Coquitlam-Buntzen Water Use Plan

Monitoring Programs and Physical Works
Annual Report: 2007

- Assessment Of Fisheries Access To Streams
- Coquitlam Dam Flow Release Ramping Interim Rate Development
- Lower Coquitlam River Habitat Requirements Study
- Assessment Of Pink Salmon Passage In Lower Coquitlam River
- Coquitlam River Periphyton And Benthic Invertebrate Monitoring
- Lower Coquitlam River Temperature Monitoring
- Lower Coquitlam Fish Productivity Index
- Lower Coquitlam River Substrate Quality Assessment
- Modification Of Coquitlam Dam Release Facilities

For Water Licences 119709, 119710 and 119711

30 April 2007
1.0 Introduction

This document represents a summary of the Coquitlam-Buntzen Water Use Plan (WUP) monitoring programs and physical works to March 2006, as per the Coquitlam-Buntzen Order under the Water Act, dated 21 April 2005 and the amendment dated 8 March 2006. All monitoring programs and physical works scheduled to March 2007 were initiated according to plan.

2.0 Background

The water use planning process for BC Hydro’s Coquitlam-Buntzen storage/hydroelectric project was initiated in September 2000 and completed in March 2003. The conditions proposed in the WUP for the operation of the project reflect the March 2003 recommendations of the WUP Consultative Committee (CC).

In May 2004, the Coquitlam-Buntzen WUP was submitted to the CWR.

On 21 April 2005, BC Hydro was ordered to implement the conditions proposed in the Coquitlam-Buntzen WUP and prepare monitoring programs and physical works terms of reference (TOR).

On 24 October 2005 the Coquitlam-Buntzen WUP monitoring programs and physical works TOR were submitted to the CWR for review and approval.

On 2 December 2005, the CWR accepted the TOR for the physical works, Coquitlam Flow Release Valve.

On 3 January 2006, the CWR accepted the TOR for all monitoring programs except the Lower Coquitlam River Habitat Suitability Criteria Development and Lower Coquitlam River Fish Productivity Indices programs. Revisions were made to the two TOR and submitted on 8 February 2006, and on 8 March 2006 the CWR accepted the Lower Coquitlam River Fish Productivity Indices monitoring program and rescinded the Lower Coquitlam River Habitat Suitability Criteria Development monitoring program from the Order.

On 10 January 2007, the Coquitlam-Buntzen TOR package was revised to account for:

- The proposed delay in the installation of the Coquitlam Dam Release Facility and the associated change of date of the instream flow release regime;

- The proposed extension of study programs resulting from the extension of the Water Use Plan review period;
• Changes to the Lower Coquitlam River Habitat Requirements Study
   (formerly submitted as the Lower Coquitlam River Habitat Suitability
   Criteria Development)

The revised TOR was accepted by the CWR on 1 February 2007.

The Order will be implemented until 2016, when BC Hydro will assess the results
of the monitoring programs. As detailed in the Coquitlam-Buntzen WUP CC
Report (2003), a review may be triggered sooner where warranted.

3.0 Status

The following table outlines the status and schedule for the Coquitlam-Buntzen
WUP monitoring programs and physical works.

Table 4.1-1: Status of Coquitlam-Buntzen WUP Monitoring Programs and Physical
Works Implementation. Note that per the 1 February 2007 approval, the
2016 monitoring program will be implemented subject to 2015 review.

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<td>Assessment of Pink Salmon Passage in Lower</td>
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<td>Recruitment Analysis</td>
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<td>Coquitlam Flow Release Valve</td>
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Legend:  ○ = Project timing subject to change according to maintenance schedule
         ■ = 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. The study scope and schedule changed as a result of the terms of reference approved 1 February 2007
2. Due to the flow regime change occurring 1 September 2007 and the potential operations issues that may arise from this program, it was agreed that the study be delayed by 1 year.
3. As per the approval 1 February 2007, the installation of the release valve was delayed due to existing dam seismic upgrade repairs.
4.0 Summary of Coquitlam-Buntzen WUP Monitoring Programs

This section outlines the status of the Coquitlam-Buntzen WUP monitoring programs as per the Order under the Water Act dated 21 April 2005 and the revisions to the monitoring program approved 1 February 2007. The following table summarizes the monitoring programs results according to the key monitoring indicators for each program approved by the Monitoring Committee.
## Table 4.1-2: Summary of Coquitlam-Buntzen WUP Monitoring Program Results

