION ESTIMATES:

SPECIES	AGE	FL RANGE	FL MEAN	MEAN WT (g)	PASS 1	PASS 2	PASS 3	EST. NUMB	95% C.I. LCI	95% C.I. UCI	N/M*M	N/100M	BIO-MASS (g/m*m)
Sthd	0+	30-44	36.9	0.5	73	45	na	190	118	283	0.205	271.9	0.103
Sthd	1+	73-83	77.0	5.6	4	1	na	5	5	7	0.006	7.6	0.032
Sthd	>1+	93-146	112.2	17.2	13	6	na	24	19	38	0.026	34.5	0.447
Char fry	0+	50-55	51.8	1.2	3	1	na	5	4	8	0.005	6.4	0.006
Bull trout	>=1+	84-146	117.4	19.2	3	2	na	9	5	36	0.010	12.9	0.186
D Varden	>=1+	105	105.0	14.1	1	0	na	1	1	1	0.001	1.4	0.015
MW	>=1+												
TOTAL								234			0.252	334.7	0.789

DIST (m)	WET WIDTH (m)	CHAN WIDTH (m)
0	12.7	12.7
5	12.0	12.5
10	13.4	13.4
15	14.2	15.2
20	13.0	16.7
25	13.5	17.1
30	14.0	16.2
35		
40		
	13.3	14.8
AREA	928.0	MARGIN (M) 70.0

SITE COVER (%)		SITE WATER TYPE (%)	DEPTH (cm)
LOD		POOL	
COBBLE	80	RIFFLE	95 47
IN VEG	5	RUN	5
OVER VEG		OTHER	
CUTBANK	10		
DEEP RUN	5		
		D90	40
TOTAL	50	D50	10
		(cm)	

HABITAT COMMENTS: Discharge = 8-10 m^3/s. Heavy rain for 2-3 days prior to sampling resulted in medium to high flows.

GOATHORN CREEK ELECTROFISHING SITE 1997

SITE:	G3	REACH:	2	DATE:	Oct-30	PHOTO:	A5/11, 12

SITE LOCATION: Drove down old road to Goathorn C. Top of site located at end of road.

ACCESS: ATV

EFFORT: (sec)		
	PASS 1	2240
	PASS 2	1695
	PASS 3	1534

MARGIN = 1 FULL=2: 2

S = SIDE / M = MAIN: M

SLOPE (%): 2

TEMP (C):	3.0
TIME:	10:00
COND.(uS):	nr

SAMPLING COMMENTS: Difficult site to sample. Nets had to be constantly cleaned due to the continual build up of leaves.

POPULATION ESTIMATES:

SPECIES	AGE	FL RANGE	FL MEAN	MEAN WT (g)	PASS 1	PASS 2	PASS 3	EST. NUMB	95% C.I. LCI	95% C.I. UCI	N/M*M	N/100M	BIO-MASS (g/m*m)
Sthd	0+	39-51	42.3	0.9	16	1	1	18	18	18	0.033	40.4	0.029
Sthd	1+												
Sthd	>1+	100-132	111.4	16.1	9	0	0	9	9	na	0.016	20.2	0.262
Char fry	0+	46-58	50.9	1.3	16	3	1	20	20	21	0.036	44.9	0.047
Bull trout	>=1+	92-124	112.1	13.4	5	1	1	7	7	11	0.013	15.7	0.170
D Varden	>=1+	77-103	90.0	9.0	2	0	0	2	2	na	0.004	4.5	0.033
MW	>=1+												
TOTAL								56			0.101	125.8	0.541

DIST (m)	WET WIDTH (m)	CHAN WIDTH (m)
0	14.0	50.0
5	13.7	
10	13.5	
15	11.7	
20	9.2	
25		
30		
35		
40		
	12.4	50.0
AREA	552.7	MARGIN (M)

SITE COVER (%)		
LOD	5	
COBBLE	80	
IN VEG		
OVER VEG	5	
CUTBANK	10	
DEEP POOL		
TOTAL	70	
		44.5

SITE WATER TYPE (%)		DEPTH (cm)
POOL		
RIFFLE	90	40
RUN	10	
OTHER		
D90	32	
D50	14	
(cm)		

HABITAT COMMENTS: Water levels moderate; water is slightly coloured.
Primarily fast boulder-riffle habitat - good for parr rearing. Some good fry habitat is present along the margins.
Char fry were identified BT with the exception of 5 fry which were DV.

GOATHORN CREEK ELECTROFISHING SITE 1997

SITE:	G4	REACH:	2	DATE:	Sep-27	PHOTO:	B4/3, 4

SITE LOCATION: Goathorn Creek mainstem, ~400 m u/s from old coal mine site.

ACCESS: V2

EFFORT: (sec)	PASS 1	4043
	PASS 2	3535
	PASS 3	2681

MARGIN = 1 FULL=2: 2

S = SIDE / M = MAIN: M SLOPE (%): 3

TEMP (C):	6.0
TIME:	10:00
COND.(uS):	90.0

SAMPLING COMMENTS: Same site as 1984. Difficult site to sample due to the build up of leaves in the net; nets had to be continually cleaned to prevent them from blowing out.

POPULATION ESTIMATES:

SPECIES	AGE	FL RANGE	FL MEAN	MEAN WT (g)	PASS 1	PASS 2	PASS 3	EST. NUMB	95% C.I. LCI	95% C.I. UCI	N/M*M	N/100M	BIO-MASS (g/m*m)
Sthd	0+	32-51	39.1	0.7	49	13	6	69	68	75	0.085	101.9	0.059
Sthd	1+												
Sthd	>1+	101-141	124.0	21.3	4	4	1	9	9	na	0.011	13.4	0.237
Char fry	0+	38-62	51.6	1.5	33	9	9	55	52	69	0.067	80.7	0.101
Bull trout	>=1+	80-126	105.3	11.7	14	3	0	17	17	17	0.021	25.0	0.243
D Varden	>=1+	73-126	99.5	11.7	3	3	0	6	6	na	0.007	8.8	0.086
MW	>=1+												
TOTAL								156			0.191	229.9	0.725

DIST (m)	WET WIDTH (m)	CHAN WIDTH (m)
0	11.0	31.6
5	16.9	31
10	15.8	25.9
15	5.8	19.3
20	10.9	20.2
25	11.9	28.5
30		
35		
40		
	12.1	26.1
AREA	819.4	MARGIN (M)

SITE COVER (%)		SITE WATER TYPE (%)	
LOD	20	POOL	5
COBBLE	60	RIFFLE	75
IN VEG		RUN	20
OVER VEG	5	OTHER	
CUTBANK			
DEEP POOL	15		
		D90	35
TOTAL	70	D50	nr
		(cm)	
	68.0		

DEPTH (cm)
50
35

HABITAT COMMENTS: Estimated discharge ~20 c.f.s. Dynamic creek; LOD within channel. Complex site: good fry rearing along the margins, boulder/cobble and deep run/pool areas provide good cover for parr. Unstable bank on R. left at top of site. All char fry were identified as BT with the exception of 5 fry which were DV.

GOATHORN CREEK ELECTROFISHING SITE 1997

SITE:	G4a	REACH:	2	DATE:	Oct-04	PHOTO:	A5/22, 23

SITE LOCATION: Goathorn Creek river right side channel, at proposed bridge site.

ACCESS: V2

EFFORT: (sec)	PASS 1	nr
	PASS 2	
	PASS 3	

MARGIN = 1 FULL=2: 2

S = SIDE / M = MAIN: S

SLOPE (%): 1.5

TEMP (C):	2.0
TIME:	12:12
COND.(uS):	nr

SAMPLING COMMENTS: Sampled upper 45 m of a 420 m long side channel at proposed bridge crossing.

POPULATION ESTIMATES:

SPECIES	AGE	FL RANGE	FL MEAN	MEAN WT (g)	PASS 1	PASS 2	PASS 3	EST. NUMB	95% C.I. LCI	95% C.I. UCI	N/M*M	N/100M	BIO-MASS (g/m*m)
Sthd	0+												
Sthd	1+												
Sthd	>1+												
Char fry	0+												
Bull trout	>=1+												
D Varden	>=1+												
MW	>=1+												
TOTAL													

NO FISH CAUGHT/OBSERVED.

DIST (m)	WET WIDTH (m)	CHAN WIDTH (m)
0	2.3	6.8
5	3.7	4.2
10	1.1	8.3
15	2.7	7.9
20		
25		
30		
35		
40		
	2.5	6.8
AREA	110.3	MARGIN (M)

SITE COVER (%)	
LOD	
COBBLE	15
IN VEG	
OVER VEG	5
CUTBANK	
DEEP POOL	80
TOTAL	20

45.0

SITE WATER TYPE (%)		DEPTH (cm)
POOL	90	35
RIFFLE	10	5
RUN		
OTHER		
D90	22	
D50	10	
(cm)		

HABITAT COMMENTS: Est. 0.5 c.f.s.
Below 45 m section sampled, channel is dewatered; suspect is seasonally wetted.
Numerous old beaver dams are present d/s of sample site and discharge is a trickle flow in the lower 20 m of channel flowing into m/s Goathorn C.

GOATHORN CREEK ELECTROFISHING SITE 1997

SITE:	G5	REACH:	2	DATE:	Oct-24	PHOTO:	A4/9-12

SITE LOCATION: Upper Goathorn Creek, ~1 km u/s from upper bridge site.

ACCESS: V2

EFFORT: (sec)		
	PASS 1	3712
	PASS 2	2906
	PASS 3	2173

MARGIN = 1 FULL=2: 2

S = SIDE / M = MAIN: M SLOPE (%): 2

TEMP (C):	2.0
TIME:	10:00
COND.(uS):	nr

SAMPLING COMMENTS: Nets were not long enough to span this site so the side channel and mainstem were sampled separately but consecutively. The data was then combined.

POPULATION ESTIMATES:

SPECIES	AGE	FL RANGE	FL MEAN	MEAN WT (g)	PASS 1	PASS 2	PASS 3	EST. NUMB	95% C.I. LCI	95% C.I. UCI	N/M*M	N/100M	BIO-MASS (g/m*m)
Sthd	0+	34-46	38.4	0.7	14	3	1	18	18	19	0.030	34.2	0.021
Sthd	1+												
Sthd	>1+	95-126	108.4	14.5	4	1	0	5	5	7	0.008	9.5	0.119
Char fry	0+	33-61	50.5	1.3	19	4	5	29	28	39	0.048	55.3	0.062
Bull trout	>=1+	68-114	91.5	8.6	7	2	3	13	13	na	0.021	24.1	0.179
D Varden	>=1+	77-127	95.3	9.6	6	1	1	8	8	11	0.013	15.2	0.126
MW	>=1+												
TOTAL								73			0.119	138.4	0.506

DIST (m)	WET WIDTH (m)	CHAN WIDTH (m)
0	13.3	40.0
5	11.4	38.0
10	8.6	50.0
15	12.0	
20	11.4	
25	12.9	
30		
35		
40		
	11.6	42.7
AREA	610.2	MARGIN (M) 52.6

SITE COVER (%)		
LOD	5	
COBBLE	90	
IN VEG		
OVER VEG		
CUTBANK	5	
DEEP POOL		
TOTAL	75	

SITE WATER TYPE (%)		DEPTH (cm)
POOL		
RIFFLE	75	36
RUN	20	
OTHER	5	
D90	85	
D50	19	
(cm)		

HABITAT COMMENTS: Creek at moderate to high flows. Immature W. Spotted Frog caught in side channel.
Mainstem: large boulder/cobble with riffle habitat; poor fish habitat due to high flows.
Side channel: smaller bed material and consisting of 60% riffle and 40% run.

GOATHORN CREEK ELECTROFISHING SITE 1997

SITE:	G6a	REACH:	1	DATE:	Sep-24	PHOTO:	B3/17, 18

SITE LOCATION: Lower Cabinet Creek, ~100 m u/s from mouth.

ACCESS: FT

EFFORT: (sec)	PASS 1	1247
	PASS 2	935
	PASS 3	na

MARGIN = 1 FULL=2: 2

S = SIDE / M = MAIN: S SLOPE (%): 2.5

TEMP (C):	7.0
TIME:	11:30
COND.(uS):	70.0

SAMPLING COMMENTS: Sample site was a side channel.
170 mm DV was a ripe male; 168 mm DV was a maturing female.

POPULATION ESTIMATES:

SPECIES	AGE	FL RANGE	FL MEAN	MEAN WT (g)	PASS 1	PASS 2	PASS 3	EST. NUMB	95% C.I. LCI	95% C.I. UCI	N/M*M	N/100M	BIO-MASS (g/m*m)
Sthd	0+												
Sthd	1+												
Sthd	>1+	106	106.0	13.7	1	0	na	1	1	1	0.006	4.0	0.081
Char fry	0+	nr	nr	nr	1	0	na	1	1	1	0.006	4.0	na
Bull trout	>=1+	73-138	96.3	10.2	3	1	na	5	4	8	0.027	18.0	0.273
D Varden	>=1+	74-170	122.3	28.8	6	0	na	6	6	6	0.036	24.0	1.028
MW	>=1+												
TOTAL								13			0.074	50.0	1.382

DIST (m)	WET WIDTH (m)	CHAN WIDTH (m)
0	6.8	25.0
5	5.4	27.8
10	6.4	27.0
15	8.3	
20		
25		
30		
35		
40		
	6.7	26.6
AREA	168.1	MARGIN (M)

SITE COVER (%)		SITE WATER TYPE (%)	DEPTH (cm)
LOD	5	POOL	10 / 65
COBBLE	75	RIFFLE	40 / 25
IN VEG		RUN	30 /
OVER VEG		OTHER	/
CUTBANK			
DEEP POOL	20		
		D90	40
TOTAL	60	D50 (cm)	17

25.0

HABITAT COMMENTS: Est. 20 c.f.s. discharge.
Mainly boulder-riffle habitat with one pool within the site.
Good fry habitat present along the margins.
Wide, unstable channel in the lower 25 m of this creek.

GOATHORN CREEK ELECTROFISHING SITE 1997

SITE:	G7	REACH:	1	DATE:	Sep-25	PHOTO:	B3/22, 23

SITE LOCATION: Cabinet Creek. Upper net 20 m d/s from main Cabinet C. bridge.

ACCESS: V2

EFFORT: (sec)		
	PASS 1	1721
	PASS 2	1780
	PASS 3	na

MARGIN = 1 FULL=2: 2

S = SIDE / M = MAIN: M

SLOPE (%): 2

TEMP (C):	6.5
TIME:	12:00
COND.(uS):	70.0

SAMPLING COMMENTS: Good clarity and no net problems i.e. no wind/leaves.

POPULATION ESTIMATES:

SPECIES	AGE	FL RANGE	FL MEAN	MEAN WT (g)	PASS 1	PASS 2	PASS 3	EST. NUMB	95% C.I. LCI	95% C.I. UCI	N/M*M	N/100M	BIO-MASS (g/m*m)
Sthd	0+												
Sthd	1+												
Sthd	>1+												
Char fry	0+	31-45	37.6	0.5	10	10	na	20	20	na	0.069	72.5	0.035
Bull trout	>=1+	65	65.0	3.4	1	0	na	1	1	1	0.003	3.6	0.012
D Varden	>=1+	53-129	71.7	4.5	38	8	na	48	46	53	0.166	174.4	0.749
MW	>=1+												
TOTAL								69			0.239	250.5	0.795

DIST (m)	WET WIDTH (m)	CHAN WIDTH (m)
0	13.1	13.7
5	11.2	12.6
10	9.3	11.5
15	8.9	10.2
20	9.6	11.0
25	10.8	12.4
30		
35		
40		
	10.5	11.9
AREA	289.3	MARGIN (M)

SITE COVER (%)		SITE WATER TYPE (%)	DEPTH (cm)
LOD		POOL	
COBBLE	90	RIFFLE	95 34
IN VEG		RUN	5
OVER VEG	10	OTHER	
CUTBANK			
DEEP POOL			
		D90	40
TOTAL	75	D50	15
		(cm)	

27.6

HABITAT COMMENTS: Low BT numbers caught at this site.
Est. 1 m^3/s discharge.

GOATHORN CREEK ELECTROFISHING SITE 1997

SITE:	G8	REACH:	3	DATE:	Sep-24	PHOTO:	B3/19, 21

SITE LOCATION: Upper Goathorn Creek, ~80 m u/s from confluence with Cabinet C.

ACCESS: FT

EFFORT: (sec)	PASS 1	1908
	PASS 2	1420
	PASS 3	na

MARGIN = 1 FULL=2: 2

S = SIDE / M = MAIN: M SLOPE (%): 2.5

TEMP (C):	8.5
TIME:	15:00
COND.(uS):	60.0

SAMPLING COMMENTS: The char fry were identified as a mix of BT and DV.
171 mm DV was a maturing female; 164 mm DV was a ripe male.

POPULATION ESTIMATES:

SPECIES	AGE	FL RANGE	FL MEAN	MEAN WT (g)	PASS 1	PASS 2	PASS 3	EST. NUMB	95% C.I. LCI	95% C.I. UCI	N/M*M	N/100M	BIO-MASS (g/m*m)
Sthd	0+												
Sthd	1+												
Sthd	>1+	116-126	120.3	19.5	3	1	na	5	5	5	0.022	12.2	0.425
Char fry	0+	49-62	55.3	1.8	17	4	na	22	21	26	0.108	60.1	0.194
Bull trout	>=1+												
D Varden	>=1+	71-171	92.9	10.5	26	10	na	42	36	55	0.205	114.2	2.151
MW	>=1+												
TOTAL								69			0.334	186.4	2.770

DIST (m)	WET WIDTH (m)	CHAN WIDTH (m)
0	6.3	9.4
5	4.3	7.8
10	5.7	10.4
15	6.0	13.1
20		
25		
30		
35		
40		
	5.6	10.2
AREA	206.3	MARGIN (M)

SITE COVER (%)		SITE WATER TYPE (%)	
LOD	20	POOL	15 / 40
COBBLE	50	RIFFLE	70 / 18
IN VEG		RUN	15 /
OVER VEG	5	OTHER	/
CUTBANK	10		
DEEP POOL	15		
		D90	18
TOTAL	75	D50	9
		(cm)	
	37.0		

HABITAT COMMENTS: Est. 8-10 c.f.s. discharge.
Excellent site with good fry habitat along the margins; unembedded cobbles
LOD, pools and cutbank provide good cover for parr.
Dynamic, unstable creek; observed several sediment wedges/debris jams u/s.

GOATHORN CREEK ELECTROFISHING SITE 1997

SITE:	G9	REACH:	2	DATE:	Sep-25	PHOTO:	B3/24, 25

SITE LOCATION: Cabinet Creek, ~400 m u/s from Webster C. confluence.

ACCESS: V2

EFFORT: (sec)	PASS 1	1084
	PASS 2	1018
	PASS 3	na

MARGIN = 1 FULL=2: 2

S = SIDE / M = MAIN: M SLOPE (%): 7

TEMP (C): 7.0
TIME: 16:00
COND.(uS): 90.0

SAMPLING COMMENTS: Lower net located on d/s side of bridge. No upper net; used 40 cm high log drop as upper barrier. No leaf problems within this creek.

POPULATION ESTIMATES:

SPECIES	AGE	FL RANGE	FL MEAN	MEAN WT (g)	PASS 1	PASS 2	PASS 3	EST. NUMB	95% C.I. LCI	95% C.I. UCI	N/M*M	N/100M	BIO-MASS (g/m*m)
Sthd	0+												
Sthd	1+												
Sthd	>1+												
Char fry	0+	35-44	40.3	0.6	2	1	na	4	3	11	0.032	17.4	0.019
Bull trout	>=1+												
D Varden	>=1+	60-130	95.1	11.2	18	5	na	25	23	30	0.198	108.4	2.223
MW	>=1+												
TOTAL								29			0.230	125.8	2.242

DIST (m)	WET WIDTH (m)	CHAN WIDTH (m)
0	3.3	5.2
5	4.2	5.8
10	5.4	6.4
15	8.1	8.1
20	6.3	7.9
25		
30		
35		
40		
	5.5	6.7
AREA	125.6	MARGIN (M)

SITE COVER (%)		
LOD	5	
COBBLE	90	
IN VEG		
OVER VEG		
CUTBANK	5	
DEEP POOL		
TOTAL	75	

23.0

SITE WATER TYPE (%)		DEPTH (cm)	
POOL	3	43	
RIFFLE	97	22	
RUN			
OTHER			
D90	33		
D50	15		
(cm)			

HABITAT COMMENTS: Only DV were caught at this site.
Est. 10-15 c.f.s. discharge.

GOATHORN CREEK ELECTROFISHING SITE 1997

SITE:	G10	REACH:	1	DATE:	Sep-27	PHOTO:	B4/1, 2

SITE LOCATION: Webster Creek, ~1.4 km u/s from main road spur 120G.

ACCESS: V2

EFFORT: (sec)	PASS 1	1400
	PASS 2	1120
	PASS 3	na

MARGIN = 1 FULL=2: 2

S = SIDE / M = MAIN: M SLOPE (%): 2

TEMP (C):	5.0
TIME:	12:00
COND.(uS):	80.0

SAMPLING COMMENTS: Route down hill to site marked with pink ribbon. No landing sites further u/s.
Lower 30' net was ~2' too short; should use 50' net.

POPULATION ESTIMATES:

SPECIES	AGE	FL RANGE	FL MEAN	MEAN WT (g)	PASS 1	PASS 2	PASS 3	EST. NUMB	95% C.I. LCI	95% C.I. UCI	N/M*M	N/100M	BIO-MASS (g/m*m)
Sthd	0+												
Sthd	1+												
Sthd	>1+												
Char fry	0+	30-32	31.0	0.3	2	0	na	2	2	2	0.012	9.5	0.004
Bull trout	>=1+	100-109	104.5	12.7	2	0	na	2	2	2	0.012	9.5	0.155
D Varden	>=1+	54-137	89.2	9.4	22	3	na	25	25	27	0.156	121.3	1.462
MW	>=1+												
TOTAL								29			0.180	140.4	1.621

DIST (m)	WET WIDTH (m)	CHAN WIDTH (m)
0	9.5	10.5
5	9.0	9.0
10	7.7	7.7
15	6.7	7.6
20	6.1	7.2
25		
30		
35		
40		
	7.8	8.4
AREA	163.8	MARGIN (M) 21.0

SITE COVER (%)		
LOD	5	
COBBLE	65	
IN VEG		
OVER VEG	20	
CUTBANK	10	
DEEP POOL		
TOTAL	70	

SITE WATER TYPE (%)		DEPTH (cm)
POOL		
RIFFLE	60	25
RUN	40	53
OTHER		
D90	40	
D50	12	
(cm)		

HABITAT COMMENTS: Est. 30 c.f.s. discharge.
No potential spawning in this section.

FOUR CREEK ELECTROFISHING SITE 1997

SITE:	F1	REACH:	2	DATE:	Sep-29	PHOTO:	A2/2-4; B4/5-7

SITE LOCATION: Four Creek, ~30-40 m d/s from Telkwa Coal Mine Road.

ACCESS: V2

EFFORT: (sec)	PASS 1	460
	PASS 2	450
	PASS 3	na

MARGIN = 1 FULL=2: 2

S = SIDE / M = MAIN: M

SLOPE (%): 8

TEMP (C): 5.0

TIME: 11:30

COND.(uS): 180.0

SAMPLING COMMENTS: Site was done below the road.
201 mm DV was a mature female. 166 mm DV was a mature male.

POPULATION ESTIMATES:

SPECIES	AGE	FL RANGE	FL MEAN	MEAN WT (g)	PASS 1	PASS 2	PASS 3	EST. NUMB	95% C.I. LCI	95% C.I. UCI	N/M*M	N/100M	BIO-MASS (g/m*m)
Sthd	0+	45-52	49.0	1.6	4	0	na	4	4	4	0.216	26.7	0.346
Sthd	1+												
Sthd	>1+												
Char fry	0+												
Bull trout	>=1+												
D Varden	>=1+	166-201	183.5	62.1	2	0	na	2	2	2	0.108	13.3	6.714
MW	>=1+												
TOTAL								6			0.324	40.0	7.059

DIST (m)	WET WIDTH (m)	CHAN WIDTH (m)
0	0.5	3.0
5	1.7	3.9
10	1.5	6.9
15		5.9
20		4.2
25		3.0
30		
35		
40		
	1.2	4.5
AREA	18.5	MARGIN (M)

SITE COVER (%)		
LOD	5	
COBBLE	65	
IN VEG		
OVER VEG	10	
CUTBANK	15	
DEEP POOL	5	
TOTAL	65	
		15.0

SITE WATER TYPE (%)		DEPTH (cm)
POOL	15	25
RIFFLE	85	14
RUN		
OTHER		
D90	35	
D50	nr	
(cm)		

HABITAT COMMENTS: 1.5 m high drop over debris is present just d/s from road culvert: fish barrier.
Good cobble-boulder fry cover. Small pockets of potential DV spawning.
Culvert dimensions: 1.9 m diameter by 17. 3 m long with ~5% gradient.
Est. 1 c.f.s. discharge.

FOUR CREEK ELECTROFISHING SITE 1997

SITE:	F2	REACH:	2	DATE:	Sep-29	PHOTO:	na

SITE LOCATION: Four Creek, ~25 m u/s from Telkwa Coal Mine Road.

