



# Aberfeldie Redevelopment Project Water Use Plan

*Revised for Acceptance  
by the Comptroller of  
Water Rights*

**6 November 2006**

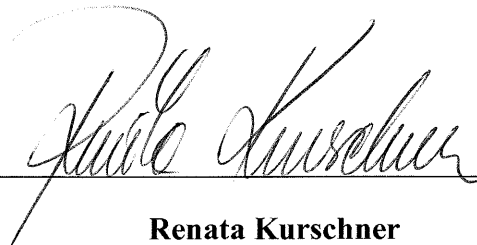


# **Aberfeldie Redevelopment Project Water Use Plan**

**Updated for Acceptance by the Comptroller of Water Rights**

# **Aberfeldie Redevelopment Project Water Use Plan**

**Revised for Acceptance by the Comptroller of Water Rights**



---

**Renata Kurschner**

**Manager, System Operations**

## **Preface**

The water use planning process for BC Hydro's Aberfeldie Project was initiated in May 2002 and concluded in April 2003. The recommendations were specific to the existing project completed in 1922 and rebuilt in 1953. The recommendations from this planning process, however, were held in abeyance until the Aberfeldie Redevelopment Project plan could be reviewed.

The Consultative Committee and the Fisheries Technical Committee from the original WUP process were reconvened to review the Aberfeldie Redevelopment Project as part of the project approval process. Operational requirements, works, and monitoring requirements in the updated Water Use Plan reflect the consensus recommendations of the aforementioned groups.

BC Hydro thanks all those who participated in the process that led to the production of this Water Use Plan. The proposed conditions for the operation of BC Hydro's facilities will not come into effect until implemented under the *Water Act*

## Table of Contents

<b>1.0</b>	<b>INTRODUCTION .....</b>	<b>1</b>
<b>2.0</b>	<b>DESCRIPTION OF WORKS.....</b>	<b>1</b>
2.1	Location .....	1
2.2	Existing Works .....	3
2.3	Redevelopment Works.....	3
<b>3.0</b>	<b>HYDROLOGY OF THE BULL RIVER BASIN.....</b>	<b>4</b>
<b>4.0</b>	<b>OPERATING CONDITIONS FOR FACILITY .....</b>	<b>4</b>
4.1	Role of Facility in Provincial System.....	4
4.2	Water Use at Aberfeldie Facility .....	5
4.3	Emergencies and Dam Safety .....	5
4.4	Conditions for the Operation of Works for Diversion and Use of Water.....	5
4.4.1	<i>Aberfeldie Dam and Headpond .....</i>	<i>5</i>
4.4.2	<i>Aberfeldie Dam: Minimum Flows Between the Dam and Powerhouse.....</i>	<i>6</i>
4.4.3	<i>Aberfeldie Generating Station Ramping Rates.....</i>	<i>6</i>
4.4.4	<i>Aberfeldie Redevelopment Project: Forced Outage Management .....</i>	<i>7</i>
4.4.5	<i>Fish and Benthic Habitat Works.....</i>	<i>7</i>
<b>5.0</b>	<b>PROGRAMS FOR ADDITIONAL INFORMATION.....</b>	<b>7</b>
<b>6.0</b>	<b>IMPLEMENTATION OF RECOMMENDATIONS.....</b>	<b>9</b>
<b>7.0</b>	<b>EXPECTED WATER MANAGEMENT IMPLICATIONS .....</b>	<b>10</b>
7.1	Other Licensed Uses of Water.....	10
7.2	Riparian Rights .....	10
7.3	Fisheries.....	10
7.4	Wildlife and Wildlife Habitat .....	10
7.5	Flood Control.....	10
7.6	Recreation .....	11
7.7	Water Quality.....	11
7.8	Industrial Use of Water.....	11
<b>8.0</b>	<b>RECORDS AND REPORTS .....</b>	<b>11</b>
8.1	Compliance Reporting.....	11
8.2	Non-compliance Reporting.....	11
8.3	Monitoring Program Reporting .....	11