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<td>Pre WLR</td>
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<td>WLR Yr1</td>
<td>WLR Yr2</td>
<td>WLR Yr3</td>
<td>WLR Yr4</td>
<td>WLR Yr5</td>
<td>WLR Yr6</td>
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<td>WLR Yr8</td>
<td>WLR Yr9</td>
<td>WLR Yr10</td>
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<td>Assessment of Fisheries Access to Streams Tributary to Coquitlam Reservoir</td>
<td>Barrier Identified?</td>
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<td>Coquitlam Dam Flow Release Interim Ramping Rate Monitoring</td>
<td>(a) Number of Rampdowns studied</td>
<td>N/A</td>
<td>Not studied</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>2 ((^1))</td>
<td>2</td>
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<td>(b) Average number of stranded fish observed</td>
<td>N/A</td>
<td>Not studied</td>
<td>6</td>
<td>15</td>
<td>13</td>
<td>0 ((^3))</td>
<td>3</td>
<td>14</td>
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<tr>
<td>Lower Coquitlam River Fish Habitat Requirements Study</td>
<td>(a) Deviation from assumed habitat preference</td>
<td>0</td>
<td>Not studied</td>
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<td>(b) Deviation from recommended flow release</td>
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<td>Assessment of Pink Salmon Passage in Lower Coquitlam River</td>
<td>Number of Days of Impeded Access</td>
<td>0</td>
<td>Not studied</td>
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<tr>
<td>Coquitlam River Periphyton and Benthic Invertebrate Monitoring</td>
<td>(a) Benthos Abundance (animals/m(^2))</td>
<td>&gt;20,000</td>
<td>Not studied</td>
<td>Not studied</td>
<td>Not studied</td>
<td>75,000</td>
<td>27,000</td>
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<td>55,000</td>
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<td>(b) Index of Biologic Integrity (IBI)</td>
<td>20</td>
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<td>6.6</td>
<td>13.8</td>
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<td>Lower Coquitlam River Temperature Monitoring</td>
<td>(a) Temperature Deviation from natural</td>
<td>0</td>
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<td>Not studied</td>
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<td>(b) Degree of operational influence</td>
<td>N/A</td>
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<td>Not studied</td>
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<tr>
<td>Lower Coquitlam River Fish Productivity Index</td>
<td>(a) Coho Smolt Density (production)</td>
<td>7</td>
<td>7.8 (19378)</td>
<td>5.1 (12581)</td>
<td>7.7 (19017)</td>
<td>5.6 (14138)</td>
<td>6.0 (14901)</td>
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<td>(b) Steelhead Smolt Density (production)</td>
<td>2.0</td>
<td>2.7 (6671)</td>
<td>2.0 (4891)</td>
<td>2.8 (6999)</td>
<td>3.0 (7621)</td>
<td>3.0 (7366)</td>
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<td>(c) Chum Fry Survival (^7)</td>
<td>9%</td>
<td>5.9%</td>
<td>3.3%</td>
<td>2.5%</td>
<td>9.7%</td>
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<td>(d) Pink Fry Survival (^7)</td>
<td>13%</td>
<td>10%</td>
<td>4.20%</td>
<td>35.0%</td>
<td>24.0%</td>
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<tr>
<td>Lower Coquitlam River Substrate Quality Assessment</td>
<td>Substrate Quality (areal fraction of fine sand)</td>
<td>10%</td>
<td>4.20%</td>
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1. Salmonid Enhancement Program biostandards for Lower Fraser River natural egg-fry survival of chum and pink salmon - March 1997
3. Estimate of coho production based on stream alkalinity (Ptolemy 1992)
6. Emergency flood control operation in January 2006 resulted in scheduled ramping rates being exceeded and stranding observed.
7. Revised adult enumeration analyses have resulted in retrospective changes to historic egg-fry survival results. See Decker et. al. in draft for context.
4.1 **Assessment of Fisheries Access to Streams Tributary to Coquitlam Reservoir**

4.1.1 **Overview**

The objective of this monitoring program is to identify fish use and/or fish habitat potential in each of the three streams identified with potential fish access issues and to recommend physical works and/or operational constraints to restore fish access for all operations.

Monitoring Indicator (a): Barrier to fish passage identified (yes/no)

The program is comprised of a field reconnaissance, fish sampling and habitat prescription and is to be completed over a one-year period.

