Columbia River Project Water Use Plan

Heritage Management Plan Monitoring Program

Reference: CLBMON 50, CLBMON 51 and CLBMON 52

Interim Analysis

Study Period: 2007-2013

BC Hydro
Burnaby, B.C.

February 11, 2014
EXECUTIVE SUMMARY

This document presents a review of the objectives and measures developed by the Water Use Planning consultative committee (CC) related to cultural heritage and archaeology and the specific management questions posed in terms of reference for the resulting monitoring programs. It summarizes the status and key results of monitoring programs implemented under the Heritage Management Plan of the Columbia River Water Use Plan (WUP) per the Columbia River Order under the Water Act, dated 26 January 2007. This includes work completed under the following monitoring programs to 31 December 2013:

- CLBMON-50 Arrow Lakes Reservoir Heritage Monitoring Wind and Wave Erosion
- CLBMON-51 Kinbasket and Revelstoke Archaeological Overview Assessment
- CLBMON-52 Arrow Archaeological Site Overview Assessment

The report also summarizes archaeological work that has been completed within the last six years for other BC Hydro projects in the Columbia system that has relevance to the considerations under the WUP and concludes with a number of recommended considerations:

- That BC Hydro’s Reservoir Archaeology Program continue to refer to the objectives and questions emanating from the WUP and find ways to meaningfully incorporate cultural perspectives into the work of this program.

- A specific interest of the CC was to incorporate re-vegetation into archaeological site protection measures and there appears to be some potential for this to be effective in the findings of studies such as CLBMON-52 and in the recent work on Kinbasket, it is recommended that the RAP connect and coordinate with re-vegetation programs that may take place in these reservoirs in the future to seek out synergies between the programs, and

- The archaeological impact assessments of individual physical works are a direct and targeted means to address potential impact to archaeological sites from these improvements and continued diligence in assessing potential conflicts related to future physical works projects will serve to address this concern of the CC.
### Table 1. WUP Chronology and Achievements to Date

<table>
<thead>
<tr>
<th>Year</th>
<th>CLBMON-50 Arrow Lakes Heritage Wind and Wave Erosion Monitoring</th>
<th>CLBMON-51 Kinbasket and Revelstoke Archaeological Overview Assessment</th>
<th>CLBMON-52 Arrow Lakes Archaeological Overview Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>Preliminary Field Reconnaissance – traverse of 12 vegetation polygons in Kinbasket, one site recorded in one and 11 recorded in another. No sites found in Revelstoke.</td>
<td>Preliminary Field Reconnaissance of northern third of study area – foot traverse of nine re-vegetation sites, eight wildlife physical works sites, and 12 bank erosion sites. Seven new sites recorded.</td>
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<tr>
<td>2008</td>
<td>Preliminary Field Reconnaissance of southern two thirds of study area – foot traverse of four re-vegetation sites. Three new sites recorded.</td>
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<tr>
<td>2009</td>
<td>Year 1 – Field work undertaken Sept 7-12, 2009 at reservoir levels of 435.4 to 435.6 m above sea level (asl). Six monitoring stations established and one new site recorded.</td>
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<tr>
<td>2010</td>
<td>Year 2 – No work undertaken due to continuous high water levels.</td>
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<tr>
<td>2011</td>
<td>Year 3 – Field work undertaken May 26- June 1, 2011, at reservoir levels of 433.65 to 435.05 m asl. One additional monitoring station established and two expanded. One station discontinued.</td>
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<tr>
<td>2012</td>
<td>Year 4 – Field work undertaken May 14-18, 2012 at reservoir levels of 430.3 to 430.9 m asl. Increased erosion occurred at all sites, both in terms of area and degree of erosion.</td>
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<tr>
<td>2013</td>
<td>Year 5 - Field work undertaken May 21 to 24, 2013 Overall more accretion than erosion at sites EaQl-17, EfQm-4 and EfQn-12. +</td>
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1 Introduction

This document represents a summary of the status and key results of monitoring programs being implemented under the Heritage Management Plan of the Columbia River Water Use Plan (WUP) per the Columbia River Order under the Water Act, dated 26 January 2007. This includes work completed under the following monitoring programs to 31 December 2013:

- CLBMON-50 Arrow Lakes Reservoir Heritage Monitoring Wind and Wave Erosion
- CLBMON-51 Kinbasket and Revelstoke Archaeological Overview Assessment
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The report also summarizes archaeological work that has been completed within the last six years for other BC Hydro projects in the Columbia system that has relevance to the considerations under the WUP.

1.1 Background to Columbia River WUP Heritage Management Plan Programs

The water use planning process for BC Hydro’s Columbia River project was initiated in August 2000 and completed in June 2004. The conditions proposed in the WUP for the operation of the project reflect the consensus recommendations of the Columbia River Water Use Planning consultative committee (CC).

Archaeological studies undertaken since the 1960s within 100 metres of the shoreline of each licenced reservoir in BC Hydro’s hydroelectric system were summarized in Archaeological Data Summary reports (Arcas, March 2006, BC Hydro internal reports) prior to implementation of the Columbia WUP Heritage Management Plan. These summaries found 35 archaeological assessment reports and a total of 154 documented archaeological sites relevant to the Arrow Lakes reservoir area, eight reports and 12 sites relevant to Revelstoke reservoir and nine reports and two sites relevant to Kinbasket reservoir at the close of 2005. However, at the time of the WUP discussions this inventory data was not known to the CC and specific recommendations were based on limited information.

The CC recognized the importance of cultural heritage and archaeological sites, particularly to the First Nations with an interest in the region. A number of aspects related to the identification and protection of these values were considered in the development of objectives and performance measures.

Objectives were broadly aimed at minimizing impacts to archaeological sites from wave and wind erosion as well as from destructive human behaviour while maintaining access to archaeological sites for appropriate uses and maintaining the cultural, aesthetic and ecological context of important cultural resources and spiritual sites. The potential for re-vegetation of the draw down zone to aid in the stabilization of soils that may slow erosion of archaeological sites and to act as a deterrent to potential unauthorized artifact collection by obscuring the ground surface was a key aspect explored by the CC.
Performance measures were developed in relation to these objectives based on contemporaneous interpretations of available information and included the frequency in days per year of the reservoir levels being within a band of elevation containing landforms considered to have high archaeological values and the presence of vegetation within a similar band of elevation that was considered to have potential to prevent wind erosion.

