

Columbia River Water Use Plan

Lower Columbia River Fish Management Plan Monitoring Programs and Physical Works

Annual Report: 2017

Implementation Period: August 2016 to July 2017

- **CLBMON-42A Lower Columbia River Fish Stranding Assessment and Ramping Protocol**
- **CLBMON-42B Lower Columbia River Physical Habitat Recontouring**
- **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, 2017

BC Hydro Columbia River Project Water Use Plan Lower Columbia River Fish Management Plan Monitoring Programs and Physical Works Annual Report: 2017

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, 2017, as per the Columbia River Order under the *Water Act*, dated January 26, 2007. There are nine 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 Comptroller of Water Rights (CWR).

Table: 2-1: Dates of Lower Columbia River Fish Management Plan of the Columbia River WUP TOR Submissions and Approvals by the Comptroller of Water Rights

Monitoring Programs TOR	Order Clause	Original TOR Submission		Most Recent TOR Resubmission	
		Date Submitted	Date Approved	Date Submitted	Date Approved
CLBMON-42A Lower Columbia River Fish Stranding Assessment and Protocol	Schedule E.2.a	Sep 10, 2007	Oct 29, 2007	Aug 22, 2016	Aug 25, 2016
CLBMON-42B Lower Columbia River Physical Habitat Recontouring	Schedule E.2.a	Aug 22, 2016	Aug 25, 2016		
CLBMON-43 Lower Columbia River Sculpin and Dace Life History Assessment	Schedule E.2.b	Oct 26, 2007	Dec 03, 2007		
CLBMON-44 Lower Columbia River Physical Habitat and Ecological Productivity Monitoring	Schedule E.2.c	Oct 26, 2007	Dec 03, 2007		
CLBMON-45 Lower Columbia River Fish Population Indexing Surveys	Schedule E.2.d	Sep 10, 2007	Oct 29, 2007		
CLBMON-46 Lower Columbia River Columbia Rainbow Trout Spawning Habitat Assessment	Schedule E.2.e	Oct 26, 2007	Dec 03, 2007	Jan 09, 2009	Mar 26, 2009
CLBMON-47 Lower Columbia River Whitefish Spawning Ground Topographic Survey	Schedule E.2.f	Oct 26, 2007	Dec 03, 2007		
CLBMON-48 Lower Columbia River Whitefish Egg Monitoring & Life History Study	Schedule E.2.g	Oct 26, 2007	Dec 03, 2007		
CLBMON-49 Lower Columbia River Effects of Whitefish Flows on Great Blue Heron and Winter Use of Waldie by Great Blue Heron	Schedule E.2.h	Oct 26, 2007	Dec 03, 2007	Oct 08, 2015	Nov 12, 2015

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, 2017

Monitoring Programs	2007 WLR YR1	2008 WLR YR2	2009 WLR YR3	2010 WLR YR4	2011 WLR YR5	2012 WLR YR6	2013 WLR YR7	2014 WLR YR8	2015 WLR YR9	2016 WLR YR10	2017 WLR YR11	2018 WLR YR12	2019 WLR YR13
CLBMON-42A Lower Columbia River Fish Stranding Assessment and Protocol	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	u/w	■	■
CLBMON-42B Lower Columbia River Physical Habitat Recontouring										x	x	■	
CLBMON-43 Lower Columbia River Sculpin and Dace Life History Assessment			✓	✓	✓	✓	✓F						
CLBMON-44 Lower Columbia River Physical Habitat and Ecological Productivity Monitoring		✓	✓	✓	✓	✓	✓	✓	✓	✓	u/w	■	
CLBMON-45 Lower Columbia River Fish Population Indexing Surveys	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	u/w	■	■
CLBMON-46 Lower Columbia River Columbia Rainbow Trout Spawning Habitat Assessment		✓	✓	✓	✓	✓	✓	✓	✓	✓	u/w		
CLBMON-47 Lower Columbia River Whitefish Spawning Ground Topographic Survey					✓	✓	✓F						
CLBMON-48 Lower Columbia River Whitefish Egg Monitoring & Life History Study		✓	✓	✓	✓	✓F							
CLBMON-49 Lower Columbia River Effects of Whitefish Flows on Great Blue Heron and Winter Use of Waldie by Great Blue Heron							✓	✓	✓F				
Legend: ■ = Program to be undertaken/initiated in identified year u/w = Project is underway ✓ = Program completed for the year ✓F = All field work for this project is complete. No further field work is planned. x = Program started, but encountered operational or other delays													

