Columbia Water Use Plan

Physical Works Terms of Reference

CLBWORKS-30B Arrow Lakes Reservoir Wildlife Enhancement Program (Arrow Lakes Reservoir)

September 20, 2016

CLBWORKS-30B Arrow Lakes Reservoir Wildlife Enhancement Program (Arrow Lakes Reservoir) - Physical Works Terms of Reference

1.0 Introduction

This Terms of Reference is for the identification and definition phases of wildlife physical works enhancement program in the Arrow Lakes reservoir, for the area outside of Revelstoke Reach. It is submitted in response to the *Water Act* Order issued by the Comptroller of Water Rights on January 26, 2007 Conditional list, Clause 7(a). The Order requires terms of reference for "*physical works to improve conditions for nesting and migratory birds and wildlife in general within the drawdown zone of Arrow Reservoir*." Clause 7(a) is similar to Clause 4(a), which requires physical works program in Revelstoke Reach, and is currently underway with CLBWORKS-30A: Arrow Lakes Reservoir Wildlife Enhancement Program (Revelstoke Reach)

This Terms of Reference builds on the conceptual design work undertaken under CLBWORKS-29B: Arrow Lakes Reservoir: Study of High-Value Wildlife Habitat for Potential Enhancement and Protection with study report from 2012 and updated in 2016 (in draft).

2.0 Project Objectives

The overall objective of CLBWORKS-30B will be to construct a physical works that meets the Order requirement of improving conditions for wildlife. This will be accomplished by creating, protecting, or enhancing habitat for nesting and migratory birds and wildlife.

CLBWORKS-29B recommended two ways by which habitat can made more suitable for wildlife. These include:

- Increasing the spatial and temporal availability of shallow wetland habitat for wildlife in the drawdown zone; and
- Enhancing the habitat complexity and/or habitat suitability for a number of groups of wildlife.

Consequently, the conceptual designs in CLBWORKS-29B are intended to create, protect or enhance the availability of shallow wetland areas in the drawdown zone, and to increase the heterogeneity of the vegetated areas which enhances habitat complexity.

In addition to the primary Order objectives, there may be other objectives that could factor into the evaluation of proposed locations for physical works. These will be developed further within the scope of this TOR. Some potential objectives may include (but are not limited to):

- Safety (e.g., safety considerations during construction or public safety considerations of the designed works);
- Cost (e.g., construction cost and ongoing maintenance);
- Stakeholder or community considerations;

- Implementation complexity (e.g., high/low construction complexity due to accessibility, site conditions etc.); and
- Risks (e.g., are there any residual environmental or other risks not easily mitigated/managed).

3.0 Linkages with Other Columbia Projects Water Use Plan Projects

In addition to CLBWORKS-29B, the CLBWORKS-30B project has linkages with the following projects and has drawn upon information gathered and reported from these projects in the preparation of the conceptual designs:

- CLBMON-11B: Arrow Revegetation and Wildlife Physical Works: Wildlife effectiveness monitoring and enhancement area identification for lower and mid-Arrow lakes Reservoir. This project provided information for the baseline biological monitoring, and will include biological monitoring post-construction.

- CLBMON-12: Arrow Lakes Reservoir Monitoring of Revegetation Efforts and Vegetation Composition Analysis; and

- CLBMON-37: Arrow Lakes Reservoirs: Amphibian and Reptile Life History and Habitat Use Assessment.

4.0 Background

During the Water Use Planning process, the Consultative Committee (CC) supported the implementation of wildlife physical works in the Arrow Reservoir in lieu of changes to reservoir operations to enhance the wildlife and wildlife habitat. No specific sites for potential enhancements were identified by the Consultative Committee for the mid or lower Arrow Lakes, unlike the area of Revelstoke Reach for which over 40 sites were identified (Consultative Committee Report, Volume 2, Appendix DD).

The Columbia Water Use Plan (WUP) recommended that a feasibility study and risk assessment be undertaken to address the target wildlife species and ecological communities, engineering design and hydrology, and potential impacts on First Nation and stakeholder interests. The WUP also recommended following an adaptive approach with small-scale soft-engineered structures to take advantage of existing landforms in the drawdown zone to improve habitat functioning.

Baseline monitoring data was initiated under CLBMON-11B – Arrow Revegetation and Wildlife Physical Works[1] at the potential sites, and post-monitoring will continue following the implementation of the works. Information from CLBMON-11B has been incorporated into the development of the conceptual designs in CLBWORKS-29B (2012 and 2016 DRAFT).

In the 2012 report for CLBWORKS-29B, it was noted that the opportunity for improving wildlife habitat in the drawdown zone of mid- and lower Arrow Lakes Reservoir was limited by topography. Much of the drawdown zone is steep and rocky

[1] The CLBMON-11B also monitors the biological impacts of revegetation undertaken in CLBWORKS-2 Mid-Columbia and Arrow Lakes Reservoir Revegetation Program.

and does not provide the opportunity to implement physical works. Consequently, the CLBWORKS-29B report identified locations that are relatively flat.

