Alouette Water Use Plan

Monitoring Programs

Annual Report: 2012

Implementation Period: May 2011 to April 2012

- 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 Structure Analysis
- ALUMON-7 Archaeological Monitoring

For Water Licences 124724, 124725, 124726

May 31, 2012
1 Introduction

This document represents a summary of the status and the results of the Alouette Project Water Use Plan (WUP) monitoring programs to April 30, 2012, as per the Alouette Project Order under the Water Act, dated April 20, 2009. There are seven monitoring programs:

a) ALUMON-1 Smolt Enumeration
b) ALUMON-2 Kokanee Out-migration
c) ALUMON-3 Substrate Quality
d) ALUMON-4 Sockeye Adult Enumeration
e) ALUMON-5 Water Temperature
f) ALUMON-6 Kokanee Age Structure Analysis
g) ALUMON-7 Archaeological Monitoring

2 Background

The water use planning process for BC Hydro’s Alouette storage/hydroelectric project was initiated in May 2005 and completed in May 2006. The conditions proposed in the WUP for the operation of the project reflect the August 2006 recommendations of the WUP Consultative Committee (CC).

In April 2006, as a component of the Alouette Water Use Plan, the draft TOR for the fisheries component of the Alouette WUP monitoring program was confirmed by the WUP fish technical committee (FTC) including Fisheries and Oceans Canada (DFO), Ministry of Environment (MOE), Katzie First Nation, City of Maple Ridge, BC Corrections (Alco Hatchery) and Alouette River Management Society.

On November 20, 2007 the Alouette WUP Monitor Committee including DFO, Ministry of Environment, Alouette River Management Committee, Katzie First Nation, City of Maple Ridge, and BC Corrections (Alco Hatchery) and local stewards met to confirm the draft TOR for the fisheries component of the Alouette WUP monitoring program with full endorsement provided based on minor revisions to the Sockeye Adult Enumeration and Smolt Enumeration TOR.

In January 2008 BC Hydro committed to the Alouette Monitoring Committee (AMC) that all recommended WUP monitoring programs including the Archaeology monitoring would be implemented in 2008 to ensure continued progress of the Alouette Sockeye Restoration Program which is contingent on three of the recommended WUP monitoring programs as well as to stay within the originally committed seven year review period through 2014.

In an attempt to facilitate the Comptroller of Water Rights (CWR) TOR review process, on January 22, 2008 BC Hydro forwarded the draft TOR for the fisheries
components of the Alouette WUP monitoring program to the CWR for consideration given impending Order issue and communicated CWR work load issues. BC Hydro acknowledged that no TOR leave to commence would be provided from the CWR until after the Alouette Order was issued.

The TOR for the WUP recommended Archaeology Monitoring was accepted by Katzie FN in January 2009 and the BC Archaeology Branch in November 2008.

In April 2009, BC Hydro submitted a revised Alouette WUP to the CWR.

On April 21, 2009, BC Hydro was ordered to implement the conditions proposed in the Alouette WUP and submit monitoring programs TOR as well as provide a summary of WUP monitoring work done to date.

Based on initial AMC TOR endorsement in November 2007, a further seven minor revisions to the fisheries component TOR including both budget increases and methodology changes were accepted by the AMC between September 2008 and September 2009.

On October 19, 2009 the Alouette WUP monitoring programs TOR were submitted to the CWR for review and approval.

On November 16, 2009, the CWR accepted the TOR for the Smolt Enumeration, Kokanee Out-migration, Substrate Quality, Sockeye Adult Enumeration, Water Temperature, Kokanee Age Structure Analysis, and Archaeological Monitoring.

On September 27, 2010, the Comptroller accepted the TOR addendums for the Smolt Enumeration and Kokanee Out-migration including revised implementation budgets accounting for cost increases related to fish trap safety upgrades and labour support.

The Order will be implemented until 2014, when BC Hydro will assess the results of the monitoring programs and merge the Stave and Alouette into a single Water Use Plan that better reflects the integrated nature of the Alouette, Stave Falls, and Ruskin hydroelectric power developments.
3 Status

The following table outlines the status and schedule for the Alouette WUP monitoring programs.

