Columbia River Project Water Use Plan

Columbia River White Sturgeon Management Plan

CLBWORKS-27 Lower Columbia White Sturgeon Physical Works: Physical works options to address white sturgeon recruitment failure in the lower Columbia River

Phase two design

Prepared by:
Golder Associates Ltd.

August 2022

GOLDER
MEMBER OF WSP

REPORT

CLBWORKS-27 Lower Columbia River White Sturgeon Physical Works

Phase 2 Construction Design and Definition

Submitted to:

BC Hydro and Power Authority

Attention: Teri Neighbour and James Crossman
6911 Southpoint Drive
Burnaby, BC V3N 4X8

Submitted by:

Golder Associates Ltd.
Suite 200 - 2920 Virtual Way, Vancouver, British Columbia, V5M 0C4, Canada

+1 604 296 4200

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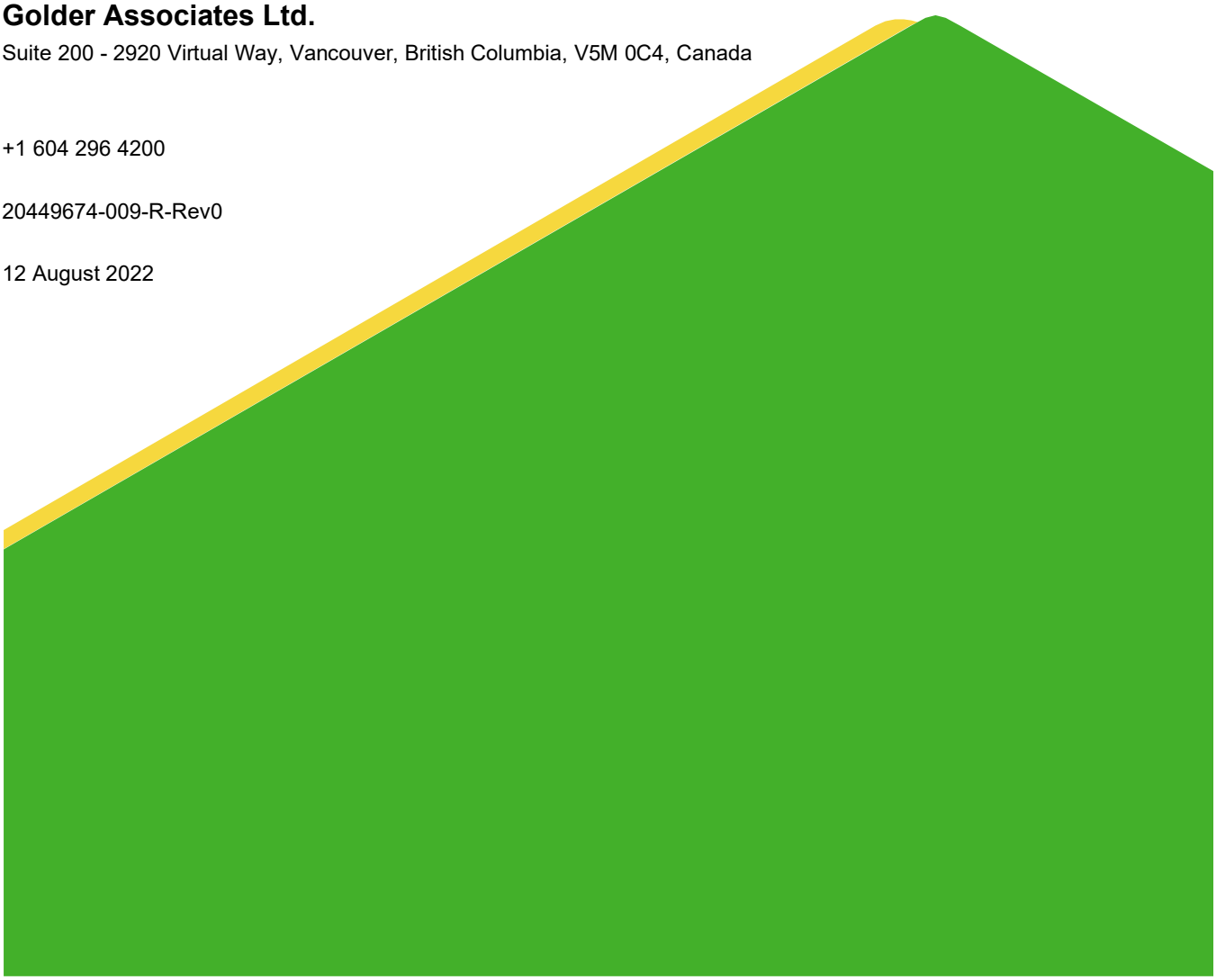
12 August 2022



Executive Summary

The wild White Sturgeon populations in the Columbia River between Hugh L. Keenleyside Dam (HLK) and Grand Coulee Dam (Transboundary Reach) have been in decline since at least the 1990s. The CLBWORKS-27 Lower Columbia White Sturgeon Physical Works Project (the Project) was developed by the Upper Columbia White Sturgeon Recovery Initiative (UCWSRI) to enhance White Sturgeon (*Acipenser transmontanus*) recruitment in the Transboundary Reach. The project is split into three phases.

- **Phase 1: Hydraulic Modelling and Restoration Option Development** was completed prior to Golder's involvement in the project. This phase included determination of the feasibility of spawning substrate restoration at three sites on the lower Columbia River and recommendation of a preferred site and substrate.
- **Phase 2: Construction Design and Definition** included further development of the project including design, environmental reporting, and planning based on the outcomes of Phase 1 and is the object of this report.
- **Phase 3: Implementation** will be focused on the completion of works outlined in Phase 2.

The selected restoration area is located approximately 8 km upstream of Castlegar along the Columbia River, approximately 160 m downstream of the Arrow Lakes Generating Station. Golder's scope of work in Phase 2 of the Project included the following tasks.

- Engineering Design,
- Construction Design,
- Technical Specifications,
- Environmental Assessment,
- Environmental Management Plan,
- Regulatory Support,
- Communications Plan, and
- Public Safety Plan.

Important Information and Limitations of This Report

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The report is of a summary nature and is not intended to stand alone without reference to the instructions given to Golder by the Client, communications between Golder and the Client, and to any other reports prepared by Golder for the Client relative to the specific site described in the report. In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the whole of the report. Golder cannot be responsible for use of portions of the report without reference to the entire report.

Unless otherwise stated, the suggestions, recommendations and opinions given in this report are intended only for the guidance of the Client in the design of the specific project. The extent and detail of investigations, including the number of test holes, necessary to determine all of the relevant conditions which may affect construction costs would normally be greater than has been carried out for design purposes. Contractors bidding on, or undertaking the work, should rely on their own investigations, as well as their own interpretations of the factual data presented in the report, as to how subsurface conditions may affect their work, including but not limited to proposed construction techniques, schedule, safety, and equipment capabilities.