CLBWORKS-29B (2012) identified five different locations and proposed conceptual designs intended to improve wildlife habitat suitability in the drawdown zone of Arrow Lakes Reservoir either directly by creating habitat or indirectly by improving existing wildlife habitat in the drawdown zone of mid- and lower Arrow Lakes Reservoir. These were identified following stakeholder meetings in 2010 and field assessments. The five locations were: Burton Flats, Edgewood South, Lower Inonoaklin Road, Edgewood North, and Dog Creek.

CLBWORKS-29B developed preliminary habitat prescriptions for three of the sites intended to create, preserve, or enhance shallow wetland habitat.[2] The prescriptions considered factors such as topography, elevation, substrate, hydrology, disturbance, land ownership, existing wildlife habitat, and access. The three sites are as follows and are shown in Figure 1 below:

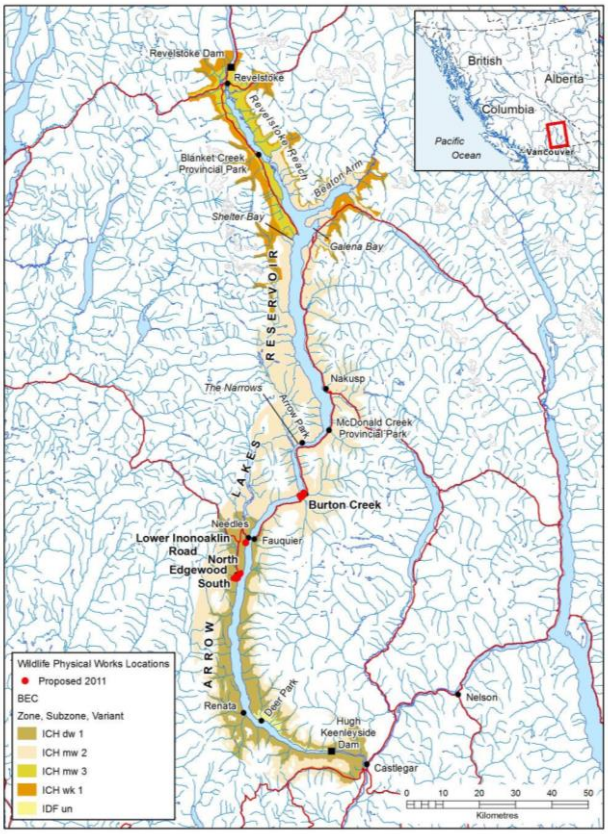
1) Burton Creek – creating 2.8 ha of shallow wetland habitat;

2) Lower Inonoaklin Road – protecting 6.2 ha of shallow wetland habitat; and

3) Edgewood South – enhancing 1.17 ha of shallow wetland habitat.

[2] The habitat enhancement at Edgewood North for Western Skink and Rubber Boa habitat improvement was put forward as a Fish and Wildlife Compensation project in 2011 and included minor vegetation removal and thus excluded from the options. Additionally the habitat enhancement project at Dog Creek for fish habitat was eliminated from further consideration as it was not related to wildlife per the Order.

Figure 1: Locations of physical works prescriptions included in CLBWORKS-29B



The three projects are briefly described below. The full description can be found in the CLBWORK-29B reports (2012 and 2016 DRAFT).

Note that alternate conceptual designs may be considered following the technical assessments should there be technical limitations to the projects proposed below.

