

Alouette Project Water Use Plan

Monitoring Program Terms of Reference

- **ALUMON#1 Smolt Enumeration**
- **ALUMON#2 Kokanee Out-migration**
- **ALUMON#3 Substrate Quality**
- **ALUMON#4 Sockeye Adult Enumeration**
- **ALUMON#5 Water Temperature**
- **ALUMON#6 Kokanee Age Class Structure**
- **ALUMON#7 Archaeological Monitoring**

October 15, 2009

Alouette Project Monitoring Program Terms of Reference

1.0 OVERVIEW

This document presents Terms of Reference for both the fisheries and archaeological monitoring programs recommended by the Alouette Water Use Plan Consultative Committee and required per the 20 October 2009 Water Act Order issued by the Comptroller of Water Rights (Table 1). These monitoring programs involve effectiveness monitoring to assess the response of the aquatic environment to licenced BC Hydro operations as well as monitoring to assess the effects of BCH operations on archaeological sites situated within the drawdown zone of the Alouette Lake Reservoir and a section of the South Alouette River.

Table 1. Alouette Fisheries and Archaeological Monitoring Plan Terms of Reference Submission Information

Name of Monitoring Program	Order Clause Fulfilled	Submitted with this Package	Previously Submitted To CWR	Submission Date	Leave to Commence
ALUMON#1 Smolt Enumeration	Section 16.a	Yes	No	20 Oct 2009	-
ALUMON#2 Kokanee Out-migration	Section 16.b	Yes	No	20 Oct 2009	-
ALUMON#3 Substrate Quality	Section 16.c	Yes	No	20 Oct 2009	-
ALUMON#4 Sockeye Adult Enumeration	Section 16.d	Yes	No	20 Oct 2009	-
ALUMON#5 Water Temperature	Section 16.e	Yes	No	20 Oct 2009	-
ALUMON#6 Kokanee Age Class Structure	Section 16.f	Yes	No	20 Oct 2009	-
ALUMON#7 Archaeological Monitoring	Section 16.g	Yes	No	20 Oct 2009	-

Fisheries Monitoring Program Terms of Reference

1.0 INTRODUCTION

As the Alouette Lake Water Use Plan (WUP) reached completion, a number of uncertainties were identified regarding the effect of BC Hydro operations on aquatic resources. The primary consequence of these uncertainties was a limited ability to predict the response of fish and wildlife populations to operational changes as a result of WUP implementation. This in turn highlighted the general uncertainty surrounding the likelihood that the expected fish and wildlife benefits of the WUP operation will be realised.

The framework for WUP process requires that it be reviewed on a periodic and ongoing basis. Therefore, in the years subsequent to the implementation the WUP, there will be a need for compliance monitoring and effectiveness monitoring to gain the information necessary to address these uncertainties. Compliance monitoring consists of monitoring activities to ensure that BC Hydro complies with the conditions of its water license. Effectiveness monitoring is more complex. It involves the observation, measurement, and evaluation of streamflows, fish and wildlife habitat, and population changes to test the efficacy of the WUP.

Effectiveness monitoring for the Alouette Lake system will require the collection of data in order to quantify relationships between specific fish population parameters and different aspects of BC Hydro operations. Monitoring will assess whether a predicted biological response to changes in operations actually occurred as predicted, and thereby assess whether the objectives of greater abundance and/or diversity were met.

2.0 OVERVIEW

At the conclusion of the Alouette Lake WUP Review process, the Consultative Committee (CC) recommended several key changes to the way Alouette Dam is operated. They are believed to have at least some impact to the ecology of resident fish species. The proposed changes are in addition to the operational changes made in 1996 as part of the original water license review process:

1. Spring surface release starting April 15 and ending June 14.
2. A higher reservoir elevation (122.5) during the peak recreation season starting June 15 and ending Labour Day (September 5).
3. Short recreation shoulder season ending Sep 15 when water levels are above 121.25m.
4. Removing the need for a prescribed flushing flow to clear fine sediments

When recommending these operational changes, the CC acknowledged that there was a need for additional fish related information that would add greater certainty to their decision making, but could not be collected at the time of the WUP review process or had to be monitored *in situ* to confirm their assumed consequences. In particular, the CC identified the following critical uncertainties:

1. Long term impact on Alouette River smolt output
2. Success of surface release in allowing kokanee to leave to reservoir and begin their seaward migration.
3. Long term impact on the transport of fine sediments in Alouette River.
4. Success of the kokanee re-anadromisation initiative, and hence an evaluation of the need for the surface release.
5. Water temperature impacts on the Alouette River.
6. Long term impact on the kokanee reproductive success.