**9.0 PLAN REVIEW ..... 11**

**10.0 NOTIFICATION PROCEDURES..... 12**

**11.0 References ..... 12**

**List of Figures**

Figure 2-1: Location of the Aberfeldie Project..... 2

## 1.0 INTRODUCTION

The operating conditions proposed in this plan reflect the recommendations of the Aberfeldie Redevelopment Project Consultative Committee and Fisheries Technical Committee, and are intended to satisfy federal and provincial regulatory requirements for the Aberfeldie Redevelopment Project. The basis for the proposed terms and conditions to be authorized under the *Water Act* for the beneficial use of water at the Aberfeldie hydroelectric project are set out in this document. Future reference to the Aberfeldie Redevelopment Project encompasses all works including, the existing Aberfeldie Dam and headpond, the redeveloped Aberfeldie powerhouse (generating station), and associated works for flow management.

The proposed conditions establish a minimum flow regime for the section of the Bull River between the dam and powerhouse, establishes limits on ramping rates downstream from the generation station, and provides measures to mitigate against sudden flow changes downstream from the generation station associated with forced outages. The proposed conditions also provide for fish and benthic habitat compensation projects.

A monitoring program and review period are proposed to study key uncertainties, validate operational recommendations, and enhance future operating decisions. Refer to the Environmental Impact Assessment of the Aberfeldie Redevelopment Project, Revision 4, dated April 2006 for details.

## 2.0 DESCRIPTION OF WORKS

### 2.1 Location

The Aberfeldie Redevelopment Project will be located in the Regional District of East Kootenay on the Bull River in southeastern British Columbia, approximately 30 km east of Cranbrook on the same footprint as the current project. The facilities associated with the Aberfeldie Redevelopment Project are easily accessible via a secondary road off Highway 3. A map showing the location and general layout of the project is provided in Figure 2.1.