### Table 3-1: Status of Alouette WUP Monitoring Programs Implementation.

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<tr>
<td></td>
<td>WLR Yr1</td>
<td>WLR Yr2</td>
<td>WLR Yr3</td>
<td>WLR Yr4</td>
<td>WLR Yr5</td>
<td>WLR Yr6</td>
<td>WLR Yr7</td>
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<tr>
<td>Smolt Enumeration</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>U/W</td>
<td>■</td>
<td>■</td>
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<tr>
<td>Kokanee Outmigration</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>U/W</td>
<td>■</td>
<td>■</td>
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<tr>
<td>Substrate Quality</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>U/W</td>
<td>■</td>
<td>■</td>
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<td>Sockeye Adult Enumeration</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>U/W</td>
<td>■</td>
<td>■</td>
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<tr>
<td>Water Temperature</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>U/W</td>
<td>■</td>
<td>■</td>
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<tr>
<td>Kokanee Age Class Structure Analysis</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>U/W</td>
<td>■</td>
<td>■</td>
</tr>
<tr>
<td>Archaeological Monitoring</td>
<td>DEL²</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>U/W</td>
<td></td>
<td></td>
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</tbody>
</table>

Legend:  
- ■ = Project to be undertaken/initiated in identified year  
- U/W = Project is underway  
- DEL = Project is delayed for this year  
- ✔ = Project is complete for the year

Footnotes:  
1. Programs initiated prior to receipt of monitoring program leave to commence from CWR.  
2. Archaeological Monitoring delay until 2009 based on delayed TOR approval by Katzie First Nation and BC Archaeological Branch

4 Summary of Alouette WUP Monitoring Programs

This section provides a summary of the Alouette WUP monitoring programs as per the Order under the Water Act dated April 20, 2009. The following table summarizes the monitoring programs results according to the key monitoring indicators for each program.
### Table 4-1: Summary of Alouette WUP Fisheries Monitoring Program Results