4.1.2 **Status**

This program was initiated in July 2006. To date two of three fish sampling and habitat surveys have been completed according to schedule. The final survey will occur in May 2007, and a final program report is expected in July 2007.

4.1.3 **Interpretation of Data**

At this time there is no data to interpret for this monitoring program. Fisheries access and, where necessary, mitigation options, will be assessed according to field reconnaissance data to be collected.

4.2 **Coquitlam Dam Flow Release Interim Ramping Rate Monitoring**

4.2.1 **Overview**

The objective of this monitoring program is to report on the fish stranding impacts in the lower Coquitlam River associated with the implementation of the interim ramping rate protocol for the Coquitlam Dam.

Monitoring Indicator (a): Stranding risk (number of fish stranded per area of dewatered habitat measured).

This program will involve the annual assessment of fish stranding following pre-spill operations at Coquitlam Dam. Up to 5 assessments per year will be funded.

4.2.2 **Status**

Assessment of stranding risk associated with ramping rate operations was initiated in 2003 at the conclusion of the Coquitlam-Buntzen WUP, with the objective of refining a ramping-rate schedule prior to the start of the monitoring program.
ramping rate schedule was drafted into the monitoring terms of reference\(^1\) for implementation and monitoring over the review period.

The first program report\(^2\) was submitted in August 2006, which summarized the findings of three (3) rampdown assessments conducted between June 2005 and January 2006. The 2007 summary report is expected 1 June 2007.

### 4.2.3 Interpretation of Data

The current ramping rate schedule was developed based on fish stranding assessments compiled over several versions of Coquitlam Dam flow release operations. The results summarized in the 2006 study report indicate the ramping rate schedule recommended in the WUP is effective at reducing stranding, although additional information regarding stranding impacts during sensitive life history period such as juvenile salmon outmigration must be investigated before instituting final recommendations for this operation. It is anticipated that all stranding information will be evaluated at the end of the Coquitlam-Buntzen WUP review period.

### 4.3 Lower Coquitlam River Fish Habitat Requirements Study

#### 4.3.1 Overview

The objective of this study is to identify any changes to the habitat suitability criteria used in the Coquitlam-Buntzen Water Use Plan calculations of weighted useable area of habitat, and refine the habitat-flow relationships and flow release targets developed in the WUP.

Monitoring Indicator (a): Habitat suitability for species of interest

Monitoring Indicator (b): Flow target (Coquitlam Dam releases) for LB1 WUP

This program will involve direct instream observations of fish habitat use in the lower Coquitlam River for spawning and rearing salmon and steelhead species.

#### 4.3.2 Status

This monitoring program will be initiated in September-October 2007 to observe habitat requirements for chum. Two other components: steelhead spawning and juvenile rearing will be conducted in early spring and late summer respectively. The first program report is expected in December 15\(^{th}\) 2008.

\(^1\) BC Hydro, 2006. Coquitlam-Buntzen Water Use Plan monitoring program terms of reference. Prepared for the BC Hydro Water License Requirements Program, Burnaby, BC.

4.3.3 Interpretation of Data

To date there is no data to interpret for this monitoring program. Previous studies on habitat use in the Coquitlam River were not sufficient to quantify habitat preference for fish species and life histories of interest.

4.4 Assessment of Pink Salmon Passage in Lower Coquitlam River

4.4.1 Overview

The objective of this monitoring program is to monitor the migration of returning pink salmon in odd years to determine if there are any flow-related partial or complete migration barriers in the Lower Coquitlam River corridor.

Monitoring Indicator (a): Number of days of unimpeded access

This program will involve direct stream-side observations at potential barriers during pink salmon migration and documenting passage issues.

4.4.2 Status

This monitoring program will be initiated in August 2007 according to the migration timing of pink salmon in the Coquitlam River. The first program report is expected in November 2008.

4.4.3 Interpretation of Data

To date there is no data to interpret for this monitoring program. Passage issues that are documented during the review period, will be assessed at the conclusion of the review period.

4.5 Coquitlam River Periphyton and Benthic Invertebrate Monitoring

4.5.1 Overview

The objective of this monitoring program is to develop a predictive model for evaluating periphyton and invertebrate benefits associated with Lower Coquitlam River flow alternatives.