ACCESS: V2

EFFORT: (sec)	PASS 1	461
	PASS 2	371
	PASS 3	na

MARGIN = 1 FULL=2: 2

S = SIDE / M = MAIN: M

SLOPE (%): 9

TEMP (C):	5.0
TIME:	11:30
COND.(uS):	180.0

SAMPLING COMMENTS: No fish were caught in site F2. ~ 15 m below site and ~15 m above site were spot shocked; no fish were caught or observed. 2 pass removal.

POPULATION ESTIMATES:

SPECIES	AGE	FL RANGE	FL MEAN	MEAN WT (g)	PASS 1	PASS 2	PASS 3	EST. NUMB	95% C.I. LCI	95% C.I. UCI	N/M*M	N/100M	BIO-MASS (g/m*m)
Sthd	0+												
Sthd	1+												
Sthd	>1+												
Char fry	0+												
Bull trout	>=1+												
D Varden	>=1+												
MW	>=1+												
TOTAL													

NO FISH CAUGHT/OBSERVED.

DIST (m)	WET WIDTH (m)	CHAN WIDTH (m)
0	2.3	3.7
5	2.3	5.2
10	2.9	3.7
15	3.6	3.6
20	2.5	4.3
25		
30		
35		
40		
	2.7	4.1
AREA	53.0	MARGIN (M)

SITE COVER (%)		SITE WATER TYPE (%)	
LOD	10	POOL	50
COBBLE	70	RIFFLE	50
IN VEG		RUN	
OVER VEG		OTHER	
CUTBANK	10		
DEEP POOL	10		
TOTAL	70		

DEPTH (cm)	
	33
	25

D90	55
D50	20
(cm)	

19.5

HABITAT COMMENTS: 1.5 m high drop d/s from culvert is a barrier to fish. Boulder-pool habitat with some log-stepping; although steep, appears to be good for parr rearing. Little potential spawning in this section of creek. Est.1- 2 c.f.s. discharge.

GOATHORN CREEK ELECTROFISHING SITE 1997

SITE:	F4	REACH:	3	DATE:	Oct-01	PHOTO:	B4/12, 13

SITE LOCATION: Four Creek, at second road crossing.

ACCESS: V2

EFFORT: (sec)		
	PASS 1	nr
	PASS 2	na
	PASS 3	na

MARGIN = 1 FULL=2: 2

S = SIDE / M = MAIN: M

SLOPE (%): 1.5

TEMP (C):	5.5
TIME:	16:00
COND.(uS):	150.0

SAMPLING COMMENTS: Spot shocked 10 m section below road culvert. Sampled 15 m enclosed site above road. Heavy debris across the channel prevented a larger site from being sampled.

POPULATION ESTIMATES:

SPECIES	AGE	FL RANGE	FL MEAN	MEAN WT (g)	PASS 1	PASS 2	PASS 3	EST. NUMB	95% C.I. LCI	95% C.I. UCI	N/M*M	N/100M	BIO-MASS (g/m*m)
Sthd	0+												
Sthd	I+												
Sthd	>1+												
Char fry	0+												
Bull trout	>=1+												
D Varden	>=1+	78-110	94.0	10.0	2	na	na	2	na	na	0.060	13.3	0.599
MW	>=1+												
TOTAL													

NOTE: Four DV were also caught below the impassable road culvert (FL's = 115 mm, 112 mm, 77 mm and 57 mm). This 10 m section was spot shocked and no nets were used.

DIST (m)	WET WIDTH (m)	CHAN WIDTH (m)
0	2.9	3.1
5	2.0	2.0
10	2.0	2.1
15	2.0	2.2
20		
25		
30		
35		
40		
	2.2	2.4
AREA	33.4	MARGIN (M)

SITE COVER (%)		
LOD	20	
COBBLE	60	
IN VEG		
OVER VEG	10	
CUTBANK		
DEEP POOL	10	
TOTAL	50	

15.0

SITE WATER TYPE (%)		DEPTH (cm)
POOL	20	
RIFFLE	75	
RUN	5	
OTHER		
D90	28	
D50	10	
(cm)		

HABITAT COMMENTS: Est. 2 c.f.s. discharge. Low gradient, cobble stream with limited potential DV spawning. Block was logged beside R. left bank; when block was burned, the small buffer zone was burned also, causing trees to fall across the creek and changing the LOD loading. Culverts at road impassable: 1m by 19m and 0.7m by 19m.

FOUR CREEK ELECTROFISHING SITE 1997

SITE:	F5	REACH:	4	DATE:	Oct-08	PHOTO:	A3/1, 2

SITE LOCATION: Upper Four Creek, just d/s of fork.

ACCESS: FT

EFFORT: (sec)	PASS 1	950
	PASS 2	814
	PASS 3	na

MARGIN = 1 FULL=2: 2

S = SIDE / M = MAIN: M SLOPE (%): 4

TEMP (C):	1.0
TIME:	16:00
COND.(uS):	130.0

SAMPLING COMMENTS: Hiked down to site from old block. All char fry were identified as DV.

POPULATION ESTIMATES:

SPECIES	AGE	FL RANGE	FL MEAN	MEAN WT (g)	PASS 1	PASS 2	PASS 3	EST. NUMB	95% C.I. LCI	95% C.I. UCI	N/M*M	N/100M	BIO-MASS (g/m*m)
Sthd	0+												
Sthd	1+												
Sthd	>1+												
Char fry	0+	39-43	41.5	0.9	4	0	na	4	4	4	0.070	13.3	0.063
Bull trout	>=1+												
D Varden	>=1+	91-122	105.8	13.0	5	1	na	6	6	8	0.110	20.8	1.425
MW	>=1+												
TOTAL								10			0.180	34.2	1.489

DIST (m)	WET WIDTH (m)	CHAN WIDTH (m)
0	2.0	2.1
5	2.4	2.7
10	1.6	1.9
15	1.5	1.7
20	2.0	2.0
25		
30		
35		
40		
	1.9	2.1
AREA	57.0	MARGIN (M)

SITE COVER (%)		SITE WATER TYPE (%)	
LOD	10	POOL	20 / 25
COBBLE	70	RIFFLE	60 / 6
IN VEG		RUN	20
OVER VEG		OTHER	
CUTBANK	10		
DEEP POOL	10		
TOTAL	60		
	30.0		

DEPTH (cm)	
D90	18
D50	7

HABITAT COMMENTS: Est. 2 c.f.s. discharge. Small, stable creek in confined gully. Some boulder/LOD habitat and pockets of potential spawning are present. Moderate to low gradient in this section of creek (steeper u/s).

GOATHORN CREEK ELECTROFISHING SITE 1997

SITE:	F7	REACH:	6	DATE:	Oct-08	PHOTO:	A3/5, 6

SITE LOCATION: Upper Four Creek.

ACCESS: V2

EFFORT: (sec)	PASS 1	190
	PASS 2	na
	PASS 3	na

MARGIN = 1 FULL=2: 2

S = SIDE / M = MAIN: M

SLOPE (%): 17

TEMP (C): 1.5

TIME: 17:00

COND.(uS): 110.0

SAMPLING COMMENTS: Spot shocked below road for ~75 m length of stream. No fish were caught/observed.

POPULATION ESTIMATES:

SPECIES	AGE	FL RANGE	FL MEAN	MEAN WT (g)	PASS 1	PASS 2	PASS 3	EST. NUMB	95% C.I. LCI	95% C.I. UCI	N/M*M	N/100M	BIO-MASS (g/m*m)
Sthd	0+												
Sthd	1+												
Sthd	>1+												
Char fry	0+												
Bull trout	>=1+												
D Varden	>=1+												
MW	>=1+												
TOTAL													

NO FISH PRESENT.

DIST (m)	WET WIDTH (m)	CHAN WIDTH (m)
0	0.9	0.9
5	0.7	0.7
10	0.8	0.8
15	1.1	1.1
20		
25		
30		
35		
40		
	0.9	0.9
AREA	65.6	MARGIN (M)

SITE COVER (%)		
LOD	15	
COBBLE	30	
IN VEG		
OVER VEG	5	
CUTBANK	20	
DEEP POOL	30	
TOTAL	50	
		75.0

SITE WATER TYPE (%)		DEPTH (cm)
POOL	15	11
RIFFLE	75	3
RUN	10	
OTHER		
D90	30	
D50	11	
(cm)		

HABITAT COMMENTS: Trickle flow discharge.
Creek too small and steep; no potential fish use.

GOATHORN CREEK ELECTROFISHING SITE 1997

SITE:	F8	REACH:	2	DATE:	Oct-22	PHOTO:	A4/7, 8

SITE LOCATION: Four Creek Tributary 1, at spur road crossing.

ACCESS: FT

EFFORT: (sec)		
	PASS 1	350
	PASS 2	na
	PASS 3	na

MARGIN = 1 FULL=2: 2

S = SIDE / M = MAIN: M

SLOPE (%): 2

TEMP (C):	2.5
TIME:	14:00
COND.(uS):	nr

SAMPLING COMMENTS: Sampled 45 m length of stream with a lower net.
No fish were caught/observed.

POPULATION ESTIMATES:

SPECIES	AGE	FL RANGE	FL MEAN	MEAN WT (g)	PASS 1	PASS 2	PASS 3	EST. NUMB	95% C.I. LCI	95% C.I. UCI	N/M*M	N/100M	BIO-MASS (g/m*m)
Sthd	0+												
Sthd	1+												
Sthd	>1+												
Char fry	0+												
Bull trout	>=1+												
D Varden	>=1+												
MW	>=1+												
TOTAL													

NO FISH PRESENT.

DIST (m)	WET WIDTH (m)	CHAN WIDTH (m)
0	4.1	4.1
5	2.9	2.9
10	3.1	3.1
15	2.8	2.8
20		
25		
30		
35		
40		
	3.2	3.2
AREA	145.1	MARGIN (M)

SITE COVER (%)		
LOD	20	
COBBLE		
IN VEG	10	
OVER VEG	20	
CUTBANK	20	
DEEP POOL	30	
TOTAL	30	

45.0

SITE WATER TYPE (%)		DEPTH (cm)
POOL	20	25
RIFFLE	10	7
RUN	70	
OTHER		

D90	nr
D50	nr
(cm)	

HABITAT COMMENTS: Est. 2 c.f.s. discharge. Water turbid with ~35 cm visibility.
Small, low gradient creek with heavy alder overstory and sand/silt bed material.
No potential spawning present in this section. May dewater in summer/winter.
D/S at mouth, steep (12-15%), cobble, ~1 c.f.s. and 1 m wide; suspect no fish use.

GOATHORN CREEK ELECTROFISHING SITE 1997

SITE:	F10	REACH:	1	DATE:	Oct-08	PHOTO:	A3/3, 4

SITE LOCATION: Four Creek Tributary 2, d/s from road culvert.

ACCESS: V2

EFFORT: (sec)		
	PASS 1	350
	PASS 2	na
	PASS 3	na

MARGIN = 1 FULL=2: 2

S = SIDE / M = MAIN: M

SLOPE (%): 18

TEMP (C):	1.5
TIME:	16:30
COND.(uS):	130.0

SAMPLING COMMENTS: Spot shocked 70 m length of stream d/s from road. No fish were caught/observed.

POPULATION ESTIMATES:

SPECIES	AGE	FL RANGE	FL MEAN	MEAN WT (g)	PASS 1	PASS 2	PASS 3	EST. NUMB	95% C.I. LCI	95% C.I. UCI	N/M*M	N/100M	BIO-MASS (g/m*m)
Sthd	0+												
Sthd	1+												
Sthd	>1+												
Char fry	0+												
Bull trout	>=1+												
D Varden	>=1+												
MW	>=1+												
TOTAL													

NO FISH PRESENT.

DIST (m)	WET WIDTH (m)	CHAN WIDTH (m)
0	0.9	0.9
5	1.1	1.1
10	1.4	1.4
15	0.7	0.7
20	0.9	0.9
25	1.3	1.3
30		
35		
40		
	1.1	1.1
AREA	73.5	MARGIN (M)

SITE COVER (%)		
LOD	20	
COBBLE	60	
IN VEG		
OVER VEG		
CUTBANK		
DEEP POOL	20	
TOTAL	30	
		70.0

SITE WATER TYPE (%)		DEPTH (cm)
POOL	5	15
RIFFLE	95	3
RUN		
OTHER		
D90	25	
D50	nr	
(cm)		

HABITAT COMMENTS: Trickle flow discharge.
Creek too small and steep; no potential fish use.

GOATHORN CREEK ELECTROFISHING SITE 1996

SITE:	Goat1	REACH:	2	DATE:	Aug-14,1996	PHOTO:	B1/1, 2

SITE LOCATION: Goathorn Creek, 94 m d/s from upper road crossing to lower net.

ACCESS: V2

EFFORT: (sec)		
	PASS 1	nr
	PASS 2	nr
	PASS 3	na

MARGIN = 1 FULL=2: 2

S = SIDE / M = MAIN: M

SLOPE (%): 3

TEMP (C):	9.0
TIME:	18:00
COND.(uS):	nr

SAMPLING COMMENTS: Problems with electrofisher.
Very large site. 1 pass consists of 1 sweep d/s to lower net.

POPULATION ESTIMATES:

SPECIES	AGE	FL RANGE	FL MEAN	MEAN WT (g)	PASS 1	PASS 2	PASS 3	EST. NUMB	95% C.I. LCI	95% C.I. UCI	N/M*M	N/100M	BIO-MASS (g/m*m)
Sthd	0+												
Sthd	>=1+	67-159	122.3	nr	5	4	na	25	9	147	0.045	35.7	na
Char fry	0+												
Bull trout	>=1+	61-110	72.9	nr	7	1	na	8	7	9	0.015	11.7	na
D Varden	>=1+	60-170	119.9	nr	9	2	na	12	9	14	0.021	16.5	na
MW	>=1+												
TOTAL								45			0.081	63.9	na

DIST (m)	WET WIDTH (m)	CHAN WIDTH (m)
0	8.8	12.1
5	5.6	16.8
10	6.6	38.6
15	7.5	38.9
20	10.9	
25		
30		
35		
40		
	7.9	26.6
AREA	551.6	MARGIN (M)

SITE COVER (%)	
LOD	
COBBLE	50
IN VEG	
OVER VEG	
CUTBANK	
DEEP POOL	
TOTAL	

70.0

SITE WATER TYPE (%)	DEPTH (cm)
POOL	
RIFFLE	70
RUN	30
OTHER	
D90	
D50	
(cm)	

HABITAT COMMENTS: 450 mm adult BT was caught in pass 1 and another adult BT escaped @ bridge pool.
It appears that BT migration u/s was taking place at this time.

GOATHORN CREEK ELECTROFISHING SITE 1996

SITE:	Goat2	REACH:	2	DATE:	Aug-14,1996	PHOTO:	A1/1, 2

SITE LOCATION: 100 m u/s from Telkwa River Road bridge crossing.

ACCESS: V2

EFFORT: (sec)	PASS 1	1088
	PASS 2	972
	PASS 3	777

MARGIN = 1 FULL=2: 2

S = SIDE / M = MAIN: M

SLOPE (%): 2

TEMP (C):	9.5
TIME:	13:00
COND.(uS):	nr

SAMPLING COMMENTS:

POPULATION ESTIMATES:

SPECIES	AGE	FL RANGE	FL MEAN	MEAN WT (g)	PASS 1	PASS 2	PASS 3	EST. NUMB	95% C.I. LCI	95% C.I. UCI	N/M*M	N/100M	BIO-MASS (g/m*m)
Sthd	0+												
Sthd	>=1+	56-174	94.1	nr	32	13	5	53.9	54	54	0.127	107.8	#VALUE!
Char fry	0+	32	32.0	nr	1	0	0	1.0	1	1	0.002	2.0	#VALUE!
Bull trout	>=1+	63-111	100.0	nr	2	0	3	2.0	2	2	0.005	4.0	#VALUE!
D Varden	>=1+												
MW	>=1+	127-231	184.0	nr	4	0	0	0.0	0	0	0.000	0.0	#VALUE!
TOTAL								57			0.134	113.8	#VALUE!

DIST (m)	WET WIDTH (m)	CHAN WIDTH (m)
0	11.6	32.0
5	8.0	28.0
10	6.5	38.0
15	7.9	49.0
20		
25		
30		
35		
40		
	8.5	36.8
AREA	425.0	MARGIN (M)

SITE COVER (%)	
LOD	
COBBLE	70
IN VEG	
OVER VEG	
CUTBANK	
DEEP POOL	
TOTAL	
	50.0

SITE WATER TYPE (%)	DEPTH (cm)
POOL	
RIFFLE	70
RUN	30
OTHER	
D90	
D50	
(cm)	

HABITAT COMMENTS: Limited areas for spawning at this site.
Excellent SST parr rearing habitat - large cobble bed material.
Very unstable channel evidence.

GOATHORN CREEK ELECTROFISHING SITE 1996

SITE:	Goat2-rep	REACH:	2	DATE:	Aug-14,1996	PHOTO:	A1/3

SITE LOCATION: 100 m u/s from top of Site Goat2.

ACCESS: V2

EFFORT: (sec)	PASS 1	936
	PASS 2	1300
	PASS 3	1040

MARGIN = 1 FULL=2: 2

S = SIDE / M = MAIN: M

SLOPE (%): 2

TEMP (C):	12.0
TIME:	16:00
COND.(uS):	nr

SAMPLING COMMENTS:

POPULATION ESTIMATES:

SPECIES	AGE	FL RANGE	FL MEAN	MEAN WT (g)	PASS 1	PASS 2	PASS 3	EST. NUMB	95% C.I. LCI	95% C.I. UCI	N/M*M	N/100M	BIO-MASS (g/m*m)
Sthd	0+												
Sthd	>=1+	50-151	76.2	nr	32	14	5	56.9	38	76	0.083	113.8	na
Char fry	0+	38	38.0	nr	1	0	0	1.0	1	1	0.001	2.0	na
Bull trout	>=1+	69-115	82.8	nr	4	2	0	8.0	-2	18	0.012	16.0	na
D Varden	>=1+	58-105	75.4	nr	3	2	2	9.0	-18	36	0.013	18.0	na
MW	>=1+	93-218	174.3	nr	0	2	1	3.0	3	3	0.004	6.0	na
TOTAL								78			0.114	155.8	na

DIST (m)	WET WIDTH (m)	CHAN WIDTH (m)
0	16.1	19.0
5	14.9	25.0
10	12.3	23.0
15	11.5	12.8
20		
25		
30		
35		
40		
	13.7	20.0
AREA	685.0	MARGIN (M)

SITE COVER (%)		SITE WATER TYPE (%)	
LOD		POOL	
COBBLE	60	RIFFLE	80
IN VEG		RUN	20
OVER VEG		OTHER	
CUTBANK			
DEEP POOL			
TOTAL		D90	
		D50	
		(cm)	

DEPTH (cm): 70

50.0

HABITAT COMMENTS: Similar to Goat2; slightly wider wetted width, shallower, and smaller bed material than in Goat2.
Very limited potential spawning; more fines/less cover around bed material.

TENAS CREEK ELECTROFISHING SITE 1997

SITE:	T1	REACH:	1	DATE:	Sep-16	PHOTO:	B3/3, 4

SITE LOCATION: Tenas Creek, ~30 m u/s from old bridge site.

ACCESS: V2

EFFORT: (sec)	PASS 1	4040
	PASS 2	3520
	PASS 3	3510

MARGIN = 1 FULL=2: 2

S = SIDE / M = MAIN: M SLOPE (%): 1.5

TEMP (C):	8.0
TIME:	9:00
COND.(uS):	120.0

SAMPLING COMMENTS: Same site location as 1984.
A lot of debris collecting in the net due to heavy alder overstory within the site.

POPULATION ESTIMATES:

SPECIES	AGE	FL RANGE	FL MEAN	MEAN WT (g)	PASS 1	PASS 2	PASS 3	EST. NUMB	95% C.I. LCI	95% C.I. UCI	N/M*M	N/100M	BIO-MASS (g/m*m)
Sthd	0+	29-52	38.9	0.7	127	76	29	265	248	297	0.409	318.7	0.287
Sthd	1+	66-91	81.1	6.7	8	1	1	10	10	11	0.015	12.0	0.104
Sthd	>1+	92-152	108.6	15.6	20	12	4	39	37	55	0.060	46.9	0.939
Char fry	0+	42	42.0	0.8	0	I	0	1	1	na	0.002	1.2	0.001
Bull trout	>=1+	106-127	113.3	15.1	2	1	0	3	3	na	0.005	3.6	0.070
D Varden	>=1+												
TOTAL								317			0.491	382.4	1.401

DIST (m)	WET WIDTH (m)	CHAN WIDTH (m)
0	7.5	7.9
5	9.2	10.3
10	7.6	12.7
15	8.4	10.9
20	8.3	8.8
25	5.7	9.3
30		
35		
40		
	7.8	10.0

AREA 646.0 MARGIN (M) 83.0

SITE COVER (%)		SITE WATER TYPE (%)	
LOD	10	POOL	20
COBBLE	60	RIFFLE	70
IN VEG		RUN	10
OVER VEG	5	OTHER	
CUTBANK	5		
DEEP POOL	20		
TOTAL	70		

DEPTH (cm)	
14	
35	

D90	30
D50	nr
(cm)	

HABITAT COMMENTS: Good SST parr rearing in the cobble-riffle sections and moderate fry rearing along the margins. Flows are moderate and water is slightly coloured (heavy rain). A large debris jam and a side channel are present within site.

TENAS CREEK ELECTROFISHING SITE 1997

SITE:	T2	REACH:	1	DATE:	Sep-20	PHOTO:	B3/13, 14

SITE LOCATION: Lower Tenas Creek, hiked in from edge of block.

ACCESS: FT

EFFORT: (sec)	PASS 1	2724
	PASS 2	2605
	PASS 3	2350

MARGIN = 1 FULL=2: 2

S = SIDE / M = MAIN: M

SLOPE (%): 1.5

TEMP (C):	5.5
TIME:	9:30
COND.(uS):	90.0

SAMPLING COMMENTS: Hiked into site from old block; trail ribboned with pink flagging tape.
152 mm DV was a spent male. Suspect the char fry is a DV.

POPULATION ESTIMATES:

SPECIES	AGE	FL RANGE	FL MEAN	MEAN WT (g)	PASS 1	PASS 2	PASS 3	EST. NUMB	95% C.I. LCI	95% C.I. UCI	N/M*M	N/100M	BIO-MASS (g/m*m)
Sthd	0+	31-49	41.0	0.8	71	24	5	102	101	107	0.242	151.8	0.194
Sthd	I+	69-91	84.9	8.2	19	1	0	20	20	20	0.048	29.9	0.391
Sthd	>I+	93-146	112.9	18.7	8	2	0	10	10	11	0.024	14.9	0.446
Char fry	0+	50	50.0	1.2	1	0	0	1	1	na	0.002	1.5	0.003
Bull trout	>=1+	102-132	117.0	17.8	2	0	0	2	2	na	0.005	3.0	0.085
D Varden	>=1+	90-152	118.3	19.1	2	1	0	3	3	na	0.007	4.5	0.137
TOTAL								138			0.328	205.5	1.255

DIST (m)	WET WIDTH (m)	CHAN WIDTH (m)
0	7.1	8.4
5	6.4	6.9
10	6.9	8.3
15	5.6	6.8
20	5.3	7.7
25		
30		
35		
40		
	6.3	7.6
AREA	419.4	MARGIN (M)

SITE COVER (%)		
LOD	10	
COBBLE	65	
IN VEG		
OVER VEG	10	
CUTBANK	5	
DEEP POOL	10	
TOTAL	60	
		67.0

SITE WATER TYPE (%)		DEPTH (cm)
POOL	10	52
RIFFLE	50	25
RUN	30	
OTHER	10	
D90	32	
D50	19	
(cm)		

HABITAT COMMENTS: Lower Tenas C. at moderate flows.
Site mainly boulder-cobble riffle with some run and flats along the margin.
Two pools in site associated with LOD.

TENAS CREEK ELECTROFISHING SITE 1997

SITE:	T3	REACH:	2	DATE:	Sep-17	PHOTO:	B3/5, 6

SITE LOCATION: Upper Tenas Creek; hiked down hillside from block. Just u/s from periphyton site.

ACCESS: FT

EFFORT: (sec)	PASS 1	1790
	PASS 2	1605
	PASS 3	na

MARGIN = 1 FULL=2: 2

S = SIDE / M = MAIN: M SLOPE (%): 3

TEMP (C):	6.0
TIME:	11:00
COND.(uS):	90.0

SAMPLING COMMENTS: In same general area as 1984 site but at new location.
Heavy rain caused flow/turbidity to increase during sampling.

POPULATION ESTIMATES:

SPECIES	AGE	FL RANGE	FL MEAN	MEAN WT (g)	PASS 1	PASS 2	PASS 3	EST. NUMB	95% C.I. LCI	95% C.I. UCI	N/M*M	N/100M	BIO-MASS (g/m*m)
Sthd	0+	28-36	30.7	0.4	5	4	na	25	9	147	0.099	56.7	0.040
Sthd	1+												
Sthd	>1+	98-183	140.5	34.0	1	1	na	2	2	na	0.008	4.5	0.271
Char fry	0+	41-53	47.5	1.0	9	2	na	12	11	14	0.046	26.2	0.046
Bull trout	>=1+												
D Varden	>=1+	67-171	98.7	11.0	19	1	na	20	20	21	0.080	45.5	0.878
TOTAL								59			0.233	132.9	1.234

DIST (m)	WET WIDTH (m)	CHAN WIDTH (m)
0	6.2	12.3
5	5.5	12.2
10	5.9	10.5
15	5.8	9.8
20	5.1	9.1
25		
30		
35		
40		
	5.7	10.8
AREA	251.4	MARGIN (M) 44.1

SITE COVER (%)		
LOD	5	
COBBLE	90	
IN VEG		
OVER VEG	5	
CUTBANK		
DEEP POOL		
TOTAL	70	

SITE WATER TYPE (%)		DEPTH (cm)
POOL		
RIFFLE	90	30
RUN	10	33
OTHER		
D90	40	
D50	24	
(cm)		

HABITAT COMMENTS: Upper Tenas C. at moderate flows.
Site mainly riffle with a small section (5-10%) of run. Pools were too deep/turbid to sample.
171 mm DV was a ripe male. All but 3 char fry were identified as a BT.