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</thead>
<tbody>
<tr>
<td><strong>Smolt Enumeration</strong></td>
<td>(a) Coho Smolt Density (Production)</td>
<td>Not Studied</td>
<td>1,400 smolts/km²</td>
<td>Not Studied</td>
<td>Not Studied</td>
<td>1,473 (16,200)</td>
<td>931 (10,238)</td>
<td>1,818 (20,003)</td>
<td>1,253 (13,789)</td>
<td>1,100 (12,102)</td>
<td>1,759 (19,358)</td>
<td>1,534 (16,880)</td>
<td>1,183 (13,020)</td>
<td>1,399 (14,951)</td>
<td>276 (3,040)</td>
<td>592 (6,508)</td>
<td>3,651 (40,156)</td>
<td>1,808 (19,885)</td>
<td>1,749 (19,240)</td>
<td></td>
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<tr>
<td></td>
<td>(b) Steelhead Smolt Density (Production)</td>
<td>Not Studied</td>
<td>418 smolts/km²</td>
<td>Not Studied</td>
<td>Not Studied</td>
<td>Low Capture</td>
<td>164 (1,803)</td>
<td>308 (3,392)</td>
<td>343 (3,768)</td>
<td>215 (2,364)</td>
<td>305 (3,355)</td>
<td>227 (2,450)</td>
<td>564 (6,204)</td>
<td>563 (6,191)</td>
<td>1,375* (15,130)</td>
<td>462 (5,077)</td>
<td></td>
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<tr>
<td></td>
<td>(c) Chum Fry Production</td>
<td>Not Studied</td>
<td>15M³</td>
<td>Not Studied</td>
<td>Not Studied</td>
<td>8.3M</td>
<td>13.4M</td>
<td>6.8M</td>
<td>6.4M</td>
<td>14.7M</td>
<td>24.1M</td>
<td>12.8M</td>
<td>16.8M</td>
<td>30.3M</td>
<td>4.3M</td>
<td>15.6M</td>
<td>54.3M</td>
<td>10.1M</td>
<td>4.9 M</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>(d) Pink Fry Production</td>
<td>Not Studied</td>
<td>1M³</td>
<td>Not Studied</td>
<td>Not Studied</td>
<td>55K</td>
<td>N/A</td>
<td>190K</td>
<td>N/A</td>
<td>143.3K</td>
<td>N/A</td>
<td>1.25M</td>
<td>N/A</td>
<td>175.9K</td>
<td>N/A</td>
<td>279.2K</td>
<td>N/A</td>
<td>118,065</td>
<td>N/A</td>
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<tr>
<td><strong>Kokanee Outmigration</strong></td>
<td>Number of Outmigrating Kokanee Smolts</td>
<td>N/A</td>
<td>Not Studied</td>
<td>Not Studied</td>
<td>Not Studied</td>
<td>Not Studied</td>
<td>Not Studied</td>
<td>Not Studied</td>
<td>Not Studied</td>
<td>7,900</td>
<td>5,064</td>
<td>62,923</td>
<td>8,257</td>
<td>4,287</td>
<td>14,201</td>
<td>35,942</td>
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<tr>
<td><strong>Substrate Quality</strong></td>
<td>Substrate Quality (areal fraction of fine sand ≤ 2mm)</td>
<td>20%³</td>
<td>31</td>
<td>16</td>
<td>13</td>
<td>12</td>
<td>17</td>
<td>Not Studied</td>
<td>Not Studied</td>
<td>20</td>
<td>10</td>
<td>9</td>
<td>Not Studied</td>
<td>12</td>
<td>16</td>
<td>10</td>
<td>14</td>
<td></td>
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<tr>
<td><strong>Sockeye Adult Enumeration</strong></td>
<td>Number of Returning Adult Sockeye</td>
<td>N/A</td>
<td>Not Studied</td>
<td>Not Studied</td>
<td>Not Studied</td>
<td>Not Studied</td>
<td>Not Studied</td>
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<td>Not Studied</td>
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<td>Not Studied</td>
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<tr>
<td><strong>Water Temperature</strong></td>
<td>(a) Number of days with temperatures &gt; 25 (Degrees Celsius)³</td>
<td>N/A</td>
<td>Not Studied</td>
<td>Not Studied</td>
<td>Not Studied</td>
<td>Not Studied</td>
<td>Not Studied</td>
<td>Not Studied</td>
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<tr>
<td></td>
<td>(b) Number of days with daily average temperatures &gt; 16 (Degrees Celsius)³</td>
<td>N/A</td>
<td>Not Studied</td>
<td>Not Studied</td>
<td>Not Studied</td>
<td>Not Studied</td>
<td>Not Studied</td>
<td>Not Studied</td>
<td>Not Studied</td>
<td>28</td>
<td>61</td>
<td>Not Studied</td>
<td>92</td>
<td>71</td>
<td>67</td>
<td>89</td>
<td>41</td>
<td>77</td>
<td>72</td>
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<tr>
<td><strong>Kokanee Age Class Structure Analysis</strong></td>
<td>kokanee Fry Abundance</td>
<td>230,000 ³⁴</td>
<td>Not Studied</td>
<td>Not Studied</td>
<td>Not Studied</td>
<td>Not Studied</td>
<td>Not Studied</td>
<td>Not Studied</td>
<td>Not Studied</td>
<td>130,196</td>
<td>120,686</td>
<td>121,149</td>
<td>145,330</td>
<td>132,860</td>
<td>118,862</td>
<td>58,434</td>
<td>111,600</td>
<td>175,297</td>
<td>227,061</td>
<td>114,263</td>
<td></td>
</tr>
</tbody>
</table>
4.1 ALUMON-1 Smolt Enumeration

4.1.1 Management Questions

The key management questions addressed by this monitoring program are:

1) Is the average base-flow release of 2.6 m$^3$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?

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?

