



Cheakamus Project Water Use Plan

Trout Abundance Monitor in the Cheakamus River (Daisy Lake to Cheakamus Canyon) Year One (2007)

Reference: CMSMON#2

*Cheakamus River Water Use Plan Monitoring Program:
Trout Abundance Monitor in the Cheakamus River (Daisy Lake to
Cheakamus Canyon) Year One (2007)*

Study Period: September to October 2007

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FINAL REPORT ON

**TROUT ABUNDANCE MONITOR IN THE
CHEAKAMUS RIVER
(DAISY LAKE DAM TO CHEAKAMUS CANYON)
YEAR ONE (2007)**

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EXECUTIVE SUMMARY

BC Hydro implemented its revised Water Use Plan (WUP) for the Cheakamus River in February 2006. In order to better understand uncertainties that were identified by the Consultative Committee (CC) as part of the WUP planning process, a monitoring program was developed to address 10 specific issues to assess the expected outcomes of the operational changes being recommended by the WUP and to provide improved information on which to base operating decisions (BC Hydro, 2005).

One of the key issues identified by the CC was the potential impact of the WUP flow regime on resident rainbow trout in the upper Cheakamus River between the Daisy Lake Dam and the Cheakamus Canyon. The CC thought that the resident rainbow trout population in the reaches downstream of the Daisy Lake Dam appeared to be somewhat more sensitive to dam operations (BC Hydro, 2002). In addition, CC members also felt that the resident trout abundance levels are an indicator of ecological health of the upper Cheakamus watershed. The CC recommended that a multi-year monitor be established to address the uncertainty of the impact of the WUP on resident trout populations immediately downstream of Daisy Lake Dam.

This report documents the findings of the first year of a five year study designed to produce data to help determine if Daisy Lake Dam water flow releases affect the resident rainbow trout population located immediately downstream of Daisy Lake Dam. This central research question will be addressed through a testing of four impact hypotheses. The parameters of interest include fish density or relative abundance, age class distribution, size-at-age, and relative condition.

Ten sites, each measuring approximately 100m² were electroshocked using multi-pass electrofishing depletion methods to determine juvenile rainbow trout abundance from September 12th – 20th 2007. Habitat characteristics and a depth-velocity transect was obtained at each site.

Among the sites, estimates ranged from 0 to 18.6 rainbow trout/ 100m² for age-0 fish, 1.4 to 19.7 rainbow trout/ 100m² for age-1 fish, 0 to 7.8 rainbow trout/ 100m² for age-2 fish, and 0 to 1.0 rainbow trout/ 100m² for age-3 fish. The predominant age class caught by electroshocking was the age-1, or parr stage which comprised of 59% of the total catch. Age-0 or fry consisted of 31% while age-2 was 8% and 1% of the catch was composed of age-3 rainbow trout.

Adult abundance was quantified using a targeted angling program during October 13th and 14th 2007 resulting in a Catch Per Unit Effort (CPUE) of 0.917 fish/hour.

A lack of baseline studies on the pre-WUP trout populations in the upper Cheakamus did not allow for a rigorous comparison of the results of this study. The two relevant studies conducted pre-WUP that were used to compare the study results to were by Clark (1989) and Riley and Korman (1995). Though density estimates for fry are lower than those reported on the Cheakamus River in these two other studies, parr estimates were greater. The data obtained during 2007 sets a starting point for the five year study that will compare changes in parameters over the five years and test the four impact hypotheses.

Recommendations from this first year of the Cheakamus River trout monitor include the following:

The following recommendations are presented for future study years:

- For future study years, it is recommended that block nets are obtained which are lighter and easier to transport than the nets used in 2007;
- It is recommended that four electrofishing passes are completed at each site. In 2007, three passes were completed at 9 sites and four passes at 1 site. As densities are required by age class, not by total numbers of rainbow trout, increasing passes would decrease the CV, and increase the accuracy of estimates;
- For the angling adult enumeration component of the study, two qualified fly fishers will be used to ensure that the effort level is maximized; and
- The inclusion of resident trout parr as well as fry in density analysis as an abundance indicator may be a consideration for tracking and using in the impact hypotheses testing given greater number of parr observed (51% of total trout caught) compared to fry (31% of total trout caught).
- Future study years will examine whether the relatively low fry abundance (relative to parr abundance) may have been the product of other factors, such as sampling design.

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1.0 INTRODUCTION

1.1 Background

BC Hydro operates the Cheakamus generating facility which consists of the Daisy Lake Dam and Reservoir and the Cheakamus Powerhouse connected by an 11 km tunnel through Cloudburst Mountain. The Daisy Lake Dam and Reservoir are located on the Cheakamus River about 40 km north of Squamish.

BC Hydro initiated a Water Use Plan (WUP) process for the Cheakamus Generating facility originally in 1996 (BC Hydro, 2005) but was put on hold when Fisheries and Oceans Canada (DFO) placed a Flow Order that specified that minimum flows be discharged from Daisy Lake Dam. The WUP was again initiated in 1999 and a Consultative Committee (CC) was established in June 1999 to oversee the WUP planning process (BC Hydro, 2002). The CC process and its final report were completed in May of 2002 without complete consensus. BC Hydro submitted a revised WUP to the Comptroller of Water Rights in October 2005 which was subsequently approved along with a recommended monitoring plan to address key issues and uncertainties identified by the CC.

During the WUP, the CC established a Fisheries Technical Committee (FTC) to examine issues and uncertainties of the potential impact of changes in the WUP on fish below the Daisy Lake Dam (BC Hydro, 2002). The FTC first conducted preliminary studies to understand the distribution of fish within the Cheakamus watershed. They then used this information to develop a set of impact hypotheses about the impact of dam operations on fish populations and aquatic ecosystems.

In particular, these studies and models indicated that the resident rainbow trout population in the reaches downstream of the Daisy Lake Dam appeared to be somewhat more sensitive to dam operations (BC Hydro, 2002). In addition, CC members also felt that the resident trout abundance levels are an indicator of ecological health of the upper Cheakamus watershed. The uncertainty surrounding the relationship between discharge from Daisy Lake Dam and the quantity of fish habitat and the resulting trout abundance was a key issue for the CC. The potential impact of the change in the WUP flow regime on trout abundance is uncertain because:

1. The actual differences in discharge downstream of Daisy Lake Dam between the Cheakamus WUP and pre-WUP flow regime are uncertain; and
2. The impact of the pre-WUP condition is uncertain due to limited historical sampling data.

The lack of baseline data of the resident trout population downstream of Daisy Lake Dam coupled with the CC's rationale for the importance of a healthy resident trout population in the upper Cheakamus led to the need for a trout abundance monitor as part of the Cheakamus WUP monitoring program. BC Hydro subsequently incorporated a 5 year trout abundance monitor as one of the 10 monitors funded under the Cheakamus WUP. This report summarizes the results from Year 1 of this 5 year study.

This project is a joint effort between Squamish Nation, the Squamish to Lillooet Sportfish Advisory Committee (SLSAC), and Golder Associates Ltd. (Golder). Squamish Nation provided overall direction and management of the project, with technical support from Golder. Two Squamish Nation fishery technicians assisted with all sampling and data collection and data compilation. The SLSAC provided one sports fisher to participate with a Squamish Nation angler in the adult trout enumeration component of this monitor. Golder provided the Project Biologist and technical oversight of the monitor's design, execution and reporting. The project team helped to foster and strengthen an already strong stewardship base in the Squamish River watershed.

1.2 Pre-WUP and WUP Minimum Flow Releases

Table 1 presents the minimum flow requirements for the WUP flow regime and the pre-WUP flow regime in the Cheakamus River.

TABLE 1: Overview Of The Minimum Flow Release Requirements Prior To The Cheakamus Water Use Plan And Under The Cheakamus Water Use Plan Regime

Minimum Flow from Daisy Dam	Pre-WUP (m ³ /s)	WUP (m ³ /s)
Jan 1 to Mar 31	5	5
Apr 1 to Oct 31	5	7
Nov 1 to Dec 31	5	3
Additional Flow Releases	Based on inflows to Daisy Lake Reservoir	Based on flow requirements at Brackendale Gauge

While changes in flow required to maintain the minimum flow at Brackendale are unpredictable and can create variability in the flow regime experienced by the trout population, the impact of these short term fluctuations is not expected to be biologically important (BC Hydro, 2007). These short-term fluctuations are well within the range found in the natural environment. For this reason, this monitor will be concerned only with the impact of changes to base flow releases on the resident trout population, and short-term fluctuations will largely be ignored with the exception of flood flow releases, which could have an impact.

1.3 Purpose and Objectives

The potential impact of the change in the annual flow release requirements as outlined in Table 1 on resident trout populations is uncertain largely due to a lack of baseline data on the impact of the pre-WUP flow regime. The overall purpose of this monitoring program is to answer the following fish management question:

- Do Daisy Lake Dam water flow releases affect the resident rainbow trout population located immediately downstream of Daisy Lake Dam? The parameters of interest include fish density or relative abundance, age class distribution, size-at-age, and relative condition.

This management question is addressed through a test of four impact hypotheses that relate to three key phases in the life history of rainbow trout: spawning success, summer rearing (growth and survival), and over-wintering survival. Direct measures of these parameters are outside the scope of this monitor. This study will therefore rely on the use of indicator variables to test the following four hypotheses:

H₀1: Relative spawning success, as indicated by fry density at the time of sampling, is not correlated with average (or some other summary statistic) discharge during the spawning, incubation, emergence, and early rearing phases of development.

H₀2: Relative rearing success, as indicated by relative condition, size-at-age, and abundance, is not correlated with average (or some other summary statistic) discharge during the summer growth season.

The following two hypotheses are used as a general test of the assumption that resident trout populations are not impacted by the change to WUP base operations.

H₀3: Relative spawning success, as indicated by fry density at the time of sampling, remains stable or increases through time following implementation of the WUP.

H₀4: Relative rearing success, as indicated by relative condition, size-at-age, and abundance, remains stable or increases through time following implementation of the WUP.

Since this is a five year study, this report will focus on summarizing the methodology, results and overall findings from Year 1. Statistical testing of the above four impact hypotheses will not be completed until the final report in Year 5.

1.4 Project Scope

The trout monitoring program for the Cheakamus River assumes the following:

- The study area will be restricted to the upper section of the Cheakamus River bounded by Daisy Lake Dam at its upstream end and the start of the canyon reach.
- The resident trout population will be the focus of the monitoring program and all species captured will be documented.
- The monitor will be carried out annually for five years.
- Sampling will be carried out over a two week period at a standardized time of the year.
- A data report will be prepared annually summarizing the year's findings.

2.0 METHODS

This study utilized two programs for catching rainbow trout in the Cheakamus River and followed the methods proposed in the Terms of Reference (TOR) (BC Hydro 2007). The first program, a multi-pass electrofishing program, was used to catch juvenile rainbow trout at ten select sites located between the Daisy Lake Dam and the Cheakamus Canyon. Methodology followed that of similar past studies (Ptolemy et al 2006, Riley and Korman 1999) and also consisted of guidance from BC Hydro (Brent Mossop and Ian Dodd) and Ministry of Environment (MOE: Ron Ptolemy) staff. The second program was an angling program that targeted adult rainbow trout in the Cheakamus River from the confluence of Rubble Creek to the Cheakamus Canyon. Data obtained from these two fish capture programs were used to deduce the parameters in question: density, size-at-age, relative condition and relative spawning success.

Prior to conducting field work, Golder crew members attended a session on the Coquitlam River with Ron Ptolemy (MOE) to ensure that the standardized electrofishing methods used by MOE were used in this study.

2.1 Pilot Snorkel Survey and Site Selection

Ten representative sites located from Daisy Lake Dam to the anadromous fish barrier were selected for electrofishing (Figure 1). Field reconnaissance and the review of relevant literature contributed to the selection of these sites. Sites were chosen based upon suitability for backpack electroshocking, accessibility, distribution throughout the project area and suitable fry and parr habitat characteristics (*i.e.*, riffles, cascades, pools). All sites were GPS'd using a Garmin handheld GPS unit so that the sites can be easily located in future years.