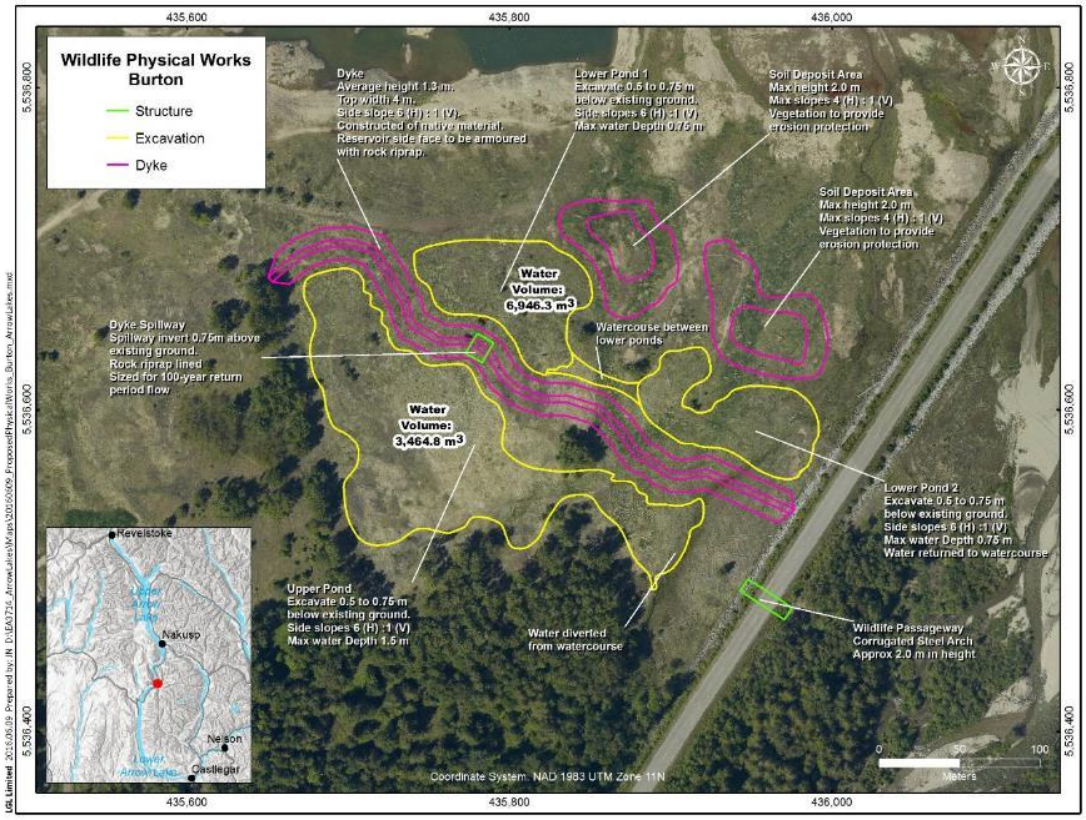
4.1 Conceptual Design – Burton Creek location

The proposed works at Burton Creek are intended to create **new** shallow wetland habitat. Burton Creek is located south of Nakusp, on the east side of Arrow Lakes reservoir. The site is currently a depression with low species diversity. The current habitat suitability is low due to the high cover of non-native Reed Canarygrass, temporal constraints on habitat availability, and the seasonal use of by motorized recreational vehicles. Due to the lack of regularly available water, the site is not currently suitable for waterfowl, aquatic invertebrates, or macrophytes. There is generally low habitat diversity currently at the site, though there is use by songbirds (likely from the adjacent wooded areas), amphibians and some reptiles.

The proposed project would **create** approximately 2.8 ha of shallow wetland habitat through a combination of site excavation and dyke construction. The proposed dike would be ~390 m in length and have a top height of 0.5 to 1.8 m. It would be expected to extend the range of wetted habitat by 88 days per year. Additionally, it

would delay flooding of the site from reservoir inundation. The type of wetland created would consist of open water with submerged and floating macrophytes.