4.1.2 Overview

Monitoring Indicator (a) smolt production (coho, steelhead, pink, chum, chinook)

Monitoring Indicator (b) Kokanee smolt migration timing (Mud Creek trap downstream to 224th trap locations)

Monitoring Indicator (c) Chum egg to smolt survival

This monitoring program is comprised of several study components involving:

- Instream trapping of fry and smolt outmigrating from the Alouette River; and
- Observations of salmon adults returning to spawn

4.1.3 Status

This program commenced in 1998 as a component of the initial 1996 Alouette WUP commitments. As a result, it is in its fourteenth year of full implementation. The 2010 study program report$^1$, which is a summary of studies between 1998 and 2010, was submitted in March 2011. The 2011 study program report is complete in draft. The final report will be submitted with the 2013 Annual Report.

4.1.4 Interpretation of Data

The 2011 chum fry out-migrant estimate was 4.9 million smolts. This represents a modest increase in smolt yield of 14.3% for this cycle-year. The current cycle-year is recovering from the lowest recorded smolt yield (2007) that occurred following extremely high spawner escapements the previous year (ALCO fence count >150,000). Since 1998, chum smolt production has averaged 1,152,174 smolts/km or 60 smolts/m². These chum smolt yields are comparable to that expected from successful fish habitat restoration projects, and in some years, approaches the estimated production benefits expected from the creation of highly productive off-channel habitat.

The 2011 coho smolt out-migration estimate was 19,240 smolts. The 14-year average coho smolt yield was 17,075 smolts or between 1,237 – 1,915 smolts/km which is comparable to the average yield predicted for Pacific Northwest streams of similar latitude.

The 2011 steelhead smolt out-migration estimate was 5,077 smolts. Steelhead smolt yield upstream of the current RST location has averaged 5,824 smolts or alternatively, 422 smolts/km or 2.2 smolts/100m². Although steelhead smolt yields meet provincial bio standards, they are lower than other regional steelhead populations that are also being monitored using similar enumeration methodology.

The 2011 sockeye smolt out-migration estimate was 23,465 smolts. It is clear from the time difference of only a day or two in out-migration peaks or pulses between the two trapping locations that sockeye smolts, following their emigration from Alouette Lake, continue their migration out of the Alouette system without delay. Furthermore, the annual 6 m³/s flushing flow dam releases (2009-2011) did not “flush out” reluctant sockeye migrants residing within the South Alouette River.

In total, 2,029 chinook salmon fry were captured representing the highest annual capture to date. Based on the significant increase in chinook salmon out-migrants during the past two years, chinook salmon appear to be responding to stocking efforts (p=0.04). An estimated 15,489 wild chinook smolts exited the South Alouette River during trapping operations; however accurate chinook estimates are not possible due to the early end of trapping operations. Reliable chinook smolt estimates would require continued trapping to at least the end of June to document the majority of the out-migration distribution.

Moving the rotary screw trapping location upstream to the 224th St. location and incorporating flow deflection panels has been successful in restoring smolt catch success. Results since 2008 clearly demonstrate the declines in coho and steelhead smolt out-migration in 2006 and 2007, and perhaps, the more subtle declines since 2003, were not accurate but an artifact of trapping bias due to the increasing effect of tidal backwatering from the Pitt River at the 216th St. location. Continued trapping at the current location is recommended to document inter-annual variability in smolt yields.
4.2 ALUMON-2 Kokanee Outmigration

4.2.1 Management Questions

The key management questions addressed by this monitoring program are:

1) Is the surface release of at least 3 m$^3$s$^{-1}$ from the Alouette Dam (obtained through the spillway gate) adequate to promote the downstream migration of kokanee smolts out of the Alouette Reservoir?

2) Does a post-surface release flush of 6-9 m$^3$s$^{-1}$, lasting 7 days following the tail end of the out migration period, encourage more smolts to leave the system?

3) How long should the surface release last to ensure out migration of all smolts prepared to leave the system?

4.2.2 Overview

Monitoring Indicator (a) Number of outmigrating kokanee smolts.

This monitoring program involves instream trapping of smolts outmigrating from the system.

