



# **Clayton Falls Project Water Use Plan**

## **Physical Works Terms of Reference**

**October 28, 2005**

## **1.0 CLAWORKS#1 Water Release and Measurement Device**

### **1.1 Introduction**

This Terms of Reference is submitted in response to the Clayton Falls Order (File No. 0234965 and 5000259), received from the Comptroller of Water Rights on 9 December 2004. As per the Order, this terms of reference provides the plans for a flow release and measuring device that is suitable for measuring the minimum flow of  $0.05 \text{ m}^3/\text{s}$ , which is to be released from the dam at Clayton Falls.

### **1.2 Background**

The Clayton Falls hydroelectric project is located on Clayton Falls Creek about 4 km west of Bella Coola on the central coast of British Columbia. A map of Clayton Falls Project is provided below in Figure 1.1. The Clayton Falls Project is a run-of-river facility. Water is diverted from the creek above Clayton Falls, passed through the powerhouse and into the tailrace channel. Flows from the tailrace re-join lower Clayton Falls Creek and flow a short distance to the ocean. For the purposes of this program, Clayton Falls Creek has been divided into the following four sections:

- a) Lower Clayton Falls Creek Reach 1: from the confluence of the powerhouse tailrace downstream to the estuary
- b) Lower Clayton Falls Creek Reach 2: from the base of the Falls downstream to the confluence with the powerhouse tailrace (Reach 2 is 83 m long)
- c) Lower Clayton Falls Canyon Reach 3: from the base of the dam to the head of the falls
- d) Upper Clayton Falls Creek: unregulated section upstream of the headpond

During the low flow period from December to March, normal operation of the facility diverts most of the inflows to the generating station. However, even during these periods of time there is typically a spill of  $\sim 0.8 \text{ m}^3/\text{s}$  or more going over the flashboards as the headpond controller maintains the headpond level at or above the top of the flashboards. However, there are occasional short periods of time (i.e., a total of 50 hours in 2002) when the headpond level may drop to just below the crest of the flashboards. As a result, flows to Reach 2 can be limited to the minimal leakage from the dam and any local inflows downstream of the dam (estimated at approximately  $0.05 \text{ m}^3/\text{s}$ ). The intent of the Ordered  $0.05 \text{ m}^3/\text{s}$  minimum continuous flow is to maintain winter flows of at least  $0.1 \text{ m}^3/\text{s}$  in Reach 2 in order to ensure the over winter survival of fish and other invertebrate species.