TENAS CREEK ELECTROFISHING SITE 1997

SITE:	T4	REACH:	1	DATE:	Sep-19	PHOTO:	B3/11, 12

SITE LOCATION: Mid section of Tenas Creek at outlet of small beaver pond.

ACCESS: FT

EFFORT: (sec)	PASS 1	2357
	PASS 2	1854
	PASS 3	na

MARGIN = 1 FULL=2: 2

S = SIDE / M = MAIN: M

SLOPE (%): 2.5

TEMP (C):	7.5
TIME:	13:00
COND.(uS):	100.0

SAMPLING COMMENTS: Hiked in from ATV road on old cutblock . ATV could not be used due to the abundance of trees/brush on the block. Char fry were a mix of BT and DV.

POPULATION ESTIMATES:

SPECIES	AGE	FL RANGE	FL MEAN	MEAN WT (g)	PASS 1	PASS 2	PASS 3	EST. NUMB	95% C.I. LCI	95% C.I. UCI	N/M*M	N/100M	BIO-MASS (g/m*m)
Sthd	0+	32-44	38.5	0.6	83	18	na	106	101	113	0.344	321.2	0.207
Sthd	1+	67-91	82.1	5.2	7	0	na	7	7	7	0.023	21.2	0.118
Sthd	>1+	92-157	110.0	17.8	22	1	na	23	23	24	0.075	69.8	1.333
Char fry	0+	44-51	47.3	1.1	1	2	na	3	3	10	0.010	9.1	0.011
Bull trout	>=1+												
D Varden	>=1+	62-73	67.5	3.4	1	1	na	2	2	na	0.006	6.1	0.022
TOTAL								141			0.458	427.4	1.691

DIST (m)	WET WIDTH (m)	CHAN WIDTH (m)
0	9.0	10.9
5	9.8	12.7
10	9.4	11.1
15	9.1	13.0
20		
25		
30		
35		
40		
	9.3	11.9
AREA	307.7	MARGIN (M)

SITE COVER (%)		
LOD	10	
COBBLE	80	
IN VEG		
OVER VEG	5	
CUTBANK	5	
DEEP POOL		
TOTAL	65	
		33.0

SITE WATER TYPE (%)		DEPTH (cm)
POOL	5	30
RIFFLE	70	24
RUN	15	
OTHER	10	
D90	25	
D50	13	
(cm)		

HABITAT COMMENTS: Est. 20 c.f.s. discharge; creek at moderate flows.
Mainly boulder-riffle habitat with some run and 2 small edge pools.
Alcove at base of seepage outlet from the beaver pond was also sampled.
Excellent fry habitat section in the side channel section.

TENAS CREEK ELECTROFISHING SITE 1997

SITE:	T5	REACH:	1	DATE:	Sep-18	PHOTO:	B3/9, 10

SITE LOCATION: Upper Tenas Creek, ~100 m u/s the East Fork.

ACCESS: FT

EFFORT: (sec)	PASS 1	868
	PASS 2	864
	PASS 3	na

MARGIN = 1 FULL=2: 2

S = SIDE / M = MAIN: M SLOPE (%): 4.5

TEMP (C):	6.0
TIME:	11:30
COND.(uS):	120.0

SAMPLING COMMENTS: The 3 largest char fry were identified as BT.

POPULATION ESTIMATES:

SPECIES	AGE	FL RANGE	FL MEAN	MEAN WT (g)	PASS 1	PASS 2	PASS 3	EST. NUMB	95% C.I. LCI	95% C.I. UCI	N/M*M	N/100M	BIO-MASS (g/m*m)
Sthd	0+												
Sthd	1+												
Sthd	>1+												
Char fry	0+	31-51	45.6	0.9	3	2	na	9	5	36	0.067	27.3	0.060
Bull trout	>=1+	197	197.0	77.8	1	0	na	1	1	1	0.007	3.0	0.581
D Varden	>=1+	77-144	110.5	19.9	2	0	na	2	2	2	0.015	6.1	0.297
TOTAL								12			0.090	36.4	0.938

DIST (m)	WET WIDTH (m)	CHAN WIDTH (m)
0	5.5	17.8
5	3.9	12.1
10	4.1	12.4
15	3.3	10.8
20	3.5	9.5
25		
30		
35		
40		
	4.1	12.5
AREA	134.0	MARGIN (M)

SITE COVER (%)		SITE WATER TYPE (%)	
LOD	20	POOL	20
COBBLE	65	RIFFLE	75
IN VEG		RUN	5
OVER VEG		OTHER	
CUTBANK			
DEEP POOL	15		
TOTAL	70		

DEPTH (cm)	
41	
24	
D90	40
D50	16
(cm)	

33.0

HABITAT COMMENTS: Est 5-6 c.f.s. discharge. Large gravel eroding bank present along river left side of site. Mainly boulder-riffle with some pool/LOD habitat. Creek quite steep for good fish habitat. Dynamic creek with potential to move debris. Drops over debris up to 1 m high present d/s; access is restricted to high flow periods.

TENAS CREEK ELECTROFISHING SITE 1997

SITE:	T6	REACH:	3	DATE:	Sep-18	PHOTO:	B3/7, 8

SITE LOCATION: Upper Tenas Creek; ~70 m u/s the West Fork.

ACCESS: FT

EFFORT: (sec)		
	PASS 1	1030
	PASS 2	901
	PASS 3	na

MARGIN = 1 FULL=2: 2

S = SIDE / M = MAIN: M SLOPE (%): 3

TEMP (C):	4.5
TIME:	11:00
COND.(uS):	90.0

SAMPLING COMMENTS: Char fry were identified as DV except the largest fry which was a BT.

POPULATION ESTIMATES:

SPECIES	AGE	FL RANGE	FL MEAN	MEAN WT (g)	PASS 1	PASS 2	PASS 3	EST. NUMB	95% C.I. LCI	95% C.I. UCI	N/M*M	N/100M	BIO-MASS (g/m*m)
Sthd	0+	33-36	34.6	0.4	5	2	na	8	7	14	0.078	34.7	0.031
Sthd	1+	89-90	89.5	10.2	2	0	na	2	2	2	0.019	8.3	0.192
Sthd	>1+	95-98	96.7	11.9	2	1	na	4	3	11	0.038	16.7	0.448
Char fry	0+	36-49	41.6	0.8	3	2	na	9	5	36	0.085	37.5	0.068
Bull trout	>=1+												
D Varden	>=1+	70-143	100.6	11.9	11	4	na	17	15	24	0.163	72.0	1.937
TOTAL								41			0.382	169.2	2.676

DIST (m)	WET WIDTH (m)	CHAN WIDTH (m)
0	3.0	12.3
5	3.4	7.3
10	5.8	7.7
15	5.5	6.3
20		
25		
30		
35		
40		
	4.4	8.4
AREA	106.2	MARGIN (M)

SITE COVER (%)		
LOD	10	
COBBLE	60	
IN VEG		
OVER VEG	15	
CUTBANK		
DEEP POOL	15	
TOTAL	90	
		24.0

SITE WATER TYPE (%)		DEPTH (cm)
POOL	15	46
RIFFLE	80	14
RUN	5	
OTHER		
D90	28	
D50	7	
(cm)		

HABITAT COMMENTS: Discharge: moderate to low flows.
Complex site consisting of riffle, 2 pools, small debris along the margins, and a small trickle side channel suitable for fry.
Bed material is primarily cobble; very limited potential spawning in lower 100 m.

TENAS CREEK ELECTROFISHING SITE 1997

SITE:	T7	REACH:	2	DATE:	Oct-14	PHOTO:	A3/13, 14

SITE LOCATION: Tenas Creek Tributary 1, upper reach along cutblock.

ACCESS: V2

EFFORT: (sec)	PASS 1	520
	PASS 2	na
	PASS 3	na

MARGIN = 1 FULL=2: 2

S = SIDE / M = MAIN: M

SLOPE (%): 1.5

TEMP (C):	3.0
TIME:	12:00
COND.(uS):	50.0

SAMPLING COMMENTS: Electrofished u/s for 70 m. No fish were caught/observed.

POPULATION ESTIMATES:

SPECIES	AGE	FL RANGE	FL MEAN	MEAN WT (g)	PASS 1	PASS 2	PASS 3	EST. NUMB	95% C.I. LCI	95% C.I. UCI	N/M*M	N/100M	BIO-MASS (g/m*m)
Sthd	0+												
Sthd	1+												
Sthd	>1+												
Char fry	0+												
Bull trout	>=1+												
D Varden	>=1+												
TOTAL													

NO FISH PRESENT.

DIST (m)	WET WIDTH (m)	CHAN WIDTH (m)
0	0.6	0.6
5	0.8	0.8
10	0.4	0.4
15		
20		
25		
30		
35		
40		
	0.6	0.6
AREA	42.0	MARGIN (M)

SITE COVER (%)		
LOD	20	
COBBLE		
IN VEG		
OVER VEG	10	
CUTBANK	50	
DEEP POOL	20	
TOTAL	40	
		70.0

SITE WATER TYPE (%)		DEPTH (cm)
POOL	15	35
RIFFLE	5	12
RUN	80	
OTHER		
D90	3	
D50	nr	
(cm)		

HABITAT COMMENTS: Small, stable, low gradient, meandering creek with moss-covered banks.
No spawning potential present in this section. Bed material consists of sand/silt.
Creek was buffered on each side from new cutblocks.

TELKWA RIVER ELECTROFISHING SITE 1997

SITE:	SC1	REACH:	1	DATE:	Sep-30	PHOTO:	B4/8, 9

SITE LOCATION: Lower Telkwa River side channel; near Bulkley R. confluence.

ACCESS: V2

EFFORT: (sec)		
	PASS 1	3271
	PASS 2	1817
	PASS 3	na

MARGIN = 1 FULL=2: 2

S = SIDE / M = MAIN: S

SLOPE (%): 0.5

TEMP (C):	9.0
TIME:	15:00
COND.(uS):	80.0

SAMPLING COMMENTS: Sampled a very small side channel.

POPULATION ESTIMATES:

SPECIES	AGE	FL RANGE	FL MEAN	MEAN WT (g)	PASS 1	PASS 2	PASS 3	EST. NUMB	95% C.I. LCI	95% C.I. UCI	N/M*M	N/100M	BIO-MASS (g/m*m)
Sthd	0+	37-63	46.0	1.2	29	11	na	47	40	59	0.143	61.5	0.172
Sthd	1+	69-96	80.0	5.9	12	1	na	13	13	14	0.040	17.2	0.236
Sthd	>1+	111-160	132.3	27.3	3	0	na	3	3	3	0.009	3.9	0.251
Char fry	0+												
Bull trout	>=1+												
D Varden	>=1+	103	103.0	10.5	1	0	na	1	1	1	0.003	1.3	0.032
Coho	0+	47-76	62.0	3.2	91	10	na	102	101	105	0.313	134.5	1.001
Coho	1+	77-104	85.3	8.1	22	1	na	23	23	24	0.071	30.3	0.571
MW	0+	47-63	54.1	1.4	28	7	na	37	35	43	0.114	49.1	0.160
TOTAL								226			0.693	297.9	2.423

DIST (m)	WET WIDTH (m)	CHAN WIDTH (m)
0	1.6	344.0
5	1.8	
10	1.6	
15	8.9	
20	7.2	
25	5.1	
30	4.9	
35	3.3	
40		
	4.3	344.0
AREA	326.8	MARGIN (M)

SITE COVER (%)		
LOD	10	
COBBLE	20	
IN VEG		
OVER VEG	10	
CUTBANK	30	
DEEP POOL	30	
TOTAL	20	
	76.0	

SITE WATER TYPE (%)		DEPTH (cm)
POOL		
RIFFLE	5	15
RUN		
OTHER	95	35
D90	20	
D50	7	
(cm)		

HABITAT COMMENTS: Est. <1 c.f.s. discharge.
Sampled a slow, flat section with cutbank and alder overstory providing good cover. Nice fry habitat along the cobble margins.
Many fish present in this site; may be survival problems in the winter?

TELKWA RIVER ELECTROFISHING SITE 1997

SITE:	SC2	REACH:	1	DATE:	Oct-01	PHOTO:	B4/10, 11

SITE LOCATION: Telkwa River side channel.

ACCESS: V2

EFFORT: (sec)		
	PASS 1	2057
	PASS 2	1847
	PASS 3	1270

MARGIN = 1 FULL=2: 2

S = SIDE / M = MAIN: S

SLOPE (%): 1

TEMP (C):	8.0
TIME:	12:00
COND.(uS):	130.0

SAMPLING COMMENTS:

POPULATION ESTIMATES:

SPECIES	AGE	FL RANGE	FL MEAN	MEAN WT (g)	PASS 1	PASS 2	PASS 3	EST. NUMB	95% C.I. LCI	95% C.I. UCI	N/M*M	N/100M	BIO-MASS (g/m*m)
Sthd	0+	30-59	43.9	1.0	142	41	15	203	199	211	0.791	406.4	0.791
Sthd	1+	72-78	75.0	5.0	1	0	1	2	2	na	0.008	4.0	0.039
Sthd	>1+												
Char fry	0+												
Bull trout	>=1+	157	157.0	45.8	0	1	0	1	1	na	0.004	2.0	0.178
Coho	0+	51-76	66.7	3.5	9	9	8	73	29	na	0.285	146.2	0.996
Coho	1+	77-103	82.1	6.7	7	3	1	11	11	16	0.043	22.0	0.287
MW	0+	35-63	48.1	1.0	19	10	2	32	31	39	0.123	63.4	0.123
LND	0+	27-32	28.7	0.3	3	3	0	6	6	na	0.023	12.0	0.007
TOTAL								328			1.277	656.0	2.422

DIST (m)	WET WIDTH (m)	CHAN WIDTH (m)
0	5.3	328.0
5	5.0	
10	2.8	
15	4.1	
20	7.4	
25	6.3	
30	5.2	
35	5.0	
40		
	5.1	328.0
AREA	256.9	MARGIN (M)

SITE COVER (%)		
LOD		
COBBLE	50	
IN VEG	40	
OVER VEG		
CUTBANK		
DEEP POOL	10	
TOTAL	30	

50.0

SITE WATER TYPE (%)		DEPTH (cm)
POOL	10	35
RIFFLE	30	10
RUN	60	
OTHER		
D90	30	
D50	7	
(cm)		

HABITAT COMMENTS: Est. 2 c.f.s. discharge, very low flows.
Sampled a slow, wide flat section with cobble margins along one side of the site. Good fry cover despite the sandy bed material due to the extensive amount of brown algae growing within the channel.

TELKWA RIVER ELECTROFISHING SITE 1997

SITE:	SC3	REACH:	1	DATE:	Oct-03	PHOTO:	B5/6, 7

SITE LOCATION: Telkwa River side channel; located between margin sites MS6 and MS7.

ACCESS: FT

EFFORT: (sec)	PASS 1	2854
	PASS 2	1806
	PASS 3	na

MARGIN = 1 FULL=2: 2

S = SIDE / M = MAIN: S

SLOPE (%): 1

TEMP (C):	4.5
TIME:	13:00
COND.(uS):	60.0

SAMPLING COMMENTS: Hiked in from private property; sampled a side channel on river right. Char fry were identified as BT.

POPULATION ESTIMATES:

SPECIES	AGE	FL RANGE	FL MEAN	MEAN WT (g)	PASS 1	PASS 2	PASS 3	EST. NUMB	95% C.I. LCI	95% C.I. UCI	N/M*M	N/100M	BIO-MASS (g/m*m)
Sthd	0+	31-48	37.4	0.7	147	25	na	177	172	184	0.672	708.5	0.470
Sthd	1+	63-86	73.2	4.5	12	2	na	14	14	16	0.055	57.6	0.246
Sthd	>1+	97-122	108.3	13.5	5	1	na	6	6	8	0.024	25.0	0.320
Char fry	0+	57	57.0	1.7	1	0	na	1	1	1	0.004	4.0	0.006
Bull trout	>=1+	71-107	89.0	8.4	2	0	na	2	2	2	0.008	8.0	0.064
D Varden	>=1+	82	82.0	4.9	1	0	na	1	1	1	0.004	4.0	0.019
Coho	0+												
Coho	1+												
MW	0+	59-61	60.3	2.0	4	0	na	4	4	4	0.015	16.0	0.030
TOTAL								206			0.780	823.1	1.155

DIST (m)	WET WIDTH (m)	CHAN WIDTH (m)
0	8.0	200.0
5	7.7	164.0
10	8.9	140.0
15	11.3	168.0
20	12.9	
25	14.5	
30		
35		
40		
	10.6	168.0
AREA	263.8	MARGIN (M)

SITE COVER (%)		SITE WATER TYPE (%)	
LOD		POOL	
COBBLE	100	RIFFLE	80
IN VEG		RUN	
OVER VEG		OTHER	20
CUTBANK			
DEEP POOL			
TOTAL	65		

DEPTH (cm)	
12	
D90	33
D50	20
(cm)	

25.0

HABITAT COMMENTS: Est. 10 c.f.s. discharge.
Habitat consists mainly of wide, fast cobble-riffle with some flats along the margins.
Bed material is covered with brown algae.

TELKWA RIVER ELECTROFISHING SITE 1997

SITE:	SC4	REACH:	1	DATE:	Oct-21	PHOTO:	A4/1, 2

SITE LOCATION: Telkwa River side channel, at proposed bridge crossing.

ACCESS: V2

EFFORT: (sec)	PASS 1	1580
	PASS 2	1150
	PASS 3	1170

MARGIN = 1 FULL=2: 2

S = SIDE / M = MAIN: S

SLOPE (%): 1.5

TEMP (C):	4.5
TIME:	11:30
COND.(uS):	nr

SAMPLING COMMENTS: Best site for good fish habitat and complexity.

POPULATION ESTIMATES:

SPECIES	AGE	FL RANGE	FL MEAN	MEAN WT (g)	PASS 1	PASS 2	PASS 3	EST. NUMB	95% C.I. LCI	95% C.I. UCI	N/M*M	N/100M	BIO-MASS (g/m*m)
Sthd	0+	34-58	43.6	1.0	37	10	6	54	53	61	0.288	164.8	0.288
Sthd	1+	66-96	79.8	5.8	9	2	1	12	12	14	0.064	36.4	0.369
Sthd	>1+	97-153	115.0	17.9	13	1	2	16	16	16	0.085	48.5	1.518
Char fry	0+												
Bull trout	>=1+	88-219	146.4	38.2	5	0	0	5	5	na	0.027	15.2	1.012
D Varden	>=1+	117-124	120.5	16.8	0	2	0	2	2	na	0.011	6.1	0.178
Coho	0+	62-72	67.8	4.0	4	1	0	5	5	7	0.027	15.2	0.106
Coho	1+	78	78.0	5.9	1	0	0	1	1	na	0.005	3.0	0.031
MW	>=1+												
TOTAL								95			0.506	289.1	3.503

DIST (m)	WET WIDTH (m)	CHAN WIDTH (m)
0	6.4	120.0
5	5.4	
10	5.5	
15	6.7	
20	5.8	
25	4.5	
30		
35		
40		
	5.7	120.0
AREA	188.7	MARGIN (M)

SITE COVER (%)	
LOD	25
COBBLE	60
IN VEG	
OVER VEG	
CUTBANK	
DEEP POOL	15
TOTAL	60
	33.0

SITE WATER TYPE (%)	DEPTH (cm)
POOL	20 75
RIFFLE	35 16
RUN	30
OTHER	15
D90	36
D50	12
(cm)	

HABITAT COMMENTS: Excellent small side channel complex of habitat types (riffle, pool, run, flats). Cobble bed material with some debris along R. left margin. Excellent parr and juv. char habitat for 75% of the site. Good fry habitat along the slower flat areas.

TELKWA RIVER ELECTROFISHING SITE 1997

SITE:	MS1	REACH:	1	DATE:	Oct-09	PHOTO:	A3/7

SITE LOCATION: Lower Telkwa River margin site; at end of Cottonwood St. in Telkwa.

ACCESS: V2

EFFORT: (sec)		
	PASS 1	945
	PASS 2	780
	PASS 3	na

MARGIN = 1 FULL=2: 1

S = SIDE / M = MAIN: M SLOPE (%): 1

TEMP (C):	1.9
TIME:	10:00
COND.(uS):	60.0

SAMPLING COMMENTS:

POPULATION ESTIMATES:

SPECIES	AGE	FL RANGE	FL MEAN	MEAN WT (g)	PASS 1	PASS 2	PASS 3	EST. NUMB	95% C.I. LCI	95% C.I. UCI	N/M*M	N/100M	BIO-MASS (g/m*m)
Sthd	0+	32-47	39.6	0.7	24	6	na	32	30	37	0.397	280.7	0.278
Sthd	1+	64-90	75.2	4.8	4	1	na	5	5	7	0.066	46.8	0.318
Sthd	>1+	108	108.0	12.4	0	1	na	1	1	1	0.012	8.8	0.154
Char fry	0+												
Bull trout	>=1+	152	152.0	31.9	1	0	na	1	1	1	0.012	8.8	0.396
D Varden	>=1+												
Coho	0+												
Coho	1+												
MW	>=1+												
TOTAL								39			0.488	345.0	1.146

DIST (m)	WET WIDTH (m)	CHAN WIDTH (m)
0	2.0	172
5	3.8	208
10	4.2	240
15	4.3	184
20	3.8	
25	3.1	
30		
35		
40		
	3.5	201
AREA	80.6	MARGIN (M)

SITE COVER (%)		SITE WATER TYPE (%)	DEPTH (cm)
LOD		POOL	
COBBLE	100	RIFFLE	60 38
IN VEG		RUN	40
OVER VEG		OTHER	
CUTBANK			
DEEP POOL			
		D90	35
TOTAL	70	D50	18
		(cm)	

22.8

HABITAT COMMENTS: Site consists mainly of boulder and cobble with high flows on the edge of the site and some slow flats within ~1.5 m of the margin.

TELKWA RIVER ELECTROFISHING SITE 1997

SITE:	MS2	REACH:	1	DATE:	Oct-09	PHOTO:	A3/8

SITE LOCATION: Telkwa River margin site, ~60 m u/s from Site MS1.

ACCESS: V2

EFFORT: (sec)	PASS 1	1065
	PASS 2	940
	PASS 3	na

MARGIN = 1 FULL=2: 1

S = SIDE / M = MAIN: M

SLOPE (%): 1

TEMP (C):	1.9
TIME:	12:00
COND.(uS):	70.0

SAMPLING COMMENTS:

POPULATION ESTIMATES:

SPECIES	AGE	FL RANGE	FL MEAN	MEAN WT (g)	PASS 1	PASS 2	PASS 3	EST. NUMB	95% C.I. LCI	95% C.I. UCI	N/M*M	N/100M	BIO-MASS (g/m*m)
Sthd	0+	33-51	41.0	0.9	26	2	na	28	28	29	0.294	278.9	0.264
Sthd	1+	67-86	76.5	5.2	2	0	na	2	2	2	0.021	19.8	0.108
Sthd	>1+												
Char fry	0+												
Bull trout	>=1+												
D Varden	>=1+												
Coho	0+												
Coho	1+												
Chinook	0+	58	58.0	2.4	1	0	na	1	1	1	0.010	9.9	0.025
TOTAL								31			0.325	308.6	0.133

DIST (m)	WET WIDTH (m)	CHAN WIDTH (m)	SITE COVER (%)		SITE WATER TYPE (%)	DEPTH (cm)
0	3.3	172	LOD		POOL	
5	5.3	208	COBBLE	100	RIFFLE	20
10	6.7	240	IN VEG		RUN	80
15	6.0	184	OVER VEG		OTHER	
20	4.3		CUTBANK			
25	2.9		DEEP POOL			
30					D90	28
35			TOTAL	60	D50	14
40					(cm)	
	4.8	201				
AREA	96.0	MARGIN (M)	20.2			

HABITAT COMMENTS: Cobble margin site with primarily run habitat with a bit of riffle.

TELKWA RIVER ELECTROFISHING SITE 1997

SITE:	MS3	REACH:	1	DATE:	Oct-09	PHOTO:	A3/9, 10

SITE LOCATION: Telkwa River margin site, u/s from Site MS2.

ACCESS: V2

EFFORT: (sec)		
	PASS 1	1297
	PASS 2	899
	PASS 3	na

MARGIN = 1 FULL=2: 1

S = SIDE / M = MAIN: M SLOPE (%): 1

TEMP (C):	2.0
TIME:	14:00
COND.(uS):	60.0

SAMPLING COMMENTS: The char fry was visually identified as a DV.