In addition to the uncertainties above, the CC also recommended that an Alouette Monitoring Review Committee be created to oversee the general progress of the monitor, review all reports before general release, and recommend changes regarding the monitoring program's implementation as deemed necessary. Committee membership is to include representatives from BC Hydro, BC Ministry of Environment, Fisheries and Oceans Canada, Katzie First Nation, District of Maple Ridge, and Alouette River Management Society.

3.0 COST

The total cost of the 7 year monitoring program, including year 1 (2008) and a component of year 2 expenditures through July 2009, is estimated to be roughly \$1,316,879 (in 2006 dollars). When incorporating a future annual inflation rate of 2%, the anticipated cost of the program is expected to be closer to \$1,437,623. Average annual cost for the remaining 5 full implementation years is expected to be \$185,258 (in 2006 dollars), but will vary between \$172,107 and \$203,909 depending on the tasks to be completed or the equipment to be purchased.

ALUMON-1

Smolt Enumeration

1.0 PROGRAM RATIONALE

1.1 Background

Since 1998, smolt output from South Alouette River has been monitored to track changes in the river's smolt carrying capacity following implementation of a new base flow regime from Alouette Dam in 1996. Results of the program to date are summarised in Cope (2005), which to date seem to suggest that salmonid smolt production is nearing capacity in the system. The duration of the monitor however, is still considered too short to assure certainty in these results. Consequently, the CC has recommended that the monitor continue until the next WUP review period in 2014. In addition, the CC has recommended that the scope of the program be expanded to include tracking of out-migrating kokanee smolts released from the dam and the use of relative egg to smolt survival estimates as a diagnostic indicator of general substrate quality.

1.2 Management Questions

The FTC identified three management questions that are to be addressed through the smolt enumeration monitor:

1. Is the average base-flow release of $2.6 \text{ m}^3\text{s}^{-1}$ from the Alouette Dam (obtained by fully opening the low level outlet) adequate to sustain or improve current levels of salmonid smolt production downstream of the dam? The species of interest include chum, pink, chinook, and coho salmon as well as steelhead and cutthroat trout.
2. Following their migration out of Alouette Lake, do the kokanee smolts immediately continue their migration out of the Alouette River or do they delay their seaward migration for a period of time?
3. Using chum salmon counts at the Alco Park Hatchery as an indicator of run strength and the results of the substrate quality monitor, is there evidence of a persistent, declining trend in egg to smolt survival that would suggest a degrading condition in spawning substrate quality.

1.3 Summary of Hypotheses

The management questions identified in section 1.2 are to be addressed through tests of the following set of hypotheses. The first group of hypotheses pertain to Management Question 1 and are tested individually for each species:

H₀₁: Annual estimates of smolt abundance remain stable through time as indicated by a lack of a significant correlation between the two variables. (*To be tested separately for each species*)

If H₀₁ is rejected, the data will be analysed for possible correlations with river discharge (from the Water Survey of Canada gauging Station No. 08MH005), water temperature (from Monitor 5), substrate quality (from H₀₅ below and Monitor 3) and relative run strength (from Monitor 4) using multiple regression techniques (Zar 1974). Where data are available, this will lead to tests of the following four sub-hypotheses:

H_{01A} The partial regression coefficient (B_A) of average (or some other summary statistic) river discharge is equal to 0

H_{01B} The partial regression coefficient (B_B) of average (or some other summary statistic) water temperature is equal to 0

H_{01C} The partial regression coefficient (B_C) of average (or some other summary statistic) substrate quality is equal to 0

H_{01D} The partial regression coefficient (B_D) of relative spawner count is equal to 0

It should be noted that it will not be possible to test all sub-hypotheses for all salmonid species (e.g., relative spawner count data will only be available for chum salmon). Because this analysis is exploratory in nature, success will be partly dependent of the choice of statistic used to summarize the discharge, temperature and substrate quality independent variables. The underlying rationale behind the choice of summary statistic will have to be clearly described for the analysis to be meaningful.

If H₀₁ is not-rejected, then the following null hypothesis will be tested to determine whether there is sufficient between-year variance in annual smolt abundance to warrant further analysis;

H₀₂: The between-year variance in annual estimates of smolt abundance is equal to or less than the average within year-variance of each annual smolt abundance estimate (or some other threshold level that may be indicative of an unstable rearing environment and or a susceptibility to low seeding conditions).