Table of Contents

1.0 INTRODUCTION **1**

1.1 Scope of Work 2

2.0 ENGINEERING DESIGN **4**

3.0 CONSTRUCTION DESIGN **5**

4.0 TECHNICAL SPECIFICATIONS **6**

5.0 ENVIRONMENTAL ASSESSMENT **6**

6.0 ENVIRONMENTAL MANAGEMENT PLAN **6**

7.0 REGULATORY SUPPORT **8**

8.0 PUBLIC SAFETY PLAN **8**

9.0 COMMUNICATIONS PLAN **9**

10.0 SUMMARY AND RECOMMENDATIONS **9**

11.0 CLOSURE **10**

REFERENCES **11**

TABLES

Table 1: Recommended Substrate Mixture GSD5 4

Figure 1: Site location 3

FIGURES

Figure 1: Site location 3

APPENDICES

APPENDIX A
Engineering Design Memorandum

APPENDIX B
Construction Design and Basis of Estimate Memorandum

APPENDIX C
Issued-for-Tender Package

APPENDIX D
Environmental Assessment

APPENDIX E
Environmental Management Plan

APPENDIX F
Public Safety Plan

APPENDIX G
Communications Plan

1.0 INTRODUCTION

Golder Associates Ltd. (Golder) was engaged by BC Hydro to provide design, construction planning, and regulatory permitting support for the Phase 2 CLBWORKS-27 Lower Columbia White Sturgeon Physical Works Project (the Project). The Project objective is to enhance White Sturgeon (*Acipenser transmontanus*) spawning substrate at the Keenleyside White Sturgeon spawning area by placing a mixture of multiple grain size substrate that will be stable and resistant to infilling by sedimentation. The enhancement of spawning substrate is required due to the insufficient level of natural recruitment of the White Sturgeon population residing in the Transboundary Reach of the Lower Columbia River to maintain a self-sustaining population.

White Sturgeon in the Columbia River between Hugh L. Keenleyside Dam (HLK) and Grand Coulee Dam (Transboundary Reach) have been extensively studied since the 1990s when their population decline was first identified (Hildebrand and Parsley 2013). The Upper Columbia White Sturgeon Recovery Initiative (UCWSRI) was formed in 2000 to aid in focusing monitoring efforts and develop recovery plans for this population (Gregory and Long 2008). The UCWSRI Technical Working Group (TWG) examined several hypotheses regarding the causes of the Transboundary Reach population decline and released a recovery plan in 2002. Unfortunately, recovery efforts directed by the plan did not correct the apparent insufficient level of natural recruitment of the population (Gregory and Long 2008).

The Upper Columbia population of White Sturgeon was designated as Endangered under the Species at Risk Act in 2006 as a result of recruitment failure (DFO 2014). This designation was the impetus for the TWG to initiate a recruitment failure hypothesis review in 2006, and in 2007 the Comptroller of Water Rights in British Columbia ordered the Upper Columbia River Water Use Plan (WUP; Gregory and Long 2008). In 2008, the TWG identified realistic in-river mitigation and research options to address key recruitment failure hypotheses. The modification/restoration of spawning substrate in key spawning areas was identified as one of the realistic options to address recruitment failure.

White Sturgeon spawning substrate restoration is a research and mitigation option that may result in a positive effect on recruitment (Gregory and Long 2008, Ecofish 2020), while posing very low risks to other fish species and resulting in little to no impacts on aquatic and riparian environments. The WUP Project is split into three phases:

- **Phase 1: Hydraulic Modeling and Restoration Option Development**
  This objective of this phase was to determine the feasibility of spawning substrate restoration on the lower Columbia River (Ecofish 2020). This phase investigated three potential sites on the Lower Columbia River for spawning substrate restoration: Keenleyside (river km 0.2) at HLK, Kinnaird (river km 13.4 to 18.4), and Waneta (river km 56.0 to 57.2). The summary report (Ecofish 2020) included a detailed assessment of the biological and technical feasibility of White Sturgeon spawning substrate restoration at the three sites. The report recommended the Keenleyside site for restoration based on the results of hydraulic simulations and sediment transport modelling, in a spawning area downstream of the ALH. The report also noted a preferred grain size distribution. The TWG selected the Keenleyside site as the preferred location for further project development in Phases 2 and 3.
- **Phase 2: Construction Design and Definition**
  This phase, the object of this report, included the development of a detailed construction design and cost estimate for restoration at the Keenleyside location. This phase also includes regulatory approvals and permitting, environmental and archaeological assessments, and development of environmental management, public safety, and communications plans.
- **Phase 3: Implementation and Monitoring**
  This phase is focused on the completion of works outlined in Phase 2. In addition to construction, this phase will include the completion of any remaining permitting and post-construction and effectiveness monitoring.

An evaluation of potential enhancement projects was completed under Phase 1 of this Project (Ecofish 2020) and included a detailed assessment of the biological and technical feasibility of White Sturgeon spawning substrate restoration at various spawning locations on the Lower Columbia River (Ecofish 2020). In Phase 1, the following three known spawning locations for White Sturgeon were assessed:

- Keenleyside (river km 0.1) at the Hugh L. Keenleyside Dam (HLK) – The Keenleyside White Sturgeon spawning area extends from HLK and the adjacent Arrow Lake Generating station (ALH), to approximately 1.25 km downstream to the confluence with Rialto Creek.
- Kinnaird (river km 13.4 to 18.4) – The exact location of White Sturgeon spawning in the Kinnaird area is unknown but the assessed area was the approximately 5 km section of river downstream from the Highway 3 bridge (river km 13.4)
- Waneta (river km 56.0 to 57.2) – The Waneta White Sturgeon spawning extends approximately 1 km downstream of the Waneta Dam to the Canada/USA Border

The selected restoration area is located approximately 8 km upstream of Castlegar along the Columbia River, approximately 160 m downstream of the Arrow Lakes Generating Station (ALH), as shown in Figure 1.