4.2.3 Status

Supporting program data was collected from 2005 through 2007 by the BC Hydro Bridge Coastal Restoration Program as a component of an Alouette sockeye restoration initiative to assess salmonid smolt passage response with spill releases in the order of 3 m$^3$s$^{-1}$ over the Alouette Dam. In 2006 the kokanee outmigration monitoring program was confirmed as a component of the Alouette WUP recommended monitoring program. As a result, it is in its seventh year of implementation. The 2010 study program (WUP monitor Year 3) report$^2$, which is a summary of studies between 2005 -2010, was submitted in April 2011. The 2011 study program report is complete in draft. The final report will be submitted with the 2013 Annual Report.

4.2.4 Interpretation of Data

The Mud Creek RST was again operated in 2011 for the duration of the kokanee migration from the Alouette Reservoir. A total of 8,525 migrants were captured and a pooled Peterson yielded a total estimate of 35,542 smolts for the duration of the migration period, April 15 to June 8. Spillway gate flows were maintained at similar levels as past years, ranging from 3.31-4.32 m$^3$/s until June 1, after which a seven-day post-surface release flush reached maximum flows of 6.21 m$^3$/s.

$^2$ Mathews, M., Bocking, B. 2011. Evaluation of the Migration Success of O. nerka (Kokanee/Sockeye) from the Alouette Reservoir, 2010. Prepared for BC Hydro, Burnaby, BC.
Biosampling conducted on the migrating kokanee smolts included length, weight, age and genetic sampling. The 2011 migrants were most abundant in the 71-75 mm length class and the average weight of all kokanee sampled was 4.5 grams.

For the third year in a row a post-surface release flush occurred at the end of the typical migration timing. During the 2009 flush the RST was unable to be monitored safely and consistently hence no conclusions were drawn regarding the impact of the flush. The 2010 flush monitoring proved successful and no increases in kokanee catch were observed during the flushing flows (only one unmarked kokanee was captured). The 2011 flush monitoring again proved to be feasible and although a total of 86 unmarked migrants were captured, catches were consistent for the tail end of the migration, hence no increases in kokanee catches were observed due to the flushing flows.

In addition to monitoring kokanee migrations, all other species captured were enumerated. This included monitoring Steelhead smolt captures of which there were a total of 350 at the Mud Creek RST in 2011.

4.3 ALUMON-3 Substrate Quality

4.3.1 Management Questions

The key management questions addressed by this monitoring program are:

1) Do the results of the Toe-Pebble count procedure reflect the general composition of bed materials within the channel downstream of the Alouette Dam?

2) Is the < 20% fines threshold adequate to distinguish a state in substrate quality that would require a prescribed flushing event?

3) Is an alternative methodology required to qualify/calibrate the results of the Toe-Pebble count procedure?

4) For each year of the monitor, is a prescribed flushing flow necessary given the current state of substrate quality?

4.3.2 Overview

The objective of this program is to assess Alouette River substrate quality considering underlying management questions to evaluate the general composition of bed material and to confirm the threshold of fine sediments less than 2 mm diameter to maintain productive salmonid habitat. Program findings will be evaluated to confirm the need for an Alouette Dam flushing flow.

Monitoring Indicator (a) Substrate Quality (areal fraction of fine sand < 2 mm)

This program will involve direct instream observations of substrate quality at index sites in the Alouette River.
4.3.3 Status

This program commenced in 1998 as a component of the initial 1996 Alouette WUP commitments. In 2006 the monitoring program was confirmed as a component of the Alouette WUP Consultative Committee recommended monitoring program. As a result, it is in its ninth year of full implementation. The 2010 study program report\(^3\), which is a summary of studies between 1998-2010, was submitted in March 2011. The 2011 study program report is complete in draft. The final report will be submitted with the 2013 Annual Report.

4.3.4 Interpretation of Data

The 2011 sampling showed an overall increase in fine particles less than 2 mm diameter of 4.0% since 2010. Regression analyses showed that the levels of fines in the river declined sharply during the 1995 high water event, and then have remained relatively stable since that time.

The 2011 sampling showed that the amount of gravel sized 16-128 mm diameter decreased overall (45-43%), with the largest decreases (34-29%) occurring in the middle sections. Upper sites decreased from 51-50%, while lower sections remained unchanged at 46%. Overall, riffle sites recorded a decrease in 6 of 10 sites, while run sites experienced a decrease in 6 of 11 sites.

