Campbell River Project Water Use Plan

Monitoring Program Terms of Reference

- **JHTMON-11 Upper Campbell Lake Reservoir Erosion Assessment**

Revision 1
July 12, 2017

JHTMON-11 Upper Campbell Lake Reservoir Erosion Assessment Monitoring Program Terms of Reference - Revision 1

Revision Rationale

The purpose of this Revision is to focus the project on providing sufficient information to determine the risk of erosion on the private properties identified within the scope of work. Understanding this risk will inform decisions on any next steps that may be required to mitigate that risk. The deliverable from this project will be an assessment report that will provide a recommendation for an overall reservoir shoreline impact line for the entire study area.

Table 1: Key changes and rationale to the JHTMON-11 TOR Revision 1

Section	Change	Rationale
Overall	• Clarifications of language throughout the document.	• Clarify relevant background information and focus objective and approach on providing a better understanding of reservoir shoreline impact risk.
Section 1.1	• General editing to focus on relevant background for the study from Order and Consultative Committee Report.	• Clarify background and intent of this study.
Section 1.2	• Clarified wording of the management questions • Provided additional information about how the study will address the Management Questions. • Removed the concept of impact hypothesis testing.	• Clarify that only the first management question will be addressed by the current scope of the study and that the second management question will only become relevant if a decision is made to proceed with physical works as a means to mitigate erosion impacts. • The relevance of management question 2 will only be determined at a later phase of work. • Hypothesis testing is not relevant to the study design as the study is currently focussed on identifying shoreline erosion risk rather than measuring change over time.
Section 1.3	• Edited for clarity.	• Clarified how the results of this study could be considered in future operational management decisions.
Section 2	• This section was extensively edited to refocus the approach and methods.	• Focused the approach and methods of the study on gathering information that will provide a better understanding of reservoir shoreline impact risk.
Remainder of document	• Minor edits	• Ensure clarity.

1 Monitoring Program Rationale

1.1 Background

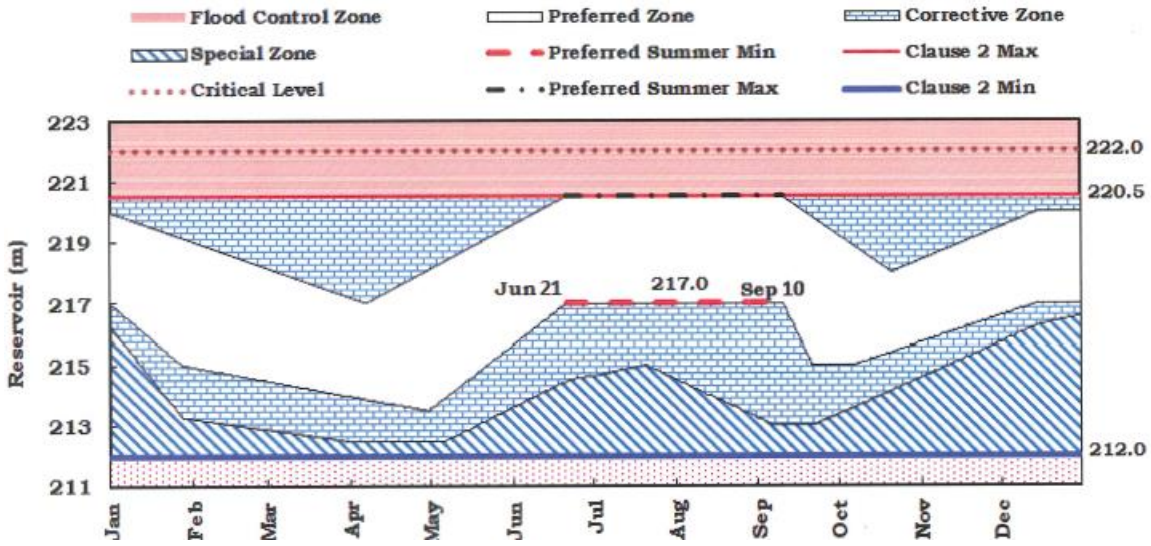
Erosion of shorelines around the Upper Campbell Lake Reservoir (Upper Reservoir) was raised as a concern during Campbell River Water Use Plan (John Hart - JHT WUP) Consultative Committee (CC) discussions by CC members representing residents of Cedar Creek and Strathcona Park subdivisions, and the owners of the Strathcona Park Lodge. The 1997 Interim Flow Management Strategy (IFMS, Campbell River Hydro/Fisheries Advisory Committee), which resulted in an increase in maximum normal reservoir elevations of approximately 1 m over historical operations may have accelerated natural processes that could affect shoreline slope stability.