The CC also supported a heritage management plan directly aimed at reducing operational impacts to archaeological sites in the Columbia system. Information was more readily available regarding archaeological values in the Arrow Lakes area when compared to the other reservoirs in the Columbia system and this is reflected in the heritage management plan in the fact that a greater number of studies were recommended for this reservoir over the Kinbasket and Revelstoke reservoirs.

The heritage management plan included a number of recommended studies including:

- Development of a management strategy and design and implement intervention (protection) for the four known archaeological sites in Arrow Lakes reservoir
- Monitor wave and wind impacts on scarp stability in Arrow Lakes reservoir
- Effectiveness monitoring at sites of active intervention in Arrow Lakes reservoir
- Archaeological site survey and inventory in Arrow Lakes, Kinbasket and Revelstoke reservoirs
- Exploratory excavations and monitoring in Kinbasket and Arrow Lakes reservoirs
- Effectiveness monitoring of active intervention at newly discovered archaeological sites
- Multi-year management strategy to address access to and monitoring of significant sites in Kinbasket, Revelstoke and Arrow Lakes reservoirs

In July 2006, the Columbia River Draft WUP was submitted to the Comptroller of Water Rights (CWR). The draft WUP was sent out to regulatory agencies, First Nations and interested stakeholders for review. The Comptroller concluded that making orders in regard to archaeological work requiring Provincial Heritage Permits was largely beyond the jurisdiction of his office and as a result included only non-intrusive work in his proposed Order.

In January 2007, the CWR approved the final WUP and issued an Order to BC Hydro to implement the conditions proposed in the Columbia River WUP and prepare the monitoring programs and physical works Terms of Reference (TOR) for:

- An archaeological overview assessment of the drawdown zones of Kinbasket, Revelstoke and Arrow Lakes reservoirs and the mid-Columbia River; and

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1 The CC was not aware at that time of the larger inventory of 154 documented sites in the Arrow Lakes Reservoir.
2 The CC had information to indicate a particular landform – a scarp at 1,436 ft. elevation had particularly high archaeological values.
3 This references sites with applied erosion protection from first bullet above.
• Non-intrusive erosion monitoring of archaeological resources located in Arrow Lakes reservoir and mid-Columbia River drawdown zones

An addendum to the Columbia River WUP was submitted to the CWR in July 2007 after an Environmental Assessment Certificate was issued for the Revelstoke Unit 5 Project. The addendum proposes additional terms and conditions for the Columbia River WUP, as recommended by the Revelstoke Unit 5 Core Committee in December 2006, to address incremental impacts of the operation of the fifth generating unit at Revelstoke Dam.

In August 2007, the CWR accepted the Columbia River Project WUP Addendum resulting from the Revelstoke Unit 5 Project, and issued amendments to the Columbia River Implementation Order to include the commitments made by BC Hydro to undertake monitoring programs and physical works associated with the Revelstoke Unit 5 Project.

The Terms of Reference (TOR) for CLBMON-51 and CLBMON-52 were submitted and approved in April 2007. TOR for CLBMON-50 were submitted in October 2007 and approved in December 2007.

As outlined in the Columbia River WUP, the CC recommended a full review of the Columbia River WUP 13 years after implementation, unless results of the monitoring program suggest an earlier review is appropriate or significant risks are identified that could result in a recommendation to change operations.

BC Hydro committed to convene a multi-party panel five years after commencing the implementation of this WUP to evaluate the effectiveness of operations and physical works in meeting the stated objectives for Arrow Lakes reservoir and the lower Columbia River. The outcomes from this process will be used to assess any potential need to review the Arrow Lakes reservoir component of this WUP. If a replacement Non-Treaty Storage Agreement (NTSA) were negotiated within this 5-year period, it was also recommended that agreement provisions and implications be reported out through this panel. Signing of a new NTSA is not a trigger for panel evaluation or a review of this WUP recommendation to change operations.

The heritage management plan recommended by the CC included a broader range of studies for assessing and protecting the archaeological and cultural heritage values in the Columbia system than was included in the Order. BC Hydro through an Memorandum of Understanding with the Province committed to a separate program of archaeological work aimed at achieving compliance with the Heritage Conservation Act as it pertains to the reservoirs for which BC Hydro maintains a licence to operate. This Reservoir Archaeology Program (RAP) is expected to address many of the archaeological objectives and recommendations raised by the CC that are not addressed in the studies that were included in the Order. A summary of the RAP work in the Columbia system to date is included in this summary.
1.2 Schedule

The following table (Table 2) outlines the current schedule for the monitoring programs being delivered under the Columbia WUP Heritage Management Plan.

Table 2: Table of WUP Schedule

<table>
<thead>
<tr>
<th>Monitoring Programs</th>
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<tr>
<td></td>
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<tr>
<td><strong>2007</strong></td>
</tr>
<tr>
<td>WLR YR1</td>
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<tr>
<td>CLBMON-50 Arrow Lakes Reservoir Heritage Monitoring Wind and Wave Erosion</td>
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<td>CLBMON-52 Arrow Archaeological Site Overview Assessment</td>
</tr>
</tbody>
</table>

Legend:  
✓ - Program to be undertaken/initiated in identified year  
✓ - Program completed for the year  
X - Program started, but encountered operational or hydrological delays

1.3 Water Use Plan Heritage Management Plan Programs

1.3.1 CLBMON-50 Arrow Lakes Reservoir Heritage Monitoring Wind and Wave Erosion

Two key management questions were raised during the WUP consultative process regarding archaeology:

1. What is the nature of the archaeological resources that are present within the reservoir?

2. What effects do reservoir operations have on these archaeological resources?

The Consultative Committee was unable to fully evaluate the potential effects of Arrow Lakes reservoir operations on archaeological sites within the drawdown zone due to the lack of information regarding location and nature of existing sites. The study area is shown in Figure 1. As part of addressing this information gap, it was recommended that a study be implemented to directly monitor the effects of wind and wave erosion on the stability of a significant escarpment in the reservoir, which is predicted to contain a large number of intact and actively eroding archaeological sites.