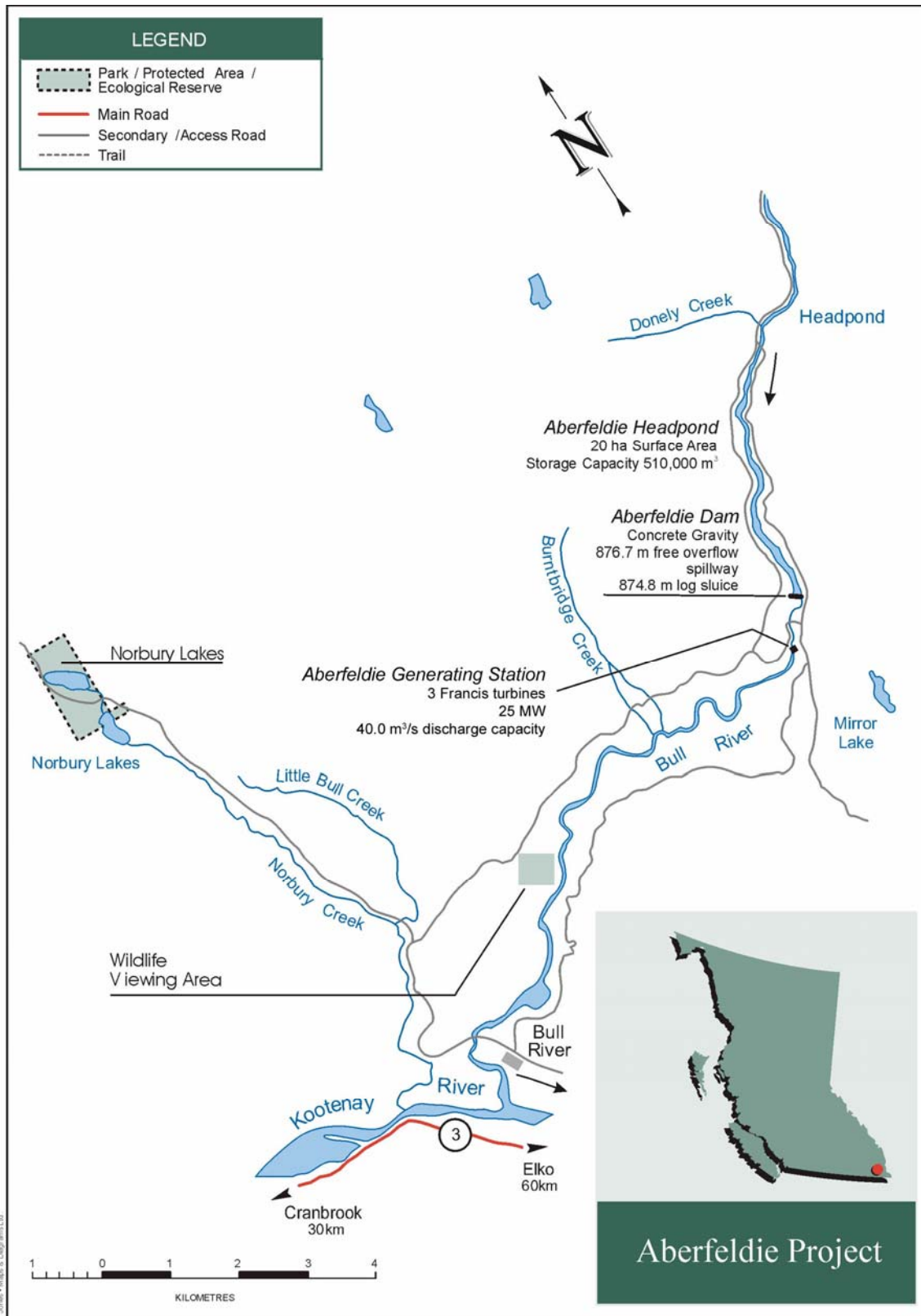


Figure 2-1: Location of the Aberfeldie Project

## 2.2 Existing Works

The existing Aberfeldie Project is an in-basin diversion consisting of the Aberfeldie Dam and headpond, a wood stave pipeline, surge tank and steel penstock leading to a concrete powerhouse (generating station). The Aberfeldie Dam is located approximately 10 kilometres (km) upstream of the confluence of the Bull and Kootenay Rivers.

The existing generating station is located approximately 1.2 km downstream of the dam and consists of two generating units with a total output capacity of 5 MW and a maximum discharge of 9.9 m<sup>3</sup>/s. Water from the generating station is discharged back into the Bull River, which flows into the Kootenay River system and then into Lake Koocanusa.

Under the Aberfeldie Redevelopment Project, the existing dam will remain in place, with some minor improvements to the existing water intake.

## 2.3 Redevelopment Works

The physical structures comprising the Aberfeldie Redevelopment Project will include the following:

**Aberfeldie Dam:** The Aberfeldie Dam is a concrete dam with crest length of 136 metres (m) and a maximum height of 32 m. The elevation at the top of the dam is El. 880.9 m above sea level<sup>1</sup>.

The dam has a free overflow spillway, which has a length of 59.7 m and a maximum discharge capacity of 923 m<sup>3</sup>/s. The elevation of the spillway is El. 876.67 m.

The log sluice is no longer used to move woody debris past the dam. It is now used every two to three years to lower the headpond level (by removing ‘stoplogs’) for headpond inspection and maintenance. The length of the log sluice is 4.3 m with an elevation of El. 874.8 m.

**Aberfeldie Headpond:** The Aberfeldie headpond has an area of 20 hectares (ha) and a storage capacity of 510 000 m<sup>3</sup>. The average drawdown of the headpond is approximately 0.5 m under normal operating conditions.

**Pipeline Surge Tower and Penstock:** A power intake located near the right side of the dam feeds into a 1 km long buried plastic pipeline located on a bench above the Bull River. This new pipeline is on the same alignment as the existing woodstave pipeline. The pipeline transitions to a 125 m-long steel penstock leading from the bench down to the generating station. A steel surge tower is situated at the transition between the pipeline and penstock.

---

<sup>1</sup> Datum relative to Geological Survey of Canada (GSC)

**Generating Station:** The generating station contains three horizontal 8.3 MW Francis turbines (~25 MW). The combined discharge capacity of the units is 40 m<sup>3</sup>/s. The Redevelopment generating station is situated immediately downstream from the existing generating station location.