A pilot snorkel survey was conducted on September 12th, 2007 and consisted of snorkeling areas predetermined as potential electrofishing sites. The purpose of the snorkel survey was to assist in site selection by providing information on the general distribution of rainbow trout within and outside of the site boundaries.

Methodology for snorkeling generally followed methods described by O'Neal (2007). Two people snorkeled at a time, working side by side and moved upstream. The first survey started from near the bottom of Site 2 and finished upstream of Site 1. Site 3 was snorkeled in a similar fashion. Optimally, the snorkel survey would be conducted at water levels similar to those during electrofishing and after water was stabilized at a constant flow rate for a few days to reduce turbidity and allow displaced fish to settle. However, water levels which were prescribed to drop from approximately 40 CMS to 12 CMS on September 1st remained at 39 to 52 CMS until the evening of September 12th. As snorkeling occurred less than 12 hours after the decreased flow

release, turbidity was relatively high and no fish were observed during any of the snorkel surveys. It was decided after completing three sites to discontinue the snorkel survey and choose sites based on other methods.

2.2 Fish Capture

2.2.1 Multiple-pass Electrofishing

Sites were electrofished between September 13th and September 20th by a three or four person crew. While focusing on minimal disturbance to fish, sites were enclosed by block nets consisting of a 1 mm and 4 mm mesh size previous to fishing. A 15 m long net was erected at the downstream boundary first with the shore line angled slightly downstream. The nets were held in place with guy ropes attached at shore, to anchors mid channel, bipod stays along the net and boulders on the bottom, which also served to knit the net to the bottom of the river. A 30 m net was then erected at the upstream boundary of the site and anchored in a similar fashion. This net was also used to close off the site to the off shore side by folding around the upper, mid channel corner of the site and attaching to the downstream net.

Some sites had variations of the methods described above. At Site 3, the outer boundary was not enclosed by a net. As guided by Ron Ptolemy, for sites with high velocities at the outer margins, the use of block nets on the outer edge are not needed. The river velocity at the outer margin at this site was 0.85 m/s. Gill nets were used at Sites 1 and 2 to block upstream and downstream perimeters due to access issues with the heavier block nets (these sites were located at the bottom of a steep embankment). Site 1 was located at the top of a side channel and Site 2 was located at the bottom of the same channel and the side channel banks acted as side perimeters. Site 8 was located at a bend in the river where eddy currents were strong. Instead of a rectangular shaped site, this site was triangular in shape. The large 30 m net was used as both the upstream and downstream block net and was anchored in the middle at the furthest point from the shore.

Electrofishing methods closely followed that of Beland (1996). The crew was equipped with a Smith Root 12B electroshocking backpack unit with a 25 cm diameter anode ring and a 3.2 m long cathode. Three passes were conducted at each site, yielding a coefficient of variation (CV) for total fish caught of less than 0.25 except at Site 3, where 4 passes were conducted. For each pass, sites were electrofished in a pattern starting from the downstream edge and fishing upstream sweeping the site in a zigzag pattern. Upon reaching the top of the site, a downstream sweep which ended at the downstream shore corner completed the pass. If the site was particularly wide, it was sectioned into quarters and fished similarly starting with the bottom outside corner to the bottom inside corner to the upper outside then upper inside and sweeping down in a similar pattern. Fish captured during each pass were immediately processed before the next pass.

Weather conditions during the sample period were suitable for electrofishing and included dry weather with water temperatures that ranged from 9°C to 13°C. It should be noted that during electrofishing, relatively few fry were observed. It is possible that fry located in water pockets under or between rocks may not have been visible or that the sample design targeted parr and not fry.

2.2.2 Adult Enumeration

Adult rainbow trout enumeration was conducted on October 13th and 14th by a two person team including a member of the Squamish Nation and of the Squamish to Lillooet Sportfish Advisory Committee (SLSAC). Though two anglers were present during the sampling, one of the experienced anglers was injured just prior to the start of the angling. He was replaced by an angler with little fly fishing experience. As a result, only the experienced angler's time spent fishing was used to determine fishing effort.

The Cheakamus River was fly-fished at six sites from Rubble Creek to the Cheakamus Canyon. Sites 1, 2 and 3 were located near Rubble Creek and were fished on only October 13th. No fish were caught and so these sites were not fished on October 14th. Sites 3, 8 and 10 were fished on both days. Each day, 6 hours were spent on the river. However, of the 6 hours, about 4 hours were actually spent fishing; time spent moving between fishing sites, note taking and taking scale samples from fish accounted for the other 2 hours. Total fishing effort over 2 days was therefore 8 hours.

During mid October, insect hatches of little yellow stoneflies (*Alloperla caudate*) increase the chances of catching trout with dry flies. During the project, flies which yielded fish included Hare's Ear, Elk Hair Caddis Lime Trude and Adams Irresistible.

2.3 Fish Processing

Juvenile fish captured by electroshocking were anaesthetized in a clove oil dilution and identified to the species level. Fish were measured to the nearest 1 mm fork length and wet weighed to the nearest 1 g. Scale samples were collected on random samples of rainbow trout over the length of 90 mm for the purposes of ageing. Once processed, the anesthetized fish were allowed to recover and were released downstream of the site boundaries for the first two passes and to the site after the last pass.

Adult fish caught by angling were measured for fork length but were not weighed to minimize handling. Scale samples from a total of ten adult fish were taken over the course of the angling to add to the juvenile samples for age determination.

2.4 Habitat Assessment

Habitat assessments were carried out at all electrofishing sites and consisted of filling out Site Cards standardized by the Resource Inventory Committee (RIC). Additionally, sample site habitat description cards supplied by Ron Ptolemy were filled out. Depth and velocity were measured along transects at 0.5 m intervals at each site with a flow meter (Global Water Instrumentation Inc., Model FP101 flow probe).

2.5 Ageing of Juvenile and Adult Rainbow Trout

Scales were processed in accordance to procedures described in Mackay et al. (1990). All scales were aged at the Golder fish ageing laboratory in Castlegar, B.C. Scales were temporarily mounted between two slides and examined using a microfiche reader. Where possible, several scales were examined and the highest quality scale was digitally scanned and saved as a JPEG-type picture file. All scales were examined independently by two experienced individuals and ages assigned. If assigned ages differed between the two examiners the sample was re-examined jointly by both examiners to establish a final age.

Of the rainbow trout (juveniles + adults) captured on the Cheakamus River, 90 were aged either by assigning them to the young of the year (age-0) age class by virtue of their size or through scale-based ageing. The remaining fish were not directly aged, but were assigned ages using mixed distribution fitting (Program MIX). Program MIX (Macdonald and Du 2004) runs within the R GUI environment (R Core Team, 2007) and assigns individuals (in this case fish) to a particular age class based on conditional probabilities. These fish were assigned to age classes and the proportion of fish in each age class from the entire sample of 181 fish determined by summing conditional probabilities across all fish within an age class.

The starting parameters for fitting the data were obtained by using the aged fish. The mean length for each age class, the proportion of aged fish in each age class and the standard deviation around the mean length were extracted and used in the fitting. Three probable distributions were fitted to the data; the normal, lognormal and Poisson. The best fitting distribution was selected and the fit iterated 10 times to allow the parameters to fit the data better.

2.6 Data Analysis

2.6.1 Data Management

Data were entered into excel spreadsheets developed by Golder for the project and into an Excel database designed by Ron Ptolemy. The latter database calculates Weighted

Useable Area (WUA) from depth-velocity transects and presents data in a similar fashion as other electroshocking removal depletion studies throughout BC. Habitat site card information was entered into the FISS database.

2.6.2 Fish Density Estimates

Population estimates were calculated from maximum likelihood estimation (MLE) procedures (Riley and Korman 1995) using a program developed and supplied to the project by BC Hydro. This program enabled the user to choose Bayesian analysis if the pattern of removal departed significantly from expected values ($CV > 0.25$). Estimates were given for each year class of rainbow trout and for any other species found at each site. Standard Error and CV were shown for each population estimate. Density estimates were reported as fish/100m² for each rainbow trout age class based on the area of the site.

2.6.3 Probability of Weighted Useable Area

To deal with the inherent variability in rainbow trout age-0 abundance at the same site among years due to hydraulic and habitat changes, Ptolemy designed a method that standardizes age-0 density. The database uses a method that divides the raw population density by the weighted usable area fraction.

Weighted usable area (WUA) was computed using depth/velocity data input into spreadsheets. Standardized age-0 densities were computed as observed density/WUA (or probability of useable area) for among year site comparisons. These methods were not applied to age classes older than age-0 as habitat use is more greatly affected by factors such as complexity than depth and velocity (Ptolemy, Pers. comm. 2007).

2.6.4 Adult Abundance

Adult abundance was reported as Catch Per Unit Effort (CPUE) calculated by dividing the total catch by the level of fishing effort (rod hours).

2.6.5 Size-at-Age

Length-at-age growth relationships were generated for rainbow trout by averaging the length for each age-class and by using the von Bertalanffy growth model (Ricker 1975). The addition of 0.5 to the age category (*i.e.*, age-0 fish are presented as age-0.5) allowed the length-at-age regression curve and the Y-intercept to more accurately reflect the actual age of the fish, given an assumed hypothetical hatch date of March 1st.

2.6.6 Relative Condition

Relative condition was calculated using the Fulton's Condition Factor which is an indicator of the plumpness of a fish (Lagler 1956). The coefficient of condition (K_{FL}) is calculated for each fish as:

$$K_{FL} = (W \times 100) / L^3$$

where W is weight in grams and L is the length in cm of the individual fish. Condition factors were then averaged for each age class. Differences in condition between age classes were assessed by ANOVA.

2.6.7 Relative Spawning Success

Relative spawning success was reported as an indicator variable calculated as the average density of fry corrected by the relative abundance of adult fish. The data is not to be interpreted as an actual measure of spawning success; it is reported for comparison to future year's data.

3.0 RESULTS

3.1 Fish Ageing

Of the 181 rainbow trout (juveniles + adults) captured on the Cheakamus River, scale samples were taken from 44 fish for ageing. Forty-six fish were assigned to the age-0 class based on an obvious distinction between age-0 and age-1 fish lengths as seen in the length-frequency distribution (Figure 2). The remaining 91 fish were assigned ages based on age classes and the proportion of fish in each age class from the entire sample of 181 fish. Proportions were determined by summing conditional probabilities across all fish within an age class (Table 2).

TABLE 2: Age, Number Of Fish Within The Sample Assigned To Each Age Class And Proportion Of Fish In Each Age Class For Rainbow Trout Within The Cheakamus River

Age Class	Number of Fish	Proportion of Fish
0	87.56066212	0.483760564
1	61.88051101	0.341881276
2	16.02153781	0.088516783
3	11.35404363	0.062729523
4	4.18324543	0.023111853

3.2 Multiple Pass Removal Juvenile Abundance Estimates

Rainbow trout were the most abundant fish caught while electroshocking the Cheakamus River between the Daisy Dam and the Cheakamus Canyon, totalling 170 juvenile fish. Among the sites, estimates ranged from 0 to 18.6 rainbow trout/ 100m² for age-0 fish, 1.4 to 19.7 rainbow trout/ 100m² for age-1 fish, 0 to 7.8 rainbow trout/ 100m² for age-2 fish, and 0 to 1.0 rainbow trout/ 100m² for age-3 fish (Table 3).

The predominant age class caught by electroshocking was the age-1, or parr stage which comprised of 59% of the total catch. Age-0 or fry consisted of 31% while age-2 was 8% and 1% of the catch was composed of age-3 rainbow trout.