POPULATION ESTIMATES:

SPECIES	AGE	FL RANGE	FL MEAN	MEAN WT (g)	PASS 1	PASS 2	PASS 3	EST. NUMB	95% C.I. LCI	95% C.I. UCI	N/M*M	N/100M	BIO-MASS (g/m*m)
Sthd	0+	32-58	42.0	0.9	28	8	na	39	36	46	0.356	502.6	0.320
Sthd	1+	64-91	78.9	5.2	4	4	na	8	8	na	0.073	102.6	0.378
Sthd	>1+	103	103.0	10.9	1	0	na	1	1	1	0.009	12.8	0.099
Char fry	0+	53	53.0	1.3	1	0	na	1	1	1	0.009	12.8	0.012
Bull trout	>=1+												
D Varden	>=1+												
Coho	0+												
Coho	1+												
MW	>=1+												
TOTAL								49			0.447	630.8	0.809

DIST (m)	WET WIDTH (m)	CHAN WIDTH (m)
0	4.1	172
5	7.3	208
10	9.4	240
15	10.3	184
20	9.5	
25	5.7	
30	3.1	
35		
40		
	7.1	201.0
AREA	110.1	MARGIN (M) 15.6

SITE COVER (%)		SITE WATER TYPE (%)	
LOD		POOL	
COBBLE	100	RIFFLE	60
IN VEG		RUN	40
OVER VEG		OTHER	
CUTBANK			
DEEP POOL			
		D90	36
TOTAL	70	D50	19
		(cm)	

DEPTH (cm): 25

HABITAT COMMENTS: Sampled a short, wide, cobble-riffle section. Excellent parr habitat for outer half of site. Good fry and small juv. habitat along margin section of site.

TELKWA RIVER ELECTROFISHING SITE 1997

SITE:	MS4	REACH:	1	DATE:	Oct-09	PHOTO:	A3/11, 12
SITE LOCATION:	Telkwa River margin site, just u/s from MS3.						
		ACCESS:	V2				
				EFFORT: (sec)	PASS 1	1663	
					PASS 2	847	
					PASS 3	na	
MARGIN = 1 FULL=2	1						
					TEMP (C):	1.9	
S = SIDE / M = MAIN:	M	SLOPE (%):	1		TIME:	16:00	
					COND.(uS):	60.0	
SAMPLING COMMENTS:							

POPULATION ESTIMATES:

SPECIES	AGE	FL RANGE	FL MEAN	MEAN WT (g)	PASS 1	2	3	EST. NUMB	95% C.I. LCI	UCI	N/M*M	N/100M	BIO-MASS (g/m*m)
Sthd	0+	32-49	40.3	0.8	19	7	na	30	26	40	0.253	290.7	0.202
Sthd	1+	68-94	78.0	5.3	8	0	na	8	8	8	0.067	77.3	0.357
Sthd	>1+	102	102.0	11.0	1	0	na	1	1	1	0.008	9.7	0.093
Chinook	0+	60-67	64.3	2.8	3	0	na	3	3	3	0.025	29.0	0.071
Bull trout	>=1+	225	225.0	102.5	1	0	na	1	1	1	0.008	9.7	0.862
D Varden	>=1+												
Coho	0+	69	69.0	4.6	1	0	na	1	1	I	0.008	9.7	0.039
Coho	1+	78-85	81.5	5.5	2	0	na	2	2	2	0.017	19.3	0.093
MW	0+	60	60.0	1.9	1	0	na	1	1	1	0.008	9.7	0.016
TOTAL								47			0.396	454.9	1.732

DIST (m)	WET WIDTH (m)	CHAN WIDTH (m)
0	4.7	172
5	6.6	208
10	7.6	240
15	7.4	184
20	6.0	
25	5.6	
30	2.3	
35		
40		
	5.7	201
AREA	118.9	MARGIN (M)

SITE COVER (%)		SITE WATER TYPE (%)	DEPTH (cm)
LOD	5	POOL	
COBBLE	95	RIFFLE	10 20
IN VEG		RUN	90 32
OVER VEG		OTHER	
CUTBANK			
DEEP POOL			
		D90	27
TOTAL	60	D50	11
		(cm)	

	20.7

HABITAT COMMENTS:	Primarily run habitat within site. Debris along margin with most of it dewatered. Fines/cobble within 2 m of the margin.

TELKWA RIVER ELECTROFISHING SITE 1997

SITE:	MS5	REACH:	1	DATE:	Oct-03	PHOTO:	B4/22, 23

SITE LOCATION: Telkwa River, bay area just off private property.

ACCESS: FT

EFFORT: (sec)	PASS 1	1454
	PASS 2	1049
	PASS 3	na

MARGIN = 1 FULL=2: 2

S = SIDE / M = MAIN: S SLOPE (%): 1

TEMP (C):	4.0
TIME:	10:00
COND.(uS):	60.0

SAMPLING COMMENTS: Sampled a bay area off the mainstem of the Telkwa R.

POPULATION ESTIMATES:

SPECIES	AGE	FL RANGE	FL MEAN	MEAN WT (g)	PASS 1	PASS 2	PASS 3	EST. NUMB	95% C.I. LCI	95% C.I. UCI	N/M*M	N/100M	BIO-MASS (g/m*m)
Sthd	0+	31-61	40.6	0.9	60	7	na	68	67	70	0.300	205.8	0.270
Sthd	1+	71	71.0	4.5	0	1	na	1	1	1	0.004	3.0	0.020
Sthd	>1+	108	108.0	14.0	1	0	na	1	1	1	0.004	3.0	0.062
Char fry	0+												
Bull trout	>=1+	180	180.0	55.3	1	0	na	1	1	1	0.004	3.0	0.244
D Varden	>=1+												
Coho	0+												
Coho	1+												
MW	0+	54-68	61.0	1.8	1	1	na	2	2	na	0.009	6.1	0.016
TOTAL								73			0.322	221.0	0.612

DIST (m)	WET WIDTH (m)	CHAN WIDTH (m)
0	8.5	200
5	8.9	164
10	8.2	140
15	8.1	168
20	3.1	
25	7.1	
30	2.8	
35		
40		
	6.7	168
*AREA	226.2	MARGIN (M)

SITE COVER (%)		SITE WATER TYPE (%)	DEPTH (cm)
LOD		POOL	
COBBLE	80	RIFFLE	10
IN VEG	10	RUN	90
OVER VEG		OTHER	
CUTBANK			
DEEP POOL	10		
		D90	32
TOTAL	25	D50	9
		(cm)	

33.0

*Note: Bay area was added to the calculated area:
4.6 m * 1.3 m = 5.98 m^2

HABITAT COMMENTS: Trickle flow discharge entering the top of the bay.

TELKWA RIVER ELECTROFISHING SITE 1997

SITE:	MS6	REACH:	1	DATE:	Oct-03	PHOTO:	B5/2, 3

SITE LOCATION: Telkwa River margin site, 50 m u/s from Site MS5.

ACCESS: FT

EFFORT: (sec)		
	PASS 1	830
	PASS 2	540
	PASS 3	na

MARGIN = 1 FULL=2: 1

S = SIDE / M = MAIN: M

SLOPE (%): 1

TEMP (C):	4.0
TIME:	11:30
COND.(uS):	60.0

SAMPLING COMMENTS: The char fry was visually identified as a BT.

POPULATION ESTIMATES:

SPECIES	AGE	FL RANGE	FL MEAN	MEAN WT (g)	PASS 1	PASS 2	PASS 3	EST. NUMB	95% C.I. LCI	95% C.I. UCI	N/M*M	N/100M	BIO-MASS (g/m*m)
Sthd	0+	31-48	38.0	0.7	25	7	na	35	32	41	0.316	420.9	0.221
Sthd	1+	70-79	74.5	4.9	2	0	na	2	2	2	0.018	24.2	0.089
Sthd	>1+	104-109	106.5	13.1	2	0	na	2	2	2	0.018	24.2	0.238
Char fry	0+	51	51.0	1.0	1	0	na	1	1	1	0.009	12.1	0.009
Bull trout	>=1+												
D Varden	>=1+												
Coho	0+												
Coho	1+												
MW	>=1+												
TOTAL								40			0.361	481.5	0.558

DIST (m)	WET WIDTH (m)	CHAN WIDTH (m)
0	5.5	200
5	7.2	164
10	7.7	140
15	7.9	168
20	5.0	
25		
30		
35		
40		
	6.7	168
AREA	109.9	MARGIN (M)

SITE COVER (%)		SITE WATER TYPE (%)	
LOD		POOL	
COBBLE	100	RIFFLE	
IN VEG		RUN	100
OVER VEG		OTHER	
CUTBANK			
DEEP POOL			
TOTAL	75		

DEPTH (cm)	
39	

D90	32
D50	17
(cm)	

16.5

HABITAT COMMENTS: Sampled a slow run section with large cobble and boulder bed material.
Excellent fry habitat for ~1.5 m along the margin.
Good parr habitat throughout site.

TELKWA RIVER ELECTROFISHING SITE 1997

SITE:	MS7	REACH:	1	DATE:	Oct-03	PHOTO:	B5/4, 5

SITE LOCATION: Telkwa River margin site, 150 m u/s from Site MS6.

ACCESS: FT

EFFORT: (sec)		
	PASS 1	2069
	PASS 2	1344
	PASS 3	na

MARGIN = 1 FULL=2: 1

S = SIDE / M = MAIN: M

SLOPE (%): 1

TEMP (C):	4.5
TIME:	12:00
COND.(uS):	60.0

SAMPLING COMMENTS: The char fry was visually identified as a BT.

POPULATION ESTIMATES:

SPECIES	AGE	FL RANGE	FL MEAN	MEAN WT (g)	PASS 1	PASS 2	PASS 3	EST. NUMB	95% C.I. LCI	95% C.I. UCI	N/M*M	N/100M	BIO-MASS (g/m*m)
Sthd	0+	31-45	38.4	0.7	61	17	na	85	78	94	0.757	768.8	0.530
Sthd	1+	78-89	82.8	5.7	4	0	na	4	4	4	0.036	36.4	0.204
Sthd	>1+	101-127	108.5	15.9	4	0	na	4	4	4	0.036	36.4	0.569
Char fry	0+	56	56.0	1.5	1	0	na	1	1	1	0.009	9.1	0.013
Bull trout	>=1+												
D Varden	>=1+												
Coho	0+												
Coho	1+												
MW	0+	60	60.0	1.5	0	1	na	1	1	1	0.009	9.1	0.013
TOTAL								95			0.846	859.7	1.330

DIST (m)	WET WIDTH (m)	CHAN WIDTH (m)
0	2.8	200
5	5.7	164
10	7.4	140
15	6.6	168
20	2.9	
25		
30		
35		
40		
	5.1	168
AREA	111.8	MARGIN (M)

SITE COVER (%)		SITE WATER TYPE (%)	DEPTH (cm)
LOD		POOL	
COBBLE	100	RIFFLE	90 25
IN VEG		RUN	
OVER VEG		OTHER	10
CUTBANK			
DEEP POOL			
		D90	35
TOTAL	80	D50	18
		(cm)	

22.0

HABITAT COMMENTS: Sampled a very fast boulder-riffle section. Excellent fry habitat for 1-2 m along the margin. Good parr habitat throughout most of the site. Poor fish habitat along outer edge of net due to high water velocities.

TELKWA RIVER ELECTROFISHING SITE 1997

SITE:	WL1	REACH:	1	DATE:	Nov-04	PHOTO:	A5/18, 19

SITE LOCATION: Lower 300 m of Telkwa R. flood channel located below road at PNG crossing.

ACCESS: FT

EFFORT: (sec)	PASS 1	na
	PASS 2	na
	PASS 3	na

MARGIN = 1 FULL=2: na

S = SIDE / M = MAIN: S

SLOPE (%): 2

TEMP (C):	4.0
TIME:	9:00
COND.(uS):	nr

SAMPLING COMMENTS: Set 10 traps in flood channel for 24 hour period.

POPULATION ESTIMATES:

SPECIES	AGE	FL RANGE	FL MEAN	MEAN WT (g)	NO. FISH	
Sthd	0+					
Sthd	1+	83	83.0	nr	1	
Sthd	>1+					
Coho	0+	49-76	62.7	nr		
Coho	>=1+	77-99	89.7	nr		Total coho catch for 10 traps: 107

TOTAL

DIST (m)	WET WIDTH (m)	CHAN WIDTH (m)
0	1.8	2.5
5	2.3	4.8
10	3.8	4.0
15	3.5	4.7
20		
25		
30		
35		
40		
	2.9	4.0

AREA: na MARGIN (M): na

SITE COVER (%)		SITE WATER TYPE (%)		DEPTH (cm)
LOD	15	POOL	10	38
COBBLE	20	RIFFLE	60	3
IN VEG		RUN	30	
OVER VEG		OTHER		
CUTBANK				
DEEP POOL	65			
		D90	13	
TOTAL	50	D50	nr	
		(cm)		

HABITAT COMMENTS: Est. 1 c.f.s. discharge. Nice low gradient seepage-fed channel. Evidence of high flows - flood waters had blown out old beaver dams and left debris above the banks. Sand/silt bed material with some cobble in riffle areas. Good coho rearing and potential coho enhancement area. No potential spawning.

BULKLEY RIVER ELECTROFISHING SITE 1997

SITE:	B1	REACH:	6	DATE:	Oct-02	PHOTO:	B4/15, 16

SITE LOCATION: Bulkley River margin site, ~100 m d/s from Hubert C. mouth.

ACCESS: BT

EFFORT: (sec)	PASS 1	1046
	PASS 2	948
	PASS 3	na

MARGIN = 1 FULL=2: 1

S = SIDE / M = MAIN: M

SLOPE (%): 1

TEMP (C):	8.0
TIME:	11:00
COND.(uS):	110.0

SAMPLING COMMENTS: Similar location to 1984; directions described 1984 site 100 m d/s Hubert C. mouth, but rock outcrop (site description) is ~1 km d/s.

POPULATION ESTIMATES:

SPECIES	AGE	FL RANGE	FL MEAN	MEAN WT (g)	PASS 1	PASS 2	PASS 3	EST. NUMB	95% C.I. LCI	95% C.I. UCI	N/M*M	N/100M	BIO-MASS (g/m*m)
Sthd	0+	33-59	42.6	0.9	29	7	na	38	36	43	0.364	382.3	0.328
Sthd	1+	71-74	72.3	4.1	3	0	na	3	3	3	0.029	30.0	0.117
Sthd	>1+												
Chinook	0+	44-70	54.3	2.1	38	8	na	48	46	53	0.458	481.3	0.963
Chinook	>=1+												
Coho	0+												
Coho	1+												
LND	0+	37	37.0	0.7	1	0	na	1	1	1	0.010	10.0	0.007
TOTAL								90			0.861	903.6	1.414

DIST (m)	WET WIDTH (m)	CHAN WIDTH (m)
0	2.4	80
5	4.6	120
10	6.5	100
15	6.7	100
20	7.2	
25	4.1	
30		
35		
40		
	5.3	100
AREA	105.0	MARGIN (M)

SITE COVER (%)		SITE WATER TYPE (%)	DEPTH (cm)
LOD		POOL	
COBBLE	100	RIFFLE	
IN VEG		RUN	100 44
OVER VEG		OTHER	
CUTBANK			
DEEP POOL			
		D90	30
TOTAL	40	D50	12
		(cm)	

20.0

HABITAT COMMENTS: Slow, flat, run habitat with cobble bed material.

BULKLEY RIVER ELECTROFISHING SITE 1997

SITE:	B2	REACH:	6	DATE:	Oct-02	PHOTO:	B4/17

SITE LOCATION: Bulkley River margin site, 100 m d/s from rock outcrop along CNR rip-rap.

ACCESS: BT

EFFORT: (sec)	PASS 1	750
	PASS 2	640
	PASS 3	na

MARGIN = 1 FULL=2: 1

S = SIDE / M = MAIN: M

SLOPE (%): 1

TEMP (C):	8.0
TIME:	13:00
COND.(uS):	50.0

SAMPLING COMMENTS: Same location as 1984.
Fish habitat is not as good as that found at Site B1.

POPULATION ESTIMATES:

SPECIES	AGE	FL RANGE	FL MEAN	MEAN WT (g)	PASS 1	PASS 2	PASS 3	EST. NUMB	95% C.I. LCI	95% C.I. UCI	N/M*M	N/100M	BIO-MASS (g/m*m)
Sthd	0+	40-47	43.0	1.0	4	0	na	4	4	4	0.059	34.8	0.059
Sthd	1+												
Sthd	>1+												
Chinook	0+	57-58	57.7	2.4	2	1	na	4	3	11	0.059	34.8	0.141
Chinook	>=1+												
Coho	0+												
Coho	1+												
LND	0+												
TOTAL								8			0.117	69.6	0.199

DIST (m)	WET WIDTH (m)	CHAN WIDTH (m)
0	2.6	80
5	3.4	120
10	4.2	100
15	4.4	100
20	2.2	
25	1.0	
30		
35		
40		
	3.0	100
AREA	68.2	MARGIN (M)

SITE COVER (%)	
LOD	
COBBLE	100
IN VEG	
OVER VEG	
CUTBANK	
DEEP POOL	
TOTAL	65
	23.0

SITE WATER TYPE (%)	DEPTH (cm)
POOL	
RIFFLE	
RUN	100 60
OTHER	

D90	28
D50	15
(cm)	

HABITAT COMMENTS: Fast and deep along outer edge of margin site and moderate flows within margin site. Bed material consists of cobble.

BULKLEY RIVER ELECTROFISHING SITE 1997

SITE:	B3	REACH:	6	DATE:	Oct-02	PHOTO:	B4/18, 19

SITE LOCATION: Bulkley River margin site.

ACCESS: BT

EFFORT: (sec)	PASS 1	500
	PASS 2	475
	PASS 3	na

MARGIN = 1 FULL=2: 1

S = SIDE / M = MAIN: M

SLOPE (%): 0.5

TEMP (C):	8.5
TIME:	14:00
COND.(uS):	50.0

SAMPLING COMMENTS: Approx. same location as 1984.

POPULATION ESTIMATES:

SPECIES	AGE	FL RANGE	FL MEAN	MEAN WT (g)	PASS 1	PASS 2	PASS 3	EST. NUMB	95% C.I. LCI	95% C.I. UCI	N/M*M	N/100M	BIO-MASS (g/m*m)
Sthd	0+	37-54	44.5	1.3	9	1	na	10	10	11	0.137	94.2	0.177
Sthd	1+	70	70.0	4.1	0	1	na	1	1	1	0.013	9.3	0.055
Sthd	>1+												
Chinook	0+	45-66	54.9	1.5	11	3	na	15	14	19	0.204	140.7	0.306
Chinook	>=1+												
Coho	0+												
Coho	1+												
LND	0+												
TOTAL								26			0.354	244.2	0.539

DIST (m)	WET WIDTH (m)	CHAN WIDTH (m)
0	2.7	80
5	4.3	120
10	4.5	100
15	3.6	100
20	3.4	
25	2.2	
30		
35		
40		
	3.5	100
AREA	74.2	MARGIN (M)

SITE COVER (%)		SITE WATER TYPE (%)	
LOD		POOL	
COBBLE	80	RIFFLE	
IN VEG		RUN	100
OVER VEG		OTHER	
CUTBANK			
DEEP RUN	20		
TOTAL	70		

DEPTH (cm)	
	55

D90	27
D50	12
(cm)	

21.5

HABITAT COMMENTS: Cobble bed material in a slow, run section.

BULKLEY RIVER ELECTROFISHING SITE 1997

SITE:	B4	REACH:	6	DATE:	Oct-02	PHOTO:	B4/20, 21

SITE LOCATION: Bulkley River margin site, 50 m d/s from Site B3.

ACCESS: BT

EFFORT: (sec)	PASS 1	824
	PASS 2	544
	PASS 3	na

MARGIN = 1 FULL=2: 1

S = SIDE / M = MAIN: M

SLOPE (%): 0.5

TEMP (C):	8.5
TIME:	16:00
COND.(uS):	50.0

SAMPLING COMMENTS: Approx. same location as 1984.

POPULATION ESTIMATES:

SPECIES	AGE	FL RANGE	FL MEAN	MEAN WT (g)	PASS 1	PASS 2	PASS 3	EST. NUMB	95% C.I. LCI	95% C.I. UCI	N/M*M	N/100M	BIO-MASS (g/m*m)
Sthd	0+	32-53	41.7	0.9	18	5	na	25	23	30	0.331	237.4	0.298
Sthd	1+	71-82	77.8	4.8	6	0	na	6	6	6	0.080	57.1	0.383
Sthd	>1+												
Chinook	0+	39-69	52.2	2.0	20	6	na	29	26	35	0.380	272.1	0.759
Chinook	>=1+												
Coho	0+												
Coho	1+												
LND	0+												
TOTAL								59			0.791	566.6	1.440

DIST (m)	WET WIDTH (m)	CHAN WIDTH (m)
0	3.0	80
5	4.3	120
10	4.6	100
15	4.3	100
20	3.4	
25	1.9	
30		
35		
40		
	3.6	100
AREA	75.3	MARGIN (M)

SITE COVER (%)	
LOD	
COBBLE	100
IN VEG	
OVER VEG	
CUTBANK	
DEEP POOL	
TOTAL	75

21.0

SITE WATER TYPE (%)		DEPTH (cm)
POOL		
RIFFLE	5	29
RUN	95	41
OTHER		

D90	30
D50	17
(cm)	

HABITAT COMMENTS: Slow, run habitat. Cobble bed material.
Good chinook and SST parr rearing habitat. Moderate habitat for large parr.
Good fry habitat within 1 m of margin.

HUBERT CREEK ELECTROFISHING SITE 1997

SITE:	HUB6	REACH:	2	DATE:	Aug-09	PHOTO:	A1/14, 15

SITE LOCATION: Immediately u/s from PNG crossing of Hubert Creek. Access via fields at Help's Farm.

ACCESS: V2

EFFORT: (sec)	PASS 1	700
	PASS 2	795
	PASS 3	na

MARGIN = 1 FULL=2: 2

S = SIDE / M = MAIN: M

SLOPE (%): 2

TEMP (C):	11.0
TIME:	14:20
COND.(uS):	110.0

SAMPLING COMMENTS: Easy site to sample. Good net sets and visibility etc.
The two fish captured at this site appear to be residents.

POPULATION ESTIMATES:

SPECIES	AGE	FL RANGE	FL MEAN	MEAN WT (g)	PASS 1	PASS 2	PASS 3	EST. NUMB	95% C.I. LCI	95% C.I. UCI	N/M*M	N/100M	BIO-MASS (g/m*m)
Ct	0+												
Ct	>1+	135-179	157.0	nr	2	0	na	2	2	2	0.023	5.3	na
Char fry	0+												
D Varden	>=1+												
LN dace	>=1+												
LN sucker	0+												
TOTAL								2			0.023	5.3	na

DIST (m)	WET WIDTH (m)	CHAN WIDTH (m)
0	3.0	6.3
5	2.3	2.8
10	2.5	2.5
15	2.5	2.5
20	1.7	2.6
25	1.5	3.8
30		
35		
40		
	2.3	3.4
AREA	85.5	MARGIN (M)

SITE COVER (%)		
LOD	5	
COBBLE	75	
IN VEG		
OVER VEG	10	
CUTBANK	10	
DEEP POOL		
TOTAL	60	
		38.0

SITE WATER TYPE (%)		DEPTH (cm)
POOL	20	27
RIFFLE	60	10
RUN	20	
OTHER		
D90	20	
D50	5	
(cm)		

HABITAT COMMENTS: Appears to be excellent rearing habitat, especially for fry.
Low fish abundance in this section; access problems d/s - beaver?
Hiked 400 m d/s: some spawning potential, 3% slope, thick brush, and several 0.5 m high debris drops (not barriers).

HUBERT CREEK ELECTROFISHING SITE 1997

SITE:	HUB8	REACH:	3	DATE:	Sep-22	PHOTO:	A4/5, 6

SITE LOCATION: Between PNG crossing and Hydro line.

ACCESS: ATV

EFFORT: (sec)	PASS 1	500
	PASS 2	390
	PASS 3	na

MARGIN = 1 FULL=2: 2

S = SIDE / M = MAIN: M

SLOPE (%): 3-4

TEMP (C): 4.0

TIME: 11:30

COND.(uS): nr

SAMPLING COMMENTS: Also spot sampled d/s for 60 m (270 sec.).
Captured one CT (FL = 177 mm).

POPULATION ESTIMATES:

SPECIES	AGE	FL RANGE	FL MEAN	MEAN WT (g)	PASS 1	PASS 2	PASS 3	EST. NUMB	95% C.I. LCI	95% C.I. UCI	N/M*M	N/100M	BIO-MASS (g/m*m)
Ct	0+												
Ct	>1+	150-177	163.5	nr	1	0	na	1	1	1	0.011	3.3	na
Char fry	0+												
D Varden	>=1+												
LN dace	>=1+												
LN sucker	0+												
TOTAL								1			0.011	3.3	na

DIST (m)	WET WIDTH (m)	CHAN WIDTH (m)
0	1.9	5.1
5	2.3	4.6
10	2.8	5.9
15	3.2	6.5
20	4.3	4.8
25		
30		
35		
40		
	2.9	5.4
AREA	87.0	MARGIN (M) 30.0

SITE COVER (%)		SITE WATER TYPE (%)	DEPTH (cm)
LOD	10	POOL	20	30
COBBLE	20	RIFFLE	60	11
IN VEG		RUN	15	
OVER VEG	20	OTHER	5	
CUTBANK	20			
DEEP POOL	30			
		D90	11	
TOTAL	50	D50	6	
		(cm)		

HABITAT COMMENTS: Limited potential spawning in this section - mainly large gravel/small cobble bed material.
Surprisingly low fish densities. Suspect access problems d/s.
Suspect the two fish sampled were stream residents.