Figure 2: Schematic of Conceptual Design for Works at Burton Creek

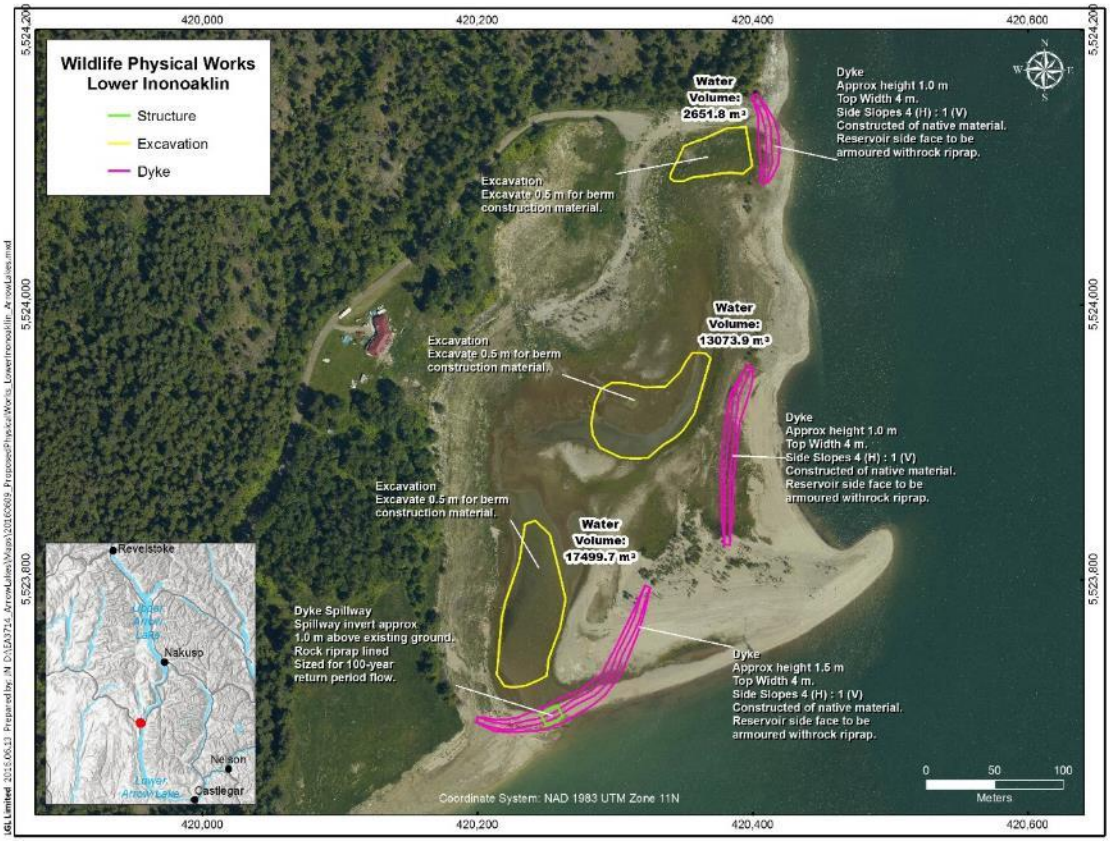


4.2 Conceptual Design – Lower Inonoaklin Road location

At Lower Inonoaklin Road, the works proposed is intended to **protect** the shallow wetland habitat that currently exists. Lower Inonoaklin Road (also known as Porcupine Island) is located immediately south of Needles on the west side of the reservoir. The site is currently a narrow linear pond with a soft mud bottom. The existing shallow wetland habitat provides high suitability wildlife habitat, particularly for waterfowl, shorebirds, and pond-breeding amphibians.

The proposed project would protect the site by delaying reservoir inundation, allowing more wildlife to complete their life cycle. It involves the construction of three dykes (63, 128 and 171 m long), which would protect the existing wetland, and would extend the range of availability of the wetland habitat on an annual basis from 57-174 days to 112-214 days.

Figure 3: Schematic of Conceptual Design for Works at Lower Inonoaklin Road



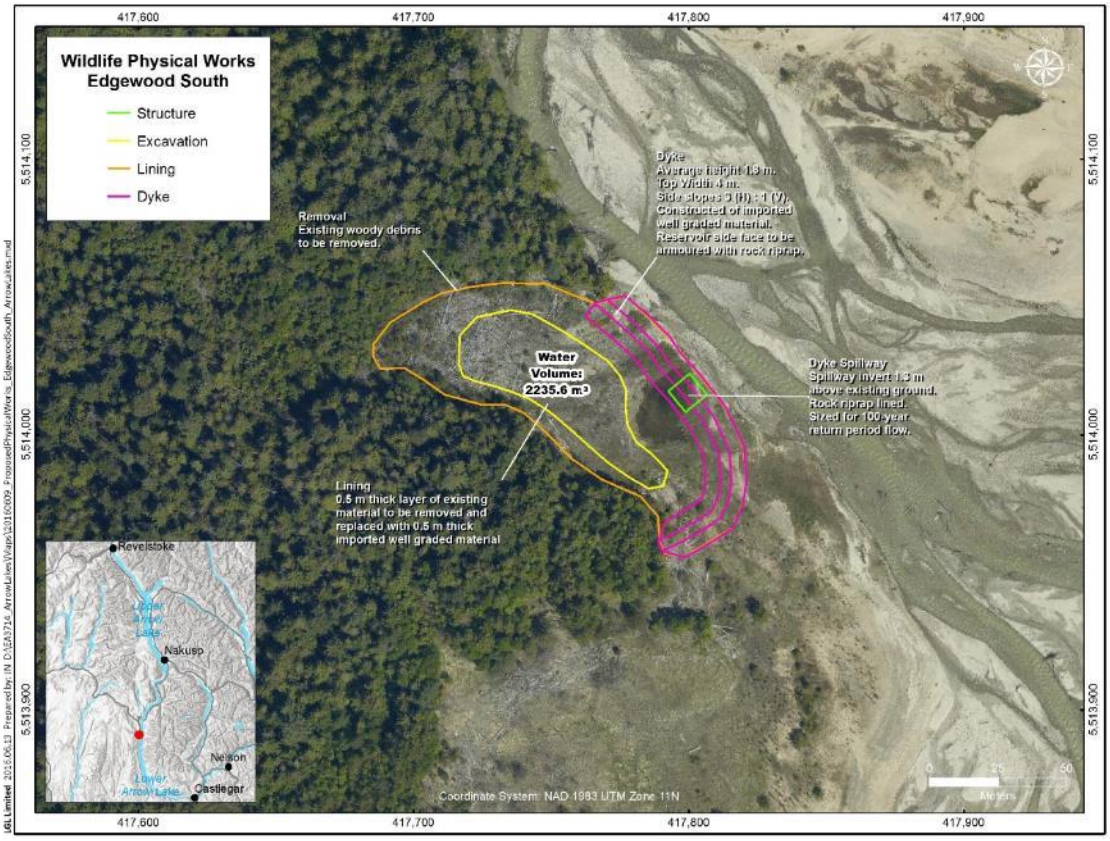
4.3 Conceptual Design – Edgewood South location

The third site of potential physical works involves enlarging an existing small wetland pond at Edgewood South to **enhance** the shallow wetland habitat. The site is adjacent to Eagle Creek, south of the town of Edgewood on the west side of the Arrow Lakes reservoir. The project involves the construction of a dyke approximately 115 m long with excavation to increase the volume of water retained for a longer duration.