TABLE 3: Population Estimates And Estimated Densities Of Juvenile Rainbow Trout In The Cheakamus River From Multi-Pass Electroshocking Methods.
Se = Standard Error, Cv = Coefficient Of Variation And
Ci = 95% Confidence Interval

Age	Population Estimate	Population SE	Population CV	Parameter Estimation	Population Lower CI	Population Upper CI	Density (RB/100m²)
0	2	2.87	1.43	Bayes	2.0	7.6	2.86
1	5	0.44	0.09	MLE exact	5.0	5.9	7.14
0	4	1.47	0.37	Bayes	4.0	6.9	3.20
1	11	0.22	0.02	MLE exact	11.0	11.4	8.80
2	2	0.00	0.00	MLE exact	2.0	2.0	1.60
0	1	0.00	0.00	MLE exact	1.0	1.0	0.71
1	2	1.04	0.52	Bayes	2.0	4.0	1.43
2	2	1.04	0.52	Bayes	2.0	4.0	1.43
0	4	1.47	0.37	Bayes	4.0	6.9	2.24
1	4	0.00	0.00	MLE exact	4.0	4.0	2.24
0	12	2.88	0.24	Bayes	11.0	17.7	7.89
1	30	0.51	0.02	MLE exact	30.0	31.0	19.74
0	6	0.67	0.11	MLE exact	6.0	7.3	5.00
1	17	0.69	0.04	MLE exact	17.0	18.3	14.17
0	8	0.51	0.06	MLE exact	8.0	9.0	4.28
1	10	0.24	0.02	MLE exact	10.0	10.5	5.35
2	2	1.04	0.52	Bayes	2.0	4.0	1.07
3	1	0.00	0.00	MLE exact	1.0	1.0	0.53
0	14	2.16	0.15	MLE exact	13.0	18.2	18.57
1	13	5.44	0.42	Bayes	11.0	23.7	15.71
0	4	0.21	0.05	MLE exact	4.0	4.4	4.97
1	2	0.00	0.00	MLE exact	2.0	2.0	2.48
0	0	0.00	0.00	MLE exact	0.0	0.0	0.00
1	9	0.46	0.05	MLE exact	9.0	9.9	8.82
2	8	1.06	0.13	MLE exact	8.0	10.1	7.84
3	1	0.73	0.73	Bayes	1.0	2.4	0.98

The probability of use for age-0 rainbow trout was highest for Site 8 (0.531) and lowest for Site 9 (0.194) (Table 4). Site 8 also had the highest Age-0 density (18.6 fish/100m²) and adjusted density (35.0 fish/m²). The adjusted fish density will be useful in subsequent years of the study for among year comparisons.

TABLE 4: Probability Of Use And Adjusted Density For Age-0 Rainbow Trout At Each Site Electroshocked. Adjusted Fish/100m² Is Calculated By Dividing The Raw Population Density By The Probability Of Use

Site	Probability of Use	Adjusted RB/100m ²
1	0.385	7.4
2	0.363	8.8
3	0.396	1.8
4	0.408	5.5
5	0.377	20.9
6	0.437	11.4
7	0.405	10.6
8	0.531	35.0
9	0.194	25.6
10	0.278	0.0

3.3 Adult Abundance

A total of 11 adult rainbow trout were captured over two days of angling. Only one of the fishermen was successful while angling due to experience. Furthermore, time spent moving from site to site and handling fish reduced the fishing effort by about 2 hours each day. Therefore, the level of fishing effort over the two 4 hour days was measured as 8 hours. Catch per unit effort was calculated as 1.375 fish/hour.

3.4 Size at Age

Average fork lengths and predicted fork lengths using the von Bertalanffy growth curve for each age class are given in Table 5. As older age classes were under-represented, due to the relative low adult capture numbers compared to juvenile captures, the asymptotic shape of the curve is not readily apparent (Figure 3). Data from future years will aid in developing the model.

TABLE 5: Average Fork Lengths And Predicted Fork Lengths For Each Age Class Of Juvenile And Adult Rainbow Trout Using The Von Bertalanffy Growth Curve

Age	Count	Average FL	Predicted FL
0	53	36.9	33.3
1	101	96.0	95.0
2	14	164.2	150.8
3	9	197.2	201.2
4	4	248.3	246.7

3.5 Relative Condition

Average condition factors of juvenile rainbow trout captured by electrofishing are presented in Table 6. Based on a limited data set (*i.e.*, low sample size), condition factor was not significantly different between age classes ($F = 1.402$, $P=0.244$).

TABLE 6: Average Condition Factor of Juvenile Rainbow Trout for Each Age Class Caught By Electrofishing in the Cheakamus River

Age	Count	Average Condition Factor	Standard Deviation
0	53	0.955	0.41
1	101	0.996	0.28
2	14	0.821	0.31
3	2	0.801	0.41

3.6 Relative Spawning Success

The total number of adults captured by angling over the 2 day period was 11, while the average adjusted juvenile density was 12.71 fry/100m². The relative spawning success was calculated as 139.81 fry/100m² per 1 adult.

4.0 DISCUSSION

The primary objectives of the first year of Cheakamus Trout Monitor is to establish methods and results for density estimates, size-at-age, relative condition, and relative spawning success of rainbow trout which can be repeated and compared in the following four years of the monitor. For the first year of the study, it is useful to validate and compare the results to other studies on the Cheakamus River which looked at rainbow trout densities using similar methods. Two past studies looked at rainbow trout densities in the Cheakamus River in early fall (September/October). Density estimates of age-0 fish (fry) were lower than those observed by Riley and Korman (1995) and by Clark (1989a). All but two sampling sites for these other studies were located below the anadromous barrier where the river consists of habitat more suitable for fry. Riley and Korman (1995) electrofished two adjacent sites above the anadromous barrier that were in close proximity to Site 8 in this study. The density estimate of 18.6 fry/100m² found at Site 8 is comparative to Riley and Korman's density estimates of 11.4 and 20.2 fry/m² at the two sites located above the anadromous barrier. All of Clark's (1989a) sites were located below the anadromous barrier and reported fish densities ranged from 93 to 568 fry/100m². An unpublished report that looked at the recreational fishery potential of the Cheakamus River upstream of the anadromous barrier (Clark 1989b) was not included for comparison as length-weight data were most likely erroneous.

In this study, density estimates for age-1 fish (parr) were higher than age-0 estimates at all but three sites. The parr density estimates reported here are also higher than those found by either Clark (1989a) which ranged from 0 to 8 parr/100m² or Riley and Korman (1995) which ranged from 0 to 2.7 parr/100m² among sites. This study found parr at each site and densities ranged from 1.4 to 19.7 parr/100m².

Disparities in fry density calculations between this and other studies could be due to the delineation of fry and parr. Though neither Riley and Korman (1995) or Clark (1989a) report length measurements, the average fry weight reported by Riley and Korman (1995) among sites ranged from 1.38 to 2.43 g and Clark (1989a) reported average weights from 0.67 to 1.59 g. The average weight for all fry found in this study was 0.55 g. The average age-2 (parr) weight (9.01 g) found in this study was similar to that found in other studies. Riley and Korman (1995) reported average parr weights among sites ranging from 6.9 to 17.4 g and Clark (1989a) reported average parr weights of 12.33 to 13.97 g. Neither of the comparative studies describes the methods used to define age classes; it is possible, however, that fish found to be age-2 (parr) in this study may have been described as fry by other study methods. In support of the age classes delineated in this study, McCubbing *et al.* (2006) distinguished Cheakamus fry by lengths of 20 mm to 79 mm based on data collected on steelhead/rainbow trout in late summer and early fall on the lower Cheakamus River.

With relatively limited information on rainbow trout above the anadromous barrier on the Cheakamus River, the results found from this study will help set a baseline of information on rainbow trout parameters within the system. Results from subsequent years will also be used to detect patterns of rainbow trout abundance in the Cheakamus River between the Daisy Lake Dam and Cheakamus Canyon. This report focuses on summarizing the methodology, results and overall findings from Year 1. Statistical testing of the four impact hypotheses will not be completed until the final report in Year 5.

5.0 RECOMMENDATIONS

The following recommendations are presented for future study years:

- For future study years, it is recommended that block nets are obtained which are lighter and easier to transport than the nets used in 2007.
- It is recommended that four electrofishing passes are completed at each site. In 2007, three passes were completed at 9 sites and four passes at 1 site. As densities are required by age class, not by total numbers of rainbow trout, increasing passes would decrease the CV, and increase the accuracy of estimates.
- For the angling adult enumeration component of the study, two qualified fly fishers will be used to maximize the level of effort. Furthermore, a technician dedicated to sampling and handling fish would increase fishing efficiency.
- The inclusion of resident trout parr as well as fry in density analysis as an abundance indicator may be a consideration for tracking and using in the impact hypotheses testing given greater number of parr observed (51% of total trout caught) compared to fry (31% of total trout caught).
- Future study years will examine whether the relatively low fry abundance (relative to parr abundance) may have been the product of other factors, such as sampling design.

6.0 CLOSURE

We trust this report provides you with the information you require at this time. Should you have any questions regarding the contents of this report, or require any further information, please do not hesitate contacting the undersigned.

Yours very truly

GOLDER ASSOCIATES LTD.

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ORIGINAL SIGNED BY

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Attachments

HL/AK/BS/wrs/asd

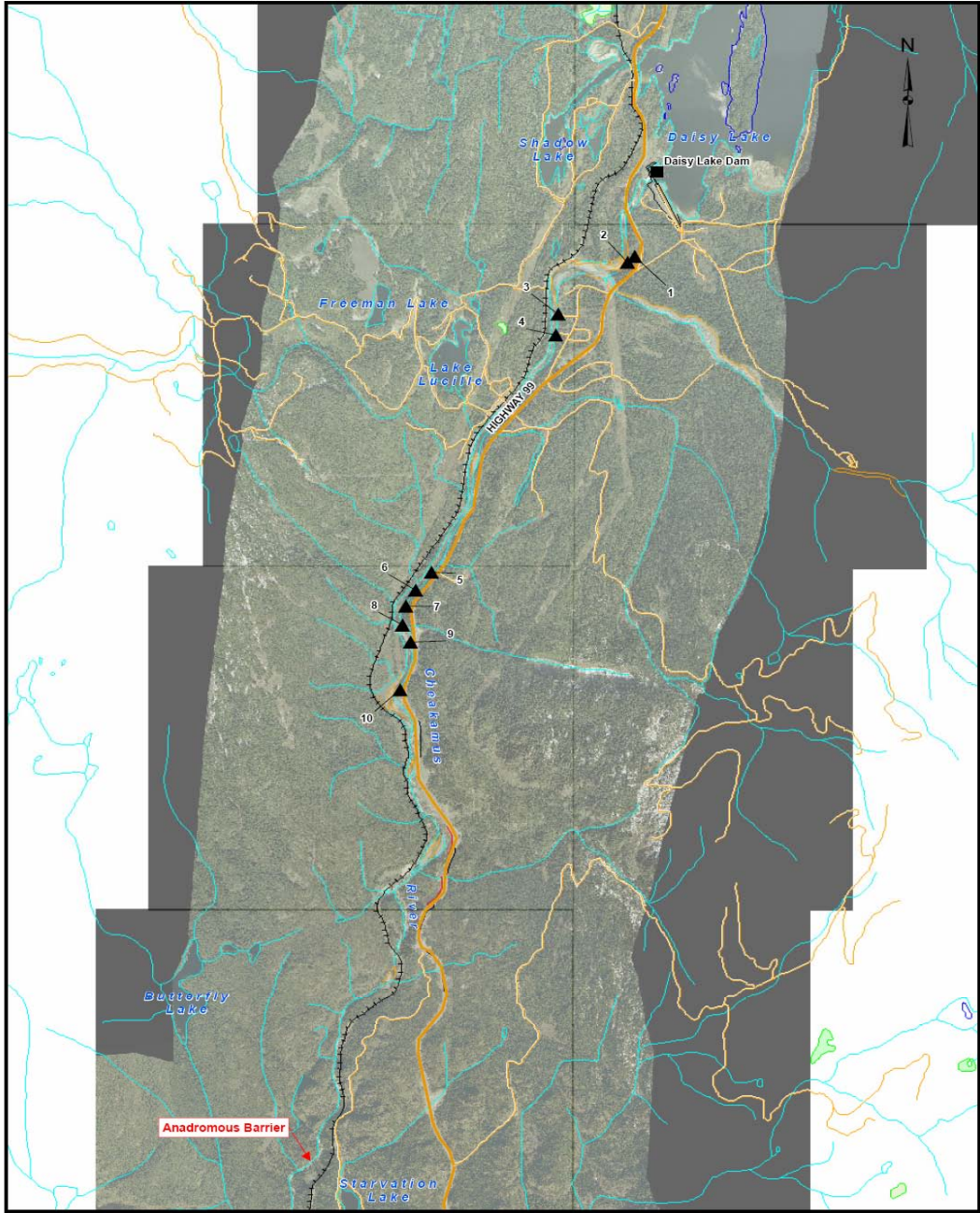
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7.0 REFERENCES