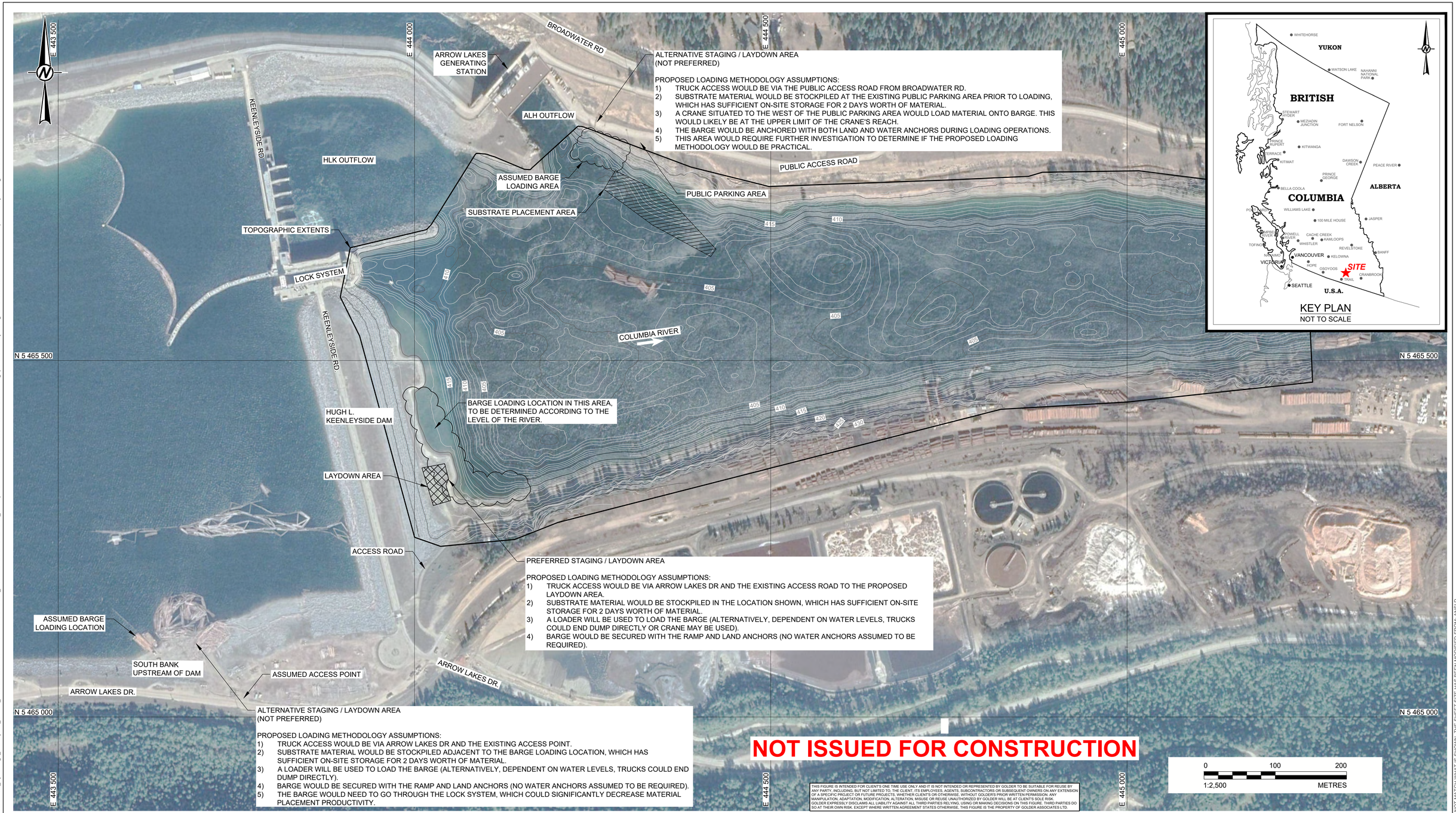
The Phase 1 report recommended restoring spawning substrate at the spawning area located downstream of HLK and ALH. Recommended restoration work included placement of an engineered substrate mix in the tailrace of the ALH dam. The report investigated an approximately 25,000 m^2 portion of the tailrace, of which roughly 6,500 m^2 would both satisfy sediment stability criteria and be in the path of drifting sturgeon eggs. The suggested conceptual design included placement of the engineered substrate mix (GSD5, see Table 1) in one-half (3,250 m^2) of this suitable area at a thickness of 0.6 m (Ecofish 2020).

This report is a summary of work completed by Golder in Phase 2 Construction Design and Definition, using recommendations from Phase 1 as a starting point to develop site-specific designs for the restoration works. This report should be read in conjunction with the “Important Information and Limitations of This Report” section, as it forms an integral part of the document.

1.1 Scope of Work

Golder’s scope of work in contribution to Phase 2 of the Project included the following tasks.

- Engineering Design,
- Construction Design,
- Technical Specifications,
- Environmental Assessment,
- Environmental Management Plan,
- Regulatory Support,
- Communications Plan, and
- Public Safety Plan.



NOT ISSUED FOR CONSTRUCTION

0 100 200
1:2,500 METRES

LEGEND

- EXISTING RIVER BED SURFACE
- SUBSTRATE PLACEMENT AREA
- TOPOGRAPHIC EXTENTS

NOTES

1. ALL UNITS ARE IN METRES UNLESS OTHERWISE NOTED.
2. COORDINATE SYSTEM IS UTM NAD 83, ZONE 11.
3. EXISTING GROUND CONTOURS ARE SHOWN AT 1 m INTERVAL RELATIVE TO CGVD 2013.

REFERENCES

1. IMAGE ©2021 GOOGLE, OBTAINED FROM GOOGLE EARTH PRO, USED UNDER LICENSE. GOOGLE EARTH IMAGE IS NOT TO SCALE.
2. BATHYMETRY SURVEY CONDUCTED BY GRANT LAND SURVEYING INC, ON JULY 01, 2019.

CLIENT
BC HYDRO

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2021-09-02
DESIGNED	RC
PREPARED	GB
REVIEWED	GT
APPROVED	CC

PROJECT
CLBWORKS-27 LOWER COLUMBIA RIVER WHITE STURGEON PHYSICAL WORKS (PHASE 2)

TITLE
SITE PLAN

PROJECT NO.	PHASE/TASK	REV.	FIGURE
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2.0 ENGINEERING DESIGN

The engineering design of the restoration works and associated design drawings (Appendix A) were developed using recommendations from Phase 1 as a starting point to develop site-specific designs for the restoration works.

The recommended restoration substrate mixture was noted by Ecofish (2020) as GSD5 (“ideal sturgeon substrate”) and validated by Golder as part of the Engineering Design. The median particle diameter of the restoration substrate was found to be fully stable. The gradation of the substrate mixture is outlined in Table 1.

Table 1: Recommended Substrate Mixture GSD5

Description		Value
Size Fraction Proportions	20-100 mm	40%
	100-200 mm	40%
	200-300 mm	20%
Median particle diameter (D_{50})		125 mm

An in place substrate layer thickness of 600 mm (twice the D_{100} of GSD5) was selected to minimize the probability of juvenile entombment (Crossman and Hildebrand 2012; Ecofish 2020) over the 5,880 m^2 placement area. The substrate blanket placement area was selected based on recommendations from Phase 1 and modified for constructability.