4 Monitoring Programs Terms of Reference

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

http://www.bchydro.com/about/sustainability/conservation/water_use_planning/southern_interior/columbia_river/lower-columbia-fish.html

5 Status of Monitoring Programs

5.1 CLBMON-42 Lower Columbia River Fish Stranding Assessment and Ramping Protocol

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 10 dated May 30, 2017.

Discharge reductions and flow ramping from Hugh L. Keenleyside Dam/Arrow Lakes Generating Station(HLK/ALH) and Brilliant Dam/Expansion (BRD/X) can result in

stranding of fish species of the lower Columbia and Kootenay rivers. This study assesses fish stranding at pre-determined sites between HLK/ALH and the Canada/USA border.

Year 10 (April 1, 2016 to April 1, 2017) stranding assessments were conducted for 17 of the 18 reduction events. The high number of stranding assessments was due to low discharge from Hugh L. Keenleyside Dam/Arrow Lakes Generating station (HLK/ALH) in the fall and insufficient inflows into Kootenay Lake in late summer affecting Brilliant Dam/Expansion (BRD/X) minimum flows. The low river discharge levels from HLK/ALH were required to keep the Arrow Lakes Reservoir levels above the 1390 ft 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

As part of the CLBMON-42 TOR, physical works were proposed as potential mitigation for fish stranding. Three sites on the LCR were identified as high priority for recontouring to minimize the stranding risk:

- Genelle,
- Kootenay River Left Upper Bank, and
- Tin Cup Rapids.

Engineering designs for these sites were developed in the fall of 2015. Preliminary Field Reconnaissance (PFR) for archaeological materials was undertaken at the Kootenay River Left Upper Bank (LUB) and Tin Cup Rapids access routes in the fall of 2016. Archaeologists recommended a pre-work surface inspection and archaeological monitoring of the access route. Subsequently, during First Nation engagement in the spring of 2017, BC Hydro cancelled recontouring work at the Kootenay River Left Upper Bank and Tin Cup Rapids due to significant concerns raised by First Nations regarding the cultural value of those sites. The PFR report for TinCup and Kootenay LUB is attached dated December 9, 2016.

First Nations are currently considering the potential impacts of recontouring at the Genelle site. An Archaeological Impact Assessment would be required at a minimum prior to proceeding with recontouring. In addition, the proposed access route to the Genelle site was recently accredited to a private landowner by the Surveyor General. At this time, it is uncertain whether BC Hydro will be able to access the site to conduct any recontouring.

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.

The main objective of this study 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.

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 report for Year 9 dated July 20, 2017.

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 on select physical habitat and ecological productivity measures:

- January 1 – March 31, Mountain Whitefish (MWF);
- April 1 – June 30, Rainbow Trout (RBT); and
- September 1 – October 31, Fall fluctuating flows (FFF).

The results to date seem to indicate that when flows are high (e.g., during freshet), the effects of the managed flow period (i.e., RBT flows) are nominal, however in the fall and winter when flows are more stable, then the managed flow periods (i.e., FFF and MWF flows) appear to play a larger role in shaping the overall benthic community.

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) as 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 the LCR. The water quality sampling done to date through this project, has been useful to understand the baseline conditions of the LCR which, along with other evidence, has 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 9 dated August 1, 2016. The Year 10 report is currently being finalized and will be included in next year's annual report.

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 50,000 in 2016. 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 (~165,000) and 2014 (~77,000), and have remained at similar levels since 2014.

Walleye abundance had lower abundance in the last five years than in all earlier years, which corresponded with the highest observed body condition.

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 9 dated February 1, 2017.

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. The conditions that lead to higher rates of dewatering, such as high water levels earlier in the season, appear to be associated with higher incubation success for the remaining embryos and alevins.

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 Consultative Committee 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.

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 field work is complete. The Year 3 report is still being finalized and will be submitted in the next annual report.

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.

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, 2017.