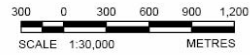
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FIGURES



LEGEND
 ▲ Sampling Site Locations



PROJECT
 BC HYDRO'S CHEAKAMUS RIVER MONITORING PROGRAM #2
 TROUT ABUNDANCE MONITOR IN THE CHEAKAMUS RIVER
 (DAISY LAKE TO CHEAKAMUS CANYON)

TITLE
SAMPLING SITE LOCATION MAP

 Golder Associates Burnaby, B.C.	PROJECT No.	07-1422-0028	SCALE AS SHOWN	REV. 0
	DESIGN	AK	03 Jan. 2008	FIGURE 1
	GIS	AL	03 Jan. 2008	
	CHECK			
	REVIEW			

REFERENCE
 Ortho imagery and base information provided by WMS openmaps.gov.bc.ca.
 Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 10

DRAFT

project:\n\air-cad\project\project\1422\01-1422-0028\gis\project\figure-1\sampling-site-location-map.mxd

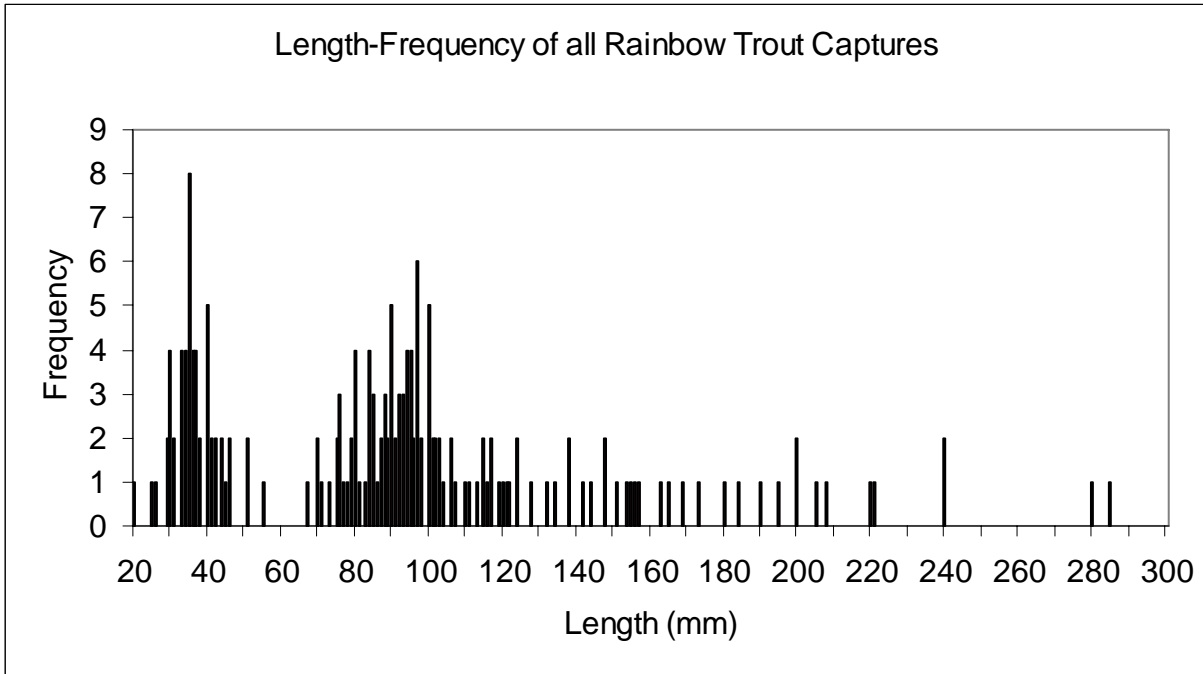


FIGURE 2: Length frequency of all rainbow trout caught on the Cheakamus River by electrofishing and angling

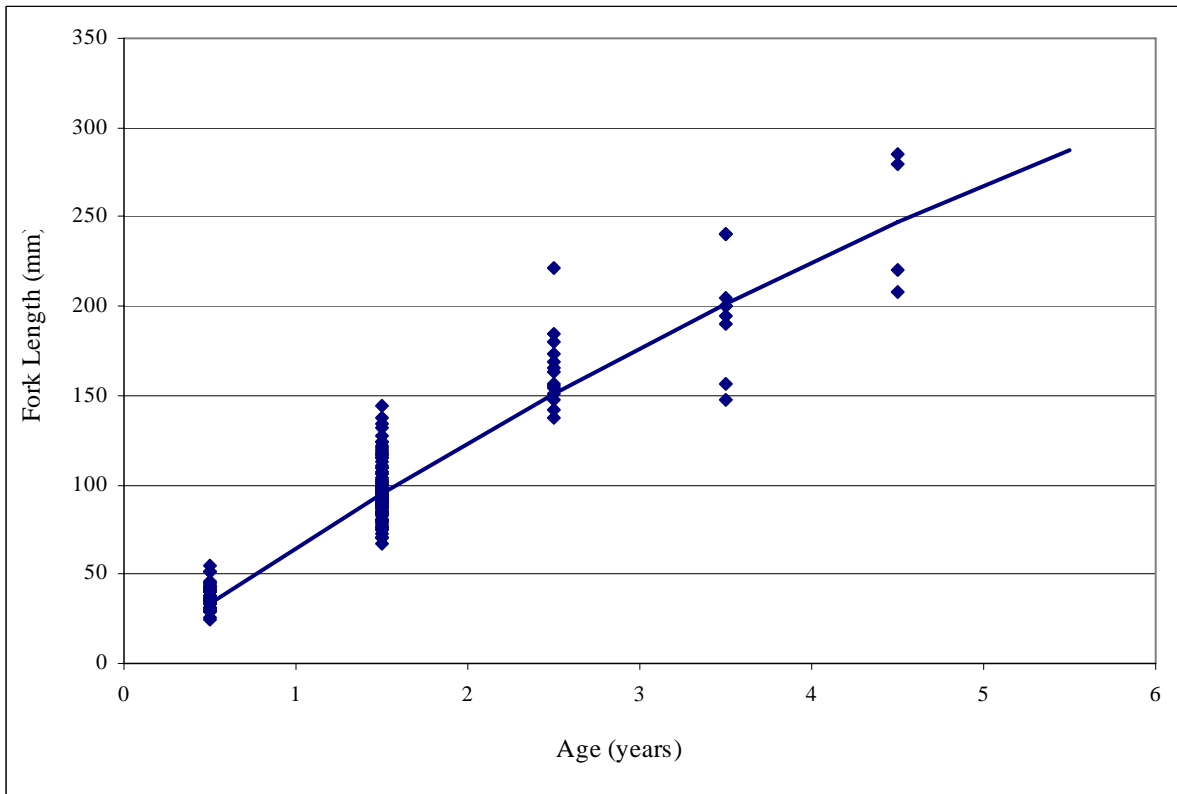


FIGURE 3: The von Bertalanffy growth curve for rainbow trout captured in the Cheakamus River. Estimates of parameters used $t_0 = 0$

APPENDIX 1

SITE DESCRIPTION, DEPTH-VELOCITY TRANSECT AND FISH CAPTURE DATA

Cheakamus River Rainbow Trout Survey, Septmeber 2007

ELECTROFISHING SITE DESCRIPTION FORM

SITE 001 Cheakamus

Stream:	Cheakamus
Watershed code:	90009760012900

Site number:	001
Date:	20/09/2007
Surveyed by:	AL/AL/HL
UTM:	0489643 5535553

Hydraulic type:	riffle
Mainstem/sidechannel (m/s,s/c):	s/c
Field gradient:	3.0 %
Stream width:	45.0 m
Channel width:	90.0 m
Mean depth:	0.35 m
Maximum depth:	0.60 m
Mean velocity:	0.06 m*s ⁻¹
Maximum velocity:	0.38 m*s ⁻¹

Turbidity:	Med
Temperature (°C @ time):	11 @ 0930

Stream Stage:	Low
Conductivity:	- μS*cm ⁻¹

COVER:		
log:	0	%
boulder:	70	%
instream vegetation:	2	%
overstream vegetation:	90	%
cutbank:	0	%

SUBSTRATE:		
finer:	2	%
small gravel:	2	%
large gravel:	2	%
cobble:	70	%
boulder:	24	%
bedrock:	0	%

Compaction:	Med
Sand (% of area):	10 %
d90:	0.55 m
dMax:	0.60 m

Site length:	10.0 m
Site width:	7.0 m
Site area*:	70.0 m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



Kanaka Creek Juvenile Steelhead Survey, October 2001

DEPTH/VELOCITY TRANSECT DATA ANALYSIS SPREADSHEET
(CALCULATES W.U.A. & DISCHARGE)

Spreadsheet modified by Heather Lamson, Golder Associates Limited, from one provided by Ron Ptolemy.
This spreadsheet applies Ptolemy WUP HSI curves, February 12, 2001.

Golder Associates Ltd.

SITE 001 Cheakamus

Stream:	Cheakamus	
Date:	20/09/2007	
Mainstem/side-channel:	s/c	
Meter:	Flow Meter	
Metered at*:	40%	dfb
Transect width:	7.0	m

Site length:	10.0	m
Site width:	7.0	m
Site area**:	70.0	m ²
Discharge:	0.142	m ³ *s ⁻¹

UTM:	489643	5535553
Watershed code:	90009760012900	
Site number:	001	
Transect #:	1	

Hydraulic type:	riffle	
Width:Mean Depth Ratio:	32.16	

Transect type:	EF site	
Stream width:	90	m
Number of stations:	15	

NOTES: * dfb = depth from bottom.

** at unsymmetrical sites, area is calculated from field measurements, not as site length * site width.

SITE WEIGHTED MEANS

Mean Depth:	0.2	m
Mean Velocity:	0.1	m*s ⁻¹
Cross-sectional area :	1.5	m ²
Mean Probability (Fry):	38.5	%
Mean Probability (Parr):	26.3	%

ADJUSTED USABLE AREAS

Usable Width for Fry:	2.7	m
%Transect Usable by Fry	38.5	%
Usable Area for Fry	27.0	m ²
Usable Width Parr:	1.8	m
%Transect Usable by Parr	26.3	%
Usable Area for Parr	18.4	m ²

This spread sheet is designed for depth/velocity transect data collected within a closed electrofishing site.

DEPTH/ VELOCITY DATA FOR WEIGHTED USABLE AREA (WUA) CALCULATIONS

TRANSECT DATA		
Station (m)	Depth (m)	Velocity (m/s)
0.00	0.00	0.00
0.50	0.12	0.00
1.00	0.05	0.00
1.50	0.14	0.00
2.00	0.11	0.00
2.50	0.04	0.00
3.00	0.19	0.38
3.50	0.32	0.07
4.00	0.30	0.15
4.50	0.21	0.00
5.00	0.42	0.16
5.50	0.47	0.12
6.00	0.25	0.08
6.50	0.31	0.00
7.00	0.04	0.00

Ptolemy WUP HSI curves, February 12, 2001.

Cheakamus River Rainbow Trout Survey, Septmeber 2007

ELECTROFISHING SITE DESCRIPTION FORM

SITE 002 Cheakamus

Stream:	Cheakamus
Watershed code:	90009760012900

Site number:	002
Date:	19/09/2007
Surveyed by:	AL/AL/HL
UTM:	0489645 5535547

Hydraulic type:	riffle
Mainstem/sidechannel (m/s,s/c):	s/c
Field gradient:	4.0 %
Stream width:	80.0 m
Channel width:	100.0 m
Mean depth:	0.35 m
Maximum depth:	0.75 m
Mean velocity:	0.18 m*s ⁻¹
Maximum velocity:	0.55 m*s ⁻¹

Turbidity:	Med
Temperature (°C @ time):	13 @ 1500

Stream Stage:	Low
Conductivity:	- μS*cm ⁻¹

COVER:		
log:	0	%
boulder:	33	%
instream vegetation:	2	%
overstream vegetation:	65	%
cutbank:	0	%

SUBSTRATE:		
finer:	0	%
small gravel:	0	%
large gravel:	2	%
cobble:	88	%
boulder:	10	%
bedrock:	0	%

Compaction:	Med
Sand (% of area):	2 %
d90:	0.75 m
dMax:	1.30 m

Site length:	16.0 m
Site width:	7.8 m
Site area*:	124.8 m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



Kanaka Creek Juvenile Steelhead Survey, October 2001

**DEPTH/VELOCITY TRANSECT DATA ANALYSIS SPREADSHEET
(CALCULATES W.U.A. & DISCHARGE)**

Spreadsheet modified by Heather Lamson, Golder Associates Limited, from one provided by Ron Ptolemy.
This spreadsheet applies Ptolemy WUP HSI curves, February 12, 2001.