Currently, wildlife use at the site is extensive: songbirds, raptors, waterfowl, amphibians, reptiles, insects, bats, ungulates, and large mammals have been regularly observed at the site.

It is expected the works will create a larger shallow wetland which would extend the range of availability by 94 days. As the site is already highly productive, this project carries the most risk that the existing functional wetland could be negatively impacted.

Figure 4: Schematic of Conceptual Design for Works at Edgewood South



4.4 Summary and Comparison of Sites

The full comparison of the three sites described in CBLWORKS-29B (2016 DRAFT) is shown in Figure 5 below including a preliminary estimate of costs and a priority ranking.

Figure 5: Summary of Physical Works Prescriptions in CLBWORKS-29B[3]

Category	Component	Location and Expected Direction of Change With Physical Works					
		Burton Creek	Change	Lower In. Rd.	Change	Edgewood South	Change
Project Overview	Existing Habitat	VDZ	SWH	SWH	None	SWH	None
	Proposed Habitat	SWH	In place of VDZ	SWH	None	SWH	Expansion of Area
	Restoration Approach	Habitat Creation		Habitat Protection		Habitat Enhancement	
	Total Area (ha)	0	⇧ 2.8	6.2	⇔ 0 (6.2 ha)	0.13	⇧ 1.17
	Water Depth (m)	0	⇧ 0.5 - 1.5	0 - 1.5	⇔ 0 - 1.5	0 - 1.5	⇔ 0 - 1.5
	Temporal Availability (days-year; range)	73 - 214	⇧ 161 - 214	57 - 174	⇧ 112 - 214	69 - 214	⇧ 165 - 214
	Change to Existing Values	Increase habitat heterogeneity via wetland creation with commensurate increases to species richness; biodiversity. Net benefit to wildlife/habitat in DDZ.		Retention of existing shallow wetland habitat value, but inundation occurs later in year. Hydrology of site unknown. Requires investigation.		Increase total area of shallow wetland habitat in the drawdown zone, but existing habitat could be negatively affected.	
	Overall Risk of Project (in terms of ecological benefit)	Low ▲	Area is a grassy field with low species diversity. Works will increase habitat suitability.	Moderate ▲	Existing wetland unlikely to be negatively affected unless berms preclude recharging of wetland.	Moderate to High ▲ or ▲	Potential for negative impact to existing functional wetland.
	Project Summary	Creation of ~2.8 ha of wetland habitat in an area currently dominated by a grassy meadow with low habitat heterogeneity. Wetland habitat would increase habitat suitability even for those groups already associated with a high overall rating (see below).		Existing wetland would be retained, but protected from inundation until later in the year, making habitat available for wildlife longer. The hydrology of the site requires further investigation.		Expanding the wetland would create a larger wetland habitat, which will benefit many species, but there is a risk that the existing wetland could be negatively impacted.	
	Project Priority and Benefit	1	Greatest potential for increasing ecological value of DDZ.	2	Good value, high probability of increasing ecological value of DDZ, but some uncertainties remain.	3	Highest overall risk to ecological integrity of existing habitat. Large upside possible, but risk too great.
Cost	Estimated Cost ($1,000's) +50%/-15%	$ 1,032	Includes optional cost of property purchase (385K)	$ 352		$ 405	

