Columbia River Water Use Plan

Lower Columbia River Fish Management Plan
Monitoring Programs and Physical Works


Implementation Period: August 2015 to July 2016

- CLBMON-42 Lower Columbia River Fish Stranding Assessment and Ramping Protocol
- CLBMON-43 Lower Columbia River Sculpin and Dace Life History Assessment
- CLBMON-44 Lower Columbia River Physical Habitat and Ecological Productivity Monitoring
- CLBMON-45 Lower Columbia River Fish Population Indexing Surveys
- CLBMON-46 Lower Columbia River Rainbow Trout Spawning Habitat Assessment
- CLBMON-47 Lower Columbia River Whitefish Spawning Ground Topographic Survey
- CLBMON-48 Lower Columbia River Whitefish Egg Monitoring & Life History Study
- CLBMON-49 Lower Columbia River Effects of Whitefish Flows on Great Blue Heron & Winter Use of Waldie by Great Blue Heron

Conditional Water Licences for Kinbasket storage (27068 and 39432), Mica diversion (39431), Revelstoke diversion and storage (47215), and Arrow storage (27066)

August 31, 2016
1 Introduction

This document represents a summary of the status and the results of the Lower Columbia River Fish Management Plan of the Columbia River Water Use Plan (WUP) monitoring programs and physical works to July 31, 2016, as per the Columbia River Order under the Water Act, dated January 26, 2007. There are eight monitoring programs.

2 Status

The following table outlines the dates that Terms of Reference (TOR) for the Lower Columbia River Fish Management Plan of the Columbia River WUP monitoring programs and physical works were submitted to and approved by the CWR.

<table>
<thead>
<tr>
<th>Monitoring Programs and Physical Works TOR</th>
<th>Order Clause</th>
<th>Original ToR Submission</th>
<th>Most Recent ToR Resubmission</th>
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<td>Schedule E.2.b</td>
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3 Schedule

The following table outlines the current schedule for the monitoring programs being delivered for the Lower Columbia River Fish Management Plan of the Columbia River WUP.
Table 3-1: Monitoring Programs Schedule as of July 31, 2016

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</tbody>
</table>

Legend:
- Program to be undertaken/initiated in identified year
- Project is underway
- Program completed for the year
- Program started, but encountered operational or hydrological delays

4 Monitoring Programs Terms of Reference
The monitoring programs works being implemented under the Lower Columbia River Fish Management Plan of the Columbia River WUP are described in Terms of Reference. These Terms of Reference can be found here:

5 Status of Monitoring Programs

5.1 CLBMON-42 Lower Columbia River Fish Stranding Assessment and Ramping Protocol
As per our letter of August 22, 2016, CLBMON-42 is being reported on as two parts:
- CLBMON-42A LCR Fish Stranding Assessment and Ramping Protocol, and
- CLBMON-42B LCR Physical Habitat Recontouring.

5.1.1 CLBMON-42A Lower Columbia River Fish Stranding Assessment and Ramping Protocol
This monitoring program was initiated in May 2007 and will be carried out over 13 years. Attached is the report for Year 9 dated July 7, 2016.
Year 9 (April 2015 - April 2016) saw the highest number of stranding assessments (n=15) for reduction events at Hugh L. Keenleyside Dam/Arrow Lakes Generating Station (HLK/ALH) over the past seven years of data collection. The higher number of stranding assessments as there was lower than average discharges from HLK/ALH during the winter due to the very dry previous summer. The low river discharge levels from HLK/ALH were required to keep the Arrow Lakes Reservoir levels above the 1390 feet minimum required for the normal ferry operations and forestry operations (floating log rafts). Response to the flow reductions included the assessment of reconnaissance sites at these less common river water levels below HLK/ALH.

5.1.2 CLBMON-42B Lower Columbia River Physical Habitat Recontouring
Three sites on the LCR have been identified as high priority for recontouring to minimize the stranding risk:

- Genelle,
- Kootenay River Confluence, and
- Tin Cup Rapids.

Engineering designs for these sites were developed in the fall of 2015 and spring of 2016, First Nation engagement has commenced and permitting is underway. BC Hydro is planning to conduct the recontouring work in the spring of 2017 so long as river levels are low enough to do the work in the dry.

