

Bridge-Seton Water Use Plan

Monitoring Program Terms of Reference

- BRGWORKS-1 Carpenter Reservoir Drawdown Zone Re-Vegetation Program

March 10, 2014

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1 Introduction

This Terms of Reference details the scope of work required for re-vegetation of the Carpenter Reservoir drawdown zone. A cost estimate for the work and a tentative schedule for overall completion of the work are also provided.

This Terms of Reference is submitted in response to the *Order* issued by the Comptroller of Water Rights on March 30, 2011. The *Order* states that the BC Hydro shall implement a short term re-vegetation program to mitigate the effects of dust storms, increase the aesthetic quality, enhance the quality of riparian habitats, and provide localized improvements in the quality and productivity of aquatic habitats in areas affected by the drafting of Carpenter Lake Reservoir (as stated in Schedule A).

1.1 Background

The *Bridge River Water Use Plan* identifies that Carpenter Reservoir under normal operations will be regulated between its licenced maximum and minimum levels of 606.55 m and 651.08 m by discharge into the Lower Bridge River and by diversion into Seton Lake. To manage the reservoir for generation, fish habitat and to minimize spills from Terzaghi Dam into the Lower Bridge River, BC Hydro will make reasonable efforts to target a maximum elevation of 648.00 m for the end of the snowmelt season in August. Extended reservoir excursions above 648.00 m are expected as a result of meeting other operational constraints with higher priorities.

The Bridge River Water Use Plan Consultative Committee as stated in Appendix D3 of the *Bridge River Water Use Plan Consultative Committee Report (WUP CC, 2003)*, recommended that a program be initiated to enhance vegetation in Carpenter Reservoir. As an integral component to the operating alternative selected by the Consultative Committee (N2-2P) the planting program was proposed as a means to mitigate the effects of dust storms resulting from reservoir drawdowns particularly in the western end of the reservoir near the town of Gold Bridge, increase the aesthetic quality and hence expected recreational opportunities in the western end of the reservoir, enhance the quality of riparian habitats to increase their potential to support wildlife populations, and provide localized improvements in the quality and productivity of aquatic habitats in the reservoir.

The intent of the Consultative Committee for this physical works project was to address a trade-off between fish, dust, aesthetic and wildlife benefits on the overall Water Use Plan, specifically related to the maximum elevation target of 648 m during tail end of the snowmelt season in August of each year. The scope of work was intended to be a five-year re-vegetation strategy that will encourage natural re-colonization of the area from Tyax junction to the Gun Creek fan (approximately 500 hectares). The original intention was to plant fall rye in barren areas to help provide protection to encourage natural re-vegetation. Selective planting of other species was also considered. Annual evaluations were intended to assess the

degree of natural re-colonization. The Consultative Committee expected that there would be ancillary benefits toward mitigating dust, aesthetics, recreational opportunities, local wildlife populations and aquatic habitats.

1.2 Project Objectives

The overall objective of the Carpenter Reservoir Drawdown Zone Re-vegetation Program is to undertake a program to establish the appropriate species of vegetation and work toward encouraging the natural re-colonization of the area of the Carpenter Reservoir drawdown zone between Tyaughton Lake Road Junction and the Gun Creek Fan. Information gained from the BRGMON-2 Carpenter Reservoir Riparian Vegetation Monitoring program and other BC Hydro reservoir re-vegetation programs such as those in the Arrow Lakes and Kinbasket Reservoir will be used in the development of this program. A supportive argument will be made regarding the choice and establishment methods for the species identified.

2 Scope and Deliverables

The scope of the program as it was identified by the Bridge River Water Use Plan Consultative Committee is as follows:

- 1) To design and implement a reservoir planting program for the western end of Carpenter Lake, focusing on the area between Tyaughton Lake Road Junction and the Gun Creek Fan.
- 2) To focus on the planting of appropriate species of vegetation (This will be done using information gained in the BRGMON-2 program. A supportive argument must be made on the choice of species).
- 3) To conduct evaluations of the program to assess the degree to which the planting program helps to establish natural re-colonization of the area from Tyaughton lake Road Junction to Gun Creek Fan (This will be covered by the BRGMON-2 program).
- 4) To conduct evaluations of the program in order to assess the degree to which the planting program helps enhance the quality of riparian habitats, increase their potential to support wildlife populations, and provide localized improvements in the quality and productivity of aquatic habitats in the reservoir

2.1 Approach

There are three phases proposed in the Carpenter Reservoir Drawdown Zone Planting Strategy: 1) Plan, 2) Implementation and 3) Evaluation. Each phase is described in more detail below.