Monitoring Indicators (short term) (a): seasonal results of benthos monitoring (e.g. number of invertebrates/m², Index of Biologic Integrity [IBI]);
Monitoring Indicators (long term) (b): modeled results of benthos abundance and diversity indicators.

The monitoring program is comprised of several seasonal sampling periods, where environmental variables (e.g. temperature) will be monitored to determine their influence on invertebrate and periphyton production.
4.5.2 Status

This program was initiated in 2003 and repeated in 2004 as part of a commitment to the Coquitlam-Buntzen WUP Consultative Committee to undertake monitoring at the conclusion of the WUP process. The third trial in this program resumed May 2006, and a final report\(^3\) was submitted 11 December 2006. The three trials completed so far fulfills the Treatment 1 phase of our plan as outlined in the study program terms of reference.

The next phase of the trials will resume after Treatment 2 of the WUP review period is initiated September 2007. It is anticipated the first trial of Treatment 2 will be spring 2008, and the final report for that trial will be submitted February 28\(^{th}\) 2009 per the study program terms of reference.

4.5.3 Interpretation of Results

Previous sampling results in 2003 and 2004 have concluded that several factors affect the production of key indicators of primary production, including water depth and velocity, suspended solids and distance from sources of impact. A preliminary model for the prediction of invertebrate production has been developed and will be revised after each successive field trial.

The results from the 2006 report are summarized with previous results in Table 4.1-2. As scheduled, the parametric model of benthic response to the flow treatments will not be fully developed until all trials are completed in 2010. Preliminary results indicate that benthos production exceeds levels for comparable watersheds in spite of a sub-standard biologic integrity rating.

4.6 Lower Coquitlam River Temperature Monitoring

4.6.1 Overview

The objective of this monitoring program is to identify if and how temperature in the lower Coquitlam River is influenced by reservoir operations.

Monitoring Indicator (a): Deviation of temperature regime from natural examples;
Monitoring Indicator (b): Correlation between temperature and reservoir operations.

This program will include the direct monitoring of stream and reservoir temperatures in the Coquitlam Watershed, as well as the analysis of local watersheds of similar characteristics to determine the level of impact due to operations.

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4.6.2 Status

The monitoring program was initiated in 2006, and a draft data report\(^4\) was submitted 31 March 2007. A final report will be forwarded to the Comptroller upon completion expected 15 May 2007. Year 2 of the monitoring program is already underway, with a final report expected 31 January 2008.

4.6.3 Interpretation of Results

The monitoring program specifies that all data analysis and interpretation will be conducted at the conclusion of year 3 data collection. The draft data report recommends minor changes to the study terms of reference (comparative analysis with Pitt River and Cultus Lake sites are to be replaced with Chehalis and Chilliwach Lake sites) that do not affect the budget or timing of this study.

4.7 Lower Coquitlam River Fish Productivity Index

4.7.1 Overview

The objective of this monitoring program is to determine the fisheries benefits of two test flows and to enable a better understanding of trade-offs between fisheries, domestic water and power generation for the benefit of future water planning processes.

Monitoring Indicator (a): Smolt per spawner (stock productivity) for coho salmon and steelhead;
Monitoring Indicator (b): Fry per spawner for chum and pink salmon (fry survival).

Note: Prior to the recruitment analysis for the base flow regime being conducted in 2007, monitoring indicators are limited to smolt productivity (fish per unit area).

This monitoring program is comprised of several study components involving the direct observation of salmon fry, smolts and adults in the Lower Coquitlam River:

- Electroshocking of rearing fry and parr in several sites;
- Instream trapping of fry and smolt outmigrating from the system; and
- Observations of salmon adults returning to spawn

4.7.2 Status

This program was started in 2000 and enhanced in 2003 as part of a commitment to the Coquitlam-Buntzen WUP Consultative Committee to undertake monitoring at the conclusion of the WUP process. As a result, it is in its fifth year of full

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implementation. The 2006 study program draft report\(^5\), which is a summary of studies between 2000-2006, was submitted on 26 March 2007. A final report will be forwarded to the Comptroller upon completion expected 15 May 2007. The 2006/2007 study program final report is expected to be completed 31 December 2007.

4.7.3 Interpretation of Data

Results of this monitoring program will be compared between flow regimes pre- and post-2007. The 2006 draft report provides a retrospective analysis of productivity under Treatment 1, as summarized in Table 4.1.