Table 6-1: Lower Columbia River Fish Management Plan WUP Monitoring Programs Costs

Monitoring Programs	Costs approved by CWR	Life to Date Actuals (LTD)	Estimated to Complete (Forecast)	Total Forecast (LTD and Forecast)	Variance Total to Approved	Explanation	Corrective Action
CLB MP8 Lower CR Fish Annual Report	\$13,121	\$10,877	\$2,244	\$13,120	\$1		
C08M42A LC: Fish Strand	\$1,110,172	\$871,751	\$237,910	\$1,109,661	\$511		
C08M42A LC: Fish Strand - OR DM	\$187,039	\$131,866	\$37,839	\$169,705	\$17,334		
C08M42A LC: Fish Strand - OR Imp	\$923,133	\$739,885	\$200,071	\$939,956	(\$16,823)		
C08M42B LC: Recontouring	\$455,799	\$84,342	\$178,863	\$263,206	\$192,593	Implementation has been delayed.	
C08M42B LC: Recontouring - OR DM	\$60,871	\$52,794	\$18,095	\$70,889	(\$10,018)		
C08M42B LC: Recontouring - OR Imp	\$394,928	\$31,549	\$160,768	\$192,317	\$202,611		
C08M43A LC: Sculpin&Dace	\$990,546	\$962,983	\$2,334	\$965,317	\$25,229	Project is complete.	
C08M43A LC: Sculpin&Dace - OR DM	\$64,043	\$61,865	\$2,334	\$64,199	(\$156)		
C08M43A LC: Sculpin&Dace - OR Imp	\$926,503	\$901,117		\$901,117	\$25,386		
C08M44A LC: Phys Hab&Eco	\$2,162,010	\$1,776,579	\$240,355	\$2,016,934	\$145,076	Water quality monitoring no longer required for remaining years.	
C08M44A LC: Phys Hab&Eco - OR DM	\$171,319	\$160,712	\$5,242	\$165,954	\$5,365		
C08M44A LC: Phys Hab&Eco - OR Imp	\$1,990,691	\$1,615,867	\$235,113	\$1,850,980	\$139,711		
C08M45A LC: Fish Pop	\$2,744,109	\$1,750,479	\$993,630	\$2,744,109	(\$0)		
C08M45A LC: Fish Pop - OR DM	\$180,037	\$90,033	\$90,004	\$180,037	(\$0)		
C08M45A LC: Fish Pop - OR Imp	\$2,564,072	\$1,660,446	\$903,626	\$2,564,072	\$0		
C08M46A LC: Rainbow Tro	\$734,980	\$678,316	\$35,530	\$713,846	\$21,134	Efficiencies found during project implementation	
C08M46A LC: Rainbow Tro - OR DM	\$115,994	\$101,076	\$7,881	\$108,957	\$7,037		
C08M46A LC: Rainbow Tro - OR Imp	\$618,986	\$577,239	\$27,649	\$604,889	\$14,097		
C08M47A LC: Whitefish Spwn	\$292,267	\$263,841	\$2,101	\$265,942	\$26,325	Project is complete.	
C08M47A LC: Whitefish Spwn - OR DM	\$38,246	\$18,510	\$2,101	\$20,610	\$17,636		
C08M47A LC: Whitefish Spwn - OR Imp	\$254,021	\$245,332		\$245,332	\$8,689		
C08M48A LC: Whitefish Egg	\$912,415	\$876,702	\$2,101	\$878,803	\$33,612	Project is complete.	
C08M48A LC: Whitefish Egg - OR DM	\$62,520	\$47,961	\$2,101	\$50,062	\$12,458		
C08M48A LC: Whitefish Egg - OR Imp	\$849,895	\$828,741		\$828,741	\$21,154		
C08M49A LC: EFF WFish GBH	\$336,448	\$335,319	\$8,000	\$343,319	(\$6,871)	Final reporting still required.	Submit TOR resubmission to CWR by Dec 31, 2017.
C08M49A LC: EFF WFish GBH - OR DM	\$68,211	\$67,082	\$3,000	\$70,082	(\$1,871)		
C08M49A LC: EFF WFish GBH - OR Imp	\$268,237	\$268,237	\$5,000	\$273,237	(\$5,000)		

* Red values in parentheses denote overage.