Regressions of Wolman data show an increase in the percentage of gravels for all sites and sections following the 2000 Bridge Coastal Restoration Program gravel placement project at Mud Creek and Alouette Dam.

Analyses of stream flow for the period 1995 to 2011 show that the largest effects on substrate composition were produced by the high flow events of November / December 1995 and October 2003. Although it is likely that the event of March 2007 produced similar results, the lack of sampling data for 2006 and 2007 means that these impacts were not documented.

Although the substrate condition is an important indicator of overall habitat performance, there is no conclusive correlation in the data between substrate condition and chum fry abundance.

4.4 ALUMON-4 Sockeye Adult Enumeration

4.4.1 Management Questions

The key management question addressed by this monitoring program is:

1) Are the Alouette Lake kokanee smolts successfully adapting to an anadromous existence by returning from the ocean environment to spawn in Alouette Lake?

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\(^3\) Davies, R., 2011 South Alouette River Substrate Monitoring 2010 Data Report. Prepared for BC Hydro, Burnaby, BC.
4.4.2 Overview

Supporting objectives of the main study management question include:
1) confirmation that the adult sockeye returns are members of the ‘Alouette stock’ and not strays from other nearby coastal systems, 2) confirmation of the adult sockeye return run timing to allow streamlining of enumeration efforts, and 3) confirmation that ocean survival rates of returning re-anadromised kokanee comparable to that of sockeye stocks found elsewhere.

Monitoring Indicator (a) Number of returning adult sockeye

This program will involve enumeration of adult sockeye captures at the Alco Hatchery fish collection facility.

4.4.3 Status

This program was supported in 2007 by the BC Hydro Bridge Coastal Restoration Program as a sockeye restoration initiative. The monitoring program was further confirmed as a component of the Alouette WUP Consultative Committee recommended monitoring program in 2006. As a result, it is in its fifth year of implementation with the 2010 third year WUP recommended study program report\(^4\) submitted in March 2011. The 2011 study program report is complete in draft. The final report will be submitted with the 2013 Annual Report.

4.4.4 Interpretation of Data

The 2011 Alouette sockeye salmon run saw 11 adults returning between July 16 and August 19, 2011. Four sockeye were caught at the Alco Fish Hatchery and seven caught at the trap at the base of the dam. Eight sockeye were released in the Alouette Reservoir (Lake). Fork length measurements and scale samples were collected for 10 sockeye and tissue samples from seven of the 11 returning sockeye. The measurements indicated an average fork length of 60.4 cm.

Of the seven sockeye samples, only six were useable for aging and 50% of those were four year old sockeye with two years in a marine environment. The genetic sampling identified all out-migrating smolts and 10 returning spawners were Alouette stock. Between the smolt migration years of 2005-2008, the smolt-to-spawner survival of the Alouette sockeye has ranged from a low of 0.084% for the 2005 smolt year to a high of 1.356% for the 2008 smolt year.

4.5 ALUMON-5 Water Temperature

4.5.1 Management Questions

The key management questions addressed by this monitoring program are:

1) How often are water temperatures \(\geq 25^\circ\text{C}\), the incipient lethal temperature of most stream rearing salmonid species, including the duration of each event and the frequency of occurrence?

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2) Is the duration of observed warm water events less than one day, thus limiting exposure to warm waters and therefore thermal stress impacts?

3) Are warm temperature events restricted to certain sections of river, indicating the inflow of cooler waters into system (most likely ground water)?

4) Is the duration and frequency of warm water events such that it would promote a shift in fish community structure and/or reduce summer survival and growth of rearing juvenile salmonids, as indicated by a change in salmonid smolt numbers?

5) Given the extent of thermal stratification in the reservoir and the location of the LLO, is there an operational change that can be implemented to mitigate the occurrence of warm water events.