**Flow Bypass Valve:** A flow bypass valve, capable of passing up to 20 m<sup>3</sup>/s situated at the generating station;

**Fish Water Release Valve:** A release structure capable of passing up to 2.0 m<sup>3</sup>/s installed off the pipeline immediately downstream from the dam.

### 3.0 HYDROLOGY OF THE BULL RIVER BASIN

The Bull River Basin is located on the western slopes of the Rocky Mountains in the Southeast Interior region of British Columbia. Rising in the southern part of the Park Ranges and descending a total of approximately 750 m, the Bull River flows approximately 80 km to meet the Kootenay River near the upper end of Lake Kootenay. The drainage area above the Aberfeldie Dam covers approximately 1530 km<sup>2</sup> with elevations varying from roughly 1200 m to 2500 m. The basin is generally wooded, vegetative cover thinning above 1500 m, with several areas of permanent snowpack. Steep side slopes characterize the river valley with short tributary streams entering nearly at right angles to the river.

The Bull River area experiences moderate snowpacks in the winter, with heavy, short-duration rainfall May through June. Accordingly, the Bull River discharge begins to rise each year in April and usually peaks in late May or early June. Periods of high flow are typically attributed to a combination of snowmelt and short duration, high intensity rainfall. The mean annual Bull River inflow is 33 m<sup>3</sup>/s, with a maximum recorded instantaneous flow of 428 m<sup>3</sup>/s and a maximum recorded mean daily flow of 388 m<sup>3</sup>/s.

## 4.0 OPERATING CONDITIONS FOR FACILITY

### 4.1 Role of Facility in Provincial System

The existing Aberfeldie generating facility is part of BC Hydro's integrated generation system which is described in "*Making the Connection*" published by BC Hydro in April 2000.

The average annual generation of the existing Aberfeldie Project is 32 GWh/yr. The average annual generation of the Aberfeldie Redevelopment Project will be approximately 105 GWh/year, enough energy to service about 10,500 homes.

## 4.2 Water Use at Aberfeldie Facility

The Aberfeldie Redevelopment Project is a run-of-river facility so energy production varies as a function of river flows throughout the year. The headpond is small and has little storage capability due in part to a significant build-up of silt. As a result, water will typically spill for 2 – 4 months of the year between April and July.

During low inflow periods (August to March), inflows are typically less than the turbine design capacity and nearly all of the inflow will be diverted to the generating station. During this time the headpond level is kept relatively constant. Low inflow operation of the generating units is controlled using an automatic control system that reads the level of the headpond. When the headpond drops to El. 876.4 m, the generating units tied to the auto-control system will gradually lower its output until the headpond level stabilizes. Output is increased if the headpond level reaches the spillway level. Any changes in headpond level are primarily caused by fluctuations in inflow (rainfall and snowmelt runoff) and generation.

The normal non-freshet headpond operating level is close to El. 876.67 m, which is the level of the crest of the overflow spillway. During spring freshet, the headpond generally rises to a maximum level between El. 878.0 m and 879.0 m.

## 4.3 Emergencies and Dam Safety

Emergencies and dam safety requirements shall take precedence over the constraints outlined in this Water Use Plan. Emergencies include actual and potential loss of power to customers. Dam safety requirements for operations are outlined in “*Aberfeldie Dam: Operation, Maintenance and Surveillance Manual for Dam Safety (OMSABF)*” issued by BC Hydro’s Director of Dam Safety.

## 4.4 Conditions for the Operation of Works for Diversion and Use of Water

The conditions outlined in this section are proposed for the operations of the Aberfeldie Redevelopment hydroelectric project. It is recognized that BC Hydro may not be able to operate within these constraints in the event of an emergency, dam safety requirement, or an extreme hydrological event.

### 4.4.1 Aberfeldie Dam and Headpond

When not spilling, normal headpond levels will be maintained between 876.15 m and 876.67 m, the free crest spillway elevation. This operation range is intended to limit the time required to surcharge, initiate spill, and restore flows downstream of the generation station in the event of a plant outage. This measure is in addition to the operation of the fish water release valve and bypass valve.

