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## **Duncan Dam Water Use Plan**

## **Physical Works Terms of Reference**

**DDMWORKS-3 – Kootenay Lake Nutrient Loading Funding**

**Addendum 1  
September 13, 2019**

## **A1.0 Addendum to Kootenay Lake Nutrient Loading Funding**

### **A1.1 Rationale for Addendum**

This addendum describes the changes to the physical works to be implemented prior to the Water Use Plan Order Review (WUPOR) process. The objective of DDMWORKS-3 is to provide annual funding towards the Kootenay Lake Nutrient Restoration Program (KLNRP) to enhance aquatic food supply in the north arm of Kootenay Lake equivalent to the operational component of nutrient supply lost to the Lower Duncan River and Kootenay Lake through retention in the Duncan Reservoir behind Duncan Dam.

The Terms of Reference (TOR; BC Hydro 2008) identified ten years of annual funding installments of 1/5.7<sup>th</sup> of the previous year's total costs for the KLNRP (approximately \$100,000 in 2004 dollars; plus inflation). This addendum will extend the annual dollar contribution an additional four years to the WUPOR.

As outlined in the TOR, assessing nutrient retention associated with Duncan Dam operations is a complex and costly exercise. As such, it was determined that the best approach was to contribute to the existing nutrient enhancement program the Fish and Wildlife Compensation Program (FWCP) conducts on Kootenay Lake. Monitoring was not included within DDMWORKS-3 as the existing KLNRP had a number of monitoring components already in place. However, prior to the WUPOR, it is prudent to evaluate the effectiveness of the DDMWORKS-3 contributions to date.

In preparation for the WUPOR this addendum will include two evaluation components: (a) evaluate the current DDMWORKS-3 contribution to determine if it is appropriate given the level of Kootenay Lake nutrient reduction associated with Duncan Dam operations; and (b) assess the KLNRP effectiveness to determine if the program is addressing the impacts on Kootenay Lake nutrient supply associated with Duncan Dam operations.

## **A2.0 Physical Works and Program Evaluation**

### **A2.1 Background – Kootenay Lake Nutrient Restoration Program**

The KLNRP began in 1992 in the North Arm of Kootenay Lake to address nutrient losses in Kootenay Lake as a result of the construction of Duncan Dam in 1967. In 2004, with funds from the Kootenai Tribe of Idaho (KTOI), the program was expanded to include the South Arm of Kootenay Lake as a result of the impacts of Libby Dam, which was constructed in 1973.

Duncan and Libby Dams have impacted native fish populations by permanently changing the hydrograph and resulting in a change to nutrient inputs to Kootenay Lake, flooding and/or blocking migration to spawning and rearing habitat, and decreasing downstream lake productivity, a process referred to as oligotrophication. Kokanee (*Onchorhynchus nerka*) stocks declined significantly through the 1980s as a result of the decreased productivity. In an effort to restore kokanee populations, which are the primary food source for Gerrard rainbow trout (*Oncorhynchus mykiss*) and bull trout (*Salvelinus confluentus*), a bottom-up approach was taken with the addition of nutrients (nitrogen and phosphorus in the form of liquid fertilizer) to increase phytoplankton populations that are suitable for the production of Daphnia, a main food source for kokanee.

The annual budget for the North Arm is over \$1M with funding from the FWCP (approx. 79%) and BC Hydro (approx. 18%) through DDMWORKS-3. KTOI provides additional funding (approx. \$800K) each year for the South Arm, resulting in annual project budget for the KLNRP of approximately \$1.8M.

Coordinated by FLNRORD, the KLNRP uses an adaptive management approach in an effort to restore lake productivity lost as a result of nutrient retention and uptake in upstream reservoirs. Annual reports summarizing program results and recommendations are prepared by FLNRORD and made available from EcoCat, once finalized (for additional Program information, see <http://fwcp.ca/app/uploads/2018/06/Info-Sheet-Columbia-Region-Nutrient-Restoration-Program-FAQ-Jul-1-2018.pdf>).

## **A2.2 Objective and Scope**

DDMWORKS-3 will extend annual funding an additional four years (2018 to 2021). In concurrence, Duncan Dam nutrient retention and DDMWORKS-3 contribution will be reviewed and evaluated to determine if the level of contribution reflects the level of impacts caused by Duncan Dam operations. The effectiveness of the DDMWORKS-3 contribution to the KLNRP will be assessed to determine if compensation for nutrient retention is being met. All evaluations will be completed by an independent reviewer.

## **A2.3 Methods – Program Evaluation**

### **A2.3.1 Component A: Evaluate Nutrient Retention by Duncan Dam Operations**

This component will evaluate if the current DDMWORKS-3 funding contribution is appropriate given the level of Kootenay Lake nutrient reduction associated with Duncan Dam operations.

Nutrient retention above Duncan Dam is affected by the dam footprint (i.e., as a result of the dam construction) and operations of the dam. Currently, compensation for retention effects on Kootenay Lake is provided through FWCP and DDMWORKS-3 to compensate for impacts caused by the footprint and dam operations (within the Columbia Treaty requirements), respectively.

The WUP Consultative Committee (CC) could not agree on funding of this physical works and requested the Fish Technical Subcommittee to make a recommendation. The subcommittee recommended the DDMWORKS-3 funding contribution as compensation based on preliminary analysis of nutrient retention caused by Duncan Dam operations within the constraints of the Columbia Treaty requirements. The objective of this component is to re-evaluate the amount of nutrient retention caused by operations beyond that caused by the presence of the dam and minimum Columbia Treaty requirements. The associated tasks under this component are described below.