The condition of a documented archaeological site is typically assessed only once, at the time of recording, and few sites are formally re-assessed. Since erosion within a reservoir takes place in a complex environment involving landform, aspect, vegetation, surface debris, surficial geology, weather, and human or animal intervention in addition to reservoir operations, the cumulative effect can be difficult to interpret. In order to develop an understanding of taphonomic process (post-depositional effects on archaeological materials) related to reservoir operations, repeated visits to a site over time are required. An important feature of erosion monitoring is the application of quantitative measures on a scale and frequency appropriate to the effects.
Figure 1 - Arrow Lakes Reservoir Heritage Monitoring Station Study Areas
The objective of the erosion monitoring study is to collect quantitative measures of the magnitude, severity, rate of change and estimated duration of erosion effects caused by reservoir operations on selected portions of escarpment and other significant landforms situated within the drawdown zone of the Arrow Lakes Reservoir. The monitoring program is expected to provide information that can be used in future WUP discussions regarding operation of Arrow Lakes reservoir.

This monitoring program was initiated in 2009 and planned to continue for five years; however, the consultants were unable to complete any field work in 2010 due to high water levels. Normal spring drafting of Arrow Lakes reservoir stopped in late January and, as a result, the terraces that are the subject of this study stayed submerged throughout the year. A sixth year has been added to enable the collection of five years of data.

1.3.1.1 Methods

This monitoring program involves research and analysis and an in-field component for establishing monitoring stations and subsequent data collection. Erosion monitoring stations were planned at a minimum of six locations within the reservoir drawdown zone divided between the Narrows locale and the Revelstoke Reach. Archaeological sites identified in Revelstoke Reach during the Arrow Lakes reservoir Archaeological Site Overview Assessment (CLBMON-52, described below) were to be selected for monitoring to the extent possible to meet BC Hydro’s commitment to assess the effects of winter flows related to the Revelstoke Unit 5 Project.

Within each monitoring station terrain features identified by the project geologist and cultural materials marked by the archaeological crew were captured by the LiDAR scan and mapped using a total station. A Digital Elevation Model (DEM) of the ground surface at each monitoring station was generated from the raw data. The DEM, which interpolates the ground surface between the lowest points in the point cloud, can be used over the course of the project to quantitatively assess changes in the ground surface due to erosion.

All previously recorded sites within the study area were assessed according to a set of criteria defined in reference to the TOR and in consideration of optimal conditions for LiDAR data acquisition. The resulting ranked list of sites guided the selection of actual monitoring locations during fieldwork. Six monitoring stations were established (EaQl-15, EaQl-16, EaQl-17, EfQm-3, EfQm-4, and EfQn-12) and one previously unrecorded site was recorded (EfQm-8).

1.3.1.2 Results

To date four data collection years of this five year study have been completed since 2009. Millennia Research Limited (Millennia) with John Clague (Simon Fraser University) and Focus Corporation conducted Year 1 (2009) of the study (Owens et. al 2010) and Millennia with Focus conducted Years 2, 3, 4, and 5 of the study (Owens et. al 2011, Owens et. al 2012, Owens et. al 2013, Owens et. al 2014). The results and considerations for Years 1 (2009) to 5 (2013) of the study are outlined below.
Year 1 (2009) field work focused on the selection of monitoring stations and the collection of baseline information against which the data gathered over the course of the project would be compared. Six monitoring stations were established (EaQl-15, EaQl-16, EaQl-17, EfQm-3, EfQm-4, and EfQn-12) and one new site was recorded (EfQm-8).

No work was undertaken for Year 2 (2010) of this project due to continuous high water levels, which prevented work in the drawdown zone.

Year 3 (2011) field work was conducted during a lower drawdown than in Year 1. One additional monitoring station was established on a lower terrace at site EaQl-16. The boundaries of the monitoring stations at EfQn-12 and EaQl-17 were set to lower elevations. A monitoring station on the west side of Revelstoke Reach at EfQn-10 was established. The expansion of the EaQl-17 to capture the 436 m elevation point and the establishment of the EfQn-10 monitoring station addressed the two outstanding requirements of the project TOR. It was decided that the data for EfQm-3, the least suitable of the monitoring stations selected in Year 1 of the study would not be processed and the site would not be revisited in subsequent years. For subsequent years of the study it was recommended in Year 3 that the edge of the bank at EfQm-4 and EfQn-12 be mapped, the water level at each site be mapped, additional monitoring points be gathered for EfQn-12, EaQl-16, and EaQl-17, and that scan results are improved by either using a longer ranger scanner, increasing the intensity on the Faro scanner, or establishing additional setups.

In Year 4 (2012) several objectives set out in Year 3 were met including improved scan results, mapping of the water level at each site, and the gathering of additional monitoring points at EfQn-12, EaQl-16 and EaQl-17. Although an effort was made to record the bank at EfQn-12 and EfQm-4, the data returned was not useable. Survey in the immediate vicinity of the recorded site boundaries identified previously unknown cultural material. The boundary of EfQn-10 was revised on the basis of scan results show an increase in erosion at all of the sites monitored, both in terms of the area eroding and the degree of erosion. Accretion of deposits continues to occur within smaller, isolated areas of most of the monitoring stations, however at a much lower scale than does the erosion.

In Year 5 (2013) work was completed at five of the six monitoring stations; one of the stations, EfQn-10, was only partially rerecorded as it was under water at the time of the survey. The loss of another year of data at EfQn-10, a monitoring station wasn’t included in the first year of the study, will undoubtedly compromise the dataset for the west side of Revelstoke Reach over the course of the five year project. Ensuring that the EfQn-10 station is revisited at low water is a primary objective of Year 6 (2014).