If H₀₂ is not rejected, then no further action/analysis is required. However, if H₀₂ is rejected, then tests of sub-hypotheses H_{01A} to H_{01D} will be carried out as described above.

The next hypothesis pertains to the out migration of kokanee smolts and relates to a perceived ancillary benefit of a $6 \text{ m}^3\text{s}^{-1}$ post surface release flush to promote the movement of 'reluctant' migrants. It is believed that the flush could also help promote the

continued migration of kokanee smolts out of the Alouette system. There are two hypotheses to test:

H₀₃: Kokanee smolts, following their release from Alouette Lake, continue their migration out of the Alouette system without delay. i.e., the time difference in peak out-migration between the Mud Creek trap and 224th Bridge trap is less than a few weeks.

Rejection of H₀₃ would suggest that the kokanee smolts may reside in the river for a time before continuing on with their seaward migration, leading to the next hypothesis:

H₀₄: The time difference in peak out-migration between the Mud Creek trap and 216th Bridge trap is the same with or without the 6 m³s⁻¹ post surface release flush.

Rejection of H₀₄ would suggest that a 3 m³s⁻¹ base-flow is inadequate to ensure continued movement of the kokanee smolts, and that the experimental 6 m³s⁻¹ post surface release flush may have to become an integral part of the surface release operation.

The final null hypothesis relates to substrate quality and its potential to impact egg to fry survival. The intent of this monitor is to provide data to compliment the substrate quality monitor described in later in Monitor 3.

H₀₅: Relative egg to smolt survival of chum salmon, as determined from the annual smolt enumeration data and Alco Hatchery annual catch data (an indicator of run strength), is not correlated with fine sediment levels recorded in the substrate quality monitor.

Rejection of H₀₅ would suggest that there is a relationship between the substrate quality data and egg to smolt survival, from which threshold sediment levels can be derived as triggers for prescribed flushing flow events.

It should be noted that the hypotheses listed above are considered the minimum to be tested and that other hypotheses may become evident as the data is collected and analysed.

1.4 Key Water Use Decision

The smolt enumeration monitor is linked to three water use decisions. The first concerns the base-flow and whether it is adequate to sustain or increase smolt production levels. It is an effectiveness monitor tracking the changes in smolt output numbers to confirm expected benefits. In the future, the results of the monitor could be used to develop a case for a variable flow release regime at the dam where the LLO release is allowed to

vary according to water flow measurements taken downstream, and thus maintain some critical level rather than be kept fully open year-round.

The second water use decision impacted by the results of this monitor is the need to provide a week long $6 \text{ m}^3\text{s}^{-1}$ post surface release flush once the kokanee smolts have left the reservoir. Presently, the post surface release flush is experimental in nature (to occur every second year until monitoring results are conclusive), but if the monitor shows that it is necessary for continued seaward migration, it may have to be re-evaluated as an integral part of the WUP.

The egg to smolt survival data will be used to determine whether there exists a threshold sediment level in the system above which impacts reproductive success occur. If such a threshold is found, then it may be used to trigger prescribed sediment flushes (surface releases $32 \text{ m}^3\text{s}^{-1}$ or greater), which were abandoned during the WUP review process but may be reinstated depending on the outcome of this and the substrate quality monitor.

2.0 PROGRAM PROPOSAL

2.1 Approach

The general approach to the monitor is to continue with the smolt enumeration monitor first established in 1998 (Cope 2005), but with a few changes in methodology to reduce the instream hazard of the traps and streamline the enumeration procedure to reduce the crew size and hence overall cost the program. These include:

1. The use of single rotary screw trap at the 224th St bridge location instead of two traps and the use sandbags to deflect a greater proportion of the stream's discharge towards the trap. A 1.5m trap will be used until roughly April 15, after which a 1.8m trap will be installed.
2. Greater use of sub-sampling procedures to collect morphometric data on captured fish.
3. Increase reliance on past measurements of trap efficiency (in a Bayesian framework) to reduce frequency of measurement.

There are to be no changes in the location and use of the incline plane traps at the 224th St Bridge. The program duration, intensity of sampling effort, level of trap maintenance, and procedures to estimate trap efficiency are not to change from the protocols established prior to the WUP review process.