It is predicted that the placement of a substrate blanket along the selected placement area will not result in a reduction in hydraulic conveyance compared with the existing critical hydraulic conveyance upstream at the ALH tailrace and the hydraulic effect of substrate placement is expected to be insignificant (nil or close to nil).

It is anticipated that the substrate mixture will be mobile, and the degree of mobility and movement beyond the selected placement area will vary from year to year based on the annual flows. An allowance for a 10% loss of the substrate mixture per year was recommended based on Golder’s experience with similar projects, an understanding of sediment entrainment processes, and the GSD5 substrate mixture gradation. To account for this and potential loss due to isolated high-flow events, Golder recommended budgeting for three potential renourishment scenarios:

- Scenario 1: Place full substrate blanket in Year 1 and allow for 25% renourishment in each of Year 2, Year 3, Year 4 and Year 5.
- Scenario 2: Place full substrate blanket in Year 1 and allow for 50% renourishment in each of Year 3 and Year 5.
- Scenario 3: Place full substrate blanket in Year 1 and allow for 100% renourishment in Year 5.

Development of a physical and biological monitoring program to act as a trigger for maintenance is recommended.

3.0 CONSTRUCTION DESIGN

The construction design and basis of estimate memorandum (Appendix B) provides a summary of the constructability review, recommended construction methods, potential constraints, and an overview of the elements of the cost estimate.

The proposed construction methodology for gravel placement developed by Golder is as follows:

- Complete general construction setup activities, including:
  - Laydown area preparation, including establishing equipment access and installing ESC measures.
  - Barge preparation, including outfitting with anchor system, winches, fairleads, sidewalls, and equipment spill containment.
  - Pre-construction bathymetric survey.
  - Setting anchors. Golder has assumed a typical four-point anchor system with anchors on the barge corners (two on the bow and two on the stern). Anchors are assumed to consist of lock blocks, with two in the river and two on the shore. River anchors will be installed by a dive crew.
    - Anchor details are responsibility of the contractor and should be provided in advance.
- Wash substrate material with a hose and water truck at the pit/quarry prior to delivery to site.
- Deliver substrate material to the proposed laydown area by truck, and stockpile prior to barge loading.
- Use a loader to load gravel material from the stockpile to the barge at the proposed loading location.
- Use tugboat to transport the barge from the loading area on the south river bank to the gravel placement area.
- Place gravel using a long reach excavator (or crane with clamshell) located on the barge. The barge will be anchored in place during placement activities.
  - In order to confirm the accuracy of placement, bathymetric surveys will be performed regularly during construction.
  - Alternatively, surveys could be substituted with instrumentation on the excavator.
- Complete construction takedown and cleanup activities, including:
  - Removing anchors, with river anchors to be removed by a dive crew.
  - Post-construction bathymetric survey
  - Clean up laydown area and barge.

The Class 3 cost estimate was developed as per the Association for the Advancement of Cost Engineering International (AACEI) and BC Hydro's in-house estimating standards. Under BC Hydro's standards, a Class 3 estimate typically carries an expected accuracy range of -10% to +15%; however, due to the uncertainty of the marine construction market and the project location, Golder has targeted the estimate accuracy to be within

the -20% to +30% range (which is within the acceptable accuracy range of a Class 3 estimate under AACEI and BC Hydro standards). Based on the three replenishment scenarios outlined in the Engineering Design, the total estimated construction costs are as follows:

- Scenario 1 (initial construction and 25% renourishment in each of Year 2, 3, 4 and 5): $5.2 million.
- Scenario 2 (initial construction and 50% renourishment in Years 3 and 5): $4.3 million.
- Scenario 3 (initial construction and 100% renourishment in Year 5): $3.8 million.

Golder recommended using a 20% contingency for overall project costs to account for unknowns and scheduling a time contingency for material placement.

4.0 TECHNICAL SPECIFICATIONS

Technical specifications for construction of the works are provided in Appendix C.

5.0 ENVIRONMENTAL ASSESSMENT

The Environmental Assessment (EA) (Appendix D) presents a description of the restoration area, overview of proposed construction methods, assessment of the potential effects of the implementation of the Project, and mitigations for any residual adverse effects. The EA includes a review of existing information and a field reconnaissance program, cumulating in an effects assessment. The effects assessment utilizes Pathways of Effects diagrams created by the DFO (2018) to determine pathways and stressors that could be mitigated or which might pose potential residual threats. Results are presented in terms of a discussion of potential effects, mitigation measures to put in place, assessment of residual effects, and long-term monitoring.

The EA concludes that the placement of substrate downstream of the HLK requires in stream work that has low potential to place stressors on fish and fish habitat immediately downstream of the HLK with the mitigation measures outlined in the EA and EMP. The potential benefits to the Upper Columbia River White Sturgeon population as a result of substrate enhancement are considered to outweigh the potential negative impacts to fish and fish habitat in the Project area. With appropriate planning and implementation of mitigation measures during construction, these stressors are not expected to cause a harmful alteration, disruption, or destruction of fish habitat (HADD) and the Project is expected to provide a net gain in the quality and quantity of White Sturgeon spawning habitat and larval rearing habitat in this reach of the Columbia River.

6.0 ENVIRONMENTAL MANAGEMENT PLAN

Environmental protection through adherence to applicable legislation, regulatory approvals, and standard management practices are required for the Project. The objective of the Environmental Management Plan (EMP) (Appendix E) is to assist Project personnel in adhering to applicable environmental legislation and recommended environmental mitigation specific to installation of the spawning substrate. The EMP provides performance-based environmental requirements, standard protocols, and mitigation measures that are intended to reduce potential for

adverse environmental effects during Project implementation. The EMP describes how environmental risks are to be managed and, in the event of an environmental incident, how emergency response procedures, mitigation measures, and reporting protocols are to be implemented.

In general, the EMP:

- Describes the environmental management responsibilities for the work.
- Describes the necessary organizational lines of reporting and communication.
- Outlines applicable environmental legislation requirements, guidance documents, and best management practices (BMPs).
- Provides an overview of key environmental issues related to the Project.
- Recommends mitigation measures to manage potential adverse effects on fish including species at risk, and their habitats within the Columbia River during implementation of the Project.

The EMP includes specific environmental measures related to erosion and sediment control, water quality monitoring, spill prevention and emergency response, material storage and handling, waste management, fisheries and aquatic habitat management and mitigation, terrestrial resource protection and mitigation, air quality and dust control, acid rock drainage and metal leachate management, and site restoration.