SITE 002 Cheakamus

Stream:	Cheakamus	
Date:	19/09/2007	
Mainstem/side-channel:	s/c	
Meter:	Digital Velocity Meter	
Metered at*:	40%	dfb
Transect width:	7.0	m

Site length:	16.0	m
Site width:	7.8	m
Site area**:	124.8	m ²
Discharge:	0.462	m ³ s ⁻¹

UTM:	489645	5535547
Watershed code:	90009760012900	
Site number:	002	
Transect #:	1	

Hydraulic type:	riffle	
Width:Mean Depth Ratio:	23.32	

Transect type:	EF site	
Stream width:	100	m
Number of stations:	15	

NOTES:
* dfb = depth from bottom.
** at unsymmetrical sites, area is calculated from field measurements, not as site length * site width.

SITE WEIGHTED MEANS

Mean Depth:	0.3	m
Mean Velocity:	0.2	m*s ⁻¹
Cross-sectional area :	2.1	m ²
Mean Probability (Fry):	36.3	%
Mean Probability (Parr):	57.0	%

ADJUSTED USABLE AREAS

Usable Width for Fry:	2.5	m
%Transect Usable by Fry	36.3	%
Usable Area for Fry	45.2	m ²
Usable Width Parr:	4.0	m
%Transect Usable by Parr	57.0	%
Usable Area for Parr	71.1	m ²

This spread sheet is designed for depth/velocity transect data collected within a closed electrofishing site.

DEPTH/ VELOCITY DATA FOR WEIGHTED USABLE AREA (WUA) CALCULATIONS

TRANSECT DATA		
Station (m)	Depth (m)	Velocity (m/s)
0.00	0.00	0.00
0.50	0.05	0.00
1.00	0.27	0.00
1.50	0.30	0.10
2.00	0.56	0.11
2.50	0.54	0.13
3.00	0.44	0.23
3.50	0.41	0.39
4.00	0.32	0.34
4.50	0.35	0.55
5.00	0.26	0.14
5.50	0.31	0.38
6.00	0.16	0.29
6.50	0.17	0.00
7.00	0.03	0.00

Ptolemy WUP HSI curves, February 12, 2001.

**Cheakamus River Rainbow Trout Survey, September 2007
FISH CAPTURE SUMMARY FORM**

Golder Associates, Ltd.

SITE 002 Cheakamus

Stream:	Cheakamus
Site number:	002
Site length:	16.0 m
Site width:	7.8 m
Site area:	124.8 m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	1445	1508	700	J5	566
Pass 2	1530	1555	700	J5	430
Pass 3	1635	1710	700	J5	

Species	Age	Pass 1	Pass 2	Pass 3	Total Fish	Mean Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Pop'n Estimate	Population Estimate SE
<i>O. mykiss</i>	0+	1	2	1	4	0.3	36.5	4	3.2	0.36	9	0.370	1.468
<i>O. mykiss</i>	1+	9	2		11	7.1	109.5	11	8.8			0.020	0.218
<i>O. mykiss</i>	2+	2			2	10.1	145.0	2	1.6			0.000	0
<i>Cottus</i>		10						10				0.000	0
<i>Gasterosteus aculeatus</i>		3						3				0.000	0

Cheakamus River Rainbow Trout Survey, September 2007

ELECTROFISHING SITE DESCRIPTION FORM

SITE 003 Cheakamus

Stream:	Cheakamus
Watershed code:	

Site number:	003
Date:	13/09/2007
Surveyed by:	AL/AL/HL
UTM:	0489121 5535128

Hydraulic type:	rapid
Mainstem/sidechannel (m/s,s/c):	m/s
Field gradient:	3.0 %
Stream width:	40.0 m
Channel width:	40.0 m
Mean depth:	0.35 m
Maximum depth:	0.60 m
Mean velocity:	0.43 m*s ⁻¹
Maximum velocity:	1.21 m*s ⁻¹

Turbidity:	Med
Temperature (°C @ time):	11 @ 1200

Stream Stage:	Low
Conductivity:	- μS*cm ⁻¹

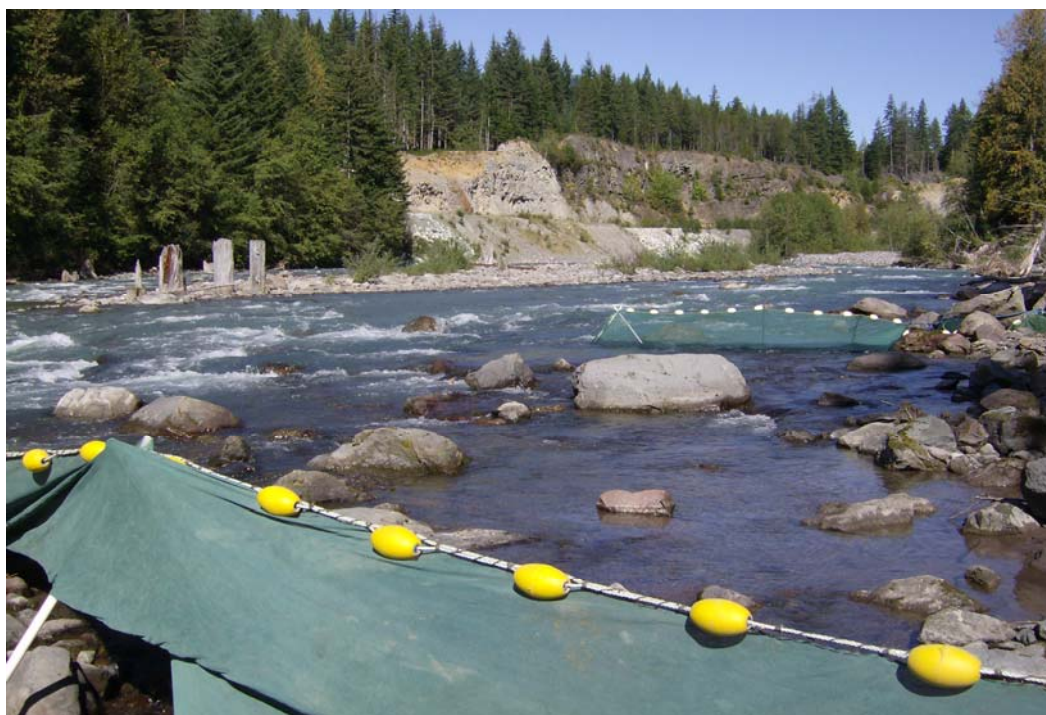
COVER:		
log:	0	%
boulder:	100	%
instream vegetation:	0	%
overstream vegetation:	0	%
cutbank:	0	%

SUBSTRATE:		
finer:	15	%
small gravel:	5	%
large gravel:	10	%
cobble:	25	%
boulder:	45	%
bedrock:	0	%

Compaction:	low
Sand (% of area):	%
d90:	1.10 m
dMax:	1.60 m

Site length:	16.5	m
Site width:	8.5	m
Site area*:	140.3	m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



Kanaka Creek Juvenile Steelhead Survey, October 2001

**DEPTH/VELOCITY TRANSECT DATA ANALYSIS SPREADSHEET
(CALCULATES W.U.A. & DISCHARGE)**

Spreadsheet modified by Heather Lamson, Golder Associates Limited, from one provided by Ron Ptolemy.

This spreadsheet applies Ptolemy WUP HSI curves, February 12, 2001.

Aquatic Resources Limited

SITE 003 Cheakamus

Stream:	Cheakamus	
Date:	13/09/2007	
Mainstem/side-channel:	m/s	
Meter:	Digital Velocity	
Metered at*:	40%	dfb
Transect width:	7.0	m

UTM:	489121	5535128
Watershed code:	0	
Site number:	003	
Transect #:	1	

Hydraulic type:	rapid	
Width:Mean Depth Ratio:	15.98	

Site length:	16.5	m
Site width:	8.5	m
Site area**:	140.3	m ²
Discharge:	1.467	m ³ *s ⁻¹

Transect type:	EF site	
Stream width:	40	m
Number of stations:	22	

NOTES: * dfb = depth from bottom.

** at unsymmetrical sites, area is calculated from field measurements, not as site length * site width.

SITE WEIGHTED MEANS

Mean Depth:	0.4	m
Mean Velocity:	0.5	m*s ⁻¹
Cross-sectional area :	3.1	m ²
Mean Probability (Fry):	39.6	%
Mean Probability (Parr):	82.8	%

ADJUSTED USABLE AREAS

Usable Width for Fry:	2.8	m
% Transect Usable by Fry	39.6	%
Usable Area for Fry	55.5	m ²
Usable Width Parr:	5.8	m
% Transect Usable by Parr	82.8	%
Usable Area for Parr	116.1	m ²

This spread sheet is designed for depth/velocity transect data collected within a closed electrofishing site.

DEPTH/ VELOCITY DATA FOR WEIGHTED USABLE AREA (WUA) CALCULATIONS

TRANSECT DATA		
Station (m)	Depth (m)	Velocity (m/s)
0.00	0.00	0.00
0.50	0.05	0.00
1.00	0.13	0.00
1.50	0.14	0.00
2.00	0.21	0.12
2.50	0.26	0.15
3.00	0.28	0.54
3.50	0.21	0.66
4.00	0.12	0.90
4.50	0.13	0.57
5.00	0.19	0.67
5.50	0.23	0.60
6.00	0.31	1.21
6.50	0.30	0.08
7.00	0.32	0.24
7.50	0.39	0.17
8.00	0.52	0.72
8.50	0.46	0.79
9.00	0.42	0.24
9.50	0.58	0.77
10.00	0.58	0.25
10.50	0.58	0.85

FISH CAPTURE SUMMARY FORM

SITE 003 Cheakamus

Stream:	Cheakamus
Site number:	003
Site length:	16.5 m
Site width:	8.5 m
Site area:	140.3 m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	1218	1247	700	J6	718
Pass 2	1350	1417	700	J6	729
Pass 3	1500	1525	700	J6	529
Pass 4	1533	1546	700	J6	503

Species	Age	Pass 1	Pass 2	Pass 3	Total Fish	Mean Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Pop'n Estimate	Population Estimate SE
<i>O. mykiss</i>	0+	1			1	0.5	36.0	1	0.7	0.40	2	0.000	0
<i>O. mykiss</i>	1+		2		2	11.7	108.5	2	1.4			0.278	1.038
<i>O. mykiss</i>	2+	1		1	2	50.6	164.0	2	1.4			0.278	1.038
<i>Cottus</i>		1	1	1	3			3	2.1			0.227	1.271

Cheakamus River Rainbow Trout Survey, September 2007

ELECTROFISHING SITE DESCRIPTION FORM

SITE 004 Cheakamus

Stream:	Cheakamus
Watershed code:	90009760012900

Site number:	004
Date:	14/09/2007
Surveyed by:	AL/AL/HL
UTM:	10U 0489105 5534957

Hydraulic type:	riffle and pool
Mainstem/sidechannel (m/s,s/c):	m/s
Field gradient:	2.0 %
Stream width:	45.0 m
Channel width:	65.0 m
Mean depth:	0.40 m
Maximum depth:	0.95 m
Mean velocity:	0.14 m*s ⁻¹
Maximum velocity:	0.63 m*s ⁻¹

Turbidity:	Med
Temperature (°C @ time):	10 @ 1200

Stream Stage:	Low
Conductivity:	- μS*cm ⁻¹

COVER:		
log:	0	%
boulder:	20	%
instream vegetation:	0	%
overstream vegetation:	0	%
cutbank:	0	%

SUBSTRATE:		
finer:	30	%
small gravel:	15	%
large gravel:	15	%
cobble:	20	%
boulder:	20	%
bedrock:	0	%

Compaction:	Med
Sand (% of area):	10 %
d90:	0.82 m
dMax:	2.00 m

Site length:	17.0 m
Site width:	10.5 m
Site area*:	178.5 m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



Kanaka Creek Juvenile Steelhead Survey, October 2001
DEPTH/VELOCITY TRANSECT DATA ANALYSIS SPREADSHEET
(CALCULATES W.U.A. & DISCHARGE)

Spreadsheet modified by Heather Lamson, Golder Associates Limited, from one provided by Ron Ptolemy.
This spreadsheet applies Ptolemy WUP HSI curves, February 12, 2001.