4.5.2 Overview

The objective of this monitoring program is assess if high summer water temperatures in Alouette River downstream of Alouette Dam approach incipient lethal limits of rearing salmonids that would impact survival and growth during the summer critical rearing period. A supporting objective includes whether a general increase in stream temperatures shifts fish community structure from a cold-water, primarily salmonid system to a warm-water primarily cyprinid system.

Monitoring Indicators (a) Number of days with temperatures > 25°C

Monitoring Indicators (b) Number of days with daily average temperatures > 16°C

The monitoring program is comprised of continuous temperatures loggers situated in the Alouette Dam forebay as well as four Alouette River downstream locations.

4.5.3 Status

This program commenced in 2001 as a component of the initial 1996 Alouette WUP commitments. The Year 3 WUP recommended program report submitted in April 2011 summarizes the temperature data collected since the beginning of the WUP monitoring program (October 2008) and also summarizes the available data collected earlier through 2001. The 2011 study program report is complete in draft. The final report will be submitted with the 2013 Annual Report.

4.5.4 Interpretation of Results

Water temperatures in the plunge pool just downstream of the Alouette Dam generally ranged from a low of about 4°C in December and January and generally increased from February with peak temperatures observed in late August and early September. Water temperatures did not reach lethal levels for salmonids. Water temperatures reached a high of 19°C to 22°C from 2000 through 2010 while temperatures in 2011 did not surpass 18°C. Weekly mean water temperatures were

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highest at the beginning of September when they approached 17°C at the Plunge Pool site.

The upper lethal temperatures for juvenile salmonids in the range of 25°C has not been approached at any of the Alouette Dam forebay or down river monitoring sites since initiation of monitoring. Daily mean water temperatures at the Plunge Pool were lower through the summer.

The highest water temperatures were observed in late August and early September in the Alouette River in 2011. Of the salmonid species present, these temperatures potentially impact summer rearing coho and steelhead as well as resident trout species. Adult sockeye returning in July may also encounter water temperatures above their optimum range.

For coho, the daily maximum water temperatures approached the upper sustained temperature range for juveniles in August 2011. Lethal temperatures were not approached. For sockeye adults, the optimum temperature range was surpassed in the beginning of July during the anticipated migration period but the upper sustained or avoidance temperature was not approached. Water temperatures are within the optimum range for adult sockeye near the beginning of the migration which is important to ensure river entry or migration is not delayed. Temperatures for juvenile sockeye during outmigration were below or within the optimum range. Steelhead are within the optimum temperature range for adult migration and incubation. Water temperatures were within or below the optimum range for juveniles surpassed in 2011.

4.6 ALUMON-6 Kokanee Age Class Structure Analysis

4.6.1 Management Questions

The key management questions addressed by this monitoring program are:

1) Is the existing kokanee population in the Alouette Lake reservoir recruitment limited?

2) If there is evidence of a recruitment constraint to productivity, can it be linked to reservoir operations, in particular the extent of reservoir fluctuation during the spawning and incubation period (deemed to be mid-October to the end of February)?

3) If found linked to reservoir operation, what is the nature of the relationship and can it guide the development of possible mitigative reservoir operations?

4.6.2 Overview

The objective of this monitoring program is to determine if there is any correlation between the extent of Alouette Reservoir fluctuation during the spawning and incubation period and reduced juvenile kokanee recruitment caused by habitat dewatering.
Monitoring Indicator (a) Total kokanee fry production.

This monitoring program is comprised of several study components involving both hydro acoustic assessments and gill netting in Alouette Reservoir:

4.6.3 Status

This program was initiated in fall 2008 as part of the 2006 Alouette WUP recommendations. Year 1 field components were completed in fall 2008 with a final report submitted in April 2010. The fall 2009 and 2010 field components were completed as scheduled in fall 2009 with a 2-year study report submitted in April 2011 and will be submitted with the 2012 Annual Report.

The flexible reporting period for this study is related to BC Ministry of Environment (MOE) study delivery and reliance on hydroacoustic data collected via BC Hydro’s non-WUP, Alouette Reservoir Fertilization program. The 2011 study program report is complete. The final report will be submitted with the 2012 Annual Report.