5.2 CLBMON-43 Lower Columbia River (LCR) Sculpin and Dace Life History Assessment
This monitoring program was initiated in 2009 and carried out over five years. This project is complete.

This LCR sculpin and dace life history assessment program’s main objective was to collect information on the life history, timing, and habitat use of four sculpins (Prickly, Torrent, Columbia, and Shorthead) and two dace (Umatilla and Longnose) species that may be affected by water level fluctuations resulting from daily and seasonal operations of Hugh L. Keenleyside (HLK) dam.

The highest risk of stranding and interference with the normal life cycles of sculpins and dace are when flow reductions occur during the spawning, incubation, and early rearing period (June to late September) for these species.

5.3 CLBMON-44 Lower Columbia River Physical Habitat and Ecological Productivity Monitoring
This monitoring program was initiated in 2008 and will be carried out until 2018. Attached is the memo that summarizes the work conducted for Year 8 dated July 8, 2016.

CLBMON-44 is a multi-year study of physical habitat and ecological productivity on the Lower Columbia River (LCR) between the outflow of the Hugh L. Keenleyside Dam (HLK) and the Birchbank gauging station. The aim of the study is to examine the influence of three different flow periods (Mountain Whitefish (MWF) January 1 – March 31; Rainbow Trout (RBT) April 1 – June 30; and fall fluctuating flows (FFF)
September 1 – October 31) on select physical habitat and ecological productivity measures.

The results to date suggest that flows from HLK have various effects on the physical and ecological productivity measures examined. For example, velocity affects the type of substrate and may be the most important determinant of the periphyton community and one of the most important determinants in the benthic community in the study area.

Water sampling suggests that the lower Columbia River has good water quality; parameters examined rarely exceeded government water quality guidelines. No further water quality sampling will occur during 2016–2019. Removing water quality sampling will result in CLBMON-44 concluding in 2018 (instead of 2019) because water quality sampling was the only scheduled activity in 2019. This component of the program was eliminated because the current sampling regime (point samples collected four times annually) does not provide enough data to statistically inform the potential effects of the three flows periods on the water quality of LCR. The water quality sampling done to date through this project, have been useful to understand the baseline conditions of LCR, and that, along with other evidence have been used to address the water quality related hypotheses.

5.4 CLBMON-45 Lower Columbia River Fish Population Indexing Surveys

This monitoring program was initiated in September 2007 and will be carried out over 13 years. Attached is the report for Year 8 dated November 11, 2015.

CLBMON-45 gathers baseline information on fish distribution, life history characteristics, and population abundance data for three index species (i.e., Mountain Whitefish, Rainbow Trout, and Walleye), and also monitors the effect of Mountain Whitefish and Rainbow Trout flows on these three species.

The results to date suggest that the estimated abundance of adult Rainbow Trout increased substantially from ~25,000 in 2002 to 51,000 in 2015, and high abundances in recent years coincided with a decline in body condition and survival, suggesting density dependence.

Adult Mountain Whitefish abundance declined by approximately half between 2001 (>200,000) and 2012 (~100,000), and have remained at similar levels between 2012 and 2015.

Although adult Walleye abundance has fluctuated throughout the study period, the most recent estimates of adult abundance were the lowest at approximately 20,000 adults or less per year (from 2012 to 2015) compared to over 60,000 adult Walleye in 2004.

5.5 CLBMON-46 Lower Columbia River Columbia Rainbow Trout Spawning Habitat Assessment

This monitoring program was initiated in 2008 and will be carried out over 10 years. Attached is the report for Year 8 dated February 2, 2016.

The current Rainbow Trout (RBT) spawning assessment monitoring program, which commenced in 2008, was implemented to better understand the linkages between the spring flow regime and the abundance of the Rainbow Trout population and to assess population trends in this ecologically and recreationally important species. The results to date suggest that the number of RBT spawners and redds has
increased about 10-fold since 1999 and the number of locations and area of spawning have increased since 1996. In addition, the mean dewatering rate is 0.75% of total RBT egg production during this study period, compared to the estimated 50–75% stranding rate in shallow water habitat on Nom’s Fan in 1990 and 1991 (i.e., the two years prior to the implementation of RBT flows).