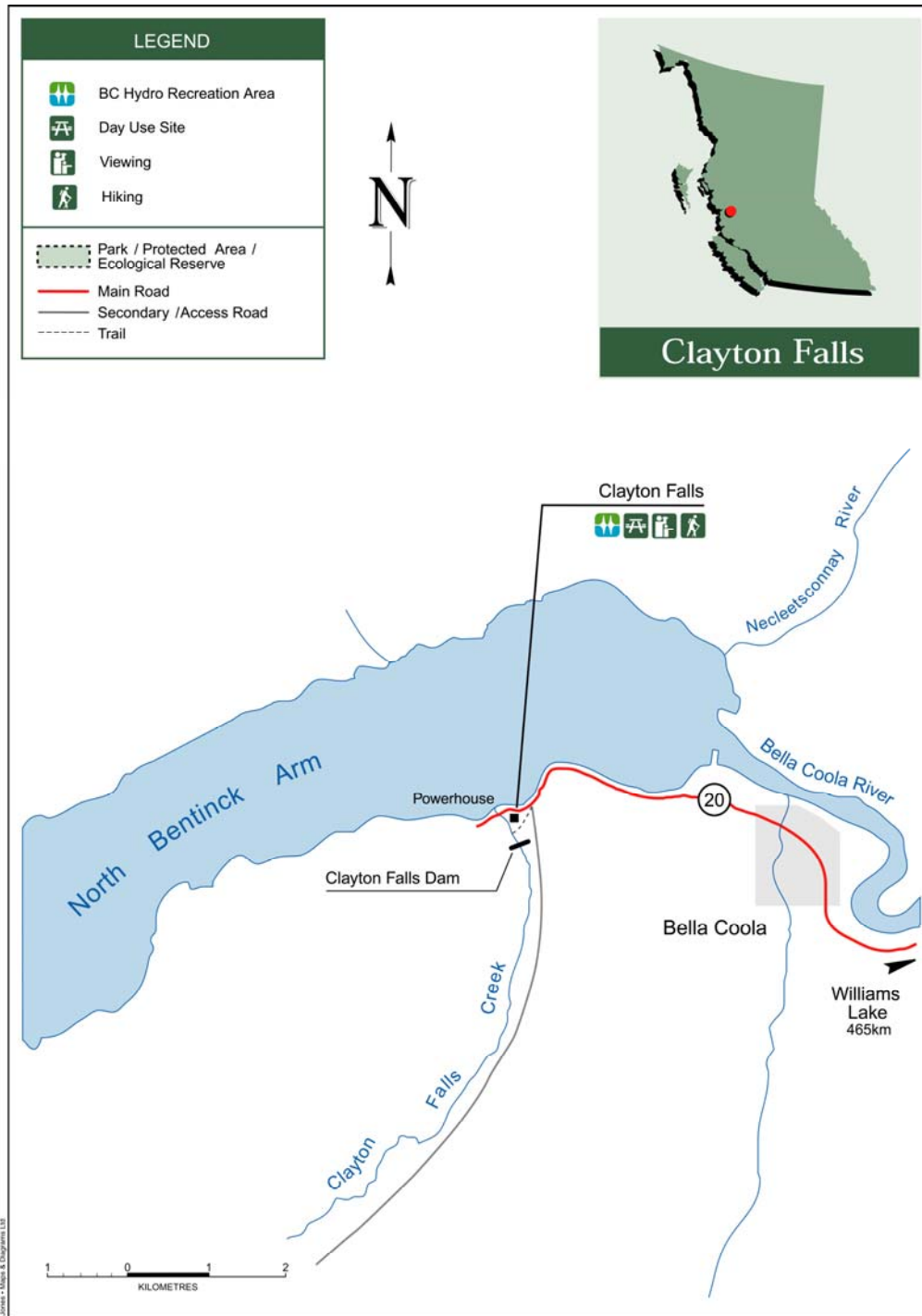


Figure 1-1: Map of Clayton Falls

Lower Clayton Falls Creek provides high quality rearing habitat for juvenile Dolly Varden (*Salvelinus malma*), rainbow trout/steelhead (*Oncorhynchus mykiss*), coho salmon (*O. kisutch*), and sculpin (*Cottus* sp.). Occasional periods of very low or no flow could affect the suitability and availability of these habitats, as well as the survival of fish and their invertebrate food sources. These effects would be realized

in Reach 2, where dam releases may be the only reliable source of flow. Conversely, flows in Reach 1 are minimally affected by facility operations; operations only affect whether the tailrace channel or Reach 2 supplies most of the flow to Reach 1. The period of lowest flow occurs from February to March. During this period it is possible for habitat de-watering in Reach 2 to occur, though its extent and duration may vary year to year. Because fish and many invertebrates generally over-winter in the interstitial spaces provided by cobbles and boulders during this period, de-watering of these habitats could reduce available habitat or cause stranding mortality, and hence have an overall impact on fish and invertebrate populations. Invertebrate rearing and survival during the winter are important as many aquatic invertebrate species have multi-year lifecycles and benthic invertebrates are active during the winter.

The Consultative Committee (CC) for the Clayton Falls Water Use Plan (WUP) expressed concern that the lack of a guaranteed base flow in the mainstem channel between Clayton Falls and the confluence of the tailrace channel might impact the over-winter survival of fish and their invertebrate prey. To address this concern, the CC recommended that the WUP include a  $0.05 \text{ m}^3/\text{s}$  minimum continuous flow release from the Clayton Falls Dam. The  $0.05 \text{ m}^3/\text{s}$  release will be provided via an engineered structure that will be designed to ensure passage of the minimum flow requirement.

It is expected that the proposed minimum flow will increase the over-winter survival of fish and invertebrate populations in lower Clayton Falls Creek by maximizing effective habitat for rainbow trout parr ( $\geq 1$  year old) and improving habitat conditions for their invertebrate food supply. Available aquatic information is limited and only confirms the presence of fish in Reach 2. In order to assess the benefits of the flow release and build on the available aquatic information for the Clayton Falls Creek, pre and post-flow release data will be collected, as detailed in the Monitoring Program Terms of Reference titled "Aquatic Productivity." In order to facilitate the collection of pre-flow release data this fall, the minimum flow release will not commence until 2006.