2.2 Objective and Scope

The objective of this monitor is to collect the data necessary to test the hypotheses listed in Section 1.3 and hence, address the management questions presented in Section 1.2. The following aspects define the scope of the study:

1. The study area will consist primarily of the riverine habitat located downstream of the Alouette Lake Dam, and will consist of two sites where fish traps will be installed and fished; two incline plane traps just upstream of the 224th St bridge, and a single rotary screw trap immediately upstream of the incline plane traps.
2. The monitor will be carried out annually until the next WUP review period in 2014
3. When possible, the traps will be fished continuously for the duration of the enumeration period starting the last week of February and ending the first week in June. A 1.5m rotary screw trap will be fished until approximately April 15, after which a 1.8m trap will be installed in its place (allowing the other trap to be used for another monitor)
4. The contractor will ensure the all traps are in proper working order for the duration of the program.
5. A data report, including a comprehensive executive summary and 15 min presentation, will be prepared annually summarising the data collected to date, as well as discuss inferences and present conclusions as they pertain to the impacts of the WUP over time.
6. A final report will be prepared at the end of the monitor that summarises the results of the entire monitoring program, discusses inferences that can be drawn from the data pertaining to the impacts of the WUP over time, and presents conclusions concerning the hypotheses and the management questions in Section 1.2.

2.3 Methods

2.3.1 Field Methods

Field methods will follow that described in Cope (2005) so that all collected data are consistent with those in prior years of monitoring (1998 to 2005). This includes the following elements:

1. Use of two incline plane traps located just upstream of the 224th St bridge. These are to be fished continuously from the last week of February until the end of the chum out-migration period (usually the first week of May)

2. Use of a single rotary screw (1.5m drum until April 15 and a 1.8 m drum afterwards) trap located just downstream of the 224th St bridge. Installation is to include the appropriate use of sand bags and screens to improve volume and direction of flow to the trap. It will be fished continuously from the last week of February to the first week of June which is typically the end of the smolt out-migration period.
3. The traps will be maintained and adjusted as required to ensure consistent trapping conditions through time.
4. Gear efficiency will be determined twice weekly for both fry (0+ fish < 70 mm FL) and smolts (fish > 70 mm FL that have over-wintered at least 1 year). Fry will be marked using Bismark Brown dye (1-2 hour immersion in 10 ppm solution) while smolts will be caudal fin clipped. Fry and smolts will be released at the 232 St bridge. If possible, the frequency of measurement will be reduced to once a week if it is determined that precision and accuracy will not be compromised by the action.
5. Captured fish will be sub-sampled for measurement of fork length (mm FL) and wet weight (g). Sub-sampling will be done daily to ensure an even distribution of effort through time. Intensity of sub-sampling will be at the discretion of the crew (e.g., at least a minimum of 10 individuals/day) but must be based on a standard sub-sampling protocol (e.g., every xth individual or be evenly distributed among the catch, etc.) and be consistent through time to minimise error.
6. All incidental catches from upstream studies will be noted, including the presence and type of marks.

Included in the monitor will be daily monitoring of water level at the 224th St. Bridge, as well as daily water temperature from TimbitsTM temperature data loggers at each trap location, and daily discharge from the Water Survey of Canada gauging station at the 232nd St. Bridge (Station No. 08MH005).

2.3.2 Safety Concerns

A safety plan will have to be developed for all aspects of the study in accordance to BCH procedures and guidelines. It is important to note that monitor must always be carried out by crews of at least two members, that appropriate safety equipment is available at the site, and that appropriate check-in and checkout procedures are followed.

2.3.3 Data Analysis

All data will be entered into a common database in a standard format for analysis. This will ensure that all data collected over the years of monitoring are compatible and can be analysed without transformation.

Data analysis will proceed as described by Cope (2005) to ensure consistency with the results in prior years. It is to include the following components:

1. Use of both pooled and stratified Peterson approaches to population estimation of each species (Ricker 1975, Schwarz and Taylor 1998), and hence trap efficiency,
2. Calculation of confidence intervals for all population estimates, and
3. Use of summary statistics and plots for all morphometric and physical data.

Hypothesis testing related to H_01 will involve the use of simple regression techniques to identify the direction and likelihood of a time trend. Appropriate transformations will be used to ensure that assumptions of normality, homoscedasticity, and linearity are met. Because variance estimates are available, bootstrapping methods should be used to account for this measure of error in the analysis (Manly1997).