5.6 CLBMON-47 Lower Columbia River Whitefish Spawning Ground Topographic Survey

This monitoring program was initiated in 2011 and was carried out over three years. This project is complete.

A key data gap identified by the WUP CC was the low quality and quantity of topographic data to describe characteristics of whitefish spawning locations, contributing to reduced confidence in the degree to which existing data represented the habitats of concern, and overall reliability of egg loss estimates. This monitoring program addresses these uncertainties by understanding how changes in dam releases influence the wetted channel area at key whitefish spawning locations.

In 2011, the HEC-RAS model was updated to adequately represent the river hydraulic situations of the key Mountain Whitefish spawning areas at CPR Island and the lower Kootenay River where spawning is prevalent. In 2012, Individual River2D hydraulic models were calibrated for the two key Mountain Whitefish spawning areas: Columbia Reach and Kootenay River.

In 2013, the Egg Loss Model was updated and redesigned as an R-based model. The updated version includes modeling of stranding across the entire River2D surface, rather than individual transects, and incorporates time, depth, and temperature effects on egg deposition and incubation. In addition, the model incorporates uncertainty of these effects and yields confidence intervals around the stranding estimates.

Over the range of discharge documented in this study, the wetted area in the Kootenay River spawning area was typically three to five times higher than at CPR Island.

5.7 CLBMON-48 Lower Columbia River Whitefish Egg Monitoring & Life History Study

This monitoring program was initiated in 2008 and was carried out over five years. This project is complete.

The purpose of this monitoring program was to collect and refine data on the location, timing, and depth distribution of mountain whitefish spawning in the Lower Columbia River below Hugh L. Keenleyside Dam to improve the annual estimate of egg mortality. Specifically, the key objectives are to: a) improve the understanding of whitefish life history and reproductive ecology; b) document topographic characteristics of representative whitefish spawning locations; and, c) improve the understanding of seasonal changes in the distribution of eggs in the river channel.

5.8 CLBMON-49 Lower Columbia River Effects of Whitefish Flows on Great Blue Heron (GBH) and Winter Use of Waldie by Great Blue Heron

This monitoring program was initiated in November 2013 and will be carried out over three years. Attached is the report for Year 2 dated November 27, 2015.
CLBMON-49 changed from a count-based study to a habitat suitability study in the final two years of this project. GBH distribution and abundance, along with physicochemical and other habitat and environmental parameters were monitored at a variety of sites throughout the Kootenays during the winter months. Surveys were completed prior to, during, and after flows related to management of Mountain Whitefish (generally November 1 to February 28) in the Castlegar area, encompassing varied water elevations and flow rates resulting from known dam operations. The information collected throughout the Kootenays will be used to assess GBH habitat and use in the Lower Columbia River.

Results from Year 2 suggest the dynamics influencing overwintering herons along the Lower Columbia River are complex and likely interconnected. Flow regime may impact shoreline utilization or heron abundance, most likely via maintaining low shoreline availability during Mountain Whitefish flow periods. However, confounding our ability to detect such a trend are changes in breeding success and colony structure, lack of flow manipulation ability, and other impacts such as human-caused disturbances.

6  Monitoring Programs Costs

The following table summarizes the Lower Columbia River Fish Management Plan of the Columbia River WUP monitoring programs costs approved by the Comptroller and the Actual Costs to July 31, 2016.
### Table 6-1: Lower Columbia River Fish Management Plan WUP Monitoring Programs Costs

<table>
<thead>
<tr>
<th>Monitoring Programs</th>
<th>Costs approved by CWR</th>
<th>Life to Date Actuals (LTD)</th>
<th>Estimated to Complete (Forecast)</th>
<th>Total Forecast (LTD and Forecast)</th>
<th>Variance Total to Approved</th>
<th>Explanation</th>
<th>Corrective Action</th>
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**OR - Ordered Remissible**  
**ONR - Ordered Non-Remissible**

* Red values in parentheses denote overage.