

Columbia River Project Water Use Plan Revelstoke Flow Management Plan

Monitoring Program

Annual Report: 2016

Implementation Period: February 2015 to January 2016

- **CLBMON-15a Middle Columbia River Physical Habitat Monitoring**
- **CLBMON-15b Middle Columbia River Ecological Productivity Monitoring**
- **CLBMON-16 Middle Columbia River Fish Population Indexing Surveys**
- **CLBMON-17 Middle Columbia River Juvenile Fish Habitat Use**
- **CLBMON-18 Middle Columbia River Adult Fish Habitat Use**
- **CLBMON-53 Middle Columbia Juvenile Fish Stranding**

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

February 29, 2016

BC Hydro Columbia River Project Water Use Plan Revelstoke Flow Management Plan Monitoring Programs Annual Report: 2016

1 Introduction

This document represents a summary of the status and the results of the Columbia River Revelstoke Flow Management Plan Water Use Plan (WUP) monitoring programs to January 31, 2016, as per the Columbia River Order under the *Water Act*, dated January 26, 2007. There are six monitoring programs.

2 Status

The following table outlines the dates that Terms of Reference (TOR) for the Revelstoke Flow Management Plan WUP monitoring programs were submitted to and approved by the CWR.

Table: 2-1: Dates of Revelstoke Flow Management Plan WUP TOR Submissions and Approvals by the Comptroller of Water Rights

Monitoring Program & Physical Works TOR	Order Clause	Original TOR Submission		Most Recent TOR Resubmission	
		Date Submitted	Date Approved	Date Submitted	Date Approved
CLBMON-15a Middle Columbia River Physical Habitat Monitoring	Schedule C, Clause 4 (a);	Mar 05, 2007	Mar 22, 2007	Jan 29, 2015	Mar 02, 2015
CLBMON-15b Middle Columbia River Ecological Productivity Monitoring	Schedule C, Clause 4 (a)	Mar 05, 2007	Mar 22, 2007	May 21, 2010	Jul 19, 2010
CLBMON-16 Middle Columbia River Fish Population Indexing Surveys	Schedule C, Clause 4 (b)	Mar 05, 2007	Mar 22, 2007	Jul 12, 2013	Jul 22, 2013
CLBMON-17 Middle Columbia River Juvenile Fish Habitat Use	Schedule C, Clause 4 (c)	Mar 05, 2007	Mar 22, 2007	May 21, 2010	Jul 19, 2010
CLBMON-18 Middle Columbia River Adult Fish Habitat Use	Schedule C, Clause 4 (d)	Mar 05, 2007	Mar 22, 2007	Mar 30, 2015	Apr 23, 2015
CLBMON-53 Middle Columbia River Juvenile Fish Stranding	Amended Order, Clause 2 (c)	Jul 31, 2008	Sep 11, 2008	Feb 02, 2009	Mar 26, 2009

3 Schedule

The following table outlines the current schedule for the monitoring programs being delivered for the Revelstoke Flow Management Plan WUP.

Table 3-1: Monitoring Programs Schedule as of January 31, 2016

Monitoring Programs	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
	WLR YR1	WLR YR2	WLR YR3	WLR YR4	WLR YR5	WLR YR6	WLR YR7	WLR YR8	WLR YR9	WLR YR10	WLR YR11	WLR YR12	WLR YR13
CLBMON-15a Middle Columbia River Physical Habitat Monitoring	✓	✓	✓	✓	✓	✓	✓	✓	✓	■	■	■	■
CLBMON-15b Middle Columbia River Ecological Productivity Monitoring	✓	✓	✓	✓	✓	✓	✓	✓	✓	■	■	■	■
CLBMON-16 Middle Columbia River Fish Population Indexing Surveys	✓	✓	✓	✓	✓	✓	✓	✓	✓	■	■	■	■
CLBMON-17 Middle Columbia River Juvenile Fish Habitat Use		✓	✓	✓	✓	✓	✓				◆		
CLBMON-18 Middle Columbia River Adult Fish Habitat Use		✓	✓	✓	×	×	×				◆		
CLBMON-53 Middle Columbia River Juvenile Fish Stranding			✓	✓	✓	×	✓						