If hypothesis H_01 is rejected, then multiple linear regression techniques will be used to identify possible correlates with annual smolt counts from among the physical data collected in this monitor. This analysis will be exploratory in nature, so care must be taken when developing statistics to summarise the temporal as dependent variables in the analysis. The choice of summary statistic should always be accompanied with a clearly stated biological rationale or hypothesis. It should be noted that the primary objective of the monitor is to identify significant correlates and the direction of the trends. It is not necessarily to develop a predictive model, though the end result of the analysis may lead to one. As above, data transformations will be used to ensure that assumptions of normality, homoscedasticity, and linearity are met.

Hypothesis H_02 will be tested using a simple coefficient of variance (CV) ratio F-test where the between-year CV for annual smolt abundance is compared to the average within-year CV of the smolt abundance estimate (Zar 1974). Rejection of H_02 will lead to the same multiple regression analysis described above should H_01 be rejected.

Both hypotheses H_03 and H_04 will be tested by comparing cumulative distributions of migrant counts past the trap over time. The comparisons will be mainly descriptive for H_03 , but may involve a simple t-test (or the non-parametric equivalent) for tests of H_04 that looks for significant treatment differences in the number of days that separate the 50 %-tile marks between upper and lower traps.

Chum relative egg to fry survival will be calculated each year by dividing annual fry estimates with the product of the number of chum females captured at the Alco Hatchery (Monitor 5) and average number of eggs per female (derived from bio-standards). The analysis will assume that the hatchery counts are proportional to the total run size, thus avoiding the need to extrapolate the count data to the whole river. Hypothesis H_05 will be

tested using simple correlation analysis with the annual substrate quality data collected in Monitor 3. The test will be carried out annually, but only after a minimum of three years of data have been collected. The test of H_05 will be most meaningful at the conclusion of the monitor when the greatest number of observations is available for testing.

It is important to note that the analyses described above are considered to be the minimum necessary, and that the nature of the data, as well as the results of studies outside the scope of this monitor, may lead to alternative or additional statistical procedures to test the hypotheses in Section 1.3 and ultimately address the management questions in section 1.2.

2.3.4 Reporting

Project reporting will consist of annual data reports and a comprehensive final report at the conclusion of the monitor. The annual data reports will summarise the year's findings and include a short discussion of how the year's data compare to that collected in previous years. It will include a brief description of methods, present the data collected that year, and report on the results of all analyses.

At the conclusion of the monitor, a final comprehensive report will be prepared from all of the annual reports written to date that:

1. Re-iterates the objective and scope of the monitor,
2. Presents the methods of data collection,
3. Describes the compiled data set and presents the results of all analyses, and
4. Discusses the consequences of these results as they pertain to the current WUP operation, and how it may or could factor into future decision making.

All reports will be submitted to regulatory agencies for review and comment prior to being finalised for general release.

2.4 Interpretation of Results

2.4.1 Smolt enumeration

For each species, rejection of H_01 would indicate that there may be indeed be a temporal trend in the long term smolt enumeration data. Analysis of the regression parameters and summary statistics, whether it be linear or non-linear, will provide the data necessary to determine whether the smolt population trend is positive (increasing through time) or negative (decreasing through time) and assess the rate of change through time. A positive trend would suggest that habitat conditions are continuing to

improve and/or the population is still hasn't reached a state of equilibrium. A negative trend would indicate that one or more constraints to population growth still persist in the system. An analysis of what are deemed to be key environmental factors (e.g., water level/habitat area, water temperature, substrate quality, and relative run strength) governing population size will help isolate the primary limiting factor(s). One of the key outcomes of the limiting factor analysis is a determination whether an observed declining trend is linked to Alouette Project operations.

Failure to reject H_01 would suggest the population has reached a relatively stable state given the range of prevailing environmental conditions. If the variance about the time-averaged smolt population size is small, then the measured population can be viewed as being indicative of the system's carrying capacity, that the habitat condition(s) which define this capacity is/are relatively stable through time, and that the population is fully seeded each year. If there is a large degree of variance, then one or more factors that define the rivers carrying capacity varies significantly and has an impact on smolt output (e.g., water level/habitat area, water temperature, substrate quality, and relative run strength). Regression analysis, both linear and non-linear, will help identify what those factors may be. A key outcome of the regression analysis will be a determination of whether fluctuations in annual smolt production are linked to operations of the Alouette Project.

If linkages to Alouette Project operations are found, whether it be to a persistent deterioration of downstream habitats, or to highly variable between-year habitat states which impact carrying capacity, they will form the basis for the development of alternative, and perhaps more sophisticated operating regimes for downstream releases to the South Alouette River during the next Water Use Plan Review Period. Evidence of a catastrophic trend in fish population may illicit a more immediate remedial response.