Specific mitigation measures recommended include:

- Utilizing a drop camera or remotely operated vehicle to visually inspect the substrate placement area immediately prior to substrate placement events,
- Ensuring substrate material is lowered slowly through the water column and placed on the bed, rather than dumping from the barge,
- Cleaning and washing substrate material,
- Utilizing biodegradable hydraulic fluids for equipment working within or above the water,
- Conducting work activities in accordance with A User's Guide to Working In and Around Water (BC MOE 2009),
- Ensuring erosion and sediment control materials are always available on site and are utilized if sedimentation is likely to occur,
- Ensure equipment used to conduct work is in good mechanical condition,
- Preventing entry of any deleterious substance, sediment, or debris into the water,
- Completing instream work as quickly and efficiently as possible,
- Implementing sediment control measures,
- Only placing clean materials in the river, and
- Retaining as much riparian vegetation as possible and restoring where not possible.

7.0 REGULATORY SUPPORT

BC Hydro prepared regulatory applications based on documents prepared in the Phase 2 project. Golder provided regulatory support and input where requested.

White Sturgeon in the Canadian portion of the Columbia River are listed as Endangered under the *Species at Risk Act* (2006). The Project is located in the Lower Columbia River immediately downstream of the HLK which is designated as Critical Habitat for White Sturgeon under SARA (Department of Fisheries and Oceans [DFO] 2014). This section of Critical Habitat is identified as the Robson Reach, which extends downstream of HLK for approximately 7.6 km to the Castlegar Robson Bridge. Because the Project is located in Critical Habitat under SARA, BC Hydro will be applying for a SARA permit to DFO to complete the Project within the Critical Habitat and will also submit a Request for Review under the *Fisheries Act*.

A *Water Sustainability Act* Section 11 Change Approval from the Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRORD) will also be required for changes in and about a stream.

The Project will also require a review by Transport Canada's Navigation Protection Program (NPP) under the *Canadian Navigable Waters Act* to determine if the Project will be considered an interference to navigation. The proposed work will occur within a Scheduled Navigable Water (i.e., the Columbia River from Kinbasket Lake to the Canada/US border) and does not readily qualify under any of the Minor Works categories, which are permitted to occur without an Approval.

Other Federal, Provincial, and municipal statutes and guidelines that may be potentially applicable to the Project include:

- *BC Environmental Management Act*
- *BC Wildlife Act*
- *BC Transport of Dangerous Goods Act*
- *BC Weed Control Act*
- *Federal Transportation of Dangerous Goods Act*
- *Federal Migratory Birds Convention Act*
- *Hazardous Waste Regulation*
- *Spill Reporting Regulation*
- *Water Sustainability Regulation*

8.0 PUBLIC SAFETY PLAN

The Public Safety Plan (Appendix F) provides an overview of the Project approach for promoting public safety and managing public access to the site during construction, noting responsibility of the Prime Contractor for overall coordination of safety during construction. The Public Safety Plan:

- identifies potential land- and water-based public safety hazards
- documents planned hours of work, security and access considerations, and required signage
- outlines safety requirements for construction, including sections on on-water work, coordination with HLK/ALH operations, generation of a site-specific health and safety plan, and incident response.

9.0 COMMUNICATIONS PLAN

The Communications Plan (Appendix G) outlines the various Project parties and external and internal stakeholders, including regulatory agencies and required permits for the Project. The Plan includes lines and levels of communications between the various parties and includes preliminary communication processes and procedures to be refined during detailed Project planning and operations.

The parties involved in the project include the Project Owner, Prime Contractor (including subcontractors) and external stakeholders. The Owner's Project Team will include BC Hydro, the Prime Consultant, and the Operations Team for HLK and ALH. External stakeholders could include Transport Canada, the Department for Fisheries and Oceans, the Ministry of Forests, Lands, Natural Resource Operations and Rural Development, local First Nations groups, the City of Castlegar, marine users, and other residents and general public in the vicinity of the Project.

The information presented in the CP is preliminary and expected to be further developed as the Project progresses and the Prime Contractor and Prime Consultant have been selected. Any additional stakeholders identified during Phase 3 (Implementation) of the Project should be added to those identified in the plan, and the Contractor should provide detailed input into communications during construction as part of their construction planning.

10.0 SUMMARY AND RECOMMENDATIONS

Golder completed Phase 2 of the CLBWORKS-27 Lower Columbia White Sturgeon Physical Works Project with the following tasks:

- Engineering Design,
- Construction Design,
- Technical Specifications,
- Environmental Assessment Report,
- Environmental Management Plan,
- Regulatory Support,
- Communications Plan, and
- Public Safety Plan.

BC Hydro should consider the following recommendations when constructing the project in Phase 3:

- Develop a physical and biological monitoring plan to act as a trigger for substrate replenishment.
- Follow mitigations identified in the Environmental Management Plan during construction.

11.0 CLOSURE

We trust this document meets your present requirements. Please direct any questions, comments, or concerns to the undersigned.

Golder Associates Ltd.

Prepared by:

Richard Cunningham, MASc, EIT
Junior Water Resources Engineer

Gaven Tang, MASc, PEng
Senior River Engineer

Reviewed by:

Chris Coles, MASc, PEng
Associate, Senior Hydrotechnical Engineer

Larry Hildebrand, BSc
Senior Aquatic Biologist, Owner (RiverRun Consulting)

RC/GT/CC/LH/syd

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APPENDIX A

Engineering Design Memorandum

TECHNICAL MEMORANDUM

DATE 11 August 2022 **Reference No.** 20449674-005-TM-Rev1

TO Teri Neighbour and James Crossman
BC Hydro and Power Authority

CC Chris Coles

FROM Richard Cunningham, Gaven Tang **EMAIL gaven_tang@golder.com**

CLBWORKS-27 LOWER COLUMBIA RIVER WHITE STURGEON PHYSICAL WORKS (PHASE 2): ENGINEERING DESIGN MEMORANDUM

1.0 INTRODUCTION

Golder Associates Ltd. (Golder) was engaged by BC Hydro to provide design, construction planning, and regulatory permitting support for the Phase 2 CLBWORKS-27 Lower Columbia White Sturgeon Physical Works Project (the Project). The Project objective is to enhance White Sturgeon (*Acipenser transmontanus*) spawning substrate at the Keenleyside White Sturgeon spawning area by placing a mixture of multiple grain size substrate that will be stable and resistant to infilling by sedimentation. The enhancement of spawning substrate is required due to the insufficient level of natural recruitment of the White Sturgeon population residing in the Transboundary Reach of the Lower Columbia River to maintain a self-sustaining population.