4.6.4 Interpretation of Data

A model based approach was used to assess whether the kokanee population was recruitment limited and whether reservoir fluctuations during the spawning and incubation period affected subsequent fry and adult abundance. The study utilized a size-at-age model of the kokanee collected from gillnet data from 2000-2011 to determine if the population’s size-at-age is stable or decreasing with optimized reservoir productivity. In addition, a kokanee stock-recruitment model was developed from hydroacoustic data collected from 2002-2011 to assess if reservoir fluctuations affected fry abundance and whether any drops in fry abundance persisted to affect the numbers of older age classes.

A stock recruitment relationship on Alouette Lake Reservoir was developed to assess the effect of reservoir fluctuations on fry abundance to address management questions 2 and 3. Analysis using the stock recruitment relationships from hydroacoustic data for ALR kokanee indicate that density dependent factors likely regulate the population abundance of both age-0 and age-1 fish. The Beverton-Holt stock recruitment model estimated a peak recruitment of ~140,000 fry (0+) while a fully density dependent linear model estimated the carrying capacity of one year old kokanee (1+) to be > 36,000 individuals. Further assessment of the survival between age-0 and age-1 fish ranged from 14.7-80.2% with a mean survival of 29.8%. Highest rate of survival (~80%) was evident in the 2007-2008 year, when densities of age-0 fish were the lowest in the system or approximately half of the usual value due to the high emigration of kokanee through the dam spillway. As a result, the residual kokanee population displayed some compensatory increase in survival within the reservoir in the 2007-2008 years. Further years of data will improve the support for model selection and the underlying mechanisms regulating the kokanee population on ALR while providing information in addressing management questions.

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7 Recruitment is generally defined as the number of new juvenile fish reaching a size where they can be sampled.
4.7 ALUMON-7 Archaeological Assessment

4.7.1 Management Questions

The key management questions addressed by this monitoring program are:

1) Where are the archaeological sites in the reservoir;

2) What are the relative heritage values of identified sites;

3) What is the nature and extent of the impacts to archaeological sites that are caused by reservoir operations;

4) Are there archaeological resources that are impacted by river flows; and

4.7.2 Overview

The objective of this monitoring program is to address a knowledge gap regarding the number, location, elevation, condition, susceptibility to erosion and relative importance of archaeological sites within the Alouette reservoir and Alouette River study area.

Monitoring Indicator (a) N/A

This monitoring program is comprised of several study components involving field survey of the Alouette Reservoir drawdown zone and Alouette River as well as an archival literature review.

4.7.3 Status

This proposed one-year program was initiated in April 2009 as part of the 2006 Alouette WUP recommendations. The 2009 field components are complete with Alouette Reservoir drawdown and Alouette River surveys complete. The program study report was finalized in fall 2010.

Based on the short duration of the 2009 Alouette Reservoir drawdown zone exposure further field reconnaissance was recommended in the associated program report. To ensure adequate consideration of the study management questions the continuation of field studies in 2011 was approved. The phase 2 field program was completed within the approved budget and the phase 2 program report is complete. The 2011 study report is complete. The final report will be submitted with the 2012 Annual Report.

4.7.4 Interpretation of Data

In order to protect sensitive information regarding the archaeological sites identified, examined or visited during the study, this section has been removed for viewing on the website.

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For further information concerning this study or the report, please contact Water Licence Requirements.

5  Alouette Project WUP Monitoring Programs Costs

The following table summarizes the Alouette Project WUP monitoring programs costs approved by the Comptroller and the actual costs to April 30, 2012.
<table>
<thead>
<tr>
<th>Monitoring Programs</th>
<th>Activity</th>
<th>Costs approved by CWR</th>
<th>Total Forecast (Life to Date Actuals and Forecast)</th>
<th>Variance Total to Approved</th>
<th>Explanation</th>
<th>Corrective Action</th>
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<tbody>
<tr>
<td>Alouette Annual Report</td>
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<td>$3,100</td>
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OR - Ordered Remissible
ONR - Ordered Non-Remissible

* Red values in parentheses denote overage.