Category	Component	Location and Direction of Change With Physical Works					
		Burton Creek	Change	Lower In. Rd.	Change	Edgewood South	Change
Current Conditions and Assessment of Benefit from Proposed Physical Works	Terrestrial Vegetation	Low	⇔	Moderate	⇔	Low	⇔
	Aquatic Macrophytes	Low/Nil	⇧	Low	⇔	Moderate	⇩ or ⇔
	Waterfowl	Low/Nil	⇧	Moderate	⇧ or ⇔	Low	⇧ or ⇔
	Songbirds	High	⇧ or ⇔	High	⇔	High	⇧ or ⇔
	Amphibians	High	⇧ or ⇔	High	⇧ or ⇔	High	⇩ or ⇔
	Reptiles	Moderate	⇧ or ⇔	High	⇔	High	⇩ or ⇔
	Mammals (incl. bats)	Moderate	⇧ or ⇔	Moderate	⇧ or ⇔	Moderate	⇧ or ⇔
	Aquatic Invertebrates	Low/Nil	? ⇧	Low	? ⇧	No Data	⇩ ? ⇧
	Terrestrial / Aerial Invertebrates	Moderate	⇧ or ⇔	No Data	⇧ or ⇔	Moderate	⇩ or ⇔
	Habitat Diversity	Low	⇧	High	⇧ or ⇔	High	⇩ or ⇔
Species with Conservation Designation	Provincial Blue-list	3	None expected	3	None expected	3	None expected
	COSEWIC Special Concern	1	None expected	3	None expected	1	None expected
	SARA Sched.1	2	None expected	4	None expected	2	None expected
	COSEWIC Endangered	1	None expected	1	None expected	1	None expected
Proposed Dikes	No.	1		3		1	
	Length (m)	390		63 128 171		115	
	Dike Elevation (m ASL; max)	439		438.5		439.2	
	Height (m)	0.5 - 1.8 m		0.5 - 1.5 m		0.5 - 1.5 m	
Impoundments / Ponds	Number of Excavations	2		3*		1	
	Total Volume of Water (m3)	6946.3 3,464.8		13,073,9 2,651.8 17,499.7		2,235.6	
Proposed Earth Works	Soil Mounds	2		0		0	
	Excavation Required?	Yes		No		Yes	
	Excavation Depth	30 to 50 cm		N/A		30 to 50 cm	
	On-site Materials?	Yes		No		No	
	Off-site Dumping?	No		N/A		Yes	
Regulations/Permits/Acts		All		All		All	
BMPs		All		All		All	
Conservation Water Licence		Yes		Yes*		Yes	
Archaeology	AIA Required?	Yes		Yes		Yes	

The CLBWORKS-29B reports ranked the three prescription locations in order of priority as illustrated in the following table:

	Rank in 2012 report	Rank in 2016 DRAFT report
Burton Creek	2	1
Lower Inonoaklin Road	1	2
Edgewood South	3	3

[3] vDZ: vegetated drawdown zone; SWH: shallow wetland habitat. Green arrow indicates predicted improvement, yellow no change relative to current conditions, red indicates a possible negative impact. Green triangle indicates proceed, yellow uncertainty remains; red indicates caution as project has risks to existing habitat. * indicates excavations may not be required and if not, a Conservation Water Licence may not be necessary.

This ranking changed due to greater consideration of risks of the existing habitat conditions, collection of wildlife usage data from 2011 to 2015, and greater awareness of stakeholder interests. In both cases, the Edgewood South project ranked third. Currently the suitability of habitat for wildlife at Lower Inonoaklin Road and Edgewood South are considered to be greater than that of the current conditions at Burton Creek. The 2016 report concluded that there is a greater risk to the existing habitat at Edgewood South than at the other two locations. As the costs for Edgewood South are approximately the same as Lower Inonoaklin, with higher risk, BC Hydro does not propose to advance the Edgewood South location through to the next phase of assessment, unless information gathered regarding the other two sites affects their viability.

4.5 Remaining Uncertainties

While the Burton Creek site may have the potential for greater benefits than Lower Inonoaklin, the early cost estimates suggest a significantly higher cost (this is partly due to an adjacent land purchase). Given the relatively high degree of uncertainties in these estimates, additional assessments are required before proceeding to recommendations. The uncertainties to be addressed include:

- Archaeological impact assessments of the sites;
- Geotechnical and hydro technical analysis of the sites, including detailed soil analysis at each site;
- Environmental management plans and considerations;
- Properties access and considerations;
- Permitting; and
- Cost estimates.

The work undertaken under this TOR will attempt to reduce these uncertainties prior to making recommendations for implementation (i.e., construction). This may lead to the development of alternative prescriptions and designs at any of the proposed locations. The approach and phases are described further below.

4.6 Approach to Physical Works

Water Use Plan physical works projects typically progress sequentially through the following phases: Identification/Feasibility, Definition, Implementation, and Monitoring and Maintenance. The general descriptions of these phases are as follows:

1) **Identification/Feasibility:** This phase typically includes the needs assessment, conceptual design and the feasibility design. In many cases, the Identification phase was initiated as part of the WUP development process. In this case, the CC identified the need for wildlife habitat enhancements, and the conceptual design was undertaken as part of CLBWORKS-29B. Additional work is required to complete the technical feasibility (included in this TOR). This phase also generally includes First Nations and some stakeholder engagement, which helps to refine the options.

2) **Definition Phase:** The purpose of this phase is to refine the technically feasible option(s) identified in the previous phase and propose recommendation(s) for a preferred option(s). Generally, the preferred design is developed from conceptual

to preliminary design, and may even include the detailed design in this phase given the lower complexity of these projects relative to highly engineered generating plant projects. The Definition phase typically includes initiating regulatory approvals, including permitting. BC Hydro will seek CWR approval at the end of the Definition Stage of the recommended design(s), prior to proceeding to construction in the Implementation phase.