2.1.1 Phase 1 Planning

The consultant is expected to develop a planting program based on detailed review of the outcome of the first year of monitoring under BRGMON-2 Carpenter Reservoir Riparian Vegetation Monitoring as well as considering the results of other planting

studies for reservoir re-vegetation programs in B.C. The planning phase will identify and select sites, and species of plants and methods for plant establishment appropriate to the program. The consultant will also need to demonstrate an appreciation of the logistics necessary to effectively fulfill a five-year strategy targeted at the eventual natural re-colonization of the Carpenter Reservoir drawdown zone and discuss contingency measures as they relate to potential setbacks. The approach should consider staging initial trials to assess and confirm feasibility before proceeding with a comprehensive planting strategy.

2.1.2 Phase 2 Implementation

The consultant is expected to develop a re-vegetation strategy, including propagation of selected species from seed, and identification of sources and opportunities for vegetative propagation of riparian plant species. The planting strategy will include a schedule, planting locations, planting methods, plan for follow-up monitoring, site access and operational logistics, required permits, estimated costs (within the approved budget available under this Terms of Reference), and expected benefits. The strategy should reference where appropriate other planting programs in B.C. and provide a justification of the strategy chosen. Implementation of the planting program should consider starting with initial trials to determine the feasibility of implementing a progressively larger scale planting strategy. After trials have been completed and feasibility assessed, and after annual reporting has been provided by the consultant, BC Hydro will make a decision based on the results about how to proceed and/or to re-evaluate the project. This may occur at annual intervals as the project progresses based on the results. The project also will include an option for BC Hydro to use discretion to defer the planting program based on the recommendations and planning provided by the consultant. Deferral of the planting program may be triggered by special circumstances such as an extreme high water year that would have a negative impact on the success of the planting strategy.

2.1.3 Phase 3 Evaluation

The details of the monitoring and evaluation pertaining to the spatial extent, species composition, relative productivity of the plant community and riparian habitat are already captured under BRGMON-2 Carpenter Reservoir Riparian Vegetation Monitoring. However, the consultant is also expected to develop a strategic and cost effective approach to evaluating the effectiveness of the re-vegetation program to mitigate the effects of dust, the aesthetic quality of the reservoir, and to improve wildlife habitat. Evaluation of potential improvements on abundance of fish in Carpenter reservoir is already covered by BRGMON-4 Carpenter Reservoir and Middle Bridge River Fish Habitat and Population Monitoring. The consultant is expected to collaborate with the BRGMON-4 project team to ensure aquatic benefits are adequately captured under the BRGMON-4 monitoring.

In order to conduct the evaluation of dust mitigation, aesthetic value and wildlife the following management questions and hypotheses are provided.

Management Questions:

- 1) Will the planting of vegetation in the drawdown area mitigate the effects of dust storms resulting from reservoir drawdowns particularly in the western end of the reservoir near the Town of Gold Bridge?
- 2) Will the planting of vegetation in the drawdown area increase the aesthetic quality and recreational opportunities in the western end of the reservoir?
- 3) Will the planting of vegetation enhance the quality of riparian habitats to increase their potential to support wildlife populations and provide localized improvements in the quality and productivity of aquatic habitats in the reservoirs?

Null Hypotheses:

- H₁ The planting of vegetation in the drawdown area does not mitigate the effects of dust storms resulting from reservoir drawdowns particularly in the western end of the reservoir near the Town of Gold Bridge.
- H₂ The planting of vegetation in the drawdown area does not increase the aesthetic quality and recreational opportunities in the western end of the reservoir.
- H₃ The planting of vegetation in the drawdown area does not enhance the quality of riparian habitats to increase their potential to support wildlife populations and provide localized improvements in the quality and productivity of aquatic habitats in the reservoirs.

Monitoring Activities (covered by BRGMON-2 Carpenter Reservoir Riparian Vegetation Monitoring):

The monitoring activities covered under BRGMON-2 Carpenter Reservoir Riparian Vegetation Monitoring will continue annually during the implementation of the re-vegetation program to allow documentation of the time course of changes in spatial extent and density of naturally occurring and planted vegetation, species composition, and relative productivity (biomass/cover). The objective of these surveys is to evaluate the overall success of the planting program for improving the spatial extent of riparian vegetation in the drawdown zone.