An evaluation of potential enhancement projects was completed under Phase 1 of this Project (Ecofish 2020) and included a detailed assessment of the biological and technical feasibility of White Sturgeon spawning substrate restoration at various spawning locations on the Lower Columbia River (Ecofish 2020). In Phase 1, the following three known spawning locations for White Sturgeon were assessed:

- Keenleyside (river km 0.1) at the Hugh L. Keenleyside Dam (HLK) – The Keenleyside White Sturgeon spawning area extends from HLK and the adjacent Arrow Lake Generating station (ALH), to approximately 1.25 km downstream to the confluence with Rialto Creek
- Kinnaird (river km 13.4 to 18.4) – The exact location of White Sturgeon spawning in the Kinnaird area is unknown but the assessed area was the approximately 5 km section of river downstream from the Highway 3 bridge (river km 13.4)
- Waneta (river km 56.0 to 57.2) – The Waneta White Sturgeon spawning extends approximately 1 km downstream of the Waneta Dam to the Canada/USA Border

Golder Associates Ltd.
2800, 700 - 2nd Street SW, Calgary, Alberta, T2P 2W2, Canada T: +1 403 299 5600 F: +1 403 299 5606

The Phase 1 report recommended restoring spawning substrate at the spawning area located downstream of HLK and ALH. Recommended restoration work included placement of an engineered substrate mix in the tailrace of the ALH dam. The report investigated an approximately 25,000 m^2 portion of the tailrace, of which roughly 6,500 m^2 would both satisfy sediment stability criteria and be in the path of drifting sturgeon eggs. The suggested conceptual design included placement of the engineered substrate mix (GSD5, see Table 2) in one-half of this suitable area, 3,250 m^2, at a thickness of 0.6 m. (Ecofish 2020).

This technical memorandum addresses the engineering design of restoration works, using recommendations from Phase 1 as a starting point to develop site-specific designs for the restoration works. A summary of the constructability review, recommended construction methods, potential constraints, and an overview of the elements of the cost estimate are provided separately in Golder (2021).

This technical memorandum should be read in conjunction with the “Important Information and Limitations of This Report” section, as it forms an integral part of the document.

1.1 Scope of Work

This scope of work addresses the engineering design component of the Project. As part of the engineering design, Golder’s scope of work includes:

- Developing engineering designs for the recommended restoration works
- Preparing construction drawings and technical specification
- Preparing an engineering design memorandum

2.0 DESIGN CRITERIA

2.1 Design Objective

The design objectives for the White Sturgeon spawning habitat enhancement design include:

- Placement of a substrate blanket that is stable during design flow conditions.
- Selection of a substrate gradation that avoids infilling due to fines deposition and resists coarse scour.
- Placement of the substrate blanket results in a minimal (or no) backwater along the ALH tailrace.
- Design life of the restoration work is to be 5 to 10 years.

2.2 Hydraulics

Eleven flow scenarios for the ALH spawning area were examined by Ecofish (2020). Golder selected three of the Ecofish (2020) scenarios (K09, K10 and K12) for comparison, covering the range of typical spawning flows expected at the site. Two additional flow scenarios from the same report that represent extreme high flows in 2012 and 1997 (K06 and K08, respectively) highlight the potential variability of flow conditions that may occur at the ALH spawning area. These scenarios are key to the selection of the substrate mixture and are summarized in Table 1. Simulated bed shear stresses for each scenario are presented in Figure 1 to Figure 5.

The maximum typical expected shear stress was determined by simulating the K09 (worst case scour) scenario in River2D (Ecofish 2020 and Steffler 2000). The K09 scenario assumed a substrate placement area (with a blanket thickness of 0.6 m) that is larger in area than Golder's recommended substrate placement area. Therefore, the simulated shear stresses are expected to be slightly higher and more conservative than for Golder's design. The simulated maximum shear stress for the worst-case scour (K09) scenario is 98 Pa within the recommended substrate placement area, as illustrated in Figure 3. The peak shear stress for the worst-case scour scenario occurs approximately 60 m upstream of the recommended substrate placement area, roughly in the vicinity of a bathymetric ridge that appears to be the hydraulic constraint of the ALH tail race (as colored in red in Figure 1).

Table 1: Flow distributions simulated with River2D hydrodynamic model (Adapted from Table 6 in Ecofish (2020))

Scenario Name	Primary Simulation Purpose	Downstream Discharge (combined) (m^3/s)	Flow From Each Source (m^3/s)		Description (Ecofish 2020)	Days/Year Above or Below[1]	Maximum Shear Stress Within Placement Area (Pa)
			ALH	HLK			
K06	Coarse Scour	3256	1100	2156	Extreme high flow year (2012)	N/A	24
K08	Coarse Scour	4400	1100	3300	Extreme high flow year (1997)	N/A	20
K09	Coarse Scour	1100	1100	0	Worst case scour scenario	11	98
K10	Habitat Suitability	1785	1100	685	Average spawning period flows	31	34
K12	Fines Deposition	474	0	474	Mean annual flow at HLK while ALH=0	7	3

[1]days per year above for peak flows and below for low flows, based on HLK flows.