3) **Implementation Phase**: In this phase, the construction of the works occurs. In a subsequent TOR, BC Hydro will submit for the completion of the following:

   - Designs of the selected option(s) for the recommended option(s);
   - Preparation of the final 'Issued for Construction' drawings;
   - Any outstanding permitting, if required;
   - Construction of the physical works; and
   - Completion reporting including operations and maintenance manual preparation, as appropriate.

4) **Monitoring Inspections and Maintenance:** Following the completion of the construction, BC Hydro will typically develop a program of monitoring inspections and maintenance, if required, to ensure that the physical structures function as designed. This should be differentiated from post-construction monitoring of the biological effectiveness of the constructed works, which is typically undertaken as part of related a Water Use Plan monitoring project – and related to another Order clause and TOR.

5.0 Approach: Identification Phase

5.1 Outcomes: Identification/Feasibility Phase

In addition to the overall project objectives, there are expected outcomes or deliverables anticipated from each phase. The key outcome of the Identification phase will be recommendations of technically, environmentally, and archaeologically sound option(s). These will be summarized in a feasibility report that will include:

- A detailed profile for each candidate site location;
- Feasible design option(s) for meeting the project objective(s);
- Description of each design option for each appropriate evaluation criteria; and
- Recommendations.

5.2 Work Steps – Identification Phase

Task 1: Project Coordination

Project coordination involves the general administration and technical oversight of the program, which will include, but not be limited to: 1) budget management, 2) study team oversight, 3) logistics coordination, and 4) technical oversight in field and analysis components.

Task 2: Engineering Technical Feasibility

Preliminary engineering assessments of candidate site upgrades identified in Task 2 will be performed using existing civil engineering, geotechnical, hydro technical, and soils analysis, site visit, and expert opinion.

This process will identify engineering challenges and provide solutions and/or engineering options for each location. This step may also include alternatives to hard-engineered designs (e.g., using wetland restoration techniques). It is anticipated that the preliminary engineering assessments will occur concurrently with archaeological and environmental assessments (Tasks 3 and 4).

Estimated annual maintenance requirements (cost and scope) will be estimated as part of the feasibility study. This will include inspections plus an estimate of structural maintenance requirements as necessary.

Task 3: Archaeological Assessment

As the three prescriptions in CLBWORK-20B were identified having high archaeological potential, an Archaeological Impact Assessment (AIA) was recommended for each. Given the long lead times necessary for permitting, BC Hydro has submitted a separate request to the CWR for approval of scope and budget associated with archaeological impact assessments of the Burton South and Lower Inonoaklin Road locations.

Task 4: Environment Management Plans

The preliminary environmental assessment has already undertaken an assessment of the candidate sites in CLBWORKS-29B (2012 and 2016 DRAFT).

In developing the more detailed designs, a registered professional biologist (RPBio) will be responsible for ensuring that sensitive areas near the proposed works have been identified, proposing alternative design options as required, suggesting methods for avoiding impacts, or providing mitigation plans for each location. These environmental requirements will be incorporated into an Environmental Management Plan.

The biologist will also be responsible for liaising with the necessary environmental regulatory agencies to confirm regulatory requirements for the proposed options to build into the Definition phase.

Additionally, we will also undertake a review of the proposed designs by a wetland restoration expert to ensure that opportunities for enhancement are validated and risks to existing wetlands are identified, and where possible mitigated or managed.

Task: 5: Other Considerations, as appropriate

There may be other considerations that require further development in this phase. For example, adjacent property considerations may require early development of a properties plan – based on property ownership, and tenure conditions and requirements.

Task 6: Reporting

It is anticipated the feasibility study will entail three components:

1) Engineering technical feasibility;
2) Archaeological recommendations (incorporated from the separate AIA report);
3) Environmental management plans; and
4) Other considerations.

Engineering Technical Feasibility

A detailed technical report outlining the findings from the site visit and investigation will be prepared. Engineering aspects for each site will be discussed and notes made where it is believed the site will prove difficult and / or infeasible. The report will include site-specific details as to what is deemed feasible for each location, including an approximate cost estimate for each of the alternatives. Designs should accompany the report. The report may provide a recommendation of the most technically feasible option.

Environmental Feasibility and Management Plans

A report detailing the seasonal conditions and circumstances at each site will be prepared, including site-specific recommendations on how to proceed with work in a manner that satisfies environmental concerns. Any mitigating measures and permitting requirements related to environmental concerns will be confirmed by the biologist. Procedures on how to secure all regulatory permits will be documented.

Task 7: Engagement

Additional First Nations and local stakeholder engagement (communities, agencies) on feasible site prescription(s) may be undertaken to ensure local considerations are reflected in the final recommendations.

Task 8: Recommendations

The recommendation will be developed based on a review of the technical feasibility study, the environmental and engineering assessments, the AIA report and from agency, stakeholder, First Nations, and public input. The recommendations will be built into the Terms of Reference for the Implementation phase.