Golder Associates Limited

SITE 004 Cheakamus

Stream:	Cheakamus	
Date:	14/09/2007	
Mainstem/side-channel:	m/s	
Meter:	Digital Velocity Meter	
Metered at*:	40%	dfb
Transect width:	7.0	m

Site length:	17.0	m
Site width:	10.5	m
Site area**:	178.5	m ²
Discharge:	0.461	m ³ *s ⁻¹

UTM:	10U 0489105	5534957
Watershed code:	90009760012900	
Site number:	004	
Transect #:	1	

Hydraulic type:	riffle and pool	
Width:Mean Depth Ratio:	14.18	

Transect type:	EF site	
Stream width:	65	m
Number of stations:	22	

NOTES: * dfb = depth from bottom.
 ** at unsymmetrical sites, area is calculated from field measurements, not as site length * site width.

SITE WEIGHTED MEANS

Mean Depth:	0.5 m
Mean Velocity:	0.1 m*s ⁻¹
Cross-sectional area :	3.5 m ²
Mean Probability (Fry):	40.8 %
Mean Probability (Parr):	58.8 %

ADJUSTED USABLE AREAS

Usable Width for Fry:	2.9 m
%Transect Usable by Fry:	40.8 %
Usable Area for Fry:	72.8 m ²
Usable Width Parr:	4.1 m
%Transect Usable by Parr:	58.8 %
Usable Area for Parr:	104.9 m ²

This spread sheet is designed for depth/velocity transect data collected within a closed electrofishing site.

DEPTH/ VELOCITY DATA FOR WEIGHTED USABLE AREA (WUA) CALCULATIONS

TRANSECT DATA		
Station (m)	Depth (m)	Velocity (m/s)
0.00	0.00	0.00
0.50	0.09	0.00
1.00	0.22	0.00
1.50	0.35	0.00
2.00	0.40	0.00
2.50	0.54	0.00
3.00	0.50	0.00
3.50	0.34	0.00
4.00	0.44	0.00
4.50	0.31	0.00
5.00	0.23	0.04
5.50	0.20	0.42
6.00	0.28	0.24
6.50	0.36	0.27
7.00	0.39	0.29
7.50	0.42	0.35
8.00	0.44	0.34
8.50	0.43	0.25
9.00	0.36	0.00
9.50	0.00	0.00
10.00	0.38	0.17
10.50	0.45	0.63

Ptolemy WUP HSI curves.

FISH CAPTURE SUMMARY FORM

Golder Associates Limited

SITE 004 Cheakamus

Stream:	Cheakamus
Site number:	004
Site length:	17.0 m
Site width:	10.5 m
Site area:	178.5 m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	1300	1330	700	G5	1090
Pass 2	1420	1420	700	G5	600
Pass 3	1500	1500	800	G5	840

Species	Age	Pass 1	Pass 2	Pass 3	Total Fish	Mean Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Pop'n Estimate	Population Estimate SE
<i>O. mykiss</i>	0+	1	2	1	4	0.5	30.5	4	2	0.41	5	0.367	0.443
<i>O. mykiss</i>	1+	4	0	0	4	12.2	102.8	4	2			0.000	0.47
<i>Cottus</i>		2	0	0	2			2	1			0.000	1.615
<i>Gasterosteus aculeatus</i>		0	0	2	2			2	1			1.433	2.866

Cheakamus River Rainbow Trout Survey, September 2007

ELECTROFISHING SITE DESCRIPTION FORM

SITE 005 Cheakamus

Stream:	Cheakamus
Watershed code:	90009760012900

Site number:	005
Date:	15/09/2007
Surveyed by:	AL/AL/HL
UTM:	0488166 5533036

Hydraulic type:	riffle/rapid
Mainstem/sidechannel (m/s,s/c):	m/s
Field gradient:	4.0 %
Stream width:	40.0 m
Channel width:	55.0 m
Mean depth:	0.38 m
Maximum depth:	0.73 m
Mean velocity:	0.05 m*s ⁻¹
Maximum velocity:	0.30 m*s ⁻¹

Turbidity:	Med
Temperature (°C @ time):	11 @ 1020

Stream Stage:	Low
Conductivity:	- μS*cm ⁻¹

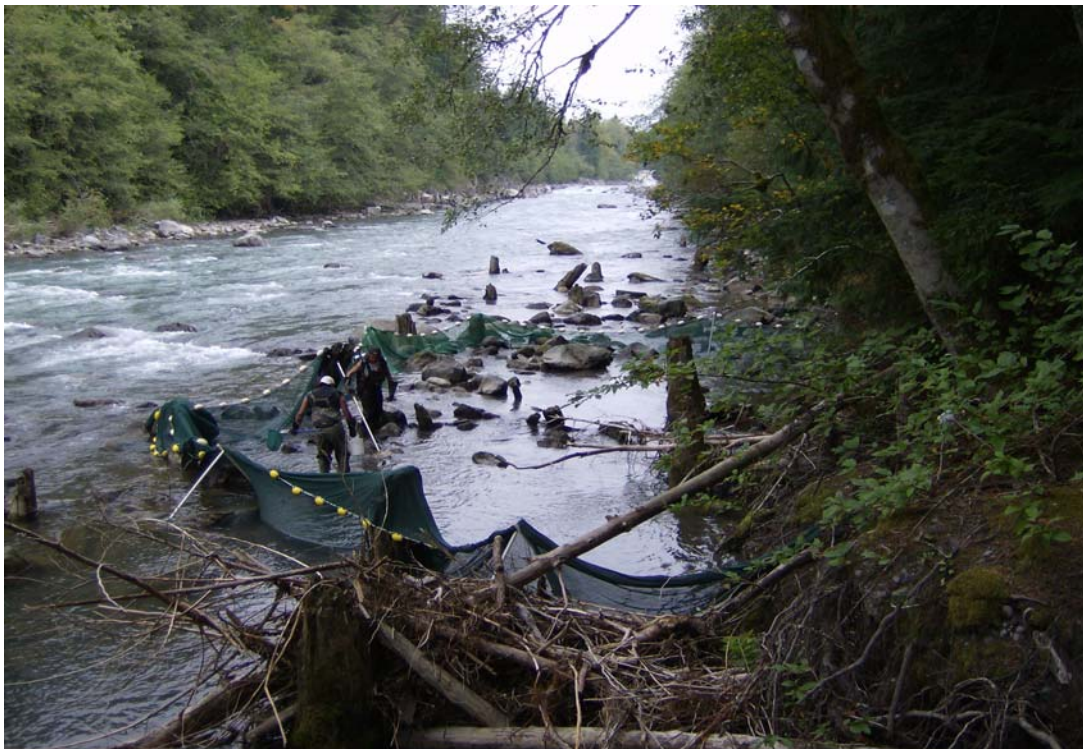
COVER:		
log:	19	%
boulder:	40	%
instream vegetation:	1	%
overstream vegetation:	20	%
cutbank:	20	%

SUBSTRATE:		
finer:	10	%
small gravel:	5	%
large gravel:	5	%
cobble:	70	%
boulder:	10	%
bedrock:	0	%

Compaction:	Med
Sand (% of area):	10 %
d90:	0.80 m
dMax:	0.90 m

Site length:	16.0 m
Site width:	9.5 m
Site area*:	152.0 m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



Kanaka Creek Juvenile Steelhead Survey, October 2001

**DEPTH/VELOCITY TRANSECT DATA ANALYSIS SPREADSHEET
(CALCULATES W.U.A. & DISCHARGE)**

Spreadsheet modified by Heather Lamson, Golder Associates Limited, from one provided by Ron Ptolemy.

This spreadsheet applies Ptolemy WUP HSI curves, February 12, 2001.

Golder Associates Limited

SITE 005 Cheakamus

Stream:	Cheakamus	
Date:	15/09/2007	
Mainstem/side-channel:	m/s	
Meter:	Digital Velocity Meter	
Metered at*:	40%	dfb
Transect width:	7.0	m

Site length:	16.0	m
Site width:	9.5	m
Site area**:	152.0	m ²
Discharge:	0.177	m ³ s ⁻¹

NOTES: * dfb = depth from bottom.

** at unsymmetrical sites, area is calculated from field measurements, not as site length * site width.

UTM:	488166	5533036
Watershed code:	90009760012900	
Site number:	005	
Transect #:	1	

Hydraulic type:	riffle/rapid	
Width:Mean Depth Ratio:	16.64	

Transect type:	EF site	
Stream width:	55	m
Number of stations:	21	

SITE WEIGHTED MEANS

Mean Depth:	0.4	m
Mean Velocity:	0.1	m ³ s ⁻¹
Cross-sectional area :	2.9	m ²
Mean Probability (Fry):	37.7	%
Mean Probability (Parr):	26.3	%

ADJUSTED USABLE AREAS

Usable Width for Fry:	2.6	m
%Transect Usable by Fry:	37.7	%
Usable Area for Fry:	57.3	m ²
Usable Width Parr:	1.8	m
%Transect Usable by Parr:	26.3	%
Usable Area for Parr:	40.0	m ²

This spread sheet is designed for depth/velocity transect data collected within a closed electrofishing site.

DEPTH/ VELOCITY DATA FOR WEIGHTED USABLE AREA (WUA) CALCULATIONS

TRANSECT DATA		
Station (m)	Depth (m)	Velocity (m/s)
0.00	0.00	0.00
0.50	0.25	0.00
1.00	0.27	0.00
1.50	0.36	0.00
2.00	0.50	0.00
2.50	0.53	0.00
3.00	0.42	0.00
3.50	0.40	0.00
4.00	0.45	0.00
4.50	0.36	0.30
5.00	0.57	0.20
5.50	0.31	0.00
6.00	0.37	0.00
6.50	0.00	0.00
7.00	0.00	0.00
7.50	0.05	0.00
8.00	0.05	0.06
8.50	0.27	0.00
9.00	0.36	0.25
9.50	0.23	0.12
10.00	0.08	0.16

Ptolemy WUP HSI curves.

**Cheakamus River Rainbow Trout Survey, September 2007
FISH CAPTURE SUMMARY FORM**

Golder Associates Limited

SITE 005 Cheakamus

Stream:	Cheakamus
Site number:	005
Site length:	16.0 m
Site width:	9.5 m
Site area:	152.0 m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	1028	1117	600	15	1111
Pass 2	1216	1248	500	15	851
Pass 3	1308	1336	500	14	771

Species	Age	Pass 1	Pass 2	Pass 3	Total Fish	Mean Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Pop'n Estimate	Population Estimate SE
<i>O. mykiss</i>	0+	4	5	2	11	0.6	37.5	12	7.9	0.38	21	0.240	2.884
<i>O. mykiss</i>	1+	24	5	1	30	9.3	91.2	30	19.7			0.017	0.51
<i>Cottus</i>		1	0	0	1			1	0.7			0.000	0
<i>Gasterosteus aculeatus</i>		2	0	1	3			3	2.0			0.236	1.038

Cheakamus River Rainbow Trout Survey, September 2007

ELECTROFISHING SITE DESCRIPTION FORM

SITE 006 Cheakamus

Stream:	Cheakamus
Watershed code:	90009760012900

Site number:	006
Date:	19/09/2007
Surveyed by:	AL/AL/HL
UTM:	0488048 5532890

Hydraulic type:	run/riffle
Mainstem/sidechannel (m/s,s/c):	m/s
Field gradient:	3.0 %
Stream width:	20.0 m
Channel width:	75.0 m
Mean depth:	0.40 m
Maximum depth:	0.73 m
Mean velocity:	0.17 m*s ⁻¹
Maximum velocity:	0.56 m*s ⁻¹

Turbidity:	Low
Temperature (°C @ time):	9 @ 0900

Stream Stage:	Low
Conductivity:	- μS*cm ⁻¹

COVER:		
log:	0	%
boulder:	100	%
instream vegetation:	0	%
overstream vegetation:	0	%
cutbank:	0	%

SUBSTRATE:		
finer:	2	%
small gravel:	2	%
large gravel:	2	%
cobble:	60	%
boulder:	34	%
bedrock:	0	%

Compaction:	high
Sand (% of area):	10 %
d90:	0.75 m
dMax:	0.83 m

Site length:	20.0	m
Site width:	6.0	m
Site area*:	120.0	m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



Kanaka Creek Juvenile Steelhead Survey, October 2001

DEPTH/VELOCITY TRANSECT DATA ANALYSIS SPREADSHEET
(CALCULATES W.U.A. & DISCHARGE)

Spreadsheet modified by Heather Lamson, Golder Associates Limited, from one provided by Ron Ptolemy.
This spreadsheet applies Ptolemy WUP HSI curves, February 12, 2001.