HUBERT CREEK ELECTROFISHING SITE 1997

SITE:	HUB9	REACH:	3	DATE:	Aur-07	PHOTO:	B1/1, 2

SITE LOCATION: Sampled at Hydro line crossing.

ACCESS: ATV

EFFORT: (sec)	PASS 1	390
	PASS 2	460
	PASS 3	na

MARGIN = 1 FULL=2: 2

S = SIDE / M = MAIN: M

SLOPE (%): 4-5

TEMP (C): nr

TIME: 14:30

COND.(uS): nr

SAMPLING COMMENTS: Two pass removal with an upper and lower net.
Estimated 3-4 c.f.s. discharge.

POPULATION ESTIMATES:

SPECIES	AGE	FL RANGE	FL MEAN	MEAN WT (g)	PASS 1	PASS 2	PASS 3	EST. NUMB	95% C.I. LCI	95% C.I. UCI	N/M*M	N/100M	BIO-MASS (g/m*m)
Ct	0+												
Ct	>1+	140	140.0	nr	2	0	na	2	2	2	0.036	6.7	na
Char fry	0+												
D Varden	>=1+	162	162.0	nr	1	0	na	1	1	1	0.018	3.3	na
LN dace	>=1+												
LN sucker	0+												
TOTAL								3			0.054	10.0	na

DIST (m)	WET WIDTH (m)	CHAN WIDTH (m)
0	1.8	1.8
5	1.9	2.1
10	1.9	2.3
15		1.7
20		2.7
25		4.5
30		
35		
40		
	1.9	2.5
AREA	56.0	MARGIN (M)

SITE COVER (%)		
LOD	20	
COBBLE	40	
IN VEG		
OVER VEG	10	
CUTBANK	10	
DEEP POOL	20	
TOTAL	60	
		30.0

SITE WATER TYPE (%)		DEPTH (cm)
POOL	20	27
RIFFLE	70	12
RUN	10	
OTHER		
D90	17	
D50	nr	
(cm)		

HABITAT COMMENTS: Small cobble bed material; limited potential spawning.
Good trout parr habitat in the cobble/riffle areas.
No fry or small juveniles were present in this section.

HUBERT CREEK ELECTROFISHING SITE 1997

SITE:	HUB10	REACH:	4	DATE:	Sep-07	PHOTO:	B1/3, 4

SITE LOCATION: Upstream from Hydro line. Sampled just d/s from upper road crossing.

ACCESS: ATV

EFFORT: (sec)	PASS 1	740
	PASS 2	440
	PASS 3	na

MARGIN = 1 FULL=2: 2

S = SIDE / M = MAIN: M SLOPE (%): 6

TEMP (C): nr
TIME: 13:00
COND.(uS): nr

SAMPLING COMMENTS: 2 pass removal with upper and lower nets.

POPULATION ESTIMATES:

SPECIES	AGE	FL RANGE	FL MEAN	MEAN WT (g)	PASS 1	PASS 2	PASS 3	EST. NUMB	95% C.I. LCI	95% C.I. UCI	N/M*M	N/100M	BIO-MASS (g/m*m)
Ct	0+												
Ct	>1+												
Char fry	0+												
D Varden	>=1+	110-153	131.3	nr	2	1	na	4	3	11	0.060	11.4	na
LN dace	>=1+												
LN sucker	0+												
TOTAL								4			0.060	11.4	na

DIST (m)	WET WIDTH (m)	CHAN WIDTH (m)
0	1.6	2.8
5	2.3	2.6
10	1.7	2.7
15	1.5	3.1
20	2.4	2.9
25		
30		
35		
40		
	1.9	2.8
AREA	66.5	MARGIN (M)

SITE COVER (%)		
LOD	10	
COBBLE	60	
IN VEG		
OVER VEG	5	
CUTBANK	5	
DEEP POOL	20	
TOTAL	75	
		35.0

SITE WATER TYPE (%)		DEPTH (cm)
POOL	15	24
RIFFLE	80	12
RUN	5	
OTHER		
D90	28	
D50	nr	
(cm)		

HABITAT COMMENTS: Limited pockets of potential spawning gravels.
Mainly confined channel with cobble/boulder bed material.
Upper end of DV habitat at this location.

HELPS CREEK ELECTROFISHING SITE 1997

SITE:	H1	REACH:	2	DATE:	Aug-17	PHOTO:	A1/1, 2

SITE LOCATION: Mid-way between cattleguard and old bridge site.

ACCESS: V2

EFFORT: (sec)	PASS 1	500
	PASS 2	400
	PASS 3	

MARGIN = 1 FULL=2: 2

S = SIDE / M = MAIN: M SLOPE (%): 1

TEMP (C):	12.0
TIME:	11:15
COND.(uS):	180.0

SAMPLING COMMENTS: Estimate 2 c.f.s. discharge at the time of sampling.

POPULATION ESTIMATES:

SPECIES	AGE	FL RANGE	FL MEAN	MEAN WT (g)	PASS 1	PASS 2	PASS 3	EST. NUMB	95% C.I. LCI	95% C.I. UCI	N/M*M	N/100M	BIO-MASS (g/m*m)
Ct	0+												
Ct	>1+	98-117	109.6	nr	8	0	na	8	8	8	0.163	26.7	na
Char fry	0+												
D Varden	>=1+												
LN dace	>=1+												
LN sucker	0+												
TOTAL								8			0.163	26.7	na

DIST (m)	WET WIDTH (m)	CHAN WIDTH (m)
0	1.3	1.3
5	2.2	2.2
10	2.2	2.2
15	1.7	1.7
20	1.3	1.3
25	1.1	1.1
30		
35		
40		
	1.6	1.6
AREA	49.0	MARGIN (M)

SITE COVER (%)	
LOD	
COBBLE	50
IN VEG	
OVER VEG	50
CUTBANK	
DEEP POOL	
TOTAL	100

SITE WATER TYPE (%)		DEPTH (cm)
POOL	10	32
RIFFLE	60	12
RUN	30	
OTHER		
D90	25	
D50	nr	
(cm)		

30.0

HABITAT COMMENTS: Creek has been diverted through this section and runs along a ditch with fencing on one side. Banks sloughing in this section - some clay.
No spawning potential.
Willow/alder cover.

HELPS CREEK ELECTROFISHING SITE 1997

SITE:	H2	REACH:	2	DATE:	Aug-07	PHOTO:	A1/3, 4

SITE LOCATION: Immediately u/s from culvert. Old bridge site.

ACCESS: V2

EFFORT: (sec)	PASS 1	450
	PASS 2	450
	PASS 3	na

MARGIN = 1 FULL=2: 2

S = SIDE / M = MAIN: M SLOPE (%): 2

TEMP (C):	12.0
TIME:	12:15
COND.(uS):	180.0

SAMPLING COMMENTS: Easy to enclose with stopnets.
Estimate 2 c.f.s. discharge at the time of sampling.

POPULATION ESTIMATES:

SPECIES	AGE	FL RANGE	FL MEAN	MEAN WT (g)	PASS 1	PASS 2	PASS 3	EST. NUMB	95% C.I. LCI	95% C.I. UCI	N/M*M	N/100M	BIO-MASS (g/m*m)
Ct	0+	43	43.0	nr	1	0	na	1	1	1	0.011	3.0	na
Ct	>1+												
Char fry	0+												
D Varden	>=1+												
LN dace	>=1+												
LN sucker	0+												
TOTAL								1			0.011	3.0	na

DIST (m)	WET WIDTH (m)	CHAN WIDTH (m)		SITE COVER (%)		SITE WATER TYPE (%)	DEPTH (cm)
0	3.4	6.2	LOD		POOL		
5	3.2	8.3	COBBLE		RIFFLE	95	11
10	1.5	9.0	IN VEG		RUN	5	
15	3.9	10.6	OVER VEG		OTHER		
20	2.6	9.5	CUTBANK				
25	1.8	7.5	DEEP POOL				
30					D90	4	
35			TOTAL	0	D50	1	
40					(cm)		
	2.7	8.5					
AREA	90.2	MARGIN (M)	33.0				

HABITAT COMMENTS: Very poor fish habitat - cattle have eroded the banks and channel is very wide from erosion. Sands/pea gravels abundant. No vegetative cover.
Suspect this site dewaters in most summers/winters due to excess bed material.
Well installed 4' culvert replaces old bridge. Temp. is cool due to cool day.

HELPS CREEK ELECTROFISHING SITE 1997

SITE:	H3	REACH:	2	DATE:	Aug-07	PHOTO:	A1/7, 8

SITE LOCATION: South side of field - 150 m u/s from Trib. 1 confluence.

ACCESS: V2

EFFORT: (sec)	PASS 1	550
	PASS 2	500
	PASS 3	na

MARGIN = 1 FULL=2: 2

S = SIDE / M = MAIN: M SLOPE (%): 3

TEMP (C):	11.5
TIME:	14:00
COND.(uS):	170.0

SAMPLING COMMENTS: Estimate 3 c.f.s. discharge.

POPULATION ESTIMATES:

SPECIES	AGE	FL RANGE	FL MEAN	MEAN WT (g)	PASS 1	PASS 2	PASS 3	EST. NUMB	95% C.I. LCI	95% C.I. UCI	N/M*M	N/100M	BIO-MASS (g/m*m)
Ct	0+	46	46.0	nr	1	0	na	1	1	1	0.013	3.0	na
Ct	>1+												
Char fry	0+												
D Varden	>=1+												
LN dace	>=1+												
LN sucker	0+												
TOTAL								1			0.013	3.0	na

DIST (m)	WET WIDTH (m)	CHAN WIDTH (m)	SITE COVER (%)		SITE WATER TYPE (%)	
0	2.1	2.6	LOD		POOL	15
5	2.7	3.0	COBBLE	65	RIFFLE	80
10	1.7	2.4	IN VEG		RUN	5
15	1.9	3.4	OVER VEG	25	OTHER	
20	3.0	4.6	CUTBANK	5		
25	2.8	4.1	DEEP POOL			
30					D90	15
35			TOTAL	5	D50	nr
40					(cm)	
	2.4	3.4				
AREA	78.1	MARGIN (M)	33.0			

DEPTH (cm)
22
12

HABITAT COMMENTS: Good rearing habitat with cobble cover and brush overstory.
Pockets of potential spawning.
Banks have some unstable clay/silt sections.

HELPS CREEK ELECTROFISHING SITE 1997

SITE:	H3a	REACH:	1	DATE:	Aug-07	PHOTO:	A1/5, 6

SITE LOCATION: Tributary HP1 immediately d/s from road crossing/culvert.

ACCESS: V2

EFFORT: (sec)	PASS 1	140
	PASS 2	140
	PASS 3	na

MARGIN = 1 FULL=2: 2

S = SIDE / M = MAIN: M SLOPE (%): 5

TEMP (C):	14.5
TIME:	13:00
COND.(uS):	170.0

SAMPLING COMMENTS: Flows are just a trickle at the time of sampling.

POPULATION ESTIMATES:

SPECIES	AGE	FL RANGE	FL MEAN	MEAN WT (g)	PASS 1	PASS 2	PASS 3	EST. NUMB	95% C.I. LCI	95% C.I. UCI	N/M*M	N/100M	BIO-MASS (g/m*m)
Ct	0+												
Ct	>1+												
Char fry	0+												
D Varden	>=1+												
LN dace	>=1+												
LN sucker	0+												
TOTAL													

NO CATCH.

DIST (m)	WET WIDTH (m)	CHAN WIDTH (m)
0	0.5	3.1
5	0.7	3.8
10	0.6	4.0
15	0.6	3.1
20	0.7	2.6
25	0.2	3.8
30		
35		
40		
	0.6	3.4
AREA	16.5	MARGIN (M)

SITE COVER (%)		
LOD	10	
COBBLE	90	
IN VEG		
OVER VEG		
CUTBANK		
DEEP POOL		
TOTAL	100	
		30.0

SITE WATER TYPE (%)		DEPTH (cm)
POOL	5	10
RIFFLE	95	5
RUN		
OTHER		
D90	40	
D50	6	
(cm)		

HABITAT COMMENTS: The creek dries up for much of the summer.
Cutthroat fry observed in 1985.
Walked 100 m u/s from the culvert; a few isolated pools are wetted.
Must dry up in late summer/winter.

HELPS CREEK ELECTROFISHING SITE 1997

SITE:	H4	REACH:	3	DATE:	Aug-07	PHOTO:	A1/9, 10

SITE LOCATION: Upper net 8 m below culvert at top end of field.

ACCESS: V2

EFFORT: (sec)	PASS 1	1300
	PASS 2	800
	PASS 3	na

MARGIN = 1 FULL=2: 2

S = SIDE / M = MAIN: M SLOPE (%): 4

TEMP (C):	11.0
TIME:	15:00
COND.(uS):	170.0

SAMPLING COMMENTS: Problems with shocker on initial passes - so repeated sampling.
Estimate 3-4 c.f.s. discharge - higher flow than d/s.

POPULATION ESTIMATES:

SPECIES	AGE	FL RANGE	FL MEAN	MEAN WT (g)	PASS 1	PASS 2	PASS 3	EST. NUMB	95% C.I. LCI	95% C.I. UCI	N/M*M	N/100M	BIO-MASS (g/m*m)
Ct	0+	29-47	37.6	nr	13	2	na	15	14	17	0.222	41.5	na
Ct	>1+	95-116	102.4	nr	5	0	na	5	5	5	0.072	13.5	na
Char fry	0+												
D Varden	>=1+												
LN dace	>=1+												
LN sucker	0+												
TOTAL								20			0.295	55.0	na

DIST (m)	WET WIDTH (m)	CHAN WIDTH (m)
0	2.3	2.4
5	1.0	3.3
10	1.8	3.4
15	2.0	2.7
20	1.2	3.4
25	2.9	3.1
30		
35		
40		
	1.9	3.1
AREA	69.1	MARGIN (M)

SITE COVER (%)		SITE WATER TYPE (%)	DEPTH (cm)
LOD	40	POOL	60
COBBLE		RIFFLE	10
IN VEG	30	RUN	
OVER VEG	30	OTHER	
CUTBANK			
DEEP POOL			
TOTAL	75		
	37.0		

D90	5
D50	3
(cm)	

HABITAT COMMENTS: Good potential spawning in this section.
LOD forming stepped pools.
Good alder overstory.

HELPS CREEK ELECTROFISHING SITE 1997

SITE:	H7	REACH:	3	DATE:	Aug-09	PHOTO:	A1/11, 12

SITE LOCATION: Just u/s from road crossing in brushy area. Access from clearing on west side of field.

ACCESS: V2

EFFORT: (sec)	PASS 1	530
	PASS 2	400
	PASS 3	na

MARGIN = 1 FULL=2: 2

S = SIDE / M = MAIN: M SLOPE (%): 1.5

TEMP (C):	11.0
TIME:	11:45
COND.(uS):	170.0

SAMPLING COMMENTS: No fish in this site. However, numerous fry were noted u/s to fork, ~180 m above this site.

POPULATION ESTIMATES:

SPECIES	AGE	FL RANGE	FL MEAN	MEAN WT (g)	PASS 1	PASS 2	PASS 3	EST. NUMB	95% C.I. LCI	95% C.I. UCI	N/M*M	N/100M	BIO-MASS (g/m*m)
Ct	0+												
Ct	>1+												
Char fry	0+												
D Varden	>=1+												
LN dace	>=1+												
LN sucker	0+												
TOTAL													

NO CATCH.

DIST (m)	WET WIDTH (m)	CHAN WIDTH (m)
0	1.3	1.8
5	1.6	1.6
10	1.7	2.0
15	0.8	1.1
20	1.5	1.6
25	1.3	1.4
30		
35		
40		
	1.4	1.6
AREA	45.1	MARGIN (M)

SITE COVER (%)		
LOD	50	
COBBLE		
IN VEG		
OVER VEG	50	
CUTBANK		
DEEP POOL		
TOTAL	80	
		33.0

SITE WATER TYPE (%)		DEPTH (cm)
POOL	10	17
RIFFLE	60	5
RUN	30	
OTHER		
D90	4	
D50	1	
(cm)		

HABITAT COMMENTS: Surprised no fish at this site; fry are numerous just u/s.
Estimated 1-2 c.f.s. discharge.

HELPS CREEK ELECTROFISHING SITE 1997

SITE:	H9	REACH:	4	DATE:	Aug-07	PHOTO:	B1/7, 8

SITE LOCATION: Helps Creek mainstem below culvert at B.C. Hydro line crossing.

ACCESS: ATV

EFFORT: (sec)	PASS 1	750
	PASS 2	530
	PASS 3	na

MARGIN = 1 FULL=2: 2

S = SIDE / M = MAIN: M

SLOPE (%): 8-10

TEMP (C):	11.0
TIME:	16:00
COND.(uS):	190.0

SAMPLING COMMENTS: Estimated 1.5 c.f.s. discharge.
Used lower net. Culvert served as upper barrier.

POPULATION ESTIMATES:

SPECIES	AGE	FL RANGE	FL MEAN	MEAN WT (g)	PASS 1	PASS 2	PASS 3	EST. NUMB	95% C.I. LCI	95% C.I. UCI	N/M*M	N/100M	BIO-MASS (g/m*m)
Ct	0+	29-33	31.3	nr	6	2	na	9	5	13	0.202	25.7	na
Ct	>1+	83-100	91.5	nr	2	0	na	2	2	2	0.045	5.7	na
Char fry	0+												
D Varden	>=1+												
LN dace	>=1+												
LN sucker	0+												
TOTAL								11			0.246	31.4	na

DIST (m)	WET WIDTH (m)	CHAN WIDTH (m)
0	1.4	2.1
5	1.3	2.4
10	1.0	1.2
15	1.4	3.0
20		
25		
30		
35		
40		
	1.3	2.2
AREA	44.6	MARGIN (M)

SITE COVER (%)		SITE WATER TYPE (%)	DEPTH (cm)
LOD	30	POOL	30 / 20
COBBLE	10	RIFFLE	50 / 8
IN VEG		RUN	20 /
OVER VEG	15	OTHER	/
CUTBANK	15		
DEEP POOL	30		
		D90	11
TOTAL	50	D50	nr
		(cm)	

35.0

HABITAT COMMENTS: Small stable creek with a lot LOD and brush cover. Some potential spawning.
Culvert (0.4 m) - 10 m long; no drop at outlet. May be passable by adults.
Triton caught CT above the culvert.
Suspect creek mismapped u/s and this is the main Helps Creek channel.

HELPS CREEK ELECTROFISHING SITE 1997

SITE:	H11	REACH:	2	DATE:	Aug-07	PHOTO:	B1/5, 6

SITE LOCATION: Tributary HP4 at Hydro line crossing.

ACCESS: ATV

EFFORT: (sec)	PASS 1	350
	PASS 2	na
	PASS 3	na

MARGIN = 1 FULL=2: 2

S = SIDE / M = MAIN: M

SLOPE (%): 15

TEMP (C):	11.0
TIME:	14:00
COND.(uS):	110.0

SAMPLING COMMENTS: 1 pass with a lower net.
Sampled directly below road culvert.

POPULATION ESTIMATES:

SPECIES	AGE	FL RANGE	FL MEAN	MEAN WT (g)	PASS 1	PASS 2	PASS 3	EST. NUMB	95% C.I. LCI	95% C.I. UCI	N/M*M	N/100M	BIO-MASS (g/m*m)
Ct	0+												
Ct	>1+												
Char fry	0+												
D Varden	>=1+												
LN dace	>=1+												
LN sucker	0+												
TOTAL													

NO CATCH.

DIST (m)	WET WIDTH (m)	CHAN WIDTH (m)
0	0.4	0.7
5	0.7	0.8
10	0.5	0.8
15	0.4	1.2
20	0.5	0.7
25	0.3	1.5
30		
35		
40		

	0.5	1.0
AREA	18.7	MARGIN (M)

SITE COVER (%)		SITE WATER TYPE (%)	DEPTH (cm)
LOD	30	POOL	15	23
COBBLE	5	RIFFLE	80	9
IN VEG		RUN	5	
OVER VEG	10	OTHER		
CUTBANK	15			
DEEP POOL	40			
		D90	37	
TOTAL	30	D50 (cm)	nr	

40.0

HABITAT COMMENTS: Not suitable fish habitat. Series of steep 0.8 m high drops over debris/rock. Culvert (0.7 m) - 8% slope - 30 m long - 0.8 m high drop at outlet. 5 m high road fill over small culvert.
Very brushy, confined, single channel.

Appendix 7 Table 1. Summary of juvenile fish densities at Goathorn Creek sites for 1983-97.

SITE	YEAR	SPECIES	AGE	N	95% C.I.		N/100m	N/100m*m
					LCI	UCI		
G1	1983	SST	0+	321	271	371	494.0	49.3
			1+	53	48	58	82.0	8.1
			>1+	18	12	24	28.0	2.8
		CHAR	0+	1	1	na	2.0	0.2
		CHAR	>=1+	5	4	10	8.0	0.8
		MW	>=1+	1	1	na	2.0	0.2
	1984	SST	0+	282	223	341	455.0	38.9
			1+	77	64	90	124.0	10.6
			>1+	15	10	27	24.0	2.1
		CHAR	0+	0	0	0	0.0	0.0
		CHAR	>=1+	4	3	9	6.0	0.6
		MW	>=1+	1	1	na	2.0	0.1
	1985	SST	0+	251	197	305	386.0	42.4
			1+	19	18	22	29.0	3.2
			>1+	1	1	na	2.0	0.2
		CHAR	0+	0	0	0	0.0	0.0
		CHAR	>=1+	0	0	0	0.0	0.0
		MW	>=1+	0	0.00	0	0.0	0.0
	1997	SST	0+	162	147	196	261.9	25.0
			1+	2	2	na	3.2	0.3
			>1+	23	23	32	36.3	3.5
		CHAR FRY	0+	6	6	9	9.7	0.9
		BT	>=1+	3	3	na	4.8	0.5
		DV	>=1+	1	na	na	1.6	0.2
		MW	>=1+	13	14	na	21.0	2.0
G2	1983	SST	0+	106	67	142	151.0	12.7
			1+	35	29	44	50.0	4.2
			>1+	22	16	34	31.0	2.6
		CHAR	0+	1	1	na	1.0	0.1
		CHAR	>=1+	14	13	17	20.0	1.7
	1984	SST	0+	64	45	83	91.0	9.0
			1+	50	45	55	71.0	7.0
			>1+	10	10	10	14.0	1.4
		CHAR	0+	0	0	0	0.0	0.0
		CHAR	>=1+	3	3	na	4.0	0.4
	1985	SST	0+	194	135	253	281.0	24.7
			1+	9	7	16	13.0	1.1
			>1+	15	13	20	22.0	1.9
		CHAR	0+	1	1	na	1.0	0.1
		CHAR	>=1+	4	4	4	6.0	0.5
	1997	SST	0+	190	118	283	271.9	20.5
			1+	5	5	7	7.6	0.6
			>1+	24	19	38	34.5	2.6
		CHAR FRY	0+	5	4	8	6.4	0.5
		BT	>=1+	9	5	36	12.9	1.0
		DV	>=1+	1	1	1	1.4	0.1

Appendix 7 Table 1. Summary of juvenile fish densities at Goathorn Creek sites for 1983-97.

SITE	YEAR	SPECIES	AGE	N	95% C.I.		N/100m	N/100m*m
					LCI	UCI		
G3	1983	SST	0+	25	18	37	56.0	5.1
			1+	17	16	18	38.0	3.5
			>1+	11	9	17	25.0	2.2
		CHAR	0+	32	19	50	72.0	6.5
		CHAR	>=1+	20	17	27	45.0	4.1
	1984	SST	0+	29	18	45	66.0	6.4
			1+	9	9	na	20.0	2.0
			>1+	19	15	27	43.0	4.2
		CHAR	0+	30	21	44	68.0	6.6
		CHAR	>=1+	31	24	40	70.0	6.8
	1985	SST	0+	42	23	66	99.0	12.1
			1+	0	0	0	0.0	0.0
			>1+	12	7	25	29.0	3.5
		CHAR	0+	24	15	40	57.0	7.0
		CHAR	>=1+	26	17	37	62.0	7.5
	1997	SST	0+	18	18	18	40.4	3.3
			1+	0	0	0	0.0	0.0
			>1+	9	9	na	20.2	1.6
		CHAR FRY	0+	20	20	21	44.9	3.6
		BT	>=1+	7	7	11	15.7	1.3
		DV	>=1+	2	2	na	4.5	0.4
G4	1983	SST	0+	15	10	27	29.0	3.3
			1+	2	2	na	4.0	0.4
			>1+	3	3	na	6.0	0.7
		CHAR	0+	63	24	126	124.0	14.0
		CHAR	>=1+	39	34	46	76.0	8.6
	1984	SST	0+	5	3	na	10.0	1.1
			1+	1	1	na	2.0	0.2
			>1+	3	3	na	6.0	0.6
		CHAR	0+	30	18	46	58.0	6.6
		CHAR	>=1+	33	27	42	63.0	7.2
	1985	SST	0+	25	13	52	50.0	6.0
			1+	0	0	0	0.0	0.0
			>1+	0	0	0	0.0	0.0
		CHAR	0+	77	39	119	154.0	18.6
		CHAR	>=1+	18	16	22	36.0	4.3
	1997	SST	0+	69	68	75	101.9	8.5
			1+	0	0	0	0.0	0.0
			>1+	9	9	na	13.4	1.1
		CHAR FRY	0+	55	52	69	80.7	6.7
		BT	>=1+	17	17	17	25.0	2.1
		DV	>=1+	6	6	na	8.8	0.7

Appendix 7 Table 1. Summary of juvenile fish densities at Goathorn Creek sites for 1983-97.