The overall Year 5 results show much more accretion than erosion. It is possible that some of the accretion is the result of redeposition of cut bank erosion from upslope at EaQl-17, EfQm-4 and EfQn-12. This area is often difficult to scan due to vegetation growth, but the addition of detailed RTK bank top line survey conducted this year will provide comparative information for the final two years for the upper elevation areas.

To date the study has demonstrated that the monitoring stations at sites EaQl-15, EaQl-16, EaQl-17, EfQn-12, EfQm-4, and EfQn-10 are being impacted by reservoir operations and by recreational use of the reservoir. However, with only one year of data acquisition remaining for the project, there is as yet no obvious patterning to the erosion or accretion.
mapped for the sites, or the movement of monitoring points. A number of factors may be contributing to the absence of any meaningful relationships, the most significant of which is likely the relatively short time span of the project. With only three years of comparative data to date, Year 1 being the baseline year, there isn’t enough time-depth to reveal patterns. The impact of the short project duration is compounded with “lost” data or data collection opportunities due to high water and vegetation growth. More sophisticated analyses are to be conducted for Year 6 and included in the project completion report. However, the time line may still be too short to be able to demonstrate diachronic patterning, especially when combined with factors such as geographic position.

1.3.2 Archaeological Overview Assessment of the Kinbasket and Revelstoke Reservoirs (CLBMON-51)

The Kinbasket and Revelstoke reservoir archaeological studies were an overview assessment of present conditions. The management questions listed below focused on the potential for physical works, such as vegetation, debris removal or recreation management plans to affect archaeological sites within the reservoirs:

1. In what ways will archaeologically sensitive locations within the reservoir be impacted by potentially intrusive physical works related to vegetation, debris removal or recreation?

2. Conversely, in what ways can re-vegetation techniques be incorporated into archaeological site mitigation measures?

The studies were primarily concerned with the latter although new information on archaeological sites was also expected to be gained as a result of this work.

During the WUP Consultative Committee discussions, it became clear that a data gap existed regarding the number and condition of actively eroding archaeological sites in the drawdown zones of Kinbasket and Revelstoke reservoirs (see Figure 2). The contents and significance of documented sites within the reservoirs had not been comprehensively reviewed, and it was likely that additional undocumented archaeological sites existed in areas that had not been previously surveyed.
Figure 2 - Location of Archaeological Overview PFR Study Areas
Several concerns were raised during the consultative process related to the potential effects of physical works projects being implemented on Kinbasket reservoir (i.e., re-vegetation program, debris management and boat ramp improvement projects) on known and yet-to-be discovered archaeological sites. It was recognized that archaeological assessments would be required to ensure that the physical works projects are undertaken in a compatible manner with archaeological site protection requirements and that opportunities to incorporate archaeological site mitigation measures be considered in the design of these works (e.g., specific re-vegetation techniques to increase site stabilization).

The objective of these archaeological overviews were to identify and assess archaeological resource potential or sensitivity within portions of the drawdown zones of the Kinbasket and Revelstoke reservoirs within the context of the terrain analysis framework outlined in the WUP report with a primary focus on those areas with potential for re-vegetation, and develop recommendations for subsequent archaeological work, as well as possible mitigative options for identified potential conflicts with the WUP physical works programs.

The Kinbasket/Revelstoke Overview Assessment was initiated and completed in 2007. The final program report was received by BC Hydro and submitted to the CWR in January of 2008 (Choquette 2008a).

1.3.2.1 Methods

This monitoring program involved documentary research and analysis, as well as an in-field survey component. The preliminary field reconnaissance (PFR) was designed to encompass a sample of each reservoir drawdown zone during a single field season.

1.3.2.2 Results

A total of 12 archaeological sites were identified in Kinbasket reservoir during a survey of 13 vegetation polygons. No archaeological sites were observed in the surveyed areas of the Revelstoke reservoir drawdown zone.

Prior to this study, only one stone artifact had been documented in the drawdown zone of the Kinbasket reservoir. Consequently, these newly discovered archaeological deposits are considered to be highly significant from an archaeological perspective.

The archaeological sites were identified within areas noted as having potential for re-vegetation. The presence of these sites will be considered in the design of vegetation programs.

At the time the PFR was conducted Vegetation Polygon #80, where 11 of the 12 archaeological sites are situated, supported significant vegetal cover and the potential for vegetation to be used in archaeological site protection in this location appeared to be promising. Closer monitoring of the sites in this area to further evaluate the potential for vegetation as a mode of site protection was recommended. It was also recommended that an archaeological inventory of both Kinbasket and Revelstoke reservoirs be undertaken to support informed assessments of operational impacts in these reservoirs.
1.3.3 Archaeological Overview Assessment of the Arrow Lakes Reservoir (CLBMON-52)

The Arrow Lakes reservoir archaeological study was an overview assessment of present conditions. The management questions listed below focused on the potential for physical works, such as vegetation, debris removal or recreation management plans to affect archaeological sites within the reservoirs:

1. In what ways will archaeologically sensitive locations within the reservoir be impacted by potentially intrusive physical works related to vegetation, debris removal or recreation?

2. Conversely, in what ways can re-vegetation techniques be incorporated into archaeological site mitigation measures?

The studies were primarily concerned with the latter although new information on archaeological sites was also expected to be gained as a result of this work.

During the WUP Consultative Committee discussions, it became clear that a data gap existed regarding the number and condition of actively eroding archaeological sites in the drawdown zone of the Arrow Lakes reservoir (see Figure 3). The contents and significance of documented sites within the reservoir had not been comprehensively reviewed, and it was likely that additional undocumented archaeological sites existed in areas that had not been previously surveyed.
Figure 3 - Location of Arrow Lakes Archaeological Overview Year 1 and Year 2 PFR Study Areas
Several concerns were raised during the consultative process related to the potential effects of physical works projects being implemented on the Arrow Lakes reservoir (i.e., re-vegetation program, debris management and boat ramp improvement projects) on known and yet-to-be discovered archaeological sites. It was recognized that archaeological assessments would be required to ensure that the physical works projects are undertaken in a compatible manner with archaeological site protection requirements and that opportunities to incorporate archaeological site mitigation measures be considered in the design of these works (e.g., specific re-vegetation techniques to increase site stabilization).