The 2000-2006 results generally indicate that the Coquitlam River is meeting provincial biostandards for fish production:

- Steelhead smolt densities have ranged between 2.1-3.4 smolts/100m\(^2\), which exceeds the provincial biostandard of 2.0 smolts/100m\(^2\);

- Steelhead egg to fry survival is 4.0% on average, comparing to a long-term average on Keogh River of 6.5%;

- Coho densities have ranged between 5.1-7.8 smolts/100m\(^2\) which is less than reported densities in other Pacific Northwest streams (where off-channel habitats dominate production): it is believed that low spawning success is to blame for this low number, given spawning habitat is likely fully seeded each year; and

- Chum and pink salmon returns have increased dramatically 2002-2006 (the years in which returns and outmigration have been monitored), with egg to fry survivals comparable to ranges reported in literature.

These results will be considered further in the 2006/2007 field program which will be the final analysis before Treatment 2 is implemented September 2007.

4.8 Lower Coquitlam River Substrate Quality Assessment

4.8.1 Overview

The objective of this monitoring program is to evaluate the effectiveness of the flushing flow provisions outlined in the Coquitlam-Buntzen WUP to increase fish productivity through improved substrate quality in the Lower Coquitlam River.

Monitoring Indicator (a): Substrate quality (areal fraction of fine sand)

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Three seasonal surveys will be conducted on an annual basis where substrate sites are repeatedly sampled and analysed for surface area grain size distribution. Surface analysis will be calibrated with bulk sieve samples to ensure sampling is indicative of substrate quality. An assessment of linkages between substrate quality and fish productivity will be provided at the end of the review period.

4.8.2 Status

A preliminary survey in 2003 was conducted to evaluate best practices for substrate sampling, which then formed the basis of the recommended monitoring program. The first program report was drafted December 2006; a final report is expected 15 May 2007. Year 2 sampling is underway with a final report expected 15 December 2007.

4.8.3 Interpretation of Data

To date, substrate quality has been assessed at several critical locations in the river representing spawning and rearing habitats. The fine sand fraction assessed at each location will be integrated with known fish response representative for those areas to determine if substrate quality is a limiting factor affecting productivity. It is anticipated that a strong correlation between substrate quality and productivity will not be available until several years of quantitative assessments have been completed.

The secondary objective of assessing flushing flow effectiveness will also require several years of information before thresholds of flushing flows are understood and recommendations for implementation can be provided.

The highest (i.e. the "worst") substrate quality assessment rating is summarized in Table 4-1; it would appear based on comparisons in 2000, 2003 and 2006 that substrate quality is improving. However, future assessments will determine if this trend is linked to operations or not. In the 2006 draft report, recommendations to modify the methods to be used to correlate surface substrate quality with sub-surface substrate quality have been accepted by the contract monitor which will not affect the scope, schedule or cost of the program.
5.0 Summary of Coquitlam-Buntzen WUP Physical Works

The following section outlines the status of the Coquitlam-Buntzen WUP physical works as per the Coquitlam Order under the Water Act, dated 21 April 2005 and the revisions to the monitoring program approved 1 February 2007.

5.1 Coquitlam Flow Release Valve

5.1.1 Overview

The replacement of the existing low level outlet gate is required to facilitate the releases to the Coquitlam River ordered by the Comptroller of Water Rights recommended in the Coquitlam-Buntzen WUP. This valve will have 12 m$^3$/s capacity to provide monthly fish flow releases from 1 September 2007 to 1 September 2016.

5.1.2 Status

The new gate assembly is expected to be installed by August 2007. A final as-built report is expected in early 2008.

6.0 Coquitlam - Buntzen WUP Monitoring Programs and Physical Works Costs

The following table summarizes the Coquitlam - Buntzen WUP monitoring programs and physical works costs approved by the Comptroller on 2 December 2005, 3 January 2006, 8 March 2006 and 1 February 2007 and the Actual Costs to 31 March 2007.
Table 5.1-1: Coquitlam - Buntzen WUP Monitoring Programs and Physical Works Costs

<table>
<thead>
<tr>
<th>Description</th>
<th>Costs Approved by Comptroller of Water Rights</th>
<th>Actual Costs to 31 March 2007</th>
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</thead>
<tbody>
<tr>
<td><strong>Monitoring Programs</strong></td>
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<tr>
<td>MON #1 – Assessment of Fisheries Access to Streams</td>
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