SITE	YEAR	SPECIES	AGE	N	95% C.I.		N/100m	N/100m*m
					LCI	UCI		
G5	1983	SST	0+	3	2	na	3.0	0.4
			1+	0	0	0	0.0	0.0
			>1+	4	4	na	4.0	0.5
		CHAR	0+	26	17	42	28.0	3.2
		CHAR	>=1+	67	52	82	73.0	8.2
	1984	SST	0+	3	2	na	3.0	0.3
			1+	1	1	na	1.0	0.1
			>1+	1	1	na	1.0	0.1
		CHAR	0+	18	15	24	19.0	1.8
		CHAR	>=1+	80	60	100	85.0	8.2
	1985	SST	0+	7	5	15	8.0	0.9
			1+	0	0	0	0.0	0.0
			>1+	5	5	5	5.0	0.6
		CHAR	0+	50	37	64	54.0	6.1
		CHAR	>=1+	54	42	68	59.0	6.7
	1997	SST	0+	18	18	19	34.2	3.0
			1+	0	0	0	0.0	0.0
			>1+	5	5	7	9.5	0.8
		CHAR FRY	0+	29	28	39	55.3	4.8
		BT	>=1+	13	13	na	24.1	2.1
		DV	>=1+	8	8	11	15.2	1.3
G6	1984	SST	0+	0	0	0	0.0	0.0
			1+	1	1	na	4.0	0.5
			>1+	0	0	0	0.0	0.0
		CHAR	0+	4	4	na	14.0	2.2
		CHAR	>=1+	43	40	49	151.0	23.2
G6a	1997	SST	0+	0	0	0	0.0	0.0
			1+	0	0	0	0.0	0.0
			>1+	1	1	1	4.0	0.6
		CHAR FRY	0+	1	1	1	4.0	0.6
		BT	>=1+	5	4	8	18.0	2.7
		DV	>=1+	6	6	6	24.0	3.6
G7	1984	SST	0+	0	0	0	0.0	0.0
			1+	0	0	0	0.0	0.0
			>1+	0	0	0	0.0	0.0
		CHAR	0+	0	0	0	0.0	0.0
		CHAR	>=1+	56	49	63	237.0	22.4
	1997	SST	0+	0	0	0	0.0	0.0
			1+	0	0	0	0.0	0.0
			>1+	0	0	0	0.0	0.0
		CHAR FRY	0+	20	20	na	72.5	6.9
		BT	>=1+	1	1	1	3.6	0.3
		DV	>=1+	48	46	53	174.4	16.6

Appendix 7 Table 1. Summary of juvenile fish densities at Goathorn Creek sites for 1983-97.

SITE	YEAR	SPECIES	AGE	N	95% C.I.		N/100m	N/100m*m
					LCI	UCI		
G8	1997	SST	0+	0	0	0	0.0	0.0
			1+	0	0	0	0.0	0.0
			>1+	5	5	5	12.2	2.2
		CHAR FRY	0+	22	21	26	60.1	10.8
		BT	>=1+	0	0	0	0.0	0.0
		DV	>=1+	42	36	55	114.2	20.5
G9	1997	SST	0+	0	0	0	0.0	0.0
			1+	0	0	0	0.0	0.0
			>1+	0	0	0	0.0	0.0
		CHAR FRY	0+	4	3	11	17.4	3.2
		BT	>=1+	0	0	0	0.0	0.0
		DV	>=1+	25	23	30	108.4	19.8
G10	1997	SST	0+	0	0	0	0.0	0.0
			1+	0	0	0	0.0	0.0
			>1+	0	0	0	0.0	0.0
		CHAR FRY	0+	2	2	2	9.5	1.2
		BT	>=1+	2	2	2	9.5	1.2
		DV	>=1+	25	25	27	121.3	15.6

Appendix 7 Table 2. Summary of juvenile fish densities in Tenas Creek for 1983-97.

SITE	YEAR	SPECIES	AGE	N	95% C.I.		N/100m	N/100m*m
					LCI	UCI		
T1	1983	SST	0+	478	403	553	531.0	87.7
			1+	55	46	64	61.0	10.0
			>1+	18	15	21	20.0	3.3
		CHAR	0+	0	0	0	0.0	0.0
		CHAR	>=1+	5	4	10	6.0	0.9
	1984	SST	0+	213	161	265	256.0	36.6
			1+	45	18	72	54.0	7.7
			>1+	2	2	na	2.0	0.3
		CHAR	0+	0	0	0	0.0	0.0
		CHAR	>=1+	4	4	na	5.0	0.7
		MW	>=1+	2	2	na	2.0	0.3
	1985	SST	0+	267	207	327	318.0	50.4
			1+	10	6	14	12.0	1.9
			>1+	23	8	38	27.0	4.3
		CHAR	0+	0	0	0	0.0	0.0
		CHAR	>=1+	2	2	na	2.0	40.0
	1997	SST	0+	265	248	297	318.7	40.9
			1+	10	10	11	12.0	1.5
			>1+	39	37	55	46.9	6.0
		CHAR FRY	0+	1	1	na	1.2	0.2
		BT	>=1+	3	3	na	3.6	0.5
		DV	>=1+	0	0	0	0.0	0.0
T2	1983	SST	0+	210	173	255	345.0	52.2
			1+	44	35	53	71.0	10.7
			>1+	27	21	33	44.0	6.6
		CHAR	0+	0	0	0	0.0	0.0
		CHAR	>=1+	6	5	12	10.0	1.5
	1984	SST	0+	18	9	39	29.0	4.4
			1+	53	47	59	85.0	13.0
			>1+	33	22	44	53.0	8.1
		CHAR	0+	0	0	0	0.0	0.0
		CHAR	>=1+	6	6	na	10.0	1.5
	1985	SST	0+	183	111	255	295.0	46.8
			1+	15	13	17	24.0	3.8
			>1+	46	34	58	75.0	11.9
		CHAR	0+	1	na	na	2.0	0.3
		CHAR	>=1+	3	na	na	5.0	0.8
	1997	SST	0+	102	101	107	151.8	24.2
			1+	20	20	20	29.9	4.8
			>1+	10	10	11	14.9	2.4
		CHAR FRY	0+	1	1	na	1.5	0.2
		BT	>=1+	2	2	na	3.0	0.5
		DV	>=1+	3	3	na	4.5	0.7

Appendix 7 Table 2. Summary of juvenile fish densities in Tenas Creek for 1983-97.

SITE	YEAR	SPECIES	AGE	N	95% C.I.		N/100m	N/100m*m
					LCI	UCI		
T3	1983	SST	0+	9	9	9	24.0	4.6
			1+	0	0	0	0.0	0.0
			>1+	0	0	0	0.0	0.0
		CHAR	0+	30	18	72	81.0	15.3
		CHAR	>=1+	27	26	41	73.0	13.8
	1984	SST	0+	1	1	na	3.0	0.5
			1+	6	6	6	16.0	2.9
			>1+	0	0	0	0.0	0.0
		CHAR	0+	7	7	7	19.0	3.3
		CHAR	>=1+	22	22	22	59.0	10.5
	1985	SST	0+	2	2	2	5.0	1.2
			1+	0	0	0	0.0	0.0
			>1+	6	6	6	16.0	3.5
		CHAR	0+	14	12	19	36.0	7.8
		CHAR	>=1+	38	37	42	104.0	22.1
	1997	SST	0+	25	9	147	56.7	9.9
			1+	0				
			>1+	2	2	na	4.5	0.8
		CHAR FRY	0+	12	11	14	26.2	4.6
		BT	>=1+	0	0	0	0.0	0.0
		DV	>=1+	20	20	21	45.5	8.0
T4	1984	SST	0+	0				
			1+	6	6	6	24.0	4.0
			>1+	7	7	7	28.0	4.7
		CHAR	0+	12	10	20	48.0	8.0
		CHAR	>=1+	11	10	14	44.0	7.3
	1997	SST	0+	106	101	113	321.2	4.4
			1+	7	7	7	21.2	2.3
			>1+	23	23	24	69.8	7.5
		CHAR FRY	0+	3	3	10	9.1	1.0
		BT	>=1+	0	0	0	0.0	0.0
		DV	>=1+	2	2	na	6.1	0.6
T5	1997	SST	0+	0	0	0	0.0	0.0
			1+	0	0	0	0.0	0.0
			>1+	0	0	0	0.0	0.0
		CHAR FRY	0+	9	5	36	27.3	6.7
		BT	>=1+	1	1	1	3.0	7.0
		DV	>=1+	2	2	2	6.1	1.5
T6	1997	SST	0+	8	7	14	34.7	7.8
			1+	2	2	2	8.3	1.9
			>1+	4	3	11	16.7	3.8
		CHAR FRY	0+	9	5	36	37.5	8.5
		BT	>=1+	0	0	0	0.0	0.0
		DV	>=1+	17	15	24	72.0	16.3

Appendix 7 Table 3. Summary of juvenile fish densities in the Telkwa River for 1983-97.

SITE	YEAR	SPECIES	AGE	N	95% C.I.		N/100m	N/100m*m
					LCI	UCI		
SC1	1983	SST	0+	215	180	250	307.0	33.0
			1+	27	15	51	39.0	4.1
			>1+	11	8	20	16.0	1.7
		CHAR	0+	2	2	na	3.0	0.3
		CHAR	>=1+	0	0	0	0.0	0.0
		CO	0+	2	2	na	3.0	0.3
		CH	0+	1	1	na	1.0	0.2
		MW	0+	41	33	52	59.0	6.3
		MW	>=1+	1	1	na	1.0	0.2
	1984	SST	0+	70	45	95	90.0	12.7
			1+	84	62	106	108.0	15.2
			>1+	9	6	19	12.0	1.6
		CHAR	0+	0	0	0	0.0	0.0
		CHAR	>=1+	0	0	0	0.0	0.0
		CO	0+	1	1	na	1.0	0.2
		CH	0+	9	5	na	12.0	1.6
		LND	0+	1	1	na	12.0	0.2
		MW	0+	27	19	40	35.0	4.9
		MW	>=1+	1	1	na	12.0	0.2
	1985	SST	0+	80	51	109	105.0	15.3
			1+	9	9	10	12.0	1.7
			>1+	4	4	6	6.0	0.8
		CHAR	0+	0	0	0	0.0	0.0
		CHAR	>=1+	0	0	0	0.0	0.0
		CO	0+	18	15	24	23.0	3.4
		CO	1+	1	1	na	1.0	0.2
		MW	0+	9	6	13	12.0	1.7
		MW	>=1+	0	0	0	0.0	0.0
	1997	SST	0+	47	40	59	61.5	14.3
			1+	13	13	14	17.2	4.0
			>1+	3	3	3	3.9	0.9
		BT	>=1+	0	0	0	0.0	0.0
		DV	>=1+	1	1	1	1.3	0.3
		CO	0+	102	101	105	134.5	31.3
		CO	1+	23	23	24	30.3	7.1
		MW	0+	37	35	43	49.1	11.4
SC2	1983	SST	0+	88	29	173	342.0	20.3
			1+	15	12	22	58.0	3.5
			>1+	12	9	15	47.0	2.8
		CHAR	>=1+	1	1	na	4.0	0.2
		CO	0+	2	2	na	8.0	0.5
		CO	1+	0	0	0	0.0	0.0
		MW	0+	49	13	na	191.0	11.3

Appendix 7 Table 3. Summary of juvenile fish densities in the Telkwa River for 1983-97.

SITE	YEAR	SPECIES	AGE	N	95% C.I.		N/100m	N/100m*m
					LCI	UCI		
	1984	SST	0+	36	17	71	73.0	4.8
			1+	59	44	75	120.0	7.9
			>1+	21	19	26	43.0	2.8
		CHAR	>=1+	0	0	0	0.0	0.0
		CO	0+	7	5	15	14.0	0.9
		CH	0+	2	2	na	4.0	0.3
		MW	0+	7	7	na	14.0	0.9
	1985	SST	0+	108	70	146	271.0	17.2
			1+	7	7	7	18.0	1.1
			>1+	16	13	22	39.0	2.5
		CHAR	>=1+	0	0	0	0.0	0.0
		CO	0+	1	1	na	3.0	0.2
		CO	1+	1	1	na	3.0	0.2
		LNS	1+	1	1	na	3.0	0.2
		MW	0+	1	1	na	3.0	0.2
	1997	SST	0+	203	199	211	376.3	73.2
			1+	2	2	na	3.7	0.7
			>1+	0	0	0	0.0	0.0
		BT	>=1+	1	1	na	1.9	0.4
		DV	>=1+	0	0	0	0.0	0.0
		CO	0+	73	29	na	135.4	26.3
		CO	1+	11	11	16	20.4	4.0
		LND	0+	6	6	na	11.1	2.2
		MW	0+	32	31	39	58.7	11.4
SC3	1983	SST	0+	20	19	28	80.0	43.5
			1+	0	0	0	0.0	0.0
			>1+	0	0	0	0.0	0.0
		CHAR	0+	0	0	0	0.0	0.0
		CHAR	>=1+	0	0	0	0.0	0.0
		CO	0+	12	11	14	48.0	26.1
		MW	0+	4	3	na	16.0	8.7
	1984	SST	0+	17	15	24	68.0	52.3
			1+	0	0	0	0.0	0.0
			>1+	0	0	0	0.0	0.0
		CHAR	0+	0	0	0	0.0	0.0
		CHAR	>=1+	0	0	0	0.0	0.0
		CO	<=1+	60	58	63	240.0	184.6
		MW	>=1+	0	0	0	0.0	0.0
	1997	SST	0+	177	172	184	708.5	67.2
			1+	14	14	16	57.6	5.5
			>1+	6	6	8	25.0	2.4
		CHAR FRY	0+	1	1	1	4.0	0.4
		BT	>=1+	2	2	2	8.0	0.8
		DV	>=1+	1	1	1	4.0	0.4
		CO	0+	0	0	0	0.0	0.0
		MW	0+	4	4	4	16.0	1.5

Appendix 7 Table 3. Summary of juvenile fish densities in the Telkwa River for 1983-97.

SITE	YEAR	SPECIES	AGE	N	95% C.I.		N/100m	N/100m*m
					LCI	UCI		
SC4	1997	SST	0+	54	53	61	164.8	28.8
			1+	12	12	14	36.4	6.4
			>1+	16	16	16	48.5	8.5
		CHAR FRY	0+	0	0	0	0.0	0.0
		BT	>=1+	5	5	na	15.2	2.7
		DV	>=1+	2	2	na	6.1	1.1
		CO	0+	5	5	7	15.2	2.7
		CO	>=1+	1	1	na	3.0	0.5
		MW	0+	0	0	0	0.0	0.0
MS1	1983	SST	0+	38	33	43	262.0	45.5
			1+	9	9	9	62.0	10.8
			>1+	3	3	3	21.0	3.6
		CHAR	0+	0	0	0	0.0	0.0
		CHAR	>=1+	0	0	0	0.0	0.0
		CO	0+	0	0	0	0.0	0.0
		CO	1+	0	0	0	0.0	0.0
		MW	0+	0	0	0	0.0	0.0
	1984	SST	0+	11	8	14	58.0	12.3
			1+	15	11	19	79.0	16.8
			>1+	8	7	9	42.0	9.0
		CHAR	0+	0	0	0	0.0	0.0
		CHAR	>=1+	0	0	0	0.0	0.0
		CO	0+	0	0	0	0.0	0.0
		CO	1+	0	0	0	0.0	0.0
		MW	0+	0	0	0	0.0	0.0
	1985	SST	0+	50	39	68	248.0	5.9
			1+	7	7	7	35.0	8.3
			>1+	5	4	8	23.0	5.4
		CHAR	0+	0	0	0	0.0	0.0
		CHAR	>=1+	0	0	0	0.0	0.0
		CO	0+	1	1	1	5.0	1.2
		CO	1+	0	0	0	0.0	0.0
		MW	0+	0	0	0	0.0	0.0
	1997	SST	0+	32	30	37	280.7	39.7
			1+	5	5	7	46.8	6.6
			>1+	1	1	1	8.8	1.2
		CHAR FRY	0+	0	0	0	0.0	0.0
		BT	>=1+	1	1	1	8.8	1.2
		DV	>=1+	0	0	0	0.0	0.0
		CO	0+	0	0	0	0.0	0.0
		CO	1+	0	0	0	0.0	0.0
		MW	0+	0	0	0	0.0	0.0

Appendix 7 Table 3. Summary of juvenile fish densities in the Telkwa River for 1983-97.

SITE	YEAR	SPECIES	AGE	N	95% C.I.		N/100m	N/100m*m
					LCI	UCI		
MS2	1983	SST	0+	39	38	40	197.0	37.2
			1+	3	3	3	15.0	2.9
			>1+	2	2	2	10.0	1.9
		CHAR	0+	0	0	0	0.0	0.0
		CHAR	>=1+	0	0	0	0.0	0.0
		CO	0+	2	2	2	10.0	1.9
		CO	1+	0	0	0	0.0	0.0
		MW	0+	1	1	1	5.0	1.0
	1984	SST	0+	14	12	19	65.0	13.7
			1+	5	5	7	23.0	4.9
			>1+	3	3	na	14.0	2.9
		CHAR	0+	0	0	0	0.0	0.0
		CHAR	>=1+	0	0	0	0.0	0.0
		CO	0+	2	2	na	9.0	2.0
		CO	1+	0	0	0	0.0	0.0
		MW	0+	1	1	na	5.0	1.0
	1985	SST	0+	37	36	38	149.0	37.3
			1+	5	5	5	20.0	5.0
			>1+	1	1	1	4.0	1.0
		CHAR	0+	0	0	0	0.0	0.0
		CHAR	>=1+	1	1	1	4.0	1.0
		CO	0+	8	8	8	32.0	8.0
		CO	1+	3	3	3	12.0	3.0
		MW	0+	0	0.00	0	0.0	0.0
	1997	SST	0+	28	28	29	278.9	29.4
			1+	2	2	2	19.8	2.1
			>1+	0	0	0	0.0	0.0
		CHAR FRY	0+	0	0	0	0.0	0.0
		BT	>=1+	0	0	0	0.0	0.0
		DV	>=1+	0	0	0	0.0	0.0
		CO	0+	0	0	0	0.0	0.0
		CO	1+	0	0	0	0.0	0.0
		CH	0+	1	1	1	9.9	1.0
MS3	1983	SST	0+	26	26	27	234.0	31.7
			1+	5	5	7	45.0	6.1
			>1+	1	1	1	0.9	1.2
		CHAR	0+	0	0	0	0.0	0.0
		CHAR	>=1+	0	0	0	0.0	0.0
		CO	0+	0	0	0	0.0	0.0
		MW	>=1+	1	1	1	9.0	1.2
	1984	SST	0+	16	16	37	100.0	15.4
			1+	12	12	13	75.0	11.5
			>1+	3	3	3	19.0	2.9
		CHAR	0+	0	0	0	0.0	0.0
		CHAR	>=1+	0	0	0	0.0	0.0
		CO	0+	1	1	1	6.0	1.0
		MW	0+	2	2	na	12.0	1.9

Appendix 7 Table 3. Summary of juvenile fish densities in the Telkwa River for 1983-97.

SITE	YEAR	SPECIES	AGE	N	95% C.I.		N/100m	N/100m*m
					LCI	UCI		
	1985	SST	0+	39	36	46	218.0	30.2
			1+	11	11	11	61.0	8.5
			>1+	8	8	8	44.0	6.2
		CHAR	0+	0	0	0	0.0	0.0
		CHAR	>=1+	1	1	1	6.0	0.8
		CO	0+	0	0	0	0.0	0.0
		MW	0+	0	0	0	0.0	0.0
	1997	SST	0+	39	36	46	502.6	35.6
			1+	8	8	na	102.6	7.3
			>1+	1	1	1	12.8	0.9
		CHAR FRY	0+	1	1	1	12.8	0.9
		BT	>=1+	0	0	0	0.0	0.0
		DV	>=1+	0	0	0	0.0	0.0
		CO	0+	0	0	0	0.0	0.0
		MW	0+	0	0	0	0.0	0.0
MS4	1983	SST	0+	12	11	14	65.0	18.5
			1+	0	0	0	0.0	0.0
			>1+	0	0	0	0.0	0.0
		CHAR	0+	0	0	0	0.0	0.0
		CHAR	>=1+	0	0	0	0.0	0.0
		CO	0+	0	0	0	0.0	0.0
		CO	1+	0	0	0	0.0	0.0
		MW	0+	2	2	2	11.0	3.1
	1984	SST	0+	0	0	0	0.0	0.0
			1+	5	5	5	31.0	6.2
			>1+	0	0	0	0.0	0.0
		CHAR	0+	0	0	0	0.0	0.0
		CHAR	>=1+	0	0	0	0.0	0.0
		CO	0+	0	0	0	0.0	0.0
		CO	1+	0	0	0	0.0	0.0
		MW	0+	1	1	na	6.0	1.2
	1985	SST	0+	7	7	7	35.0	7.4
			1+	0	0	0	0.0	0.0
			>1+	0	0	0	0.0	0.0
		CHAR	0+	1	1	1	5.0	1.1
		CHAR	>=1+	0	0	0	0.0	0.0
		CO	0+	0	0	0	0.0	0.0
		CO	1+	0	0	0	0.0	0.0
		MW	>=1+	0	0	0	0.0	0.0

Appendix 7 Table 3. Summary of juvenile fish densities in the Telkwa River for 1983-97.

SITE	YEAR	SPECIES	AGE	N	95% C.I.		N/100m	N/100m*m
					LCI	UCI		
	1997	SST	0+	30	26	40	290.7	25.3
			1+	8	8	8	77.3	6.7
			>1+	1	1	1	9.7	0.8
		CH	0+	3	3	3	29.0	2.5
		BT	>=1+	1	1	1	9.7	0.8
		DV	>=1+	0	0	0	0.0	0.0
		CO	0+	1	1	1	9.7	0.8
		CO	1+	2	2	2	19.3	1.7
		MW	0+	1	1	1	9.7	0.8
MS5	1983	SST	0+	36	30	42	150.0	23.8
			1+	0	0	0	0.0	0.0
			>1+	0	0	0	0.0	0.0
		CHAR	0+	0	0	0	0.0	0.0
		CHAR	>=1+	0	0	0	0.0	0.0
		CO	0+	15	15	32	62.0	9.9
		CO	1+	1	1	na	4.0	0.7
		MW	0+	7	4	na	29.0	4.6
		MW	>=1+	1	1	na	4.0	0.7
	1984	SST	0+	38	25	60	169.0	32.5
			1+	0	0	0	0.0	0.0
			>1+	0	0	0	0.0	0.0
		CHAR	0+	0	0	0	0.0	0.0
		CHAR	>=1+	0	0	0	0.0	0.0
		CO	0+	0	0	0	0.0	0.0
		CO	1+	0	0	0	0.0	0.0
		MW	>=1+	0	0	0	0.0	0.0
	1985	SST	0+	64	57	75	354.0	72.3
			1+	1	1	1	6.0	1.1
			>1+	2	2	2	11.0	2.3
		CHAR	0+	0	0	0	0.0	0.0
		CHAR	>=1+	1	1	na	6.0	1.1
		CO	0+	15	15	17	85.0	17.4
		CO	1+	4	4	4	22.0	4.5
		MW	0+	1	1.00	1	6.0	1.1
	1997	SST	0+	68	67	70	205.8	30.0
			1+	1	1	1	3.0	0.4
			>1+	1	1	1	3.0	0.4
		CHAR FRY	0+	0	0	0	0.0	0.0
		BT	>=1+	1	1	1	3.0	0.4
		DV	>=1+	0	0	0	0.0	0.0
		CO	0+	0	0	0	0.0	0.0
		CO	1+	0	0	0	0.0	0.0
		MW	0+	2	2	na	6.1	0.9

Appendix 7 Table 3. Summary of juvenile fish densities in the Telkwa River for 1983-97.