Aquatic Resources Limited

SITE 006 Cheakamus

Stream:	Cheakamus
Date:	19/09/2007
Mainstem/side-channel:	m/s
Meter:	Digital Velocity Meter
Metered at*:	40% dfb
Transect width:	6.5 m

Site length:	20.0 m
Site width:	6.0 m
Site area**:	120.0 m ²
Discharge:	0.446 m ³ *s ⁻¹

UTM:	488048 5532890
Watershed code:	90009760012900
Site number:	006
Transect #:	1

Hydraulic type:	run/riffle
Width:Mean Depth Ratio:	22.53

Transect type:	EF site
Stream width:	75 m
Number of stations:	14

NOTES: * dfb = depth from bottom.

** at unsymmetrical sites, area is calculated from field measurements, not as site length * site width.

SITE WEIGHTED MEANS

Mean Depth:	0.3 m
Mean Velocity:	0.2 m*s ⁻¹
Cross-sectional area :	1.9 m ²
Mean Probability (Fry):	43.7 %
Mean Probability (Parr):	48.6 %

ADJUSTED USABLE AREAS

Usable Width for Fry:	2.8 m
%Transect Usable by Fry	43.7 %
Usable Area for Fry	52.4 m ²
Usable Width Parr:	3.2 m
%Transect Usable by Parr	48.6 %
Usable Area for Parr	58.3 m ²

This spread sheet is designed for depth/velocity transect data collected within a closed electrofishing site.

DEPTH/VELOCITY DATA FOR WEIGHTED USABLE AREA (WUA) CALCULATIONS

TRANSECT DATA		
Station (m)	Depth (m)	Velocity (m/s)
0.00	0.00	0.00
0.50	0.01	0.00
1.00	0.05	0.00
1.50	0.10	0.00
2.00	0.24	0.04
2.50	0.24	0.11
3.00	0.36	0.00
3.50	0.26	0.19
4.00	0.11	0.21
4.50	0.37	0.28
5.00	0.36	0.21
5.50	0.50	0.44
6.00	0.76	0.29
6.50	0.79	0.56

**Cheakamus River Rainbow Trout Survey, September 2007
FISH CAPTURE SUMMARY FORM**

Golder Associates Limited

SITE 006 Cheakamus

Stream:	Cheakamus
Site number:	006
Site length:	20.0 m
Site width:	6.0 m
Site area:	120.0 m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	0950	1010	700	J4	575
Pass 2	1030	1100	700	J5	542
Pass 3	1115	1130	700	J6	450

Species	Age	Pass 1	Pass 2	Pass 3	Total Fish	Mean Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Pop'n Estimate	Population Estimate SE
<i>O. mykiss</i>	0+	3	3	0	6	0.6	39.2	6	5.0	0.44	11	0.083	1.468
<i>O. mykiss</i>	1+	11	6	0	17	9.2	93.6	17	14.2			0.045	0.218
<i>Cottus</i>		1	1	1	3			3	2.5			0.420	0
<i>Gasterosteus aculeatus</i>		0	0	1	1			1	0.8			2.020	0

Cheakamus River Rainbow Trout Survey, September 2007

ELECTROFISHING SITE DESCRIPTION FORM

SITE 007 Cheakamus

Stream:	Cheakamus
Watershed code:	90009760012900

Site number:	007
Date:	18/09/2007
Surveyed by:	AL/AL/HL
UTM:	0487949 5532607

Hydraulic type:	riffle/rapid
Mainstem/sidechannel (m/s,s/c):	m/s
Field gradient:	4.0 %
Stream width:	60.0 m
Channel width:	55.0 m
Mean depth:	0.30 m
Maximum depth:	0.60 m
Mean velocity:	0.35 m*s ⁻¹
Maximum velocity:	0.65 m*s ⁻¹

Turbidity:	Med
Temperature (°C @ time):	10.5 @ 0900

Stream Stage:	Low
Conductivity:	- μS*cm ⁻¹

COVER:		
log:	0	%
boulder:	20	%
instream vegetation:	2	%
overstream vegetation:	80	%
cutbank:	0	%

SUBSTRATE:		
finer:	0	%
small gravel:	0	%
large gravel:	10	%
cobble:	80	%
boulder:	10	%
bedrock:	0	%

Compaction:	High
Sand (% of area):	10 %
d90:	0.60 m
dMax:	0.70 m

Site length:	17.0	m
Site width:	11.0	m
Site area*:	187.0	m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



Kanaka Creek Juvenile Steelhead Survey, October 2001

DEPTH/VELOCITY TRANSECT DATA ANALYSIS SPREADSHEET
(CALCULATES W.U.A. & DISCHARGE)

Spreadsheet modified by Heather Lamson, Golder Associates Limited, from one provided by Ron Ptolemy.

This spreadsheet applies Ptolemy WUP HSI curves, February 12, 2001.

Golder Associates Limited

SITE 007 Cheakamus

Stream:	Cheakamus
Date:	18/09/2007
Mainstem/side-channel:	m/s
Meter:	Digital Velocity Meter
Metered at*:	40% dfb
Transect width:	7.0 m

Site length:	17.0 m
Site width:	11.0 m
Site area**:	187.0 m ²
Discharge:	1.546 m ³ *s ⁻¹

UTM:	487949 5532607
Watershed code:	90009760012900
Site number:	007
Transect #:	1

Hydraulic type:	riffle/rapid
Width:Mean Depth Ratio:	12.11

Transect type:	EF site
Stream width:	55 m
Number of stations:	22

NOTES: * dfb = depth from bottom.

** at unsymmetrical sites, area is calculated from field measurements, not as site length * site width.

SITE WEIGHTED MEANS

Mean Depth:	0.6 m
Mean Velocity:	0.4 m*s ⁻¹
Cross-sectional area :	4.0 m ²
Mean Probability (Fry):	40.5 %
Mean Probability (Parr):	127.2 %

ADJUSTED USABLE AREAS

Usable Width for Fry:	2.8 m
%Transect Usable by Fry	40.5 %
Usable Area for Fry	75.8 m ²
Usable Width Parr:	8.9 m
%Transect Usable by Parr	127.2 %
Usable Area for Parr	237.8 m ²

This spread sheet is designed for depth/velocity transect data collected within a closed electrofishing site.

DEPTH/ VELOCITY DATA FOR WEIGHTED USABLE AREA (WUA) CALCULATIONS

TRANSECT DATA		
Station (m)	Depth (m)	Velocity (m/s)
0.00	0.00	0.00
0.50	0.80	0.00
1.00	0.00	0.00
1.50	0.23	0.20
2.00	0.34	0.29
2.50	0.29	0.28
3.00	0.28	0.28
3.50	0.31	0.21
4.00	0.37	0.34
4.50	0.40	0.48
5.00	0.36	0.65
5.50	0.48	0.61
6.00	0.48	0.50
6.50	0.48	0.50
7.00	0.44	0.50
7.50	0.40	0.51
8.00	0.46	0.45
8.50	0.44	0.44
9.00	0.45	0.44
9.50	0.45	0.55
10.00	0.29	0.33
10.50	0.27	0.13

Ptolemy WUP HSI curves.

Cheakamus River Rainbow Trout Survey, September 2007
FISH CAPTURE SUMMARY FORM

Golder Associates Ltd.

SITE 007 Cheakamus

Stream:	Cheakamus
Site number:	007
Site length:	17.0 m
Site width:	11.0 m
Site area:	187.0 m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	1000	1030	700	J4	902
Pass 2	1100	1130	700	J4	666
Pass 3	1140	1200	700	J4	591

Species	Age	Pass 1	Pass 2	Pass 3	Total Fish	Mean Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Pop'n Estimate	Population Estimate SE
<i>O. mykiss</i>	0+	6	1	1	8	0.7	39.3	8	4.3	0.41	11	0.064	0.512
<i>O. mykiss</i>	1+	8	2		10	8.2	90.0	10	5.3			0.023	0.237
<i>O. mykiss</i>	2+		2		2	41.5	147.0	2	1.1			0.519	1.038
<i>O. mykiss</i>	3+	1			1	42.2	157.0	1	0.5			0.000	0
<i>Cottus</i>		4	2		6			6	3.2			0.063	0.376

Cheakamus River Rainbow Trout Survey, September 2007

ELECTROFISHING SITE DESCRIPTION FORM

SITE 008 Cheakamus

Stream:	Cheakamus
Watershed code:	90009760012900

Site number:	008
Date:	17/09/2007
Surveyed by:	AL/AL/HL
UTM:	487949 5532607

Hydraulic type:	riffle/rapid
Mainstem/sidechannel (m/s,s/c):	m/s
Field gradient:	4.0 %
Stream width:	20.0 m
Channel width:	35.0 m
Mean depth:	0.45 m
Maximum depth:	0.83 m
Mean velocity:	0.12 m*s ⁻¹
Maximum velocity:	0.89 m*s ⁻¹

Turbidity:	Med
Temperature (°C @ time):	11 @ 1000

Stream Stage:	Low
Conductivity:	- μS*cm ⁻¹

COVER:		
log:	0	%
boulder:	75	%
instream vegetation:	0	%
overstream vegetation:	0	%
cutbank:	0	%

SUBSTRATE:		
finer:	0	%
small gravel:	2	%
large gravel:	3	%
cobble:	15	%
boulder:	80	%
bedrock:	0	%

Compaction:	Med
Sand (% of area):	10 %
d90:	0.85 m
dMax:	1.00 m

Site length:	16.0	m
Site width:	14.0	m
Site area*:	70.0	m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



Kanaka Creek Juvenile Steelhead Survey, October 2001
DEPTH/VELOCITY TRANSECT DATA ANALYSIS SPREADSHEET
(CALCULATES W.U.A. & DISCHARGE)

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This spreadsheet applies Ptolemy WUP HSI curves, February 12, 2001.

Aquatic Resources Limited

SITE 008 Cheakamus

Stream:	Cheakamus	
Date:	17/09/2007	
Mainstem/side-channel:	m/s	
Meter:	Digital Velocity Meter	
Metered at*:	40%	dfb
Transect width:	7.0	m

UTM:	487949	5532607
Watershed code:	90009760012900	
Site number:	008	
Transect #:	1	

Hydraulic type:	riffle/rapid	
Width:Mean Depth Ratio:	12.08	

Site length:	16.0	m
Site width:	14.0	m
Site area**:	183.3	m ²
Discharge:	0.664	m ³ s ⁻¹

Transect type:	EF site	
Stream width:	35	m
Number of stations:	26	

NOTES: * dfb = depth from bottom.
 ** at unsymmetrical sites, area is calculated from field measurements, not as site length * site width.

SITE WEIGHTED MEANS

Mean Depth:	0.6	m
Mean Velocity:	0.2	m*s ⁻¹
Cross-sectional area :	4.1	m ²
Mean Probability (Fry):	53.1	%
Mean Probability (Parr):	62.1	%

ADJUSTED USABLE AREAS

Usable Width for Fry:	3.7	m
%Transect Usable by Fry	53.1	%
Usable Area for Fry	97.4	m ²
Usable Width Parr:	4.3	m
%Transect Usable by Parr	62.1	%
Usable Area for Parr	113.9	m ²

This spread sheet is designed for depth/velocity transect data collected within a closed electrofishing site.