Previous studies on the Upper Reservoir have indicated that shoreline erosion is influenced primarily by the erosive action of wind-generated waves acting on the upper portion of the existing beach profile (BC Hydro, 1995). While this erosive action has attained a degree of stabilization from years of impoundment, the shoreline is still impacted by wave action, and upland areas, above the beach, may be subject to erosion and/or landsliding when the reservoir is surcharged.

Licence operations prior to 1997 were a maximum of El. 221.0 m, after 1997, this maximum was raised to El. 222.0 m under the IFMS. Subsequently, the CC recommended that the maximum “normal” operating condition for the reservoir be reduced from El. 222 m to El. 220.5 m, which was fully implemented under the current Order issued to BC Hydro by the Comptroller of Water Rights (CWR) for the Campbell River system dated November 21, 2012. Although not an operating constraint, the system is managed below the “preferred” maximum elevation except during very high inflow conditions. The CC also recommended that conditions at the three areas of concern be monitored, and mitigation be considered using “soft” engineering techniques at critical locations.

These Terms of Reference (TOR) are submitted in response to the *Water Act* Order issued by the CWR on November 21, 2012, Schedule C, Clause 1(a) and 2(a). The Order requires terms of reference for the “identification of erosion concerns at Cedar Creek Subdivision, Strathcona Park Subdivision and Strathcona Park Lodge, and plans to address the erosion concerns”, and to “monitor rates of erosion at selected sites on the Upper Reservoir”.

Figure 1 Upper Campbell Lake and Buttle Lake Reservoir (Upper Reservoir) Operations



1.2 Management Questions

In developing these Terms of Reference for the monitoring program on behalf of the Consultative Committee, the Recreation Technical Committee wished to see the following questions addressed:

1) What is the relationship between the Upper Reservoir operations and shoreline erosion at the areas of concern identified by the Consultative Committee?

2) If implemented, how effective are physical works in controlling erosion at the areas of concern identified by the Consultative Committee?

Areas of concern for shoreline erosion that were identified by the CC include:

- Cedar Creek Subdivision;
- Strathcona Park Subdivision; and
- Strathcona Park Lodge.

Determining an answer to the second management question about the effectiveness of physical works at controlling erosion will only be considered if any physical works are in place, and if physical works are determined to be an appropriate and feasible approach to managing risk following investigation under this project. An assessment of the shoreline at the areas of concern and an accurate assessment of property boundaries will be necessary to determine if there may be immediate or long-term risk requiring further action. In addition, in the event that mitigation in the form of physical works is determined to be appropriate and feasible, consideration of a variety of conceptual options will be reviewed for feasibility in a future phase of work.

In order to gather enough information about the erosion risk to private properties within the areas of concern and to provide information to answer the Management Questions, this project will be conducted in phases as follows:

Phase 1:

- Determine the relationship between existing shoreline impacts from reservoir operations and the reasonably foreseeable reservoir impacts[1] to private properties.

Phase 2:

- Consider if erosion monitoring and periodic review are necessary where there is uncertainty about whether a specific private property may be at risk.
- If there is a risk of reservoir impacts on private property, determine if there is a demonstrated need to address erosion risks to safeguard the integrity of private property and related improvements.

Phase 3 - If mitigating risk of shoreline impacts on private property in the form of physical works is determined to be an appropriate and feasible approach following investigation under this project, then:

- Develop conceptual strategies for addressing erosion risk at critical sites.
- If the implementation of protective physical works is determined to be an appropriate option by BC Hydro and the CWR to address erosion risk at critical sites, complete the design and implementation of such protective works, and develop a monitoring program to determine its effectiveness.

The Phases listed above are described in more detail in Section 2.3 below.

1.3 Key Water Use Decision

BC Hydro is required to maintain a maximum “preferred” reservoir operating condition at El. 220.5 m under the current Order issued by the CWR. Results from this study will inform future discussions about the relationship between reservoir operations and reservoir impacts and whether El 220.5 m has provided a net benefit to mitigating these impacts.

2 Program Proposal

2.1 Objectives

The current objective of this monitoring program is to complete an assessment to evaluate past and existing reservoir operations and determine the potential impacts of reservoir operations to private properties at Cedar Creek Subdivision, Strathcona Park Subdivision, and Strathcona Park Lodge.

2.2 Scope of work

The study area is limited to three areas of concern within a small portion of the Upper Reservoir (see Figure 2):

- Cedar Creek Subdivision;
- Strathcona Park Lodge Subdivision; and

[1] Reservoir impacts from BC Hydro operations typically include impacts related to flooding, erosion, landslides, changes in groundwater, and landslide generated displacement waves. This study focuses on the assumption that erosion is the dominant impact related to the Water Use Plan operations. However other impacts may be considered as well to support the assessment.