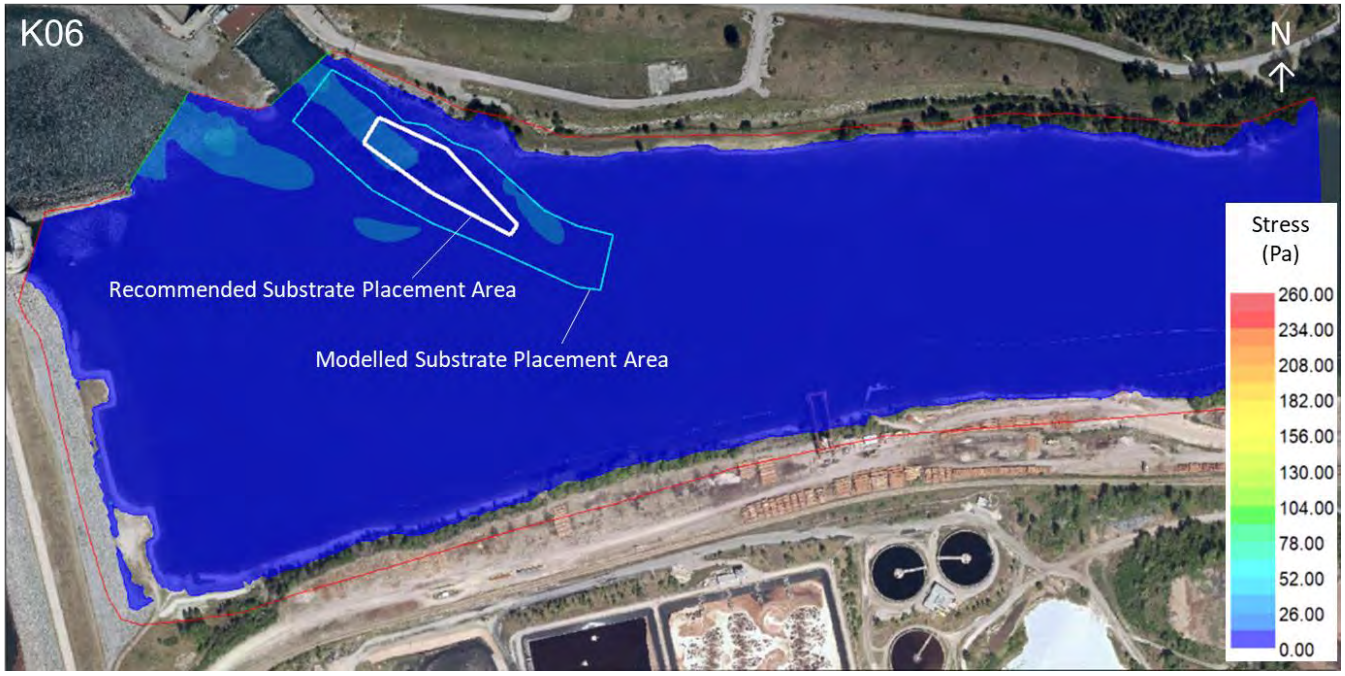

Figure 1: River2D Simulated Shear Stresses (Pa) for the K06 (Extreme high flow event: 2012) Scenario (Extracted from Hydrodynamic Modelling by Ecofish (2020))

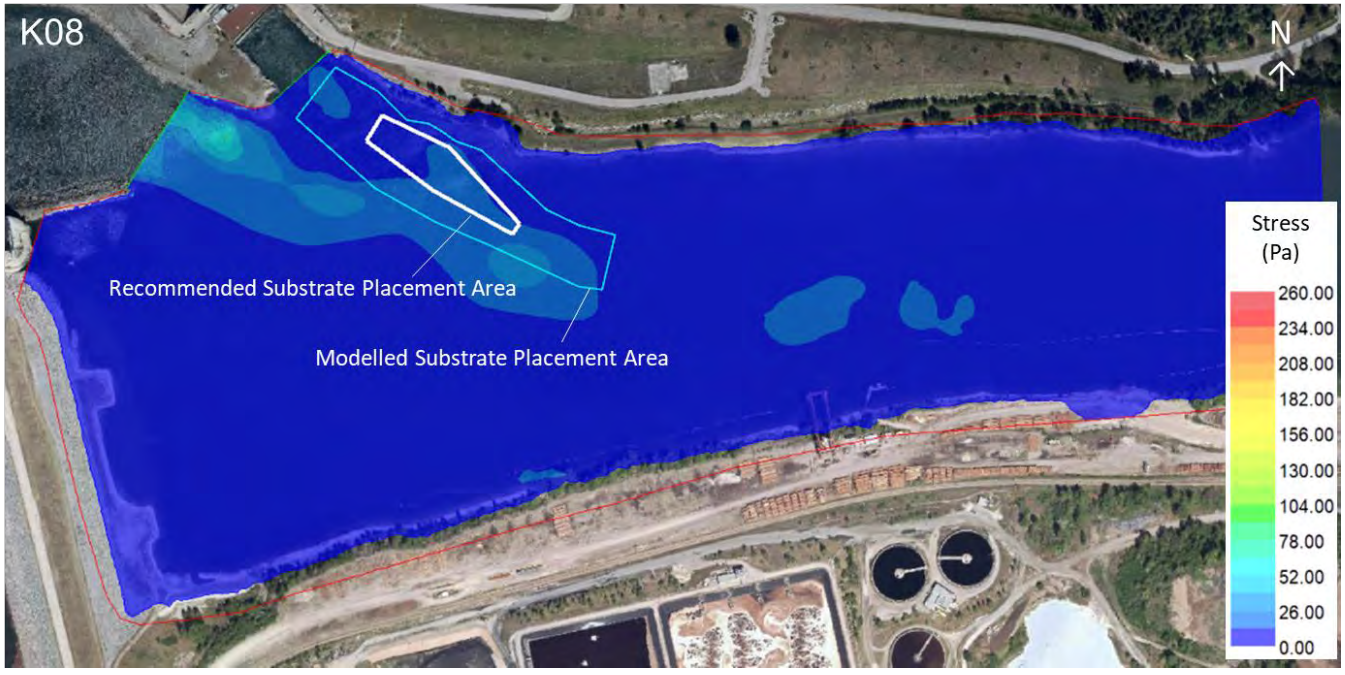

Figure 2: River2D Simulated Shear Stresses (Pa) for the K08 (Extreme high flow event: 1997) Scenario (Extracted From Hydrodynamic Modelling by Ecofish (2020))