Legend:

- = Program to be undertaken/initiated in identified year
- ◆ = Program proposed to be undertaken in identified year (pending approval)
- ✓ = Program completed for the year
- × = Program started, but encountered operational or hydrological delays

4 Monitoring Programs Terms of Reference

The monitoring programs being implemented under the Revelstoke Flow Management Plan WUP are described in Terms of Reference. These Terms of Reference and the reports for work completed to date can be found here:

http://www.bchydro.com/about/sustainability/conservation/water_use_planning/southern_interior/columbia_river/revelstoke-flow.html

5 Status of Monitoring Programs

5.1 CLBMON-15a Middle Columbia River Physical Habitat Monitoring

This monitoring program was initiated in 2007 and will be carried out annually over 13 years.

As an outcome of the Revelstoke Flow Management Plan (RFMP) technical review in February 2014, BC Hydro resubmitted a TOR on January 29, 2015, and received CWR approval on March 2, 2015. The study team was successful in implementing the changes that were associated with the revised TOR, which included:

- Shifting the focus of water quality data collection towards hydraulic modeling as *in situ* sampling had thus far been insensitive to variations in flow changes, and;
- Removal of water stage level data collection, as the HEC-RAS model is now well calibrated for this variable.

Attached is the report for Year 8 (2014) dated June 2015. The Year 9 (2015) draft report is in preparation and will be included in next year's annual report.

5.2 CLBMON-15b Middle Columbia River Ecological Productivity Monitoring

This monitoring program was initiated in July 2007 and will be carried out annually over 13 years.

In 2016 and 2017, we will only conduct spring sampling, as sufficient data has already been collected during the fall and refocusing efforts on spring sampling best addresses the remaining uncertainties in the management questions.

Attached is the report for Year 8 (2014) dated January 2016. The Year 9 (2015) draft report is in preparation and will be included in next year's annual report.

5.3 CLBMON-16 Middle Columbia River Fish Population Indexing Surveys

This monitoring program was initiated in October 2007 and will be carried out annually over 13 years.

In 2014 an independent review of the monitoring study was completed at the request of the Ministry of Environment; particular focus was placed on evaluating the impacts of electrofishing sampling methods during the fall. The review concluded that spring and fall sampling should continue; however, where there were budget constraints, consistent fall sampling was of higher priority to best assess pre- and post-treatment effects of the minimum flow regime. In addition, the reviewers concluded that perceived threats to Bull Trout spawners was insufficient to justify prohibition of electrofishing during the time of sampling.

In 2015, we conducted both spring and fall sampling based on the results of the independent review; however, due to budget constraints, fall sampling (pending annual receipt of the permit from MOE) will occur for the remainder of the study in order to gather data comparable to years prior to the flow regime change and adequately address the management questions. A TOR revision is not required as a result of these changes.

Attached is the report for Year 8 (2014) dated September 14, 2015. The Year 9 (2015) draft report is in preparation and will be included in next year's annual report.

5.4 CLBMON-17 Middle Columbia River Juvenile Fish Habitat Use

This monitoring program was initiated in 2008 and has been carried out over six years. While the study has been completed according to the current TOR, the outcomes of the Revelstoke Flow Management Plan Technical Review in 2014 indicated that the resolution of some of the management questions would benefit from further analysis of the relationship between discharge and juvenile habitat availability taking into account habitat suitability indices derived from modelling in CLBMON-15a.

A TOR resubmission outlining the recommended additional analysis will be submitted by March 31, 2017.

5.5 CLBMON-18 Middle Columbia River Adult Fish Habitat Use

This monitoring program was initiated in 2008 and was originally scheduled to be carried out over six years. The first three years were completed in 2008-2010.

As an outcome of the RFMP technical review, BC Hydro postponed the final three years of the monitoring project to develop a proposal to model the energetic expenditure of fish based on flow. A TOR resubmission outlining the proposal was

submitted to your office March 30, 2015, and received approval on April 23, 2015, which outlined four tasks that were to be completed in collaboration with BC Hydro, agencies and First Nations.