- Strathcona Park Lodge.

This study will take a phased approach. These Terms of Reference cover the first two phases of the project (see approach outlined in Section 2.3 below). Following completion of the first two phases of the project, if appropriate, another TOR revision will be prepared to cover the third phase of the project.

To support the objectives of this study, BC Hydro has implemented a wind and wave monitoring program on the Upper Reservoir in September 2016 to gather data for quantifying erosive forces acting on the study shorelines. A dedicated wind and wave buoy was deployed at the confluence of Elk River reach and the mainstem of the Upper Campbell Reservoir (see Figure 2; buoy location: 49 53'29.37" N, 125 40'8.00" W) and it is expected to run for a period of about two years. The compilation and analysis of this wind and wave data will be included within this study.

2.3 Approach

These Terms of Reference provide a description of a conceptual approach to meet the objectives, but consultants engaged by BC Hydro to assist in meeting the study objectives will be encouraged to identify other approaches that may be more suitable, provided the objectives are met. The conceptual approach for the study is as follows:

Phase 1 – Legal survey, baseline data collection, inventory and impact assessment:

- Verify the legal survey of subject properties. Note, BC Hydro Properties has original legal survey information already available but some additional spatial information and updating of survey plans may be required.
    1. Prepare a Reference Plan(s) suitable for Land Title Office registration for the lakeside properties shown on the legal plans (31 lots along 1800 m of shoreline at Strathcona Park Subdivision and 33 lots along 1600 m of shoreline at Cedar Creek Subdivision).
    2. The Reference Plan(s) is to show the natural boundary defined by contour 224.64 m according to the legal plans from the original legal survey, as well as the present location of contour 224.64 m and the present water level at the time of survey.
    3. All property line intersections with the present location of contour 224.64 m will be posted with a suitable witness post to enable identification/relocation of the post in case it is lost due to erosion.
    4. Separate plans will be prepared at a suitable scale to show all improvements relative to the lakeside properties.
    5. Additional spatial data gathering (possibly LiDAR) may be required for the impact assessment.
- Review historical information, including (but not limited to); previous reports; reservoir water level data; air photography; cadastral mapping and related surveys; topographic surveys and digital elevation models (if available); groundwater records, published geological information; and available regional

and site-specific wind and wave data, including newly acquired data from the wind and wave buoy in place for this project.

- Conduct a detailed field program to inspect the morphology, condition and characteristics of the shoreline materials; nature and extent of improvements on private property, including existing erosion protection works; develop site-specific representative profiles of the beach, backslope and upland morphology; and to develop an understanding of prevailing wind and fetch directions.
- Develop an inventory of existing erosion sites noting the current status of erosion on those sites and compare with any available historical information.
- Where possible, and using the above information sources, develop an understanding of historic erosion rates.
- Complete an assessment of reservoir shoreline impacts in accordance with BC Hydro's geotechnical guidelines (BC Hydro, 1993) and provide an update to the impact lines initially developed for the three areas of concern (BC Hydro, 1995). Provide a recommendation for an *overall reservoir shoreline impact line* for the entire study area.