DEPTH/ VELOCITY DATA FOR WEIGHTED USABLE AREA (WUA) CALCULATIONS

TRANSECT DATA		
Station (m)	Depth (m)	Velocity (m/s)
0.00	0.00	0.00
0.50	0.00	0.00
1.00	0.12	0.00
1.50	0.19	0.05
2.00	0.24	0.00
2.50	0.18	0.09
3.00	0.05	0.00
3.50	0.20	0.00
4.00	0.00	0.00
4.50	0.15	0.30
5.00	0.10	0.00
5.50	0.22	0.00
6.00	0.26	0.00
6.50	0.37	0.10
7.00	0.53	0.14
7.50	0.55	0.12
8.00	0.40	0.13
8.50	0.54	0.09
9.00	0.51	0.09
9.50	0.58	0.09
10.00	0.55	0.10
10.50	0.43	0.11
11.00	0.38	0.11
11.50	0.60	0.12
12.00	0.64	0.65
12.50	0.65	0.89

Ptolemy WUP HSI curves.

**Cheakamus River Rainbow Trout Survey, September 2007
FISH CAPTURE SUMMARY FORM**

Golder Associates Limited

SITE 008 Cheakamus

Stream:	Cheakamus
Site number:	008
Site length:	16.0 m
Site width:	14.0 m
Site area:	70.0 m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	1410	1440			738
Pass 2	1500	1525			548
Pass 3	1535	1552			546

Species	Age	Pass 1	Pass 2	Pass 3	Total Fish	Mean Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Pop'n Estimate	Population Estimate SE
<i>O. mykiss</i>	0+	9		4	13	0.4	34.8	13	18.6	0.53	35	0.154	2.156
<i>O. mykiss</i>	1+		10	1	11	7.4	88.0	11	15.7			0.418	5.435
<i>Cottus</i>		1	1		2			2	2.9			0.192	0.384
<i>Gasterosteus aculeatus</i>		1			1			1	1.4			0.000	0.738

Cheakamus River Rainbow Trout Survey, September 2007

ELECTROFISHING SITE DESCRIPTION FORM

SITE 009 Cheakamus

Stream:	Cheakamus
Watershed code:	90009760012900

Site number:	009
Date:	17/09/2007
Surveyed by:	AL/AL/HL
UTM:	488028 5532370

Hydraulic type:	riffle/rapid
Mainstem/sidechannel (m/s,s/c):	m/s
Field gradient:	3.0 %
Stream width:	45.0 m
Channel width:	60.0 m
Mean depth:	0.40 m
Maximum depth:	0.60 m
Mean velocity:	0.37 m*s ⁻¹
Maximum velocity:	0.53 m*s ⁻¹

Turbidity:	Med
Temperature (°C @ time):	

Stream Stage:	Low
Conductivity:	- μS*cm ⁻¹

COVER:		
log:	25	%
boulder:	5	%
instream vegetation:	0	%
overstream vegetation:	20	%
cutbank:	5	%

SUBSTRATE:		
finer:	0	%
small gravel:	5	%
large gravel:	10	%
cobble:	80	%
boulder:	5	%
bedrock:	0	%

Compaction:	Med
Sand (% of area):	10 %
d90:	0.55 m
dMax:	0.70 m

Site length:	23.0 m
Site width:	3.5 m
Site area*:	80.5 m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



Kanaka Creek Juvenile Steelhead Survey, October 2001

DEPTH/VELOCITY TRANSECT DATA ANALYSIS SPREADSHEET
(CALCULATES W.U.A. & DISCHARGE)

Spreadsheet modified by Heather Lamson, Golder Associates Limited, from one provided by Ron Ptolemy.
This spreadsheet applies Ptolemy WUP HSI curves, February 12, 2001.

Golder Associates Limited

SITE 009 Cheakamus

Stream:	Cheakamus	
Date:	17/09/2007	
Mainstem/side-channel:	m/s	
Meter:	Digital Velocity Meter	
Metered at*:	40%	dfb
Transect width:	7.0	m
Site length:	23.0	m
Site width:	3.5	m
Site area**:	80.5	m ²
Discharge:	1.059	m ³ *s ⁻¹

UTM:	488028	5532370
Watershed code:	90009760012900	
Site number:	009	
Transect #:	1	
Hydraulic type:	riffle/rapid	
Width:Mean Depth Ratio:	21.04	
Transect type:	EF site	
Stream width:	60	m
Number of stations:	11	

NOTES: * dfb = depth from bottom.
** at unsymmetrical sites, area is calculated from field measurements, not as site length * site width.

SITE WEIGHTED MEANS

Mean Depth:	0.3	m
Mean Velocity:	0.5	m*s ⁻¹
Cross-sectional area :	2.3	m ²
Mean Probability (Fry):	19.4	%
Mean Probability (Parr):	58.2	%

ADJUSTED USABLE AREAS

Usable Width for Fry:	1.4	m
%Transect Usable by Fry	19.4	%
Usable Area for Fry	15.6	m ²
Usable Width Parr:	4.1	m
%Transect Usable by Parr	58.2	%
Usable Area for Parr	46.8	m ²

This spread sheet is designed for depth/velocity transect data collected within a closed electrofishing site.

DEPTH/ VELOCITY DATA FOR WEIGHTED USABLE AREA (WUA) CALCULATIONS

TRANSECT DATA		
Station (m)	Depth (m)	Velocity (m/s)
0.00	0.00	0.00
0.50	0.20	0.08
1.00	0.27	0.05
1.50	0.32	0.43
2.00	0.41	0.51
2.50	0.46	0.50
3.00	0.48	0.50
3.50	0.63	0.50
4.00	0.74	0.51
4.50	0.74	0.53
5.00	0.69	0.51

Cheakamus River Rainbow Trout Survey, September 2007
FISH CAPTURE SUMMARY FORM

Golder Associates Limited

SITE 009 Cheakamus

Stream:	Cheakamus
Site number:	009
Site length:	23.0 m
Site width:	3.5 m
Site area:	80.5 m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	1100	1128	600	J4	330
Pass 2	1145	1204	600	J4	332
Pass 3	1210	1223	700	J6	373

Species	Age	Pass 1	Pass 2	Pass 3	Total Fish	Mean Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Pop'n Estimate	Population Estimate SE
<i>O. mykiss</i>	0+	3	1	0	4	0.5	38.3	4	5.0	0.19	26	0.051	0.205
<i>O. mykiss</i>	1+	2	0	0	2	9.7	95.5	2	2.5			0.000	0
<i>Gasterosteus aculeatus</i>		0	0	1	1			1	1.2			2.020	2.027
<i>Salvelinus confluentus</i>		1	0	0	1	117.7	220.0	1	1.2			0.000	0

Cheakamus River Rainbow Trout Survey, September 2007

ELECTROFISHING SITE DESCRIPTION FORM

SITE 010 Cheakamus

Stream:	Cheakamus
Watershed code:	90009760012900

Site number:	010
Date:	20/09/2007
Surveyed by:	AL/AL/HL
UTM:	0487932 5532083

Hydraulic type:	run/rapid/pool
Mainstem/sidechannel (m/s,s/c):	m/s
Field gradient:	6.0 %
Stream width:	60.0 m
Channel width:	80.0 m
Mean depth:	0.60 m
Maximum depth:	1.60 m
Mean velocity:	0.20 m*s ⁻¹
Maximum velocity:	1.12 m*s ⁻¹

Turbidity:	Low
Temperature (°C @ time):	11 @ 1400

Stream Stage:	Low
Conductivity:	- μS*cm ⁻¹

COVER:		
log:	0	%
boulder:	100	%
instream vegetation:	0	%
overstream vegetation:	0	%
cutbank:	0	%

SUBSTRATE:		
finer:	2	%
small gravel:	1	%
large gravel:	1	%
cobble:	5	%
boulder:	91	%
bedrock:	0	%

Compaction:	Med
Sand (% of area):	0 %
d90:	1.65 m
dMax:	2.90 m

Site length:	14.0 m
Site width:	7.0 m
Site area*:	98.0 m ²

* At non-symmetrical sites, area is calculated from field measurements, not as site length * site width.



Kanaka Creek Juvenile Steelhead Survey, October 2001

**DEPTH/VELOCITY TRANSECT DATA ANALYSIS SPREADSHEET
(CALCULATES W.U.A. & DISCHARGE)**

Spreadsheet modified by Heather Lamson, Golder Associates Limited, from one provided by Ron Ptolemy.

This spreadsheet applies Ptolemy WUP HSI curves, February 12, 2001.

Aquatic Resources Limited

SITE 010 Cheakamus

Stream:	Cheakamus	
Date:	20/09/2007	
Mainstem/side-channel:	m/s	
Meter:	Digital Velocity Meter	
Metered at*:	40%	dfb
Transect width:	7.0	m

UTM:	487932	5532083
Watershed code:	90009760012900	
Site number:	010	
Transect #:	1	

Hydraulic type:	run/rapid/pool	
Width:Mean Depth Ratio:	30.65	

Site length:	14.0	m
Site width:	7.0	m
Site area**:	98.0	m ²
Discharge:	0.397	m ³ s ⁻¹

Transect type:	EF site	
Stream width:	80	m
Number of stations:	21	

NOTES: * dfb = depth from bottom.

** at unsymmetrical sites, area is calculated from field measurements, not as site length * site width.

SITE WEIGHTED MEANS

Mean Depth:	0.2	m
Mean Velocity:	0.2	m*s ⁻¹
Cross-sectional area :	1.6	m ²
Mean Probability (Fry):	27.8	%
Mean Probability (Parr):	35.8	%

ADJUSTED USABLE AREAS

Usable Width for Fry:	1.9	m
%Transect Usable by Fry	27.8	%
Usable Area for Fry	27.2	m ²
Usable Width Parr:	2.5	m
%Transect Usable by Parr	35.8	%
Usable Area for Parr	35.1	m ²

This spread sheet is designed for depth/velocity transect data collected within a closed electrofishing site.

DEPTH/ VELOCITY DATA FOR WEIGHTED USABLE AREA (WUA) CALCULATIONS

TRANSECT DATA		
Station (m)	Depth (m)	Velocity (m/s)
0.00	0.00	0.00
0.50	0.00	0.00
1.00	0.00	0.00
1.50	0.00	0.00
2.00	0.36	0.00
2.50	0.35	0.00
3.00	0.25	0.78
3.50	0.17	0.34
4.00	0.00	0.00
4.50	0.00	0.00
5.00	0.18	0.18
5.50	0.13	0.52
6.00	0.18	0.36
6.50	0.36	0.10
7.00	0.40	0.00
7.50	0.00	0.00
8.00	0.00	0.00
8.50	0.15	1.12
9.00	0.23	0.00
9.50	0.29	0.38
10.00	0.30	0.45

Cheakamus River Rainbow Trout Survey, September 2007
FISH CAPTURE SUMMARY FORM

Golder Associates Limited

SITE 010 Cheakamus

Stream:	Cheakamus	
Site number:	010	
Site length:	14.0	m
Site width:	7.0	m
Site area:	98.0	m ²

	Start:	Finish:	Volts:	Setting:	Seconds:
Pass 1	1345	1405	700	J5	499
Pass 2	1420	1441	700	J5	423
Pass 3	1453	1517	500-700	J5	404

Species	Age	Pass 1	Pass 2	Pass 3	Total Fish	Mean Weight (g)	Mn Length (mm)	Population Estimate	Fish/100m ²	Probability of Use	Adjusted Fish/100m ²	CV Pop'n Estimate	Population Estimate SE
<i>O. mykiss</i>	0+	0	0	0	0			0	0	0.28	0		
<i>O. mykiss</i>	1+	6	3	0	9	10.8	113.7	9	8.8			0.051	0.461
<i>O. mykiss</i>	2+	4	3	1	8	40.1	173.4	8	7.8			0.132	1.056
<i>O. mykiss</i>	3+	0	1	0	1	16.6	148.0	1	1.0			0.734	0.734