6.0 Definition Phase

6.1 Outcomes – Definition Phase

The scope of the Definition Phase includes the development of the designs and plans for the recommended site(s) from the previous phase, and obtaining all of the necessary permits to be able to proceed, once CWR approval is obtained.

The Definition phase deliverables will include:

- Estimated budget (+15%/-10%)
- Design drawings including Issued for Construction (IFC) drawings;
- Materials specifications

- Permits secured and regulatory approvals; and
- Expected construction approach, plans and schedule.

A TOR will be submitted to the CWR for Implementation prior to construction.

6.2 Work steps – Definition Phase

Task 9: Design and Specifications

Site-specific plans will be developed for recommended option(s). These include, but are not limited to:

- Develop engineering specifications: Design standards for engineering will meet professional standards and will be reviewed by BC Hydro or BC Hydro's representative (e.g., owner's engineer);

- Undertake a Constructability Review – establish construction methods, equipment requirements, site work layouts and constraints;

- Prepare construction cost estimates: This may involve tendering, early stage procurement, or other estimation methods to ensure construction costs estimates are within the +15%/-10% tolerances.

Task 10: Seek regulatory approvals

Typically, permits are sought in this phase. However, given the long lead times, it may be necessary to initiate permit applications at an earlier stage (i.e., during Identification phase) on multiple options to ensure that permits are available for the construction windows (e.g., water conservation licences). It is not anticipated this would add significant costs, but will greatly facilitate scheduling flexibility, given the variability of the elevation levels of the Arrow Lakes reservoir.

Task 11: Develop relevant plans

A few construction-related plans will be developed for managing the work during construction. These include (but are not limited to) the following:

- Communications plan: This plan covers the signs, notifications, site closures notices etc. during construction;

- Safety Plan/Public Safety Plan: for managing public access to the site during construction;

- Heritage Management Plan: for managing archaeological risks during construction; and

- Final Environmental Protection Plan: for managing environmental risks during construction.

7.0 Project Risks

At this stage, the identified projects risks are listed below with the proposed mitigation/management.

Risk	Mitigation
The variability of the reservoir and difficulty predicting future levels creates risks and challenges for scheduling: the construction window is often not predictable and we may only have one winter window within which to build the works creating scheduling challenges for resources and contractors.	Rather than undertaking all tasks sequentially, BC Hydro will undertake more tasks concurrently to create more flexibility for scheduling construction.
High archaeological values in the area may affect the viability of constructing wetlands or dykes at the site locations.	BC Hydro has advanced the funding and scheduling of Archaeological Impact Assessments separate from this TOR.
Long lead times associated with permitting can result in missing a construction window.	Permits may be sought on more than one location to ensure that critical path tasks do not limit opportunities for construction.
Multiple stakeholder objectives: Not all stakeholders' objectives may be satisfied by any one option.	BC Hydro will seek First Nations and community input to attempt to balance the objectives of multiple stakeholders while ensuring the objectives of the Order are met.
Current high functioning habitats may be negatively altered by the physical works.	BC Hydro will seek to advance projects with the greatest opportunity for enhancement, and the lowest risk by engaging a wetland restoration expert in an advisory role.

8.0 Schedule

The tasks will be undertaken in 2016 and 2017, as reservoir levels allow.

9.0 Budget

Total program cost: $207,541.

10.0 References

Order of the Comptroller of Water Rights dated January 26, 2007

Columbia Project Water Use Plan, Revised for Acceptance by the Comptroller of Water Rights dated January 11, 2007.

Columbia Project, Consultative Committee Report Volumes 1 and 1, July 2005

Golder. 2009. CLBWORKS-29A Phase II. Arrow Lakes Reservoir wildlife physical works feasibility study phase II. Unpublished report by Golder Associates, Kamloops, for BC Hydro, Castlegar, BC.

Hawkes, V.C., M.T. Miller, J.D. Fenneman and N. Winchester. 2011. CLBMON-11B4 Monitoring Wetland and Riparian Habitat in Revelstoke Reach in Response to Wildlife Physical Habitat Works. Annual Report – 2010. Report EA3232 to BC Hydro, Burnaby, BC.

Hawkes, V.C. and J. Howard. 2012. CLBMON-11B. Wildlife effectiveness monitoring and enhancement area identification for lower and mid-Arrow Lakes Reservoir: CLBWORKS-29B. Mid- and lower Arrow Lakes Reservoir wildlife enhancement prescriptions. LGL Report EA3274 for B.C. Hydro Generation, Water Licence Requirements, Burnaby, BC.

Hawkes, V.C. and K. Tuttle. 2016 DRAFT. CLBMON-11B. Wildlife effectiveness monitoring and enhancement area identification for lower and mid-Arrow Lakes Reservoir: CLBWORKS-29B. Mid- and lower Arrow Lakes Reservoir wildlife enhancement prescriptions. LGL Report EA3274 for B.C. Hydro Generation, Water License Requirements, Burnaby, BC.