#### 4.4.2 Aberfeldie Dam: Minimum Flows Between the Dam and Powerhouse

Minimum instream flows shall be provided to the natural channel immediately downstream of the Aberfeldie dam to maintain fish habitat and pool connectivity. The minimum flows must be delivered to the following schedule:

- a) 0.5 cubic metres per second (1 April to 31 May);
- b) 2.0 cubic metres per second (1 June to 30 September)
- c) 0.5 cubic metres per second (1 October to 30 November); and
- d) 0.25 cubic metres per second (1 December to 31 March).

The 2.0 m<sup>3</sup>/s flow between June 1 and September 30, in combination with the fish and benthic habitat works (Section 4.4.5), is hypothesized to provide benthic productive capacity in excess of that required to compensate for annual losses not mitigated by minimum flows. It is further hypothesized that a lesser flow, such as 0.5 m<sup>3</sup>/s, in combination with fish and benthic habitat works, may still provide the required compensatory productive capacity benefits. Effectiveness monitoring studies summarized in the Environmental Impact Assessment of the Aberfeldie Redevelopment Project, Revision 4 (Cope 2006), have been proposed to test this hypothesis.

#### 4.4.3 Aberfeldie Generating Station Ramping Rates

Ramp rates are implemented to reduce the impact of fish stranding associated with sudden flow decreases downstream of the generation station. Total downstream discharge is the sum of any spill discharge, discharge from the fish water release valve, discharge from the bypass valve, and generation station discharge. The ability to control downstream flow changes, however, is associated with the bypass valve and discharge from the generation station.

For planned discharge changes, the combined discharge from the bypass valve and the generating station must be:

- i. ramped down at a maximum rate of 10 m<sup>3</sup>/s/hr when combined discharge is greater than 20 m<sup>3</sup>/s; or
- ii. ramped down to 0 m<sup>3</sup>/s or some greater amount, over a minimum of 2 hours when combined discharge is equal to or less than 20 m<sup>3</sup>/s.

To ensure that these rates are achieved smoothly over each hour, generation and bypass valve reduction must be done in step intervals of 30 minutes or less.

The aforementioned ramp rates do not apply to normal changes in generation discharge associated with simply passing variation in natural inflows. It is also recommended that the ramp rates do not apply when the combined discharge of the bypass valve and generation station is less than 20% of the total downstream flow. At these levels, changes to the combined bypass valve and generation flow are not expected to significantly affect downstream stage.

BC Hydro may periodically backflush the intake trashracks during spill events by rapidly, and briefly, shutting down the generating units and causing a pulse to flow back up the penstock. BC Hydro may also periodically test flow release devices such as the bypass valve, the fish water release valve, and the log sluice. The short duration of these events and negligible downstream impacts, precludes the implementation of ramping rates.

#### **4.4.4 Aberfeldie Redevelopment Project: Forced Outage Management**

A bypass valve will be incorporated in the Aberfeldie Redevelopment Project to manage downstream flows in the event of a forced outage. The bypass valve, located immediately adjacent to the generation station, will be used to divert water in a timely manner to the channel following a forced outage. During the outage and until such time generation is restored, the bypass valve will be operated in such a manner to minimize downstream flow reductions measured immediately downstream of the generation station.

It is recommended that the bypass valve, upon a forced outage, release flows sufficient to provide 80% or more of the generation discharge observed immediately prior to the outage event up to a maximum of 20 m<sup>3</sup>/s. The remaining portion of the disrupted generation flow will be routed by surcharging the reservoir and subsequently spilling down the natural channel until such time that generation is restored or the downstream flow is managed in whole or in part by free spill at the dam. Note that reductions of the bypass valve during such operations remain subject to the ramp rate constraints in 4.4.3.

#### **4.4.5 Fish and Benthic Habitat Works**

In compensation for lost habitat associated with the Aberfeldie Redevelopment Project, 3000 m<sup>2</sup> of fish habitat works and 3000 m<sup>2</sup> of benthic habitat works is recommended to be provided. As benthic habitat and fisheries habitat may not be mutually exclusive, it is also recommended that the works may be achieved in whole or in part with each other.