2.4.2 Kokanee out-migration – river residence time

Hypothesis H_03 is designed to test the general hypothesis that kokanee, once in the South Alouette River, immediately continue their seaward migration out of the river and onwards to the ocean via the Pitt and Fraser Rivers. Presently, that is believed to be the case, but it is uncertain whether a proportion of individuals fail to make the journey. Failure to reject H_03 would suggest that the majority of individuals do indeed continue their seaward migration. However, rejection of H_03 , would suggest that the base surficial release regime may not adequate to meet the kokanee's hydraulic needs. It is hoped that there would be sufficient inter-annual variability in release timing to be able to tease out ideal timing windows. Test of H_04 , would in turn help assess whether there is an adequate downstream flow to sustain the seaward movement (i.e., does a higher pulse flow trigger or sustain downstream movement in these fish?). Failure to reject H_03 and H_04 , despite inter-annual variability in flow conditions, would suggest that the proposed surface release regime is ineffective at promoting reliable out-migration responses in the Alouette kokanee population, or that the propensity of these fish to migrate seaward has

been lost since impoundment. Either way, this result would require a re-evaluation of the current approach to re-introducing sockeye salmon to the Alouette Lake system, including the need for an annual surficial release operation.

2.4.3 Relative egg to smolt survival of chum salmon

A key concern in the river is the quality of spawning substrate. During the WUP, it was accepted that naturally occurring flood events, along with the redd-building activity of the salmonids themselves, have created what are believed to be excellent spawning habitat conditions. However, there is some uncertainty as to whether this condition can persist through time with the new WUP. Though this issue is being evaluated directly in a separate monitor (Monitor 3), uncertainty in the methodology requires that an independent corroborative measure be used as well. Because at the Alco Hatchery brood-stock collection fence are already be collected through separate monitors, The CC recommended that the chum fry counts and the chum adult counts from Monitor 4 be combined to create a relative measure of egg-fry survival to track relative reproductive success during the egg incubation phase.

Rejection of H_0 would suggest incubation conditions are at least in part dependent substrate quality. If a drop in relative egg to fry survival over time corresponds with a drop in substrate quality as indicated in Monitor 3, then a strong case may be made that spawning conditions in the river are deteriorating and that remedial action may be required (possibly a prescribed flushing flow). Failure to reject H_0 , even if results of Monitor 4 seem to suggest deteriorating substrate conditions, would indicate that there is no causal relationship and that spawning conditions are still sufficiently high to sustain high relative egg to fry survival rates. No action would then be required

Care should be used when interpreting the relative egg to fry ratio data. It assumes that the catch of chum spawners at the Alco Hatchery fence is consistently proportional to the total number of spawners in the river when this may not always be the case. This may require independent verification in a separate study. Also problematic with the data is that egg to fry survival tends to drop when the number of spawners reaches and exceeds the capacity of the system due to the damaging effects of redd superimposition. Both of these issues need to be taken into account when using this data to corroborate the substrate quality monitoring results.

2.5 Schedule

The enumeration program will be carried out annually until the next WUP review period in 2014. Fry enumeration will begin in the last week in February, and continue until the end of the out-migration period (usually the 1st week of May). A data report and executive summary of the year's data will be due the 1st week of February the following year. The final report will be due just prior to the start of the next UP review process in 2014, though the precise due date will be set at BC Hydro's discretion.

2.6 Budget

The total cost of the 7-year smolt enumeration monitor, including February 2008 (year 1) through July 2009 (portion of year 2) expenditures of \$189,970, is estimated to be \$704,350 in 2006 dollars. Taking into account an average inflation rate of 2%, the total cost is expected to be closer to \$579,099 over the remaining 6-year period. The average annual cost of the monitor, not taking into account inflation, is expected to be \$100,617 per year.

2.7 References

Cope, S. 2005. Alouette River Salmonid Smolt Migration Enumeration: 2005 Data Report. *Prepared by Westlope Fisheries Ltd. for the Alouette Management Committee and BC Hydro Generation.* September 2005. 48 pp.+ App.

Manly, B.F.J. 1997. Randomization, Bootstrap and Monte Carlo methods in Biology. 2nd Ed. Chapman and Hall. New York, NY. 399 pp.

Zar, J.H. 1974. Biostatistical Analysis. Prentice-Hall, Inc. Englewood Cliffs, N.J. 620 pp.