The objective of this archaeological overview was to identify and assess archaeological resource potential or sensitivity within portions of the drawdown zone of the Arrow Lakes reservoir within the context of the terrain analysis framework outlined in the WUP report with a primary focus on those areas with potential for re-vegetation, and develop recommendations for subsequent archaeological work, as well as possible mitigative options for identified potential conflicts with the WUP physical works programs.

A further objective of the Arrow Lakes overview assessment study was to evaluate the possible effects of incremental increases in water levels and water velocities associated with five-unit operations at Revelstoke Dam on archaeological values, as it pertains to potential bank erosion within the Revelstoke Reach portion of the study area.

The two-year Arrow Lakes Overview Assessment was initiated in spring of 2007 and was completed in 2008 (Choquette 2008b, 2009).

1.3.3.1 Methods

This monitoring program involved documentary research and analysis, as as well as an in-field survey component. Year 1 of the program was focused on portions of the drawdown zone within Revelstoke Reach, while Year 2 focused on portions of the drawdown zone of other parts of Arrow Lakes reservoir with special attention to the narrows that demarcate the joining of Upper and Lower Arrow Lakes.

1.3.3.2 Results

Over the course of this two season study, a total of 26 new archaeological site locations were identified and documented. During the 2007 field survey, nine proposed vegetation polygons, seven potential wildlife habitat physical works sites and 12 bank erosion loci (delineated by Northwest Hydraulic Consultants (NHC) in 2006) within Revelstoke Reach were traversed on foot. A total of 13 archaeological sites were discovered during the field visits. Seven of these sites were located within proposed vegetation areas, and six were located in bank erosion loci.

Cultural deposits exposed on the surface of all 13 sites contain fire altered rock. Three sites also contain lithic (stone) artifacts, and segments of large mammal bone were also observed at one of these lithic sites. Of the 13 newly identified sites, 12 are considered to be of potentially high archaeological significance and one appears to be largely disturbed.
Four of the newly discovered archaeological sites (EfQm-3, EfQm-4, EfQn-10, and EfQn-12) are situated in bank erosion loci identified by NHC as having potential to be affected by increased water level fluctuations associated with five-unit operations at Revelstoke Dam. The study report recommended that monitoring of these locations be undertaken to better assess the potential effects of Revelstoke 5 flows on these archaeological resources. Monitoring stations were established at sites EfQm-4, EfQn-10, and EfQn-12 for the Arrow Wind and Wave Erosion Monitoring Study (CLBMON-50). Although a monitoring station was initially established at EfQm-3 it was considered not to be a suitable candidate for the study.

In 2008, portions of four large proposed vegetation polygons situated in the southern two thirds of the reservoir were surveyed along with several other localities in the higher elevations of the reservoir draw down zone.

A total of 13 archaeological sites were recorded in 2008. Three sites are situated within proposed vegetation areas at East Arrow Park. These three newly recorded sites are represented by extensive scatters of fire altered rock and lithic artifacts. A number of previously documented sites are reported to exist in this area but these could not be accurately relocated.

Relic delta-fans at Taite, Octopus, Johnston, Bowman, Sunshine, Mosquito, McDonald and Twobit Creeks were also examined. Archaeological materials comprising the remaining ten sites recorded during 2008 were observed in the vicinity of McDonald, Taite, Twobit and Mosquito Creeks. Cultural depression features were observed along with artifacts and other archaeological materials at Taite and Twobit Creeks.

Twelve of the 13 sites identified in 2008 are considered to be of high scientific significance according to the evaluation matrix designed as part of the study. One site at McDonald Creek is considered to be of lower scientific significance due to a high degree of disturbance.

The study recommends that BC Hydro further consider the potential use of vegetation as a means of protecting two of the archaeological sites where there has been successful establishment of reed canary grass. The study further recommends that coordination of the archaeology and vegetation work in Arrow be continued and improved to ensure the maximum benefit to the archaeological protection. BC Hydro will consider this recommendation in developing site-specific prescriptions/treatments as part of the WUP re-vegetation program and other longer term initiatives being undertaken by BC Hydro (i.e., RAP). Further work will be required in consultation with the Archaeology Branch and interested First Nations to investigate the suitability of these sites for re-vegetation as a means of site protection.

The study further recommends that BC Hydro undertake an archaeological inventory of the Arrow Lakes reservoir to support informed assessments of operational effects on archaeology sites. It is expected that the Reservoir Archaeological Program will address this need as part of its comprehensive management plan for the reservoir. A focus on delta-fans and high lacustrine terraces is recommended by the study as archaeological materials are observed to be actively eroding at these locations.
1.4 Reservoir Archaeology Program

BC Hydro’s RAP aims to ensure that the reservoirs are operating in compliance with the Heritage Conservation Act. The RAP is conducted in two phases. Phase one is an archaeological inventory within the active erosion zone under the terms of a Heritage Inspection Permit issued by the Archaeology Branch, Ministry of Forests, Lands and Natural Resource Operations (Archaeology Branch). This includes the draw-down zone and critical eroding lands above high pool affected by reservoir operations. As the Arrow Lakes, Revelstoke and Kinbasket reservoirs cover such a large geographic area and the draw-down zones are accessible for such a brief period each year, these are planned to be multi-year programs. Yearly reports describing the results of the inventory assessments will be distributed to interested First Nations and the Archaeology Branch. First Nations have opportunities for input to the design of the inventories through Technical Working Group forums. At the conclusion of the inventory study, an Archaeological Management Plan (AMP) will be developed. The AMP will detail the archaeological sites within the active erosion zone and describe site specific steps for ongoing monitoring or mitigating adverse impacts.