### **1.3 Scope**

This project includes the design and construction of a water release and measurement device to be installed in Clayton Falls Dam in order to ensure a minimum flow of  $0.05 \text{ m}^3/\text{s}$  from the dam.

The proposed design for the water release and measurement device will consist of a pipe inserted through the flashboard of the dam. The pipe has been designed to release a minimum of  $0.05 \text{ m}^3/\text{s}$  of water from the dam. In order to determine the flow being released at a given head pond elevation upstream of the dam, a flow release curve will be created based on the design of the release device.

During the annual maintenance period, the reservoir is drawn down below the crest of the spillway and the minimum flow release pipe will be dewatered. During this period of time, the sluice gate is opened to pass the project inflow while the unit is out of service thus sustaining the minimum flow to the downstream channel. At the end of the maintenance period when the sluice gate is closed to allow the headpond to refill, there will be a short period of time (1 – 3 hours) when there will be no

minimum flow release until the headpond fills to the elevation of the flow release pipe.

For details of the design, see section 1.7 Appendix A: Design and Installation Details.

#### **1.4 Deliverables**

This project includes the following deliverables:

- Plans for the alteration of works at Clayton Falls Dam to allow a flow release into Clayton Falls River, as per operational requirements specified in the Clayton Falls Water License and Order
- Construction of the works
- Flow release curve for the device
- A construction report, once construction of the release/measurement device has been completed

#### **1.5 Schedule**

This project includes the following schedule:

- 28 October 2005 Terms of Reference submitted to the Comptroller of Water Rights
- 1 December 2005 Detailed Design finalized
- February-March, 2006 Installation of Flow Release/Measurement Device  
(Subject to receipt of Leave to Commence)
- 1 April 2006 Commencement of 0.05 m<sup>3</sup>/s minimum flow through the device

Installation will be scheduled to occur during the annual maintenance period. This is typically a three-week period scheduled during the low inflow period in mid February. During this time, the head pond is drawn down for a period of 3-5 days to permit the dredging of sediment that has accumulated in the head pond and allow for other repairs. The flow release device will be installed during this drawn-down period, subject to receipt of Leave to Commence from the Comptroller of Water Rights.

#### **1.6 Cost Objectives**

The following table provides a breakdown of the costs for the project.

**Table 1-1: Cost Objectives<sup>1</sup> for the Implementation of CLAWORKS#1 Water Release/Measurement Device**

<b>Task Description</b>	<b>Total</b>
<b>Design</b>	
Detailed design of the release/measurement device	<b>\$ 1000</b>
<b>Equipment Procurement</b>	
Purchase of pipe and fabrication of other materials for construction	<b>\$ 1500</b>
<b>Construction</b>	
Installation of flow release pipe	<b>\$ 2525</b>
<b>TOTAL</b>	<b>\$ 5025</b>

### 1.7 Appendix A: Design and Installation Details

The design consists of a pipe inserted through the lower flashboards installed in the Clayton Falls spillway.

#### Pipe Dimensions:

Minimum Pipe Diameter = 0.14 m (or closest larger standard size)

Maximum Pipe Length = 1 m (length will be cut to fit)

The pipe will be installed in the lower flashboards at an elevation of approximately 76.75m.

Metal plates will be installed to support the pipe on both the upstream and downstream side as well as to reinforce the flashboard around the hole and distribute load across the flashboards.

Flow through the pipe will be head dependent. There will be no flow control device. The pipe has been sized to provide a minimum flow of 0.05 m<sup>3</sup>/s when the reservoir is at elevation 77.97m GSC. Note that except during the maintenance outage, when the sluice gate is opened, the reservoir headpond controller maintains the reservoir level at or above El. 77.97m virtually all the time.

The site maintenance crew will install the pipe and reinforcing plates during the maintenance period.

There is a possibility that the selected flashboard will need to be replaced with a stronger board. This will be determined once the required plate dimensions have been confirmed.

<sup>1</sup> The costs shown do not include the cost of terms of reference development, project management, contract management or site co-ordination.

## **1.8 Appendix B: References**

BC Hydro 2003. Consultative committee report: Clayton Falls water use plan. Prepared for and by the Consultative Committee for the Clayton Falls Water Use Plan.

BC Hydro 2004. Clayton Falls Water Use Plan.

BC Hydro 2005. Terms of Reference for the Clayton Falls Project Water Use Plan Monitoring Program: Aquatic Productivity. Unpublished Manuscript.