Monitoring Activities (covered by BRGMON-4 Carpenter Reservoir and Middle Bridge River Fish Habitat and Population Monitoring):

The monitoring activities covered under BRGMON-4 Carpenter Reservoir and Middle Bridge River Fish Habitat and Population Monitoring will continue annually during the implementation of the re-vegetation program to allow documentation of comprehensive information of life history, biological characteristics, distribution, abundance and composition of the fish community in Carpenter Reservoir and the Middle Bridge River. The information collected by BRGMON-4 will be used to support the evaluation of the re-vegetation strategy with respect to quality and productivity of riparian and aquatic habitats for fish.

Dust Monitoring:

The consultant is expected to come up with a dust monitoring program for pre and post re-vegetation. The timing of the pre-vegetation sampling needs to be identified as a baseline or a reference point. The consultant will identify the details of the monitoring program in their proposal. Consultation with dust monitoring experts to confirm the efficacy of this part of the program is encouraged to assist with analysis, interpretation and reporting. An example of a monitoring approach has been provided here for consideration; however, the consultant is at liberty to propose a more effective approach in their proposal. The objective of the approach is to provide before and/or after or progressive performance measurement to demonstrate the effectiveness of the program for dust mitigation.

The example for consideration is a passive dust deposition monitoring technique involving low-tech approaches generally applied in monitoring of nuisance ambient dust assessments. The techniques are based on the principle that coarse particulates suspended in the air will fall out either under the influence of gravity - dry deposition- or in contact with water droplets -wet deposition- (Miro, 2013). Such systems are designed to collect and measure deposited dust over long period of time usually for days, weeks or months to determine dust deposition rates by mass expressed in mg/m² (Miro, 2013). Deposit gauges, such as ISO deposit gauge, Frisbee gauge and glass slides, could be considered to collect dust deposition at selected sites. However, during the planning phase, the contractor is encouraged to research and consider other alternative techniques that might be better suited for the site and scope of the project. Dust collection sites will be selected in areas expected to be affected by dust-storms around the Gold Bridge community and local recreational sites.

Aesthetic Value:

Scenic value is a measure of visual appeal of a landscape using some key factors such as vegetation cover and/or color. During the planning phase, the consultant is expected to develop qualitative rating criteria where scenic value is ranked on a comparative basis for pre and post re-vegetation periods. As with dust monitoring, consultation with a visual resource consultant is encouraged to identify appropriate metrics and thus the ability to report on aesthetic objectives being or not being met. The consultant may consider community consultations as a tool for measuring the effects of planting efforts on aesthetic perception by the local community; however, the consultant is at liberty to propose a more effective approach in their proposal. The objective of the approach is to provide a before and after performance measurement to demonstrate the effectiveness of the program for improving aesthetics.

Wildlife Populations:

The consultant is expected to lay out a strategic and cost effective survey program that could be implemented over the area covered by the re-vegetation project. The consultant will identify the details of survey program in their proposal. For scoping purposes we have provided the following; however, the consultant is at liberty to propose a more effective approach in their proposal:

- 1) As part of the process of laying out a grid using aerial photos within which plantings will be planned, consider laying out a preliminary access path. This would constrain the footprint from pedestrians/study team members. This access path would provide access to all areas to be studied. This path would also serve as a transect to be walked by a qualified wildlife observer.
- 2) The wildlife survey will target a number of key periods in the wildlife annual cycle, as well as target the bird breeding season (ideally early June and also the fall migration period) as it represents more substantive use relative to the study area.
- 3) Consider monitoring for wildlife sign including feces, tracks and plant utilization in the form of browse. Record anecdotal observations of wildlife.
- 4) Consider establishing a path or gridlines between test plot sites taking recordings of wildlife sign as well as GPS locations. The numbers of tracks per set distance of transect or path could be utilized as a baseline for monitoring wildlife presence.
- 5) Consider also the encounter transect methods outlined by RIC, 1999 and document all wildlife and wildlife sign along the path system.
- 6) The survey protocol could be repeated at other seasons of the year or during additional years as required.
- 7) The results of one or more surveys could then be used as a baseline against which to compare wildlife use at some future period when successful re-colonization by has occurred.