Phase two will consist of implementation of the AMP. This is also expected to be an extended multi-year process to ensure ample opportunity for monitoring and managing impacts to archaeological sites. Periodic reviews will ensure the AMP is addressing the impacts appropriately and can be adjusted as required.

Phase 1 RAP field studies have begun in the Kinbasket and Arrow Lakes reservoirs. The sections below summarize the work to date.

1.4.1 Kinbasket Reservoir Archaeological Inventory and Impact Assessment Program

Below is a summary of fieldwork studies that have taken place in the Kinbasket reservoir under the RAP.

1.4.1.1 Archaeological Inventory and Impact Assessment of Bear Island

This project was initiated and funded by Ktunaxa Nation and facilitated and supported by BC Hydro with additional funds to ensure the opportunity for participation by all interested First Nations in the project. Tipi Mountain Eco-Cultural Services Ltd. (Tipi Mountain) (Thompson et. al 2012) carried out an inventory and impact assessment of areas along the west and south sides of Bear Island, the shoreline along the Kinbasket reservoir north of Bear Island, and Esplanade Bay. The 2012 fieldwork was intended to further past inventory survey efforts in the Kinbasket reservoir. Eleven sites located on Bear Island originally recorded in 2007 were revisited in 2012 to monitor reservoir related impacts.

The project included re-visiting eleven previously recorded archaeological sites (EkQk-1 to EkQk-11) and several exploratory pedestrian traverses in previously un-surveyed terrain; the survey resulted in the recording of eight new archaeological sites (EkQj-1, EkQj-2, and EkQk-13 to EkQk-18). The 2012 field investigations documented ongoing and significant disturbance to the ground surface and the sub-surface sediments at the sites through erosional processes and mechanical and vehicle disturbance. Water related erosion in the reservoir has resulted in deflation and collapse of landform
margins and the deposition of substantial amounts of sediment on the terrace surfaces within both the high and low water zones. The report recommends consistent monitoring of lower impact sites, site re-visitation on a regular (annual) basis, and the emergency excavation of high risk sites in areas where erosion is acting at an accelerated rate.

### 1.4.1.2 Kinbasket Reservoir Archaeological Inventory and Impact Assessment

In 2013 Tipi Mountain and Brown & Oakes Archaeology completed Year 1 of the archaeological inventory and impact assessment for the Kinbasket reservoir RAP (Thompson and Choquette 2013). Survey locations for the 2013 field season were identified using a statistical sampling strategy initiated by BC Hydro with the aim of characterizing the archaeological landscape in the Kinbasket reservoir by the survey and inventory of randomly selected portions of the reservoir drawdown zone using a stratified sampling approach based on geomorphological characteristics represented in the study area. A total of 138 sampling units were defined and selected via stratified random sample. Fourteen of the randomly selected survey areas totalling 241.3 hectares in size were surveyed during the 2013 field program. Four of the 22 previously recorded archaeological sites in the Kinbasket reservoir were revisited during the RAP program and four new archaeological sites were recorded in the reservoir drawdown zone.

This initial year of inventory observed that negative impacts to previously recorded and new archaeological sites are both severe and ongoing. Both deflation of landform surfaces along the high pool mark and along reservoir banks and deposition of thick layers of post-reservoir silt and mud at lower elevations, are impacting portions of existing archaeological sites and hindering visibility and access to sites and areas of archaeological potential. The raising and lowering of water levels in the reservoir annually, wave action and changes in water currents throughout the year, also appears to have the effect of moving cultural materials across the ground surface and obscuring vertical distribution through sorting. Loading facilities for heavy equipment, the use of excavators to collect and stack wood debris, and burning of wood debris all pose threats to archaeological sites and areas of archaeological potential in the drawdown zone. Impacts due to recreational use of the shoreline were also observed in accessible portions of the drawdown zone.

### 1.4.2 Arrow Lakes Reservoir Archaeological Inventory and Impact Assessment Program

Ursus Heritage Consulting (Ursus) has conducted three years (2011 to 2013) of BC Hydro’s Arrow Lakes reservoir inventory (Cameron et al 2012, Cameron and Lyons 2012, Thorogood 2013). The objectives of the Arrow Lakes RAP study are to identify and evaluate any archaeological deposits that may be present within the study area, identify and assess impacts of reservoir operations to any identified archaeological sites, provide recommendations regarding the need for and appropriate scope of further archaeological studies and recommend viable alternatives for managing adverse impacts.

In 2011 the area surveyed with high intensity pedestrian traverses totalled 265.237 hectares. One new archaeological site was identified and eleven previously identified sites were revisited and mapped. Ten more archaeological sites were revisited but could not be found and are believed to be destroyed or inaccessible due to water levels at the time of the site visits.
In 2012 Ursus identified a total of five new archaeological sites and fifteen previously identified sites were revisited and mapped. Twenty-eight randomly selected survey areas (approximately 280 hectares in total) were inspected.

In 2013 Ursus selected a total of 37 randomly selected stratified areas but only 34 were accessible at the time of survey. During the course of the 2013 inventory 21 new archaeological sites were identified and eight previously-recorded archaeological sites were revisited. Overall the impact assessment study has stated that continued BC Hydro operations will have an adverse impact to protected archaeological sites within the Arrow Reservoir.

1.4.3 Summary of Work to Date

A total of 19 previously recorded archaeological sites have been revisited and eight new archaeological sites have been recorded under the Kinbasket RAP program. It was observed in 2012 and 2013 that negative impacts to previously recorded and new archaeological sites are ongoing due to water level fluctuation within the Kinbasket reservoir. The RAP program in the Revelstoke reservoir is scheduled to start in 2026.

A total of 44 previously recorded archaeological sites have been revisited and 27 new archaeological sites have been recorded under the Arrow Lakes RAP program. Observations of adverse impacts to archaeological sites within the drawdown zone have been made each year related to wave and wind erosion as well as by human related impacts such as recreation vehicle use and unauthorized artifact collections.