In June 2015 Technical Review Committee (TRC) (comprised of BC Hydro representatives, agencies and local First Nations) directed an independent literature review to assess whether bioenergetics modelling could be used to assess the effects of discharge on Mountain Whitefish and Bull Trout energy expenditures instead of continuing with the remaining three years of monitoring in the field.

The review concluded that bioenergetics modelling was feasible provided that River-2D modeling results were available. The TRC further recommended that some field work might be required to calibrate the model at various discharges. As the Revelstoke 6 technical working group has recently made available a calibrated 2D HEC-RAS model, BC Hydro will be resubmitting the TOR to reflect the updated modelling requirements by March 31, 2017.

5.6 CLBMON-53 Middle Columbia River Juvenile Fish Stranding

This monitoring program was initiated in 2009 and completed in 2013. The project is now complete.

6 Monitoring Programs Costs

The following table summarizes the Revelstoke Flow Management Plan WUP monitoring programs costs approved by the Comptroller and the Actual Costs to January 31, 2016.

Table 6-1: Revelstoke Flow 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 MP4 Revelstoke Flow Annual Report	\$5,463	\$3,568	\$2,734	\$6,302	(\$839)	Original forecast was conservative for annual report costs.	Letter to CWR for increase in budget will be resubmitted prior to exceeding approved budget.
C04M15 MID COL Phy Hab & Eco Prod	\$4,052,513	\$2,461,332	\$1,088,001	\$3,549,332	\$503,181	Efficiencies found during project implementation	
C04M15 MID COL PhyHab & EcoProd - OR DM	\$264,235	\$122,879	\$69,468	\$192,347	\$71,888		
C04M15 MID COL PhyHab & EcoProd- OR Imp	\$3,788,278	\$2,338,453	\$1,018,532	\$3,356,986	\$431,292		
C04M16A MID COL Fish Index	\$2,880,201	\$1,606,973	\$911,785	\$2,518,759	\$361,442	Efficiencies found during project implementation	
C04M16A MID COL Fish Index - OR DM	\$105,704	\$90,486	\$40,050	\$130,536	(\$24,832)		
C04M16A MID COL Fish Index - OR Imp	\$2,774,497	\$1,516,487	\$871,736	\$2,388,223	\$386,274		
C04M17A MID COL Juvenile Hat - ONR	\$103,056	\$103,074		\$103,074	(\$18)	Project Complete	
C04M17A MID COL Juvenile Hat - ONR Imp	\$103,056	\$103,074		\$103,074	(\$18)		
C04M17A MID COL Juvenile Hat - OR	\$495,994	\$472,451		\$472,451	\$23,543	Revised TOR currently being drafted.	Submit TOR resubmission to CWR by March 31, 2017.
C04M17A MID COL Juvenile Hat - OR DM	\$39,494	\$38,446		\$38,446	\$1,048		
C04M17A MID COL Juvenile Hat - OR Imp	\$456,500	\$434,005		\$434,005	\$22,495		
C04M18A MID COL Adult Fish - ONR	\$178,104		\$178,104	\$178,104	\$0	Project has not yet commenced.	
C04M18A MID COL Adult Fish - ONR Imp	\$178,104		\$178,104	\$178,104			
C04M18A MID COL Adult Fish - OR	\$960,358	\$574,877	\$325,068	\$899,945	\$60,413	Revised TOR currently being drafted.	Submit TOR resubmission to CWR by March 31, 2017.
C04M18A MID COL Adult Fish - OR DM	\$60,645	\$50,948	\$17,279	\$68,227	(\$7,582)		
C04M18A MID COL Adult Fish - OR Imp	\$899,713	\$523,929	\$307,789	\$831,718	\$67,995		
C04M53A MID COL Fish Strand	\$179,222	\$155,451	\$1,814	\$157,266	\$21,956	Project Completed. Final completion report outstanding.	
C04M53A MID COL Fish Strand - ONR DM	\$58,310	\$40,181	\$1,814	\$41,996	\$16,314		
C04M53A MID COL Fish Strand - ONR Imp	\$120,912	\$115,270		\$115,270	\$5,642		

OR - Ordered Remissible
 ONR - Ordered Non-Remissible

* Red values in parentheses denote overage.