Potential Metals and Contaminant Monitoring:

Concerns have been raised about potential implications of the planting project on methylmercury concentrations in fish tissue due to organic decomposition of emergent plants. The consultant is expected to discuss the implementation of strategic measurements of metals and contaminant monitoring in fish tissues subsequent to full scale implementation of the planting strategy. The monitoring approach is expected to complement and follow the methods and approach already established between the ongoing monitoring program efforts within BRGMON-12 Bridge Seton Metals and Contaminant Monitoring Program and BRGMON-4 Carpenter Reservoir and Middle Bridge River Fish Habitat and Population Monitoring. The consultant is expected to consult with the BRGMON-12 and BRGMON-4 project teams to ensure that pre-plantation contaminant data is available from BRGMON-12. This may require some modification to the scope of BRGMON-12 that BC Hydro will have to revisit in the planning stage of this program. Input from the consulting team will be important for BC Hydro to ensure that potential metals and contaminant monitoring is adequately addressed within the scope of BRGMON-12. Additional fish tissue collection, analysis and reporting relative to the scope of the re-vegetation works may need to be considered.

2.2 Schedule

The proposed schedule for the planting program is provided in the table below.

After the completion of the first year of data collection for BRGMON-2 Carpenter Reservoir Riparian Vegetation Monitoring, a plan will be developed for the re-vegetation activities included in this Terms of Reference.

This project will begin with initial planting trials and evaluation of their effectiveness and then a decision on the scope of the remaining planting efforts will be made before each subsequent planting season as the program progresses. If each year's trials are found to be effective, we propose more intensive planting activities for the subsequent year of the project. However, if the trials are found to be ineffective, there will be a re-evaluation and a decision made about how to modify or potentially defer the project before proceeding with the subsequent year of planting. This approach is intended to ensure that we are getting the best value for the amount expended on the project. Monitoring of the effectiveness of the project including dust, aesthetic, wildlife, and metals and contaminant monitoring will be conducted according to Table 1 below.

Evaluation of the success of planting activities will occur on an annual basis during all years of the project to monitor the annual success of the program. This will be conducted under BRGMON-2 Carpenter Reservoir Riparian Vegetation Monitoring. The consultant is expected to indicate how the objectives and measures of this latter program will adequately monitor the BRGWORKS-1 program and identify any gaps that may require consideration.

Mapping and transect evaluation will occur in the final year of BRGMON-2 Carpenter Reservoir Riparian Vegetation Monitoring to allow determination of the extent to which the program successfully initiated the natural re-colonization of the area between Tyaughton Lake Road Junction and the Gun Creek Fan.

Table 1 Schedule

Task	Year 1 2012	Year 2 2013	Year 3 2014	Year 4 2015	Year 5 2016	Year 6 2017	Year 7 2018	Year 8 2019	Year 9 2020	Year 10 2021
1 Plan Development			X							
a Planting Trials			X							
b Full Scale Planting Implementation				X	X	X	X			
c Dust/Aesthetic Monitoring			X					X		
d Planting/Wildlife Monitoring			X	X	X	X	X	X		
e Metals & Contaminant Monitoring				X				X		
2 Analysis and Reporting										
a Annual Report			X	X	X	X	X			
b Final Report								X		

2.3 Budget

The total estimated cost of the Carpenter Reservoir Re-Vegetation Program is \$1,273,238.

3 References:

Bridge River WUP Consultative Committee Report (WUP CC), 2003. Compass Resource Management and BC Hydro. A report produced for BC hydro Water Use Planning group. (Executive Summary available on website: http://www.bchydro.com/content/dam/hydro/medialib/internet/documents/environment/pdf/wup_bridge_river_executive_summary_pdf.pdf)

Bridge River Power Development Water Use Plan, March 17, 2011: Revised for Acceptance for the Comptroller of Water Rights. (http://www.bchydro.com/content/dam/hydro/medialib/internet/documents/planning_regulatory/wup/lower_mainland/2011q2/bridge_river_wup_rev.pdf)

Mineral industry Research Organization (MIRO), 2013. Sustainable aggregates (www.sustainableaggregates.com/sourcesofaggregates/landbased/dust/dust_monitoring.htm)

RIC 1999. Inventory Methods for Forest and Grassland Songbirds Standards for Components of British Columbia's Biodiversity No.15, March 16, 1999, Version 2.0; Prepared by Ministry of Environment, Lands and Parks Resources Inventory Branch for the Terrestrial Ecosystems Task Force Resources Inventory Committee. (<http://www.llbc.leg.bc.ca/public/pubdocs/bcdocs/330770/songml20.pdf>)