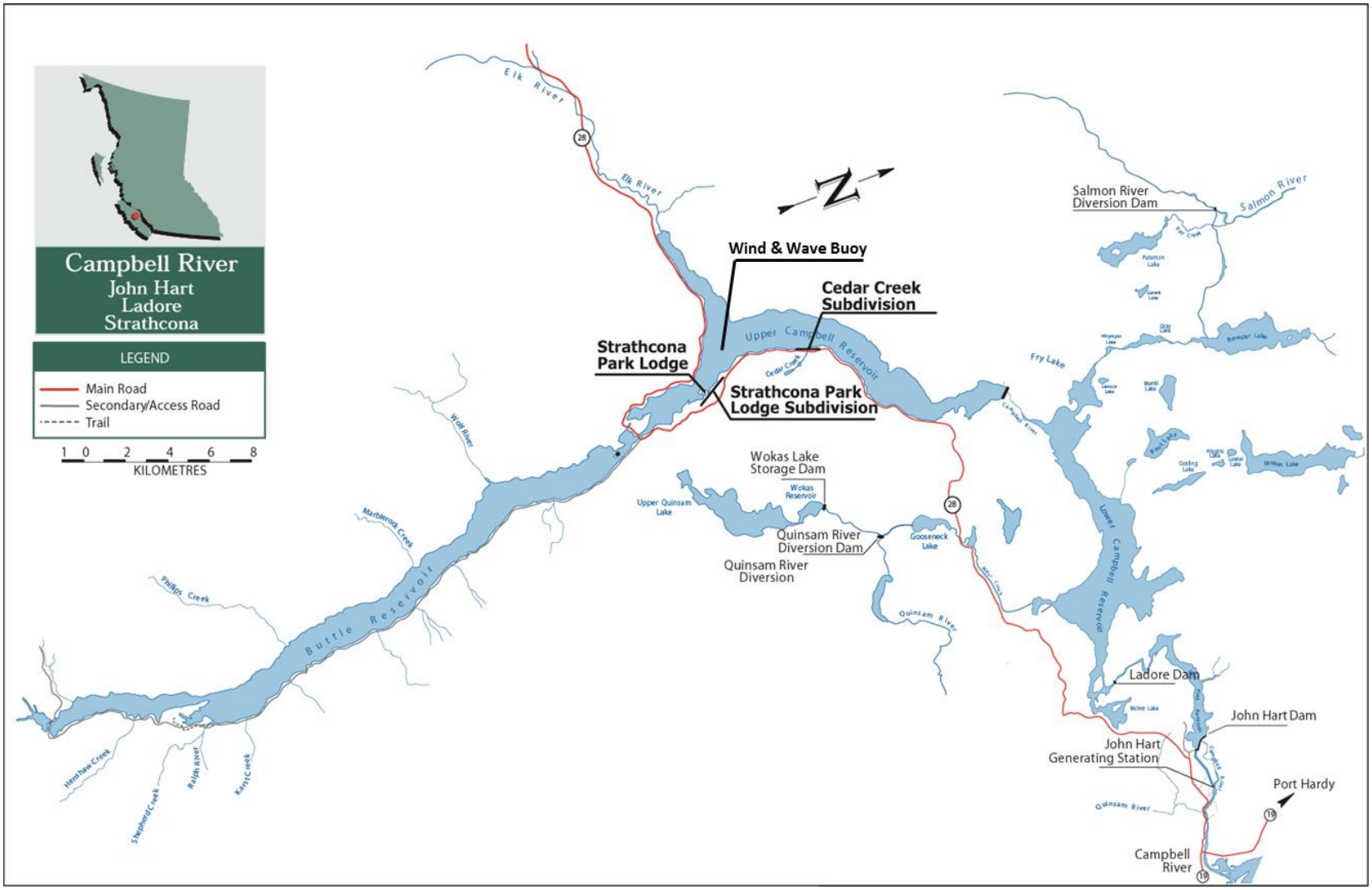
Phase 2 – Monitoring program:

- Based on the results of Phase 1, identify the need (on a site-specific basis) for erosion monitoring.
- Develop a monitoring plan for review, including methodology, frequency and expected duration.

Phase 3 – Monitoring and Mitigation:

- Implement a monitoring plan, if appropriate, and subject to the approval of the CWR.
- Based on the results of the assessment of reservoir shoreline impacts (Phase 1) and if appropriate, the monitoring program (Phase 2), BC Hydro will review with the CWR if and where developing plans for mitigation is appropriate.
- If deemed appropriate, a TOR revision will be prepared for developing erosion mitigation plans and designs, and implementation.

Figure 2 Study area noting the locations of the three areas of concern – Strathcona Park Lodge, Strathcona ParkSubdivision, and Cedar Creek Subdivision (from BC Hydro, 1995).



2.4 Reporting

A report will be completed at the end of each phase of the project. In addition, if a monitoring plan is established, an annual summary report of each year of monitoring data collection will be expected.

2.5 Schedule

The work may have to coincide with favourable reservoir elevations, likely in the fall.

3 Budget

Total Program Cost $344.874.

4 References

Anon. 2004. Campbell River Water Use Plan: Consultative Committee Report. Prepared on behalf of the Consultative Committee for the Campbell River Water Use Plan. 132 pp. + App.

BC Hydro. 1993. Geotechnical Guidelines for Determining Slope Stability and Groundwater Impacts on Reservoir Shorelines for Land Use Purposes. Report No. H2293, March.

BC Hydro. 2002. Strathcona Park Lodge and Cedar Creek subdivision shoreline impact (file folder). Prepared for Vancouver Island Generation, Campbell River, BC.

Campbell River Hydro/Fisheries Advisory Committee. 1997. Campbell River Interim Flow Management Strategy (IFMS). 51 pp.

Comptroller of Water Rights, November 21, 2012. Campbell River Water Use Plan Order. Province of British Columbia, Water Act.

BC Hydro. 1995. Upper Campbell Lake Shoreline Impact Study. MEP (Maintenance, Engineering and Projects). Prepared for BC Hydro, Burnaby, BC.

RISC (Resource Inventory Standards Committee). 2001. Reconnaissance (1:20,000) fish and fish habitat inventory standards and procedures. Prepared by BC Fisheries Information Services Branch, Victoria, BC.