1.5 Other BC Hydro Sponsored Archaeological Studies in the Columbia WUP

The CC were concerned about the potential for physical works (i.e., recreation, vegetation, habitat restoration etc.) to impact archaeological sites. BC Hydro has undertaken archaeological assessments of physical works projects proposed in the Columbia watershed in accordance with the Archaeological Impact Assessment (AIA) guidelines issued by the Province. Physical works projects assessed for potential archaeological conflicts include 17 proposed boat ramps and three proposed fisheries habitat rehabilitation sites and are summarized below.

1.5.1 Boat Ramps

Golder Associates Ltd. (Golder) (2007) conducted an archaeological overview assessment (AOA) for nine proposed boat launch ramp locations in the Arrow Lakes reservoir, between McDonald Creek Park and Edgewood, south of Nakusp, BC. A total of four existing boat launch ramp locations (Burton, Edgewood, Fauquier, and McDonald) and five proposed new locations (Burton Alternative Site 1, Burton Alternative Site 2, Fauquier North, Fauquier Ferry Ramp, and Edgewood Proposed Ramp) were examined during the study.

Archaeological impact assessments (AIAs) were subsequently completed in 2008 by Rogers Archaeological Consulting and Eaglevision Geomatics & Archaeology Ltd. (Rogers 2008a, 2008b, 2008c, 2008d, 2008e, 2008f, and 2008g) for six boat ramps at Burton, Bush Harbour, Centennial, Fauquier South, McDonald Creek, and Valemount.
Ursus completed an AIA in 2012 and a monitoring program under a Site Alteration Permit in 2013 of the Eagle Creek Park boat launch in Edgewood, BC.

Golder (2008) conducted an AOA of four proposed boat ramp locations located on the east shore of Arrow Lakes reservoir near Nakusp, B.C. The AOA study consisted of a combination of background research and a PFR of each of the ramp locations. One existing boat ramp (Nakusp) and three potential boat ramp locations (North Nakusp, Nakusp Public Beach, and South Nakusp) were examined during the study. In 2012 Ursus completed an AOA of the existing Nakusp boat ramp as a feasibility study concluded that this location was the most appropriate.

Tipi Mountain completed a PFR in 2011 and a post impact field assessment in 2013 of the Anderson Point boat launch located on the Arrow Reservoir (Tamasi 2012 and 2013).

Summaries of the results of these studies are included below.

### 1.5.1.1 CLBWORKS-18 Arrow Lakes Boat Ramp Upgrade and Installation Project

The Golder 2007 AOA study recommended that AIAs be conducted for all five existing ramps and four of the five proposed ramps. The AOA recommended no further work for the Burton Alternative Site 2 as this area was considered to have low archaeological potential. Rogers Archaeological Consulting and Eaglevision Geomatics & Archaeology Ltd. conducted AIAs of the Burton Alternative Site 2, Bush Harbour, Centennial, Fauquier South, McDonald Creek, Valemount boat ramps with negative results (Rogers 2008a, 2008b, 2008c, 2008d, 2008f, 2008g). As such it was recommended that no further work be conducted for these boat ramp locations. One archaeological site was identified within the boundaries of the proposed Fauquier North project (Rogers 2008e). Therefore, further mitigation and monitoring work was recommended if the Fauquier North was chosen for development, which it was not.

An AIA was completed by Ursus (Bonner 2012) for proposed upgrades to the BC Hydro boat launch ramp at Eagle Creek Park, Edgewood B.C. The project was located within the boundaries of previously recorded archaeological site DkQm-12 and in proximity to site DkQm-5. No archaeological remains were identified during the field survey, however, it was concluded that the project footprint was located within a previously developed and highly impacted area, and it was likely that any archaeological remains would be in heavily disturbed context and be limited to isolated finds. No further archaeological work was recommended for the remainder of the project area examined during the AIA.

Monitoring of boat launch ramp at Eagle Creek Park Boat Ramp Improvement project development activities were conducted by Ursus (Bonner 2013) under Site Alteration permit 2013-0032. No archaeological remains were identified within the project area during the monitoring program.

### 1.5.1.2 CLBWORKS-32 Anderson Point Boat Ramp Upgrade Project

The Anderson Point Boat Launch upgrade project is located on the east side of the Arrow Reservoir approximately 2 km east of Renata, BC. In 2011 Tipi Mountain visited the project area to determine whether a nearby recorded archaeological site DiQm-17 was
correctly plotted on the Provincial GIS database which indicated a possible conflict with the proposed Anderson Point boat ramp project area. At the time it was determined that no archaeological materials or sites were present or suspected to be located within the portion of the project footprint as observed above the high water level. In addition, the site location was revised and re-mapped to the north-northwest, well outside the project area. In 2013 Tipi Mountain conducted a post impact assessment of the Anderson Point boat ramp project and again did not observe any archaeological materials within the project footprint. Upon further investigation to the north-northwest of the project area archaeological materials associated with site DiQm-17 were observed at low water and the site boundaries further refined.

1.5.1.3 CLBWORKS-43 Nakusp Boat Ramp Upgrade Project

The Golder AOA and PFR study (Golder 2008) did not identify any archaeological materials or features on or adjacent to any of the existing (Nakusp) or proposed (North Nakusp, Nakusp Public Beach, and South Nakusp) boat ramp locations. However, the portion of the South Nakusp site located to the north of a private wharf, directly adjacent to the creek, is considered to have high archaeological potential due to the presence of intact sediments. The existing Nakusp boat ramp was chosen as the most appropriate location for upgrade and Ursus subsequently conducted a more detailed AOA in 2012 to assess potential conflicts with EbQk-5 a shipwreck site determining through that assessment that the shipwreck is located at minimum 50 m from the proposed development area. As such it was the author’s opinion that the development as currently designed would have little chance of being in conflict with the shipwreck site and therefore no further PFR or underwater survey work was necessary.

1.5.2 Wildlife Physical Works

Golder prepared an AOA and Antiquus Archaeological Consultants Ltd. (Antiquus) conducted an AIA of a proposed wildlife physical works project located on the east shore of the main channel of the Columbia River in the upper Arrow Lake reservoir south of Revelstoke. A summary of these studies are included below.