In lieu of 3000 m<sup>2</sup> of works for fish and benthic habitat, it is also recommended that a lesser amount could be provided in so far that it provides the same or more productive capacity associated with the 3000 m<sup>2</sup> of instream habitat lost due to the Aberfeldie Redevelopment Project.

## **5.0 PROGRAMS FOR ADDITIONAL INFORMATION**

The operating recommendations of the project application process are contingent on the implementation of effectiveness monitoring programs to substantiate the recommendations and hypothesized benefits. Upon direction from the Comptroller of Water Rights, BC Hydro will undertake a monitoring program that will:

- a) provide two years of primary and secondary productivity monitoring to establish baseline conditions prior to project completion of the Aberfeldie Redevelopment Project;
- b) provide two years of primary and secondary productivity monitoring commencing upon completion of the Aberfeldie Redevelopment Project;
- c) an effectiveness monitoring program to assess the fish and benthic habitat works;
- d) an effectiveness monitoring program to determine changes in habitat associated with the instream flow provisions between the dam and the generating station; and
- e) an effectiveness monitoring program to assess the winter flow provisions between the dam and the generating station.

The main elements of the monitoring program<sup>1</sup> are described in detail in section 5.0 of the Environmental Impact Assessment and summarized below. Estimated annual costs for these studies and associated tasks are summarized in the Aberfeldie Re-Development Project – Revising the Water Use Plan (WUP) Consultative Committee Meeting #1, Final Meeting Notes, dated January 26, 2005.

- a) Primary productivity (periphyton) and secondary productivity (benthic invertebrates) would be monitored within the diversion reach between the dam and the powerhouse for two years prior to facility redevelopment being brought on-line (*i.e.* summer 2005 and 2006). Monitoring objectives are to establish an aquatic productivity baseline within the diversion reach for comparison with post-construction impact monitoring at the prescribed instream flows and effectiveness monitoring of aquatic habitat and primary productivity compensation works.
- b) Primary productivity (periphyton) and secondary productivity (benthic invertebrates) would be monitored at the aquatic habitat and primary productivity compensation sites for two years post-construction (2008/09). Monitoring objectives are to collect aquatic productivity effectiveness data for comparison with baseline aquatic productivity data to verify that compensation objectives are achieved. Periphyton and benthic invertebrate monitoring may allow for a decrease in the 2.0 m<sup>3</sup>/s summer productivity flows to some lower level, if it can be demonstrated not to be detrimental to aquatic productivity.
- c) Structural integrity and stability and fish use of the aquatic habitat compensation works would be conducted for three years post construction (2009-2011). The fish use monitoring would be completed in 3 consecutive

---

<sup>1</sup> Time line examples assume an in-service date of 2008.

years post construction. The monitoring program would contain the following components:

- i. Watershed Restoration Program (WRP) restoration works summary and routine monitoring (level 1) forms, or equivalent, for compensation works and riparian planting would be completed for three years following construction.
  - ii. Enumerate juvenile fish within shallow, complex margin habitat in the aquatic habitat compensation works using single-pass open-system backpack electrofishing, or equivalent methodology.
  - iii. Enumerate adult and juvenile fish within the deeper water habitat of the aquatic habitat compensation works using visual snorkel or equivalent methodology.
  - iv. For the remaining life of the project, compensation works would be monitored for structural integrity and maintenance requirements using visual inspection and photo documentation or equivalent methodology.
- d) Post-construction habitat impact monitoring would also be completed for the canyon reach between the dam and the powerhouse. Monitoring objectives are to quantify the habitat area and habitat productivity at the prescribed instream flows (0.25 m<sup>3</sup>/s, 0.50 m<sup>3</sup>/s, and 2.0 m<sup>3</sup>/s). Observations and measurements would be used to calibrate the flow model at the prescribed flows and refine wetted area estimates between flow increments to verify the residual impacts. BC Hydro may demonstrate that the prescribed instream summer productivity flow release, combined with aquatic habitat and primary productivity compensation works are exceeding compensation objectives. If this scenario is true, then under consultation with stakeholders and regulatory agencies, a decrease in the 2.0 m<sup>3</sup>/s summer productivity flow to some lower level may be permitted, provided it can be demonstrated not to be detrimental to aquatic productivity.
- e) Winter flow effectiveness monitoring consists of winter observations (2008-2010) to assess flow and pool connectivity, particularly during extended period of cold weather. Monitoring objectives are to ensure the adequacy of the winter flow provision to maintain flow and pool connectivity during periods of extended severe freezing.