#### **Task 1a: Literature Review and Methodology Development**

A literature review of external programs addressing nutrient retention caused by dam construction and operations will be conducted. This review will include the methodology of: i) addressing nutrient retention; ii) monitoring; and iii) effectiveness evaluations.

The objective of the literature review is to ensure the data available (either from the KLNRP reports or Task 2: additional monitoring) can provide the basis for a suitable model to predict effects of DDM operations on Kootenay Lake nutrient retention.

Based on the literature review, the awarded contractor will develop the methodology to complete Task 2: Data Collection, Modeling and Analysis for review by the Technical Review Committee (Task 1b).

#### **Task 1b: Technical Review Committee**

A Technical Review Committee (TRC) composed of representatives of BC Hydro, First Nations, agencies, and FWCP will assess the conclusions of Task 1a literature review and evaluate the methodology to complete Task 2 as proposed by the awarded contractor. Specialist support in limnology is likely to be required to support the TRC. The TRC will agree on the proposed methodology or provide revisions prior to implementing Task 2.

#### **Task 2a: Data Collection, Modeling and Analyses**

Task 2 methodology will be subject to review by the Technical Review Committee (Task 1b). It is anticipated field data collection will occur monthly over the course of one year.

The objective of this task is to: i) re-evaluate the amount of nutrient retention within Duncan reservoir caused by Duncan Dam operations. The operational component is defined as the difference in nutrient retention between status quo operation and a yet undefined operation which optimizes productivity in Kootenay Lake. The boundaries for the undefined operation are the minimum Columbia Treaty requirements and/or other hard constraints caused by the presence of the dam; ii) compare results to the WUP performance measure that was based on preliminary analysis of nutrient retention; and iii) assess if the current DDMWORKS-3 funding contribution is appropriate given the level of Kootenay Lake nutrient reduction associated with Duncan Dam operations within the minimum Columbia Treaty requirements.

#### **Task 3: Reporting and Technical Review**

A report will provide results of Component A: Tasks 1 and 2 including a detailed evaluation of Duncan reservoir nutrient retention based on data collected under this TOR addendum. The report will also assess if the DDMWORKS-3 WUP performance measure was accurate in predicting nutrient retention for Duncan reservoir and consider whether the current DDMWORKS-3 funding contribution is appropriate given the level of nutrient retention caused by Duncan dam operations beyond the Columbia Treaty requirements. All final interpretations from this study will be done in consideration of input from the TRC.

### **A2.3.2 Component B: Evaluate Effectiveness of Kootenay Lake Nutrient Restoration Program**

The effectiveness of the KLNRP will be evaluated under the FWCP Action Plan to determine if the DDMWORKS-3 funding contribution is compensating for the operational impacts of Duncan Dam nutrient retention on the productivity of lower trophic levels in Kootenay Lake. If the FWCP Action is not completed by January 2021, prior to the Duncan Dam Water Use Plan Order Review (DDM WUPOR), a TOR addendum will be submitted to complete this component under DDMWORKS-3.

## A2.4 Schedule

Annual payments to the Fish & Wildlife Compensation Program Columbia Region will commence December 2018 (retroactively) and continue to December 2021.

The effectiveness evaluation will be completed prior to January 2021 to support discussions of the WUPOR. If the FWCP Action is not completed by this date, a TOR revision will be submitted to complete Component B under DDMWORKS-3.

**Table 1: Proposed schedule for Component A of DDMWORKS-3 TOR Addendum.**

Task	Month / Year	Deliverables
1a. Literature Review and Methodology Development	November 2019 – December 2019	Proposed Task 2 methodology
1b. Technical Review Committee	January 2020	Review and approve Task 2 methodology
2a. Data Collection	February 2020 – January 2021	Progress reports
2b. Modeling and Analysis	February 2021 – March 2021	Progress reports
3a. Draft Report	April 2021 to May 2021	Draft report (May 31, 2020)
3b. Technical Review Committee	June 2021 - July 2021	Review draft report (July 15, 2021)
3c. Final Report	July 2021 – August 2021	Final Report (August 31, 2021)

## A2.5 Budget

The Kootenay Lake fertilization program funding amount recommended by the Consultative Committee is \$100,000 (in 2004 dollars; plus inflation) annually. The average annual dollar contribution from the Duncan WUP will be \$165,000 (17.5% of annual fertilization cost) for years 2018 to 2021. These costs are a single annual transfer of funds and expected to be incurred mid-year.

The budget for Component A: Evaluation of Nutrient Retention of Duncan Dam Operations is limited to \$56,569.

Component B: Evaluation of Effectiveness of Kootenay Lake Nutrient Restoration Program will be funded through the FWCP Action Plan. If the effectiveness evaluation is not complete by January 2021, additional budget will be required to conduct an effectiveness evaluation under a DDMWORKS-3 addendum.

The total cost estimate of the project is 716,569\$

## A3.0 References

BC Hydro. 2008. Physical Works Terms of Reference: DDMWORKS#3 – Kootenay Lake Nutrient Loading Funding.

Order of the Comptroller of Water Rights, for Duncan Dam and Duncan Reservoir.