SITE	YEAR	SPECIES	AGE	N	95% C.I.		N/100m	N/100m*m
					LCI	UCI		
MS6	1983	SST	0+	32	31	35	246.0	35.2
			1+	4	4	na	31.0	4.4
			>1+	2	2	2	15.0	2.2
		CHAR	0+	0	0	0	0.0	0.0
		CHAR	>=1+	0	0	0	0.0	0.0
		CO	0+	0	0	0	0.0	0.0
		CO	1+	0	0	0	0.0	0.0
		MW	>=1+	0	0	0	0.0	0.0
	1984	SST	0+	29	29	59	165.0	22.9
			1+	8	6	18	45.0	6.3
			>1+	2	2	na	11.0	1.6
		CHAR	0+	0	0	0	0.0	0.0
		CHAR	>=1+	0	0	0	0.0	0.0
		CO	0+	0	0	0	0.0	0.0
		CO	1+	0	0	0	0.0	0.0
		MW	0+	4	4	na	23.0	3.2
	1985	SST	0+	32	31	35	169.0	30.3
			1+	7	7	7	37.0	6.6
			>1+	1	1	1	5.0	0.9
		CHAR	0+	0	0	0	0.0	0.0
		CHAR	>=1+	0	0	0	0.0	0.0
		CO	0+	1	1	1	5.0	0.9
		CO	1+	0	0	0	0.0	0.0
		MW	0+	36	29.00	52	191.0	34.2
	1997	SST	0+	35	32	41	420.9	31.6
			1+	2	2	2	24.2	1.8
			>1+	2	2	2	24.2	1.8
		CHAR FRY	0+	1	1	1	12.1	0.9
		BT	>=1+	0	0	0	0.0	0.0
		DV	>=1+	0	0	0	0.0	0.0
		CO	0+	0	0	0	0.0	0.0
		CO	1+	0	0	0	0.0	0.0
		MW	>=1+	0	0	0	0.0	0.0
MS7	1983	SST	0+	32	28	40	213.0	30.9
			1+	12	11	14	80.0	11.6
			>1+	8	7	14	53.0	7.7
		CHAR	0+	0	0	0	0.0	0.0
		CHAR	>=1+	4	3	na	27.0	3.9
		CO	0+	0	0	0	0.0	0.0
		CO	1+	0	0	0	0.0	0.0
		MW	>=1+	1	1	na	7.0	1.0

Appendix 7 Table 3. Summary of juvenile fish densities in the Telkwa River for 1983-97.

SITE	YEAR	SPECIES	AGE	N	95% C.I.		N/100m	N/100m*m
					LCI	UCI		
	1984	SST	0+	24	24	24	145.0	16.9
			1+	25	25	26	152.0	17.6
			>1+	10	9	13	61.0	7.0
		CHAR	0+	0	0	0	0.0	0.0
		CHAR	>=1+	4	4	na	24.0	2.8
		CO	0+	4	4	7	24.0	2.8
		MW	0+	1	1	na	6.0	0.7
		MW	>=1+	1	1	na	6.0	0.7
	1985	SST	0+	72	69	77	341.0	72.5
			1+	20	19	22	94.0	20.0
			>1+	15	15	16	72.0	15.3
		CHAR	0+	0	0	0	0.0	0.0
		CHAR	>=1+	0	0	0	0.0	0.0
		CO	0+	1	1	1	5.0	1.0
		CO	1+	1	1	1	5.0	1.0
		MW	0+	0	0.00	0	0.0	0.0
	1997	SST	0+	85	78	94	768.8	75.7
			1+	4	4	4	36.4	3.6
			>1+	4	4	4	36.4	3.6
		CHAR FRY	0+	1	1	1	9.1	0.9
		BT	>=1+	0	0	0	0.0	0.0
		DV	>=1+	0	0	0	0.0	0.0
		CO	0+	0	0	0	0.0	0.0
		CO	1+	0	0	0	0.0	0.0
		MW	0+	1	1	1	9.1	0.9
MS8	1997	SST	0+	13	12	15	129.5	13.7
			1+	1	1	1	10.4	1.1
			>1+	1	1	1	10.4	1.1
		CHAR FRY	0+	0	0	0	0.0	0.0
		BT	>=1+	0	0	0	0.0	0.0
		DV	>=1+	0	0	0	0.0	0.0
		CO	0+	0	0	0	0.0	0.0
		CO	1+	0	0	0	0.0	0.0
		MW	0+	2	2	na	20.7	2.2

Appendix 7 Table 4. Summary of juvenile fish densities in the Bulkley River 1984-97.

SITE	YEAR	SPECIES	AGE	N	95% C.I.		N/100m	N/100m*m
					LCI	UCI		
B1	1984	SST	0+	5	5	na	23.0	7.5
			1+	4	4	na	19.0	6.0
			>1+	3	3	na	14.0	4.5
		CH	0+	8	8	na	37.0	12.1
		LND	0+	0	0	0	0.0	0.0
	1997	SST	0+	38	36	43	382.3	36.4
			1+	3	3	3	30.0	2.9
			>1+	0	0	0	0.0	0.0
		CH	0+	48	46	53	481.3	45.8
		LND	0+	1	1	1	10.0	1.0
B2	1984	SST	0+	2	2	na	8.0	3.8
			1+	0	0	0	0.0	0.0
			>1+	4	4	7	16.0	7.6
		CH	0+	1	1	na	4.0	1.9
		LND	0+	0	0	0	0.0	0.0
	1997	SST	0+	4	4	4	34.8	5.9
			1+	0	0	0	0.0	0.0
			>1+	0	0	0	0.0	0.0
		CH	0+	4	3	11	34.8	5.9
		LND	0+	0	0	0	0.0	0.0
B3	1984	SST	0+	10	9	13	52.0	15.2
			1+	4	4	na	21.0	6.1
			>1+	1	1	na	5.0	1.5
		CH	0+	5	5	7	26.0	7.6
		MW	0+	1	1	na	5.0	1.5
		LND	0+	0	0	0	0.0	0.0
	1997	SST	0+	10	10	11	94.2	13.7
			1+	1	1	1	9.3	1.3
			>1+	0	0	0	0.0	0.0
		CH	0+	15	14	19	140.7	20.4
		MW	0+	0	0	0	0.0	0.0
		LND	0+	0	0	0	0.0	0.0
B4	1984	SST	0+	7	7	na	35.0	11.3
			1+	1	1	na	5.0	1.6
			>1+	1	1	na	5.0	1.6
		CH	0+	2	2	na	10.0	3.2
		MW	0+	1	1	na	5.0	1.6
		LND	0+	0	0	0	0.0	0.0
	1997	SST	0+	25	23	30	237.4	33.1
			1+	6	6	6	57.1	8.0
			>1+	0	0	0	0.0	0.0
		CH	0+	29	26	35	272.1	38.0
		MW	0+	0	0	0	0.0	0.0
		LND	0+	0	0	0	0.0	0.0

Appendix 8 Table 1. Length by age data for steelhead and char in Goathorn Creek (Sites G1-G5).

STEELHEAD						CHAR				
Age	**Year**	**n**	**%**	**fl (mm)**		**Age**	**Year**	**n**	**%**	**fl (mm)**
0+	**1983**	470	74.0	43.7		**0+**	**1983**	123	45.9	50.7
	1984	378	67.0	38.3			**1984**	78	34.1	47.8
	1985	519	89.5	34.4			**1985**	152	59.8	47.3
	1997	457	86.6	38.2			**1997**	115	65.3	51.1
1+	**1983**	107	16.9	79.7		**>=1+**	**1983**	145	54.1	100.9
	1984	138	24.5	77.7			**1984**	151	65.9	100
	1985	28	4.8	71.7			**1985**	102	40.2	100.7
	1997	7	1.3	78.4			**1997**	61	34.7	104.3
>=2+	**1983**	58	9.1	144.7			**1997**			
	1984	48	8.5	125.5			**Bull trout**	43	70.5	107.2
	1985	33	5.7	114.9			**DV**	18	29.5	97.6
	1997	64	12.1	112.7						

Appendix 8 Table 2. Length by age data for steelhead and char in Tenas Creek (Sites T1-T3).

STEELHEAD						CHAR				
Age	Year	n	%	fl (mm)		Age	Year	n	%	fl (mm)
0+	1983	701	83.0	45.1		0+	1983	30	44.1	45.2
	1984	232	62.5	38.0			1984	7	17.9	44.7
	1985	452	81.9	38.0			1985	15	25.9	44.3
	1997	392	82.9	38.7			1997	14	33.3	47.3
1+	1983	99	11.7	83.2		>=1+	1983	38	55.9	109.2.
	1984	104	28.1	78.5			1984	32	82.1	109.5
	1985	25	4.5	70.3			1985	43	74.1	90.2
	1997	30	6.3	82.9			1997	28	66.7	103.7
							1997			
>=2+	1983	45	5.3	126.1			DV	23	82.2	101.3
	1984	35	9.4	123.2			Bull trout	5	17.8	114.8
	1985	75	13.6	111.5						
	1997	51	10.8	111.2						

Appendix 8 Table 3. Length by age data for steelhead in the lower Telkwa River.

STEELHEAD				
Age	**Year**	**n**	**%**	**fl (mm)**
0+	**1983**	538	82.5	45.5
	1984	255	48.7	37.8
	1985	489	80.4	38.7
	1997	744	90.5	40.7
1+	**1983**	75	11.5	82.6
	1984	213	40.6	76.2
	1985	67	11	74.6
	1997	59	7.2	77.1
>=2+	**1983**	39	6	132.9
	1984	56	10.7	126.6
	1985	52	8.6	107.7
	1997	19	2.3	106.8

Appendix 9 Table 1. Length-age for scales taken from juvenile steelhead in Goathorn Creek, 1997.

SLIDE #	SITE	DATE	RBT	
			FL (mm)	AGE
1	G1	22-Sep-97	105	2+
			98	2+
			133	3+
2			107	2+
			114	2+
			125	3+
3			106	2+
			89	1+
			137	3+
4			97	2+
			108	2+
			123	3+
5			75	1+
			143	3+
1	G2	15-Sep-97	108	2+
			128	3+
			127	3+
2			100	2+
			138	3+
			99	r
3			120	3+
			105	2+
			96	2+
4			73	1+
			104	2+
			146	3+
5			115	2+
			93	2+
			82	1+
6			113	2+
			113	2+
			103	2+
7			113	2+
			108	2+
			102	2+
8			83	1+
1	G3	23-Sep-97	122	3+
1	G4	27-Sep-97	136	3+
			129	3+
			101	2+
2			130	3+
			120	3+
			121	3+
3			116	2+
			122	3+
			141	3+
1	G8	24-Sep-97	116	2+
			118	2+
			121	2+

Appendix 9 Table 2. Length-age for scales taken from juvenile steelhead in Tenas Creek, 1997.

SLIDE #	SITE	DATE	RBT	
			FL (mm)	AGE
1	T1	16-Sep-97	103	2+
			107	2+
			117	
2			72	1+
			88	r
			121	3+
3			92	1+
			91	2+
			98	2+
4			125	2+
			81	1+
			108	2+
5			118	2+
			118	2+
			110	2+
6			87	1+ r
			88	1+
			107	2+
7			113	2+
			114	2+
			93	2+
8			104	2+
			120	3+ r
			88	1+
9			114	
			100	2+
			66	0+ ??
10			101	2+
			95	2+
			152	3+
11			98	2+ r
			102	2+
			100	2+
12			107	2+
			83	1+ r
			98	2+
13			103	2+
			114	r
			122	2+
14			125	2+
			137	3+
			67	1+
1	T2	20-Sep-97	122	r
			132	3+
			83	1+
2			164	3+
			69	1+
			76	1+
1	T3	17-Sep-97	183	3+
1	T4	19-Sep-97	118	

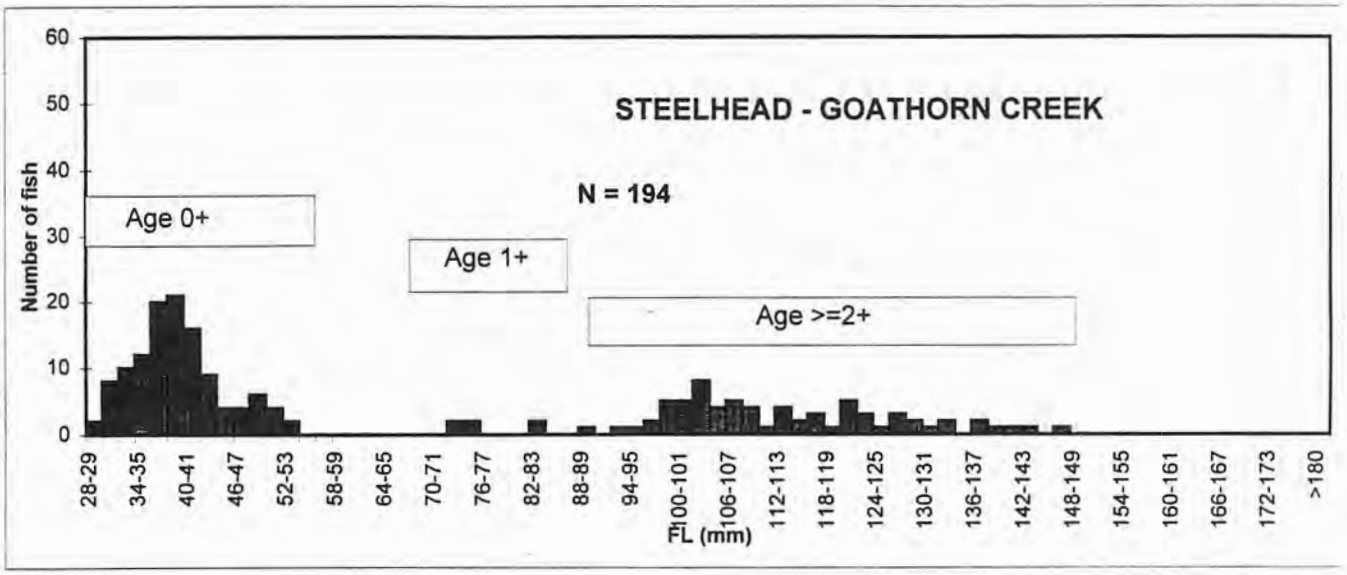
Appendix 9 Table 2. Length-age for scales taken from juvenile steelhead in Tenas Creek, 1997.

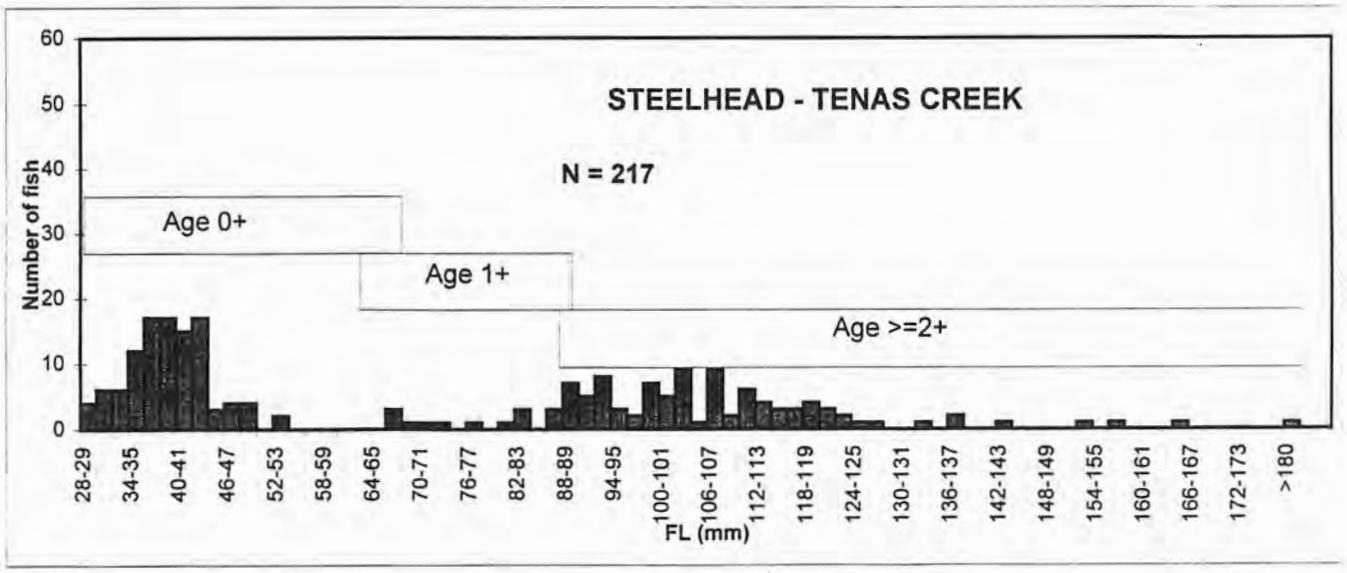
SLIDE #	SITE	DATE	RBT	
			FL (mm)	AGE
			113	
			127	2+
2			136	2+
			119	2+
			83	r
3			107	2+
			157	3+
			70	r
1	T5	18-Sep-97	89	1+

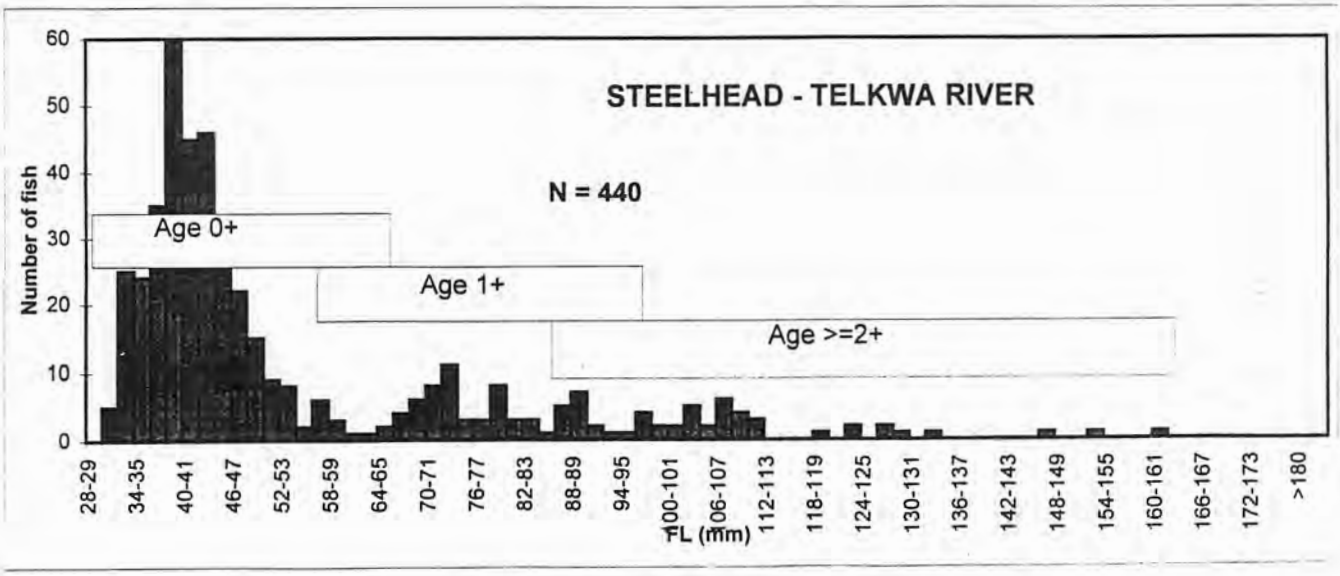
Appendix 9 Table 3. Length-age for scales taken from juvenile steelhead in the Lower Telkwa River, 1997.

SLIDE #	SITE	DATE	RBT	
			FL (mm)	AGE
1	SC1	30-Sep-97	111	2+
			96	1+
			78	1+
2			80	1+
			69	1+
			82	1+
3			73	1+
			88	1+
			79	1+
4			63	0+
			88	1+
			160	>=3
5			78	1+
			126	3+
			78	1+
1	SC2	01-Oct-97	72	1+
1	SC3	03-Oct-97	71	1+
			97	2+
			111	2+
2			75	1+
			107	2+
			122	3+
3			66	1+ r
			81	1+
			110	2+ r
4			71	1+
			63	1+
			103	2+
1	MS1	09-Oct-97	82	1+
			68	1+
			64	1+
1	MS3	09-Oct-97	58	0+
			91	2+
			56	0+
2			64	1+ r
1	MS4	09-Oct-97	94	1+
			82	1+
1	MS5	03-Oct-97	108	2+
			71	1+
1	MS6	03-Oct-97	104	2+
			109	2+
			70	1+
1	MS7	03-Oct-97	104	2+
			102	2+
			127	3+
2			86	1+
			101	1+
			78	1+
3			89	1+

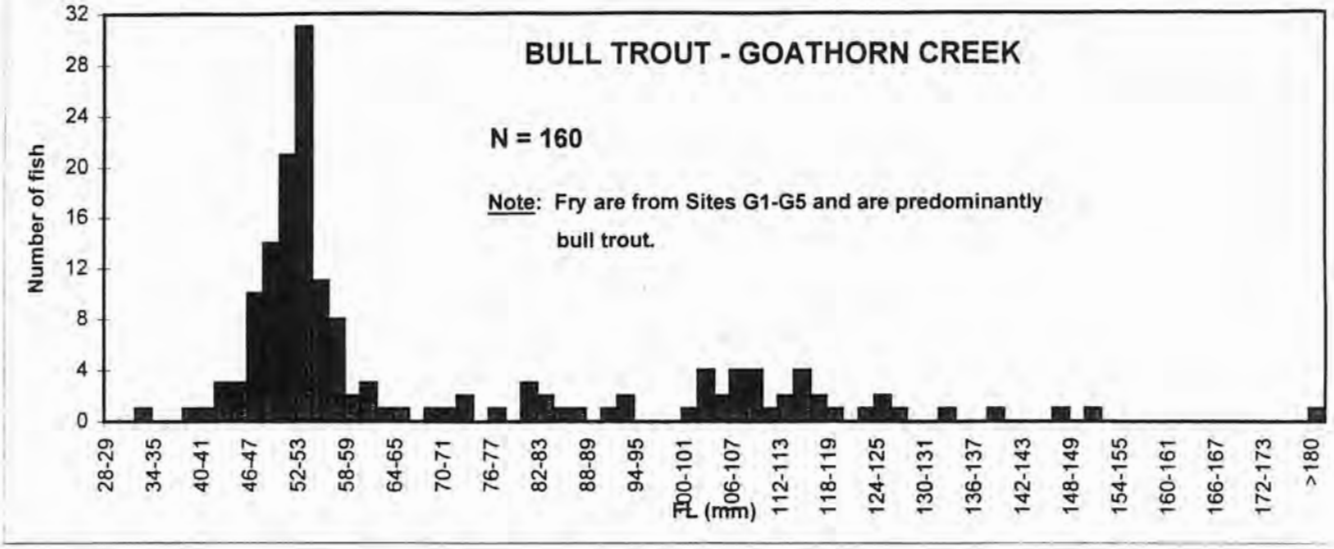
Appendix 9 Figure 1. Juvenile steelhead length-frequency distributions in Goathorn and Tenas creeks and the Telkwa River, September and October 1997.