## 6.0 IMPLEMENTATION OF RECOMMENDATIONS

The proposed conditions and the monitoring program in this Water Use Plan will be implemented after BC Hydro receives direction from the Comptroller of Water Rights according to the scope and schedule of the terms of reference approved by the Comptroller.

## **7.0 EXPECTED WATER MANAGEMENT IMPLICATIONS**

The implications for the provincial interests considered during preparation of this Water Use Plan are expected outcomes based on the best available information. After BC Hydro has been directed to implement the operational changes, BC Hydro will be responsible for meeting the operational parameters but not for achieving the expected outcomes.

### **7.1 Other Licensed Uses of Water**

The proposed conditions are not expected to impact other water licence holders on the Bull River.

### **7.2 Riparian Rights**

The proposed conditions are not expected to affect riparian rights associated with the headpond or along the river below the facilities.

### **7.3 Fisheries**

The proposed conditions are expected to benefit fish and fish habitat as follows:

- Provision of a seasonally staged minimum flow through the canyon reach below the dam.
- Compensation for residual habitat and benthic productivity losses.
- Implementation of ramping rates to reduce the impact of fish stranding associated with sudden flow decreases downstream from the generating station.
- Installation of a bypass valve at the generating station to manage downstream flows in the event of a forced plant outage.

### **7.4 Wildlife and Wildlife Habitat**

The proposed conditions are not expected to significantly affect wildlife or wildlife habitat; however, some indirect effects are expected as a result of fish benefits.

A net positive gain in terrestrial productive capacity is expected due to replacement of the existing woodstave pipeline with a buried pipeline and implementation of a native species re-vegetation plan.

### **7.5 Flood Control**

The proposed conditions are not expected to affect flood control on the Bull River.

## **7.6 Recreation**

There are no formal agreements, restrictions or obligations for recreational purposes associated with operation of the Aberfeldie Project. The proposed conditions are not expected to affect the recreational activities on the Bull River.

## **7.7 Water Quality**

The proposed conditions are not expected to change the quality of water released from the Aberfeldie Project.

## **7.8 Industrial Use of Water**

There are no formal agreements, restrictions or obligations for residential, commercial and industrial purposes associated with operation of the Aberfeldie facility.

## **8.0 RECORDS AND REPORTS**

### **8.1 Compliance Reporting**

BC Hydro will submit data to the Comptroller of Water Rights as required to demonstrate compliance with conditions conveyed in the Water Licences.

### **8.2 Non-compliance Reporting**

Non-compliance with any operation ordered by the Comptroller of Water Rights will be reported to the Comptroller in a timely manner.

### **8.3 Monitoring Program Reporting**

Reporting procedures will be determined as part of the terms of reference for each study or undertaking. Details on the monitoring program are included in the Environmental Impact Assessment of the Aberfeldie Redevelopment Project, Revision 4 (Cope 2006).

## **9.0 PLAN REVIEW**

A formal review of this Water Use Plan is recommended within 15 years of its implementation. A review may be triggered earlier by BC Hydro if significant new risks or opportunities are identified.

## 10.0 NOTIFICATION PROCEDURES

Notification procedures for floods and other emergency events are outlined in the “*Aberfeldie, Elko and Spillimacheen Dams Emergency Planning Guide*” and the “*Power Supply Emergency Plan East Kootenay Generation (PSEP)*”. Both these documents are filed with the Office of the Comptroller of Water Rights.

## 11.0 REFERENCES

Cope, S. 2006. Environmental Impact Assessment of the Aberfeldie Redevelopment Project, Bull River, British Columbia, Revision 4. Prepared for BC Hydro.