1.5.2.1 CLBWORKS-30 Habitat Rehabilitation

Golder (2011) prepared a desktop AOA of for BC Hydro as part of the Wildlife Physical Works study of three project areas including the Airport Lagoon Outflow (Site 6A), Cartier Area (Site 14), and Cartier Bay (Site 15A) within the Revelstoke Reach of the Arrow Lakes reservoir. The AOA includes a review of available ethnographic literature, Provincial Heritage Register search results, environmental information (i.e., biogeoclimatic zone and surficial geology), and an archaeological potential assessment. The AOA identified that all three project areas had high archaeological potential and recommended that additional archaeological work in the form of an AIA be conducted. An AIA was completed by Antiquus in 2013 for proposed habitat rehabilitation sites 6A, 14 and 15A (Sagarbarria and Rousseau 2013). The AIA did not identify any pre-historic cultural deposits and no further archaeological work was recommended.
1.5.3 Summary of Other BC Hydro Sponsored Archaeological Studies in the Columbia WUP Results

Archaeological assessments were conducted of 12 proposed boat ramp upgrade locations (existing Burton, Burton Alternative Site 1, Burton Alternative Site 2, Bush Harbour, Centennial, existing Edgewood, Edgewood Proposed Ramp, existing Fauquier, Fauquier South, Fauquier North, existing McDonald, and Valemount) for the CLBWORKS-18 project. Conflicts related to archaeological concerns were identified for two project areas (existing Edgewood and Fauquier North). No archaeological conflicts were identified for the remainder of the CLBWORKS proposed boat ramps. Although no archaeological materials were located during the AIA of existing Edgewood boat ramp, site DkQm-12 was identified as possibly being in conflict with development activities related to upgrades of the existing Edgewood boat ramp. Therefore an SAP was applied for and project development activities within the site boundaries were monitored with negative results. The proposed boat ramp at Faurier North was never developed.

No archaeological conflicts were identified for the three proposed habitat rehabilitation sites for the CLBWORKS-30 (Habitat Rehabilitation) project.

A PFR and post impact assessment was conducted for the CLBWORKS-32 (Anderson Point Boat Ramp Upgrade) project. These studies determined that archaeological site DiQm-17 was incorrectly plotted on RAAD and was not in conflict with the boat ramp upgrade works.

Archaeological assessments were conducted of four proposed boat ramp upgrade locations (existing Nakusp, North Nakusp, Nakusp Public Beach, and South Nakusp) for the CLBWORKS-43 (Nakusp Boat Ramp Upgrade) project. Shipwreck site EbQk-5 was identified by the AOA as possibly being in conflict with the existing Nakusp boat ramp, but it was determined during the AIA that site was located outside of the project footprint.
2 Conclusions and Recommendation

In recognizing the importance of cultural heritage and archaeological values, particularly to First Nations in the region, the CC developed a number of objectives broadly aimed at minimizing impacts to archaeological sites from wave and wind erosion as well as from destructive human behaviour while maintaining access to archaeological sites for appropriate uses and maintaining the cultural, aesthetic and ecological context of important cultural resources and spiritual sites.

The CC recommended a series of specific studies aimed at identifying archaeological sites within the reservoir system and developing measures that may assist in protecting these values.

Re-vegetation within the draw down was explored by the CC as one potential means of protecting and obscuring archaeological sites. The potential for re-vegetation of portions of the drawdown to support cultural values and practices beyond even the potential direct protection of archaeological sites was also a key consideration in the CC discussions.

The Water Comptroller ordered the following studies related to cultural heritage:

- An AOA of the drawdown zones of Kinbasket, Revelstoke and Arrow Lakes reservoirs and the mid-Columbia River; and

- Non-intrusive erosion monitoring of archaeological resources located in Arrow Lakes reservoir and mid-Columbia River drawdown zones

However BC Hydro remains committed to Programs and other assessments that will assist in addressing many of the objectives and specific recommendations of the CC.

A number of management questions were posed through the individual WUP study TOR:

- What is the nature of the archaeological resources that are present within the reservoir?

- What effects do reservoir operations have on these archaeological resources?

- In what ways will archaeologically sensitive locations within the reservoir be impacted by potentially intrusive physical works related to vegetation, debris removal or recreation?

- Conversely, in what ways can re-vegetation techniques be incorporated into archaeological site mitigation measures?

The three WUP monitoring programs, CLBMON-50, CLBMON-51 and CLBMON-52, each began an exploration of these management questions but the effort required to obtain the detailed archaeological information needed to more fully explore these questions over a large study area like the Columbia system is significantly greater than could be achieved in these non-intrusive short term studies.
BC Hydro’s RAP takes a long term approach to identifying and assessing the effects of reservoir operations on archaeological sites. Work in this program is completed under the terms of Provincial Heritage Permits which allow for the retrieval of artifacts and the exploration of site content and integrity through subsurface excavations. This program will over time provide information toward the questions posed through the WUP as they pertain to archaeological resources and will develop new questions as more information is revealed.

Identifying and protecting cultural values related to archaeology, plants, wildlife and other resources including places with spiritual and cultural resonance for First Nations presents a challenge when approached through the blunt instruments of multi-stakeholder process or regulated programs. Existing programs for archaeology and re-vegetation as examples can be made more sensitive to these values through a continued multi-way connection with interested First Nations but by their very definition are always limited in their scope.

- It is recommended that the RAP continue to refer to the objectives and questions emanating from the WUP and find ways to meaningfully incorporate cultural perspectives into the work of this program.

- A specific interest of the CC was to incorporate re-vegetation into archaeological site protection measures and there appears to be some potential for this to be effective in the findings of studies such as CLBMON-52 and in the recent work on Kinbasket, it is recommended that the RAP connect and coordinate with re-vegetation programs that may take place in these reservoirs in the future to seek out synergies between the programs, and

- The AIAs of individual physical works are a direct and targeted means to address potential impact to archaeological sites from these improvements and continued diligence in assessing potential conflicts related to future physical works projects will serve to address this concern of the CC.
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