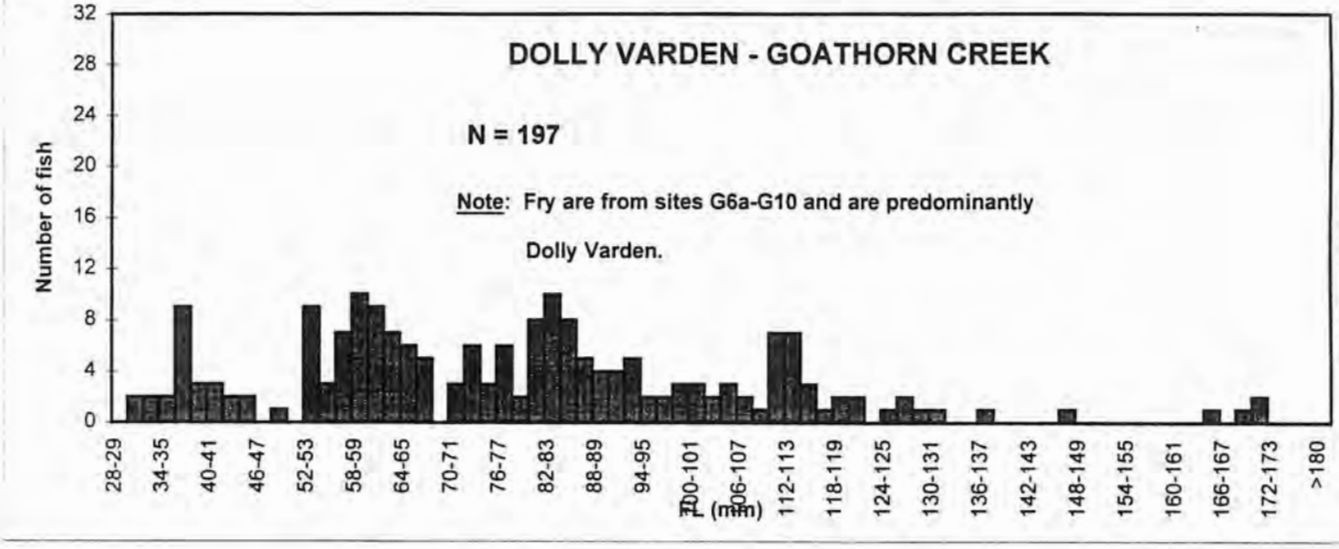


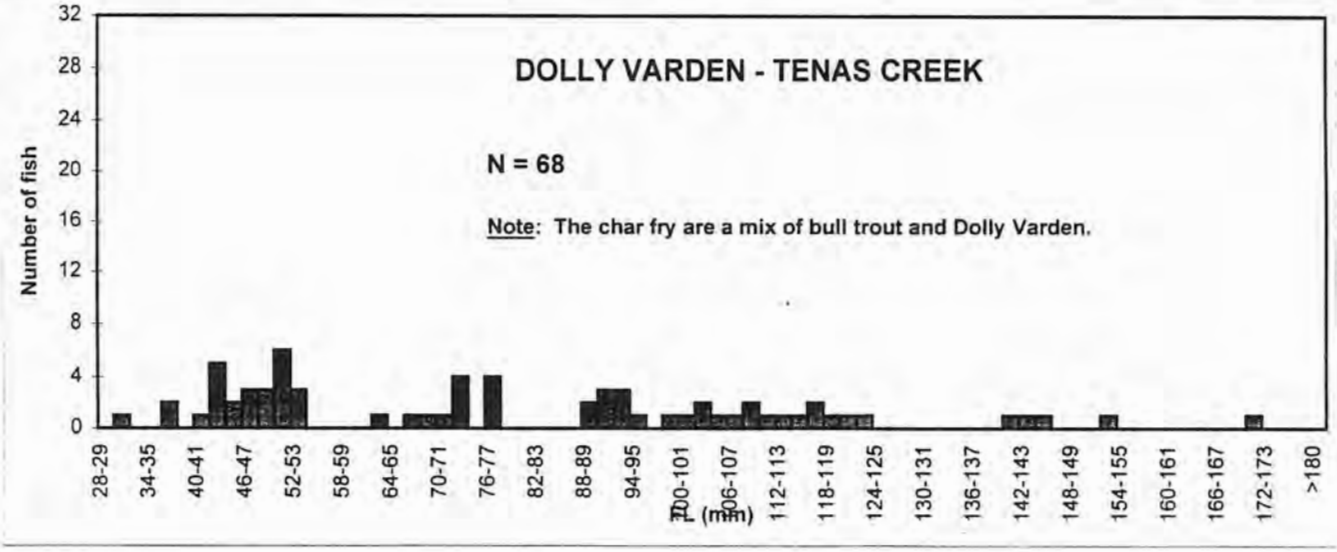




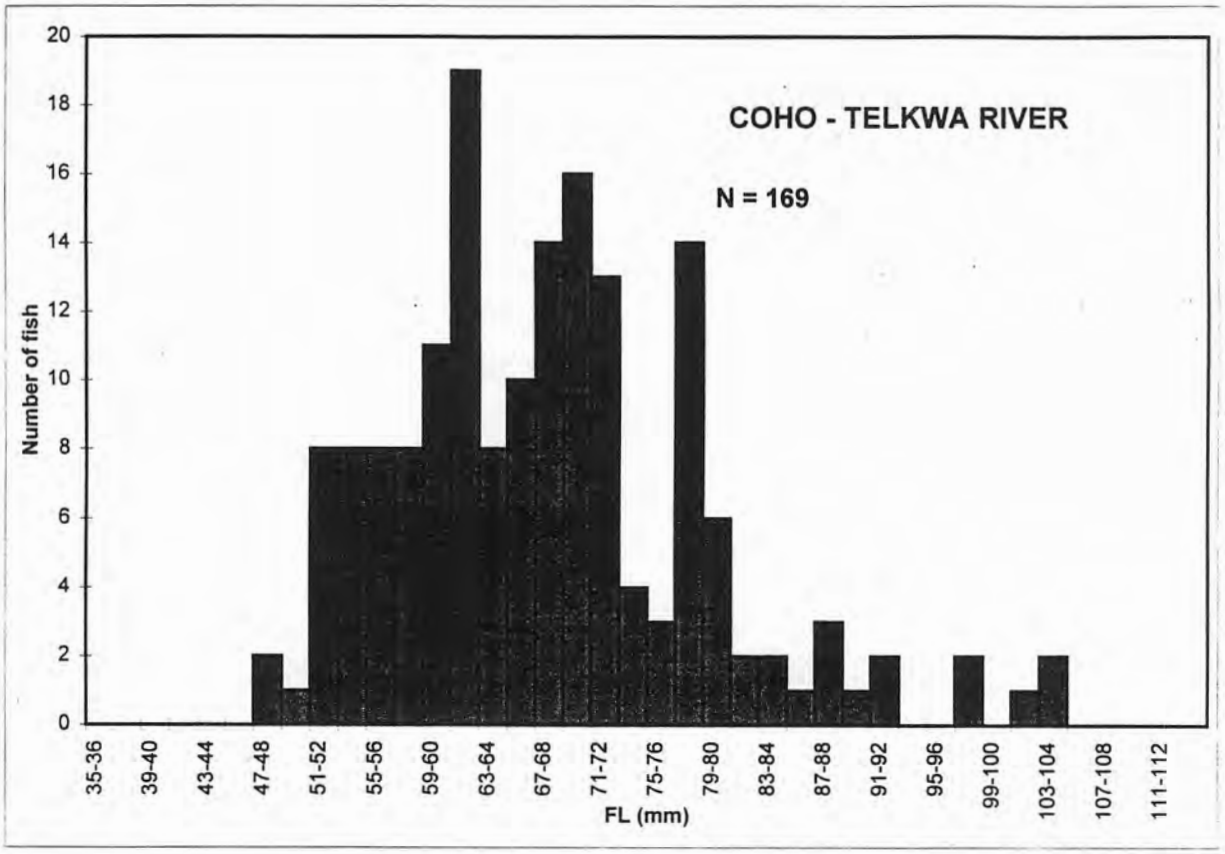
Appendix 9 Figure 2. Juvenile bull trout and Dolly Varden length-frequency distributions in Goathorn and Tenas creeks.







Appendix 9 Figure 3. Juvenile coho length-frequency distribution in the Telkwa River.



Appendix 10 Table 1. Summary of juvenile salmonid density and biomass estimates at sample sites in Goathorn Creek, 1997.

Reach	Site	Fish/100m^2						
		Steelhead			Char	Bull trout	Dolly Varden	Total
		0+	1+	>=2+	0+	>=1+	>=1+	
Goat -1	G1	25	0.3	3.5	0.9	0.5	0.2	30.4
Goat - 2	G2	20.5	0.6	2.6	0.5	1	0.1	25.3
Goat - 2	G3	3.3	0	1.6	3.6	1.3	0.4	10.2
Goat - 2	G4	8.5	0	1.1	6.7	2.1	0.7	19.1
Goat - 2	G5	3	0	0.8	4.8	2.1	1.3	12.0
Cabinet 1	G6a	0	0	0.6	0.6	2.7	3.6	7.5
Cabinet -1	G7	0	0	0	6.9	0.3	16.6	23.8
Goat - 3	G8	0	0	2.2	10.8	0	20.5	33.5
Cabinet 2	G9	0	0	0	3.2	0	19.8	23.0
Webster - 1	G10	0	0	0	1.2	1.2	15.6	18.0
Four - 1	F1	21.6	0	0	0	0	10.8	32.4
Four - 4	F5	0	0	0	7.0	0	11.0	18.0

Reach	Site	Biomass grams/100m^2						
		Steelhead			Char	Bull trout	Dolly Varden	Total
		0+	1+	>=2+	0+	>=1+	>=1+	
Goat -1	G1	17.5	2.2	53.3	1.2	18.9	2.5	95.6
Goat - 2	G2	10.3	3.2	44.7	0.6	18.6	1.5	78.9
Goat - 2	G3	2.9	0	26.2	4.7	17	3.3	54.1
Goat - 2	G4	5.9	0	23.7	10.1	24.3	8.6	72.6
Goat - 2	G5	2.1	0	11.9	6.2	17.9	12.6	50.7
Cabinet 1	G6a	0	0	8.1	nr	27.3	102.8	138.2
Cabinet -1	G7	0	0	0	3.5	1.2	74.9	79.6
Goat - 3	G8	0	0	42.5	19.4	0	21.5	83.4
Cabinet 2	G9	0	0	0	1.9	0	222.3	224.2
Webster - 1	G10	0	0	0	0.4	15.5	146.2	162.1
Four - 1	F1	34.6	0	0	0	0	671.4	706.0
Four - 4	F5	0	0	0	6.3	0	142.5	148.8

Appendix 10 Table 2. Summary of juvenile salmonid density and biomass estimates at sample sites in Tenas Creek, 1997.

Reach	Site	Fish/100m^2						
		Steelhead			Char	Bull trout	Dolly Varden	Total
		0+	1+	>=2+	0+	>=1+	>=1+	
1	T1	265	10	39	1	3	0	318
1	T2	102	20	10	1	2	3	138
1	T4	106	7	23	3	0	2	141
2	T3	25	0	2	12	0	20	59
3	T6	8	2	4	9	0	17	40
East Fork -1	T5	0	0	0	9	1	2	12

Reach	Site	Biomass grams/100m^2						
		Steelhead			Char	Bull trout	Dolly Varden	Total
		0+	1+	>=2+	0+	>=1+	>=1+	
1	T1	28.7	10.4	93.9	0.1	7.0	0.0	140.1
1	T2	19.4	39.1	44.6	0.3	8.5	13.7	125.6
1	T4	20.7	11.8	133.3	1.1	0.0	2.2	169.1
2	T3	4.0	0.0	27.1	4.6	0.0	87.8	123.5
3	T6	3.1	19.2	44.8	6.8	0.0	193.7	267.6
East Fork -1	T5	0.0	0.0	0.0	6.0	58.1	29.7	93.8

Appendix 11 Table 1. Summary of bull trout redd and spawner obervations in Goathorn and Tenas creeks.

Stream Section	Distance Surveyed (m)	# of Spawners Observed	Redds	Comments
GOATHORN				
Lower Goathorn Creek from Telkwa River to Cabinet Creek.	10500	7	3	Most redds and bull trout spawners observed from 8.5 to 10.5 km upstream. Single redd in lower system.
Goathorn Creek upstream from Cabinet Creek	4400	0	0	Suspect no access beyond 435 m debris jam.
Cabinet Creek to Webster Creek	3800	7	1	Fish mainly moving upstream throughout this section.
Cabinet Creek upstream from Webster Creek	1400	0	0	Appears mainly DV use of this section. No bull trout spawning potential identified.
Webster Creek upstream from Cabinet.	6700	2	2	Spawning identified 3.8 to 4.2 km upstream. Difficult observations due to debris. Suspect more spawning and holding fish may use this section.
Lower Four Creek	1350	0	0	Suspect no access beyond road culvert at 150 m. Probably too small for bull trout.
TENAS CREEK				
Tenas confluence with Goathorn up to East-West Fork.	13300	7	7	6 of 7 redds and all BT spawners observed in the upper 1500 m of this section.
Upper Tenas Creek - left or West Fork	2100	3	5	Fish observed to 1.2 km upstream.
Upper Tenas Creek - right or East Fork.	1300	0	0	Bull trout fry in juvenile site suggests spawning upstream in this stream.

Appendix 11 Table 2. Results of ground surveys for bull trout spawners and redds in Tenas Creek, 1997.

Location (m)	Observations			Habitat Comments
	Fish	BT Redds	Area (m*m)	
Survey Dates:	Sept 3- 5/97			
Survey Crew:	JH/KP & RD/GM			
Survey section:	Lower Tenas from East/West Fork confluence downstream.			
0	2 DV		8	Temp = 7-12 C; TDS = 100 uS.
25	1 BT (45 cm)	1		Potential redd site where fish obs. - started
125				Large eroding cutbank at this location.
200	2 BT (pair)		24	Fish on Redd (#T3a)
334	DV (20cm)			
431	1 BT (50 cm)	1		Redd - 1.5x0,9 m -#T4
				Photo B2-8
500	2 BT (35 & 50 cm)	1		Redd - 1.5x0.7 - #T3
	1 DV (17 cm)			
542		1		Redd - 1x1m - #T2
700	1 DV		2	Start of RD/GM
820				Gauging station - water quality site.
880	1 DV			
970	1 BT (45 cm)			Moving u/s in riffle.
1075				Periphyton sample site
1115	Uid fish just u/s	1		Redd - 1.4x0.4 - #T5
1300			3	Evidence of some digging in this area.
1325	2 DV		2	
1430		1	4	Redd - not complete - #T6
1620			8	
1700				Debris jam and clay bank on right side.
1800			4	Unstable clay bank in this section.

Appendix 11 Table 2. Results of ground surveys for bull trout spawners and redds in Tenas Creek, 1997.

Location (m)	Observations			Habitat Comments
	Fish	BT Redds	Area (m*m)	
Survey Dates:	Sept 3- 5/97			
1900			13	
2200			10	
2300				Boulder and cobble bed material starts.
2460			6.5	Unstable bank
2660				Unstable bank - right side.
2780				2 m x 0.5 m high bedrock chute.
				Not a barrier for larger fish.
2960				Unstable bank on right side.
3462				Large unstable bank on right side.
3540	Fry obs.			
3600	Fry obs.			Beaver dam restriction.
3900				Unstable clay bank - right side. Photo B2-1
4100	Fry obs in side chan.			Mainly boulder and cobble with limited spawning.
4165	1 DV (15 cm)			Maturing fish
				Single channel - width 2-4 m with high banks.
4200	Fry and juvenile obs.			
4400	1 DV spawner (15 cm)			Wider valley flat through here.
				Some potential spawning in here.
4516	1 DV (10 cm)			
4710				Unstable bank on right side.
4890	1 DV (15 cm)			
5560				Beaver pond on right side - 0.6 m beaver dam
				on pond outlet. No access.
5680				Clay bank right side.
6000				Unstable bank on right side. Photo B2-2

Appendix 11 Table 2. Results of ground surveys for bull trout spawners and redds in Tenas Creek, 1997.

Location (m)	Observations			Habitat Comments
	Fish	BT Redds	Area (m*m)	
Survey Dates:	Sept 3- 5/97			
6400	More trout fry and some juveniles.			Some good spanwing potential in this section.
7296	Fry and juveniles observed.			Unstable bank on right side. Photo B2-3
7475				Large unstable bank.
7888				Large unstable bank. Photo B2-4.
8785	Fewer trout fry			
9636	Trout fry obs. as well as 1 DV (15 cm)			
10140				Unstable silt bank.
10506				Lower spawning potential. Steeper with some boulders through this section.
11990				Power line crossing.
12330				Large slump on right bank.
12406		1		Redd - 1.0x0.6 m
12960	1 unspawned pink			Dead female - fairly fresh.
13400				Confluence with Goathorn Creek
TOTAL	**7**	**7**	**84.5**	Note - spawning area not recorded in lower 10 km of Tenas Creek.

Appendix 11 Table 2. Results of ground surveys for bull trout spawners and redds in Tenas Creek, 1997.

Location (m)	Observations			Habitat Comments
	Fish	BT Redds	Area (m*m)	
Survey Dates:	Sept 5/97			
Survey Crew:	JH/KP			
Survey section:	Upper Tenas - West or left fork			
0				Channel Width - 4-5 m
				Temp = 7 C; pH = 7.4; TDS =110 uS
				Estimate 4 cfs
148		1	7	WT#1 - completed
	Sthd fry abundant			
471	Steelhead redd			Channel excavated to main creek channel for
	and stranded fry			fry to exit.
588	1 DV (20 cm)			
	Sthd fry present			
618		1		WT#2 - completed (Photo A2-12)
873	1 BT spawner	1	13	WT#3 - completed; small male obs (35 cm)
				Some potential area for DV spawning.
1164		1	10	WT#4 - Redd 1.3x1.2 m
1264	2 BT spawners	1		Spawners est. 50 cm fl. (Photo A2-13&14)
				Paired and just starting to spawn.
1283	Fry obs.			Trib on left - some potential DV spawning.
				8% in lower section.
1300-1600			3	Series of unstable debris jams - passable.
1600-2074	None observed		2	Channel confined with passable debris jams.
				Angular bed material with low spawning potential.
2074				Gradient steepens to 5% or more with little
				potential spawning habitat.
TOTAL	**3**	**5**	**35**	

Appendix 11 Table 2. Results of ground surveys for bull trout spawners and redds, 1997.

Location (m)	Observations			Habitat Comments
	Fish	BT	Area (m*m)	
		Redds		
Survey Dates:	Sept 5/97			
Survey Crew:	KP			
Survey section:	Upper Tenas - right fork. Note - 0 m starts at confluence of two forks.			
50				1.3 m debris drop may be barrier at these flows.
140				Unstable bank.
600				1 m debris drop. Not a barrier.
650				Small trib on right; Ch width = 2 m.
1000	Low densities of fry		14	1.2 m high debris drop.
	& two juveniles obs.			
1150	through this section			Unstable bank.
1300			1	End of survey
				Channel is dominated by steep boulder habitat
				and debris jams with a few low gradient sections.
				Small pockets of potential bull trout spawning.
				Since bull trout fry were captured at index site
				in the lower end of this reach - some spawning
				must occur in this system.

Appendix 11 Table 3. Results of ground surveys for bull trout spawners and redds in Goathorn Creek, 1997.

Location (m)	Observations			Habitat Comments
	Fish	BT Redds	Area (m*m)	
Survey Dates:	September 2-4/97			
Survey Crew:	JH/GM			
Survey section:	Goathorn Creek upstream from Telkwa River to Cabinet Creek.			
0				Telkwa River confluence.
				Temp = 12C @ 1600 hr; TDS = 110 uS.
741		1		1.0x1.5 m GH#1. (Large redd - pink?)
1132	Fry abundant		44	Road crossing
	Parr in pools			
2782			63	Good potential spawning in this section.
				Photo A2-1
4822	Fry abundant		48	Seepage at base of gully with high fry densities.
6472				Upper bridge crossing.
6680			28	
7741			36	3 old redds (sp. unknown); possibly 1 new redd.
8612	1BT (45-50 cm)			No redd
8812	1BT(45 cm)			No redd
8842	1BT (50 cm) female	1	60	
8878 & 9176				Unstable banks - 50-60 m long.
9557		1		1.4 x 0.9 m GH#3. Completed
9609	1BT (50 cm)			Moving upstream.
9720	1BT(45-50 cm)		35	Moving upstream
10237	2BT(50-55 cm)	1		Redd GH#2. In progress under fallen spruce.
10492			15	Confluence of upper Goathorn and Cabinet Ck.
				Temp = 10.5 C@1700 hr
				TDS=90 uS.
TOTAL	**7 BT**	**3**	**329**	

Appendix 11 Table 3. Results of ground surveys for bull trout spawners and redds in Goathorn Creek, 1997.

Location (m)	Observations			Habitat Comments
	Fish	BT Redds	Area (m*m)	
Survey Dates:	September 3/97			
Survey Crew:	JH/GM			
Survey section:	Goathorn Creek upstream from Cabinet confluence.			
0	1DV (20cm)			Confluence with Cabinet Creek.
435	1 DV		20	Massive debris jam at 435 m.
				Impassable at these flows.
1453	8 DV (15-20 cm)		18	Passable debris jam.
1630	Fry obs. - few			50 m long debris jam with sediment wedge.
				3 m high and subsurface flows at this point.
				Photo A2-11.
2460	3DV (14-16 cm)			35 m long eroding bank - 20 m high.
				Blowdown along slump.
2950				2 m drop over massive debris jam.
				Impassable to fish.
3186				Reach boundary.
				Canyon section with bedrock and large boulders.
				Lower 500 m is accessible.
3655				2 m high by 10 m long cascade. Barrier to fish
				migration.
3670				1.5 m chute. Photo A2-10.
3730-4240	2DV (14 cm)		10	Series of small rock chutes.
4240				1.7 m drop. Permanent migration barrier.
4370	1DV (16 cm)			Starting point of surveys.
				This site is located approx. 500 m below 5 m
				falls; 200 m u/s of trib entering on left.
				Temp = 7.5 C; TDS = 60 uS.
Summary:	435 m accessible BT; 10 m^2 of potential spawning habitat in this section.			
	Massive debris jams limit access upstream. Lots of instability in this section.			

Appendix 11 Table 3. Results of ground surveys for bull trout spawners and redds in Goathorn Creek, 1997.

Location (m)	Observations			Habitat Comments
	Fish	BT Redds	Area (m*m)	
Survey Dates:	September 3/97			
Survey Crew:	JH/GM			
Survey section:	Cabinet Creek from Goathorn confluence upstream.			
0				Goathorn Creek confluence.
875	1BT (45-50 cm)		23	Fish moving upstream.
1000	1BT(50 cm)		58	Fish moving upstream.
1523				Extensive gravel wedge - channel breakout.
				Photo A2-8.
1800	2BT (50-55 cm)		15	Moving upstream in cobble riffle habitat.
2661	2BT (50-55 cm)	1		Pair of fish holding on cobbly tailout. Female
				is digging redd in large bed material.
2744-3162			44	Generally poor quality habitat in this section.
3162	1BT (50 cm)			Fish moving upstream.
3700				DV spawning areas available in sidechannels.
	3DV (15-18 cm)			Suitable for DV spawning @ confluence
				Cabinet Creek = 8 C; TDS = 70 uS.
3793				U/s from Webster confluence.
				Repeated sequence of debris jams/steps.
				Photo -A2-7.
4117				0.9 m debris jam; 7% gradient.
				Suitable spawning for DV in gravel pockets
				associated with debris.
				Photo A2-6.
4215				Bridge crossing of upper Cabinet. Sample site.
4215-4583	3DV (14-18 cm)			Debris jam <0.5 m; some bed material for BT.
4583-5114				0.5-1.0 m debris jams. Limited spawning for BT
				Photo A2-5
TOTAL	**7**	**1**	**140**	14% gradient; 1.5 m debris jam.
				Cabinet Creek = 8 C; TDS=90 uS.
Note: 5 of 7 bull trout were observed moving upstream in riffles - surveys slightly early.				

Appendix 11 Table 3. Results of ground surveys for bull trout spawners and redds in Goathorn Creek, 1997.

Location (m)	Observations			Habitat Comments
	Fish	BT Redds	Area (m*m)	
Survey Dates:	September 4/97			
Survey Crew:	RD/GM			
Survey section:	Webster Ck confluence with Cabinet Creek upstream.			
235			3	Temp = 7 C in afternoon
297			1.5	Unstable bank on left.
1210				Boulder and rapids
1615			1.5	
2075				LOD/boulders and rapids
2170				Large trib on left side at this location.
				Slope = 12%; channel width = 3-4 m.
				Boulder/cobble with lots of debris. Some
				potential fish use in lower end. No BT spawning
				potential in lower section.
2540				Small very steep trib on left side.
				0.9 m wide.
2575				Large boulders/riffles and LOD in this section.
2860			2.5	2 m high debris jam. Not an access problem.
2910			2.5	
3560				Boulder and rapids
3625			5	
3820	2 BT (40-50 cm)	1	9	Tagged 44 cm female - #10150 - short orange
				Fish mostly spent.
				Photo B2-6&7
3860			2	Some sections of good gravel with lots of LOD
				cover. High velocity.
3960			4	
4179		1		Redd - 0.65x0.95 m
4360			5	Small sidechannel

Appendix 11 Table 3. Results of ground surveys for bull trout spawners and redds in Goathorn Creek, 1997.

Location (m)	Observations			Habitat Comments
	Fish	BT Redds	Area (m*m)	
4935			7	Some good spawning habitat but high velocity.
5078			5	
5335				Lots of debris and some spawning in pool outlet
				Photo B2-5
5621			7	Start of best spawning habitat.
5685			1.5	Reach break - some potential spawning.
5995				Boulder scree slopes in here.
				Boulder and cobble riffle areas.
6295			7	Low quality spawning habitat.
6375				Cobble and boulder habitat - unstable debris
				drops.
6735				Steep boulder section.
				Temp = 5C in AM; pH 7.4.
				Helicopter drop-off.
TOTAL	**2**	**2**	**63.5**	

Appendix 12 Table 1. Minnow trap results from lower Hubert Creek, August 12-14, 1997.

Trap #	Location	Water Type	Coho		Steelhead	Chinook	Longnose Dace	Longnose Sucker
			0+	1+		0+		
1	20 m above Bulkley R.	Pool	0	0		0	0	
2	50 m above Bulkley R.	Pool	0	0		9	0	
3	100 m above Bulkley R.	Pool	0	0	1	3	0	1
4	150 m above Bulkley R.	Pool	1	0	1	16	0	
5	160 m above Bulkley R.	Pool	0	0		7	0	
6	200 m above Bulkley R.	Pool	0	0		0	0	
7	240 m above Bulkley R.	Pool	0	0	2	0	0	
8	260 m above Bulkley R.	Ponded	0	0		1	9	
9	310 m above Bulkley R.	Pool	0	1		1	1	
10	350 m above Bulkley R.	Glide	0	1	1	5	0	1
11	40 m below CN Rail culverts	Ponded	1	0		0	0	
12	Pool at culverts	Pool	0	0		2	0	
13	Pond below lower road	Ponded	0	0		0	0	
14	25 m above lower culvert	Ponded	0	0		0	0	
15	100 m above lower culvert	Ponded	0	0		0	0	
16	150 m above lower culvert	Ponded	0	0		0	0	
17	190 m above lower culvert	Ponded	0	0		0	31	
18	215 m above lower culvert	Ponded	0	0		0	27	1
19	260 m below powerline	Ponded	0	0	1	0	36	
20	210 m below powerline	Ponded	0	0		0	2	
21	190 m below powerline	Ponded	0	1		0	9	
22	155 m below powerline	Pool	0	0		0	8	2
23	110 m below powerline	Pool	2	0	1	2	1	
24	at powerline	Glide	0	0		0	0	
25	10 m below upper road	Glide	0	0		0	0	
26	25 m below upper road	Glide	0	0		0	0	
27	35 m below upper road	Glide	0	0		0	0	
28	5 m above upper road	Ponded	0	0		0	0	1
29	5 m above upper road	Ponded	0	0		0	2	
30	~30 m above upper road	Pool	0	1		0	0	
31	~40 m above upper road	Ponded	0	1		0	0	
32-36	200 m above upper road	Ponded		0	0		3	
37-56	1000 m above upper road	Ponded	0	0	0	0	0	0
	TOTAL		4	5	7	46	129	6
	CPUE		0.07	0.09	0.13	0.82	2.30	0.11

Appendix 13 Figure 1. Tyee Test Fishery Index of Skeena steelhead run strength for period of record highlighting years prior to Telkwa juvenile assessments.