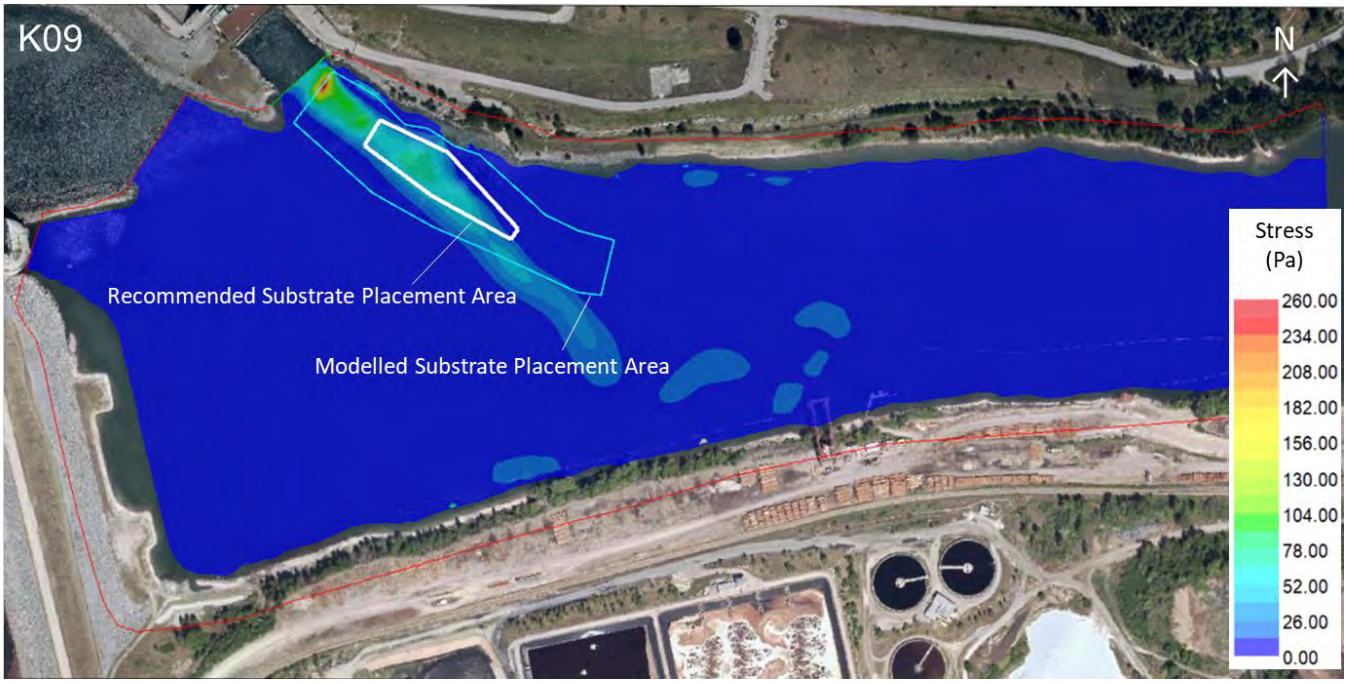

Figure 3: River2D Simulated Shear Stresses (Pa) for the K09 (Worst Case Scour) Scenario (Extracted from Hydrodynamic Modelling by Ecofish (2020))

Figure 4: River2D Simulated Shear Stresses (Pa) for the K10 (Average Spawning Flow) Scenario (Extracted from Hydrodynamic Modelling by Ecofish (2020))

Figure 5: River2D Simulated Shear Stresses (Pa) for the K12 (Fines Deposition) Scenario (Extracted from Hydrodynamic Modelling by Ecofish (2020))

2.3 Substrate Selection

The local bed is armoured due to flow regulation by the HLK and ALH dams upstream. This armouring does not provide favourable sturgeon spawning habitat. Six substrate mixtures were examined by Ecofish (2020) for White Sturgeon spawning habitat suitability, all of which consisted solely of substrate ranging between 20 and 300 mm in diameter. The recommended restoration substrate mixture was noted in by Ecofish (2020) as GSD5 (“ideal sturgeon substrate”). The leading alternative gradation option was noted as GSD6. Smaller substrate gradation mixtures were not considered as they are expected to mobilize more easily than both GSD5 and GSD6. Gradations for the two substrate mixtures are provided in Table 2.

Table 2: Substrate Mixture Descriptions for GSD5 (Ideal Sturgeon Substrate) and GSD6 (Leading Alternative Option) (Adapted from Table 7 in Ecofish (2020))

Description		GSD5 (Recommended)	GSD6 (Alternative)
Size Fraction Proportions (mm)	20-100	40%	20%
	100-200	40%	40%
	200-300	20%	40%
Median particle diameter, D_{50} (mm)		125	175

Substrate stability is a key concern for the Project. Loss of substrate will occur when shear stress is high enough to initiate particle movement and sediment transport. Two critical shear stress models were used to estimate the threshold for sediment transport: the Shields equation (Shields 1936) and the Wilcock and Crowe (W&C) equation (Wilcock and Crowe 2003). The estimated critical shear stress for incipient motion of GSD5 and GSD6 are in Table 3. The assumed critical Shields parameter is 0.06, appropriate for the expected range of Reynold's numbers expected at the Site (USACE 2006).

Table 3: Critical Shear Stress for Entrainment of Median Particle Diameter of GSD5 and GSD5 Substrate Mixtures

Method	GSD5 (Recommended)	GSD6 (Alternative)
Shields	121 Pa	170 Pa
Wilcock and Crowe	77 Pa	101 Pa

The median particle diameter is fully stable for both GSD5 and GSD6 according to the two models during typical flows (K10). Based on the Shields critical shear stress, both substrates are stable along the full placement area during worst-case scour flows (Scenario K09). GSD5 appears to be less stable when only examining the W&C critical shear stress, but the hydraulic model simulation results (Figure 1) still suggest that the median particle diameter is stable along 86% of the placement area during K09 conditions.

While it has been suggested that the D_{84} may provide a more accurate estimate of overall channel stability, the median particle size has been used in this analysis to better reflect the stability of the full range of particle sizes present in the substrate mixture. The effectiveness of the remediation relies not only on the stability of the larger particles, but in the stability of the full gradation of the placed substrate.

Habitat suitability in Phase 1 was determined using the methodology outlined Hatten et al (2018), based on Froude number, embeddedness, and gravel-cobble fraction of the substrate material. Embeddedness and Froude number do not change between GSD5 and GSD6. However, the GSD5 mix has an improved gravel-cobble fraction over GSD6. Since the Shields model predicts no difference in stability between GSD5 and GSD6, and GSD5 is more conducive for sturgeon spawning habitat, Golder recommends selection of GSD5 as the selected substrate mixture for the substrate blanket with the understanding that there will be an allowance for annual loss of some substrate due to sediment transport under typical flows. This substrate loss allowance is discussed in section 2.4.

2.4 Design Longevity and Substrate Blanket Thickness

Based on a discussion with BC Hydro on 11 May 2021, it is understood that BC Hydro wishes for this substrate blanket placement experiment to have a design life of five to ten years. It is also understood that maintenance (renourishment) of substrate material should be considered within the design to address uncertainties in the simulation of particle mobility and that a physical and biological monitoring program be established to inform and trigger maintenance activities. There is recent BC Hydro experience with a similar project at Revelstoke that all

placed substrate material displaced after 1.5 years. The Revelstoke experience is for a river with very different hydraulic characteristics, but it highlights the importance of the need to consider sediment loss and maintenance into the design.

Numerical modeling of sediment transport contains inherent uncertainties due to factors such as model scale, model grid spacing and computation of near-bed hydraulics relative to the contribution of near-bed roughness elements and vortex-related shear around large bed material. In the case of the Columbia River, the presence of large cobbles and boulders at the bed in sections of the proposed placement area implies that near-bed turbulence will be highly local, likely of sufficient magnitude to develop small, localized jets (at scales of < 1 m) of higher shear capable of suspending particles larger than those estimated by the available modeling. The computational requirements to calculate this localized shear exceed the capability of a river-wide model with model grid spacing of the order of metres to tens of metres because the bed roughness features are not captured at that level of detail. Furthermore, the computational time required to run a model with centimetre scale grids would make such a model impractical and costly.

To address this uncertainty and to achieve the necessary longevity, Golder has used engineering experience and judgement to consider a design where the initial placement is monitored, and subsequent placement efforts are used to maintain the required spawning habitat benefit. The timing of material loss and the necessary volume to be replaced cannot be predicted because it will depend on the occurrence of high localized shear as well as the occurrence of large flow events which are, although regulated, driven by random natural events (e.g., probabilistic precipitation in the watershed) that are modified by the regulation regime (e.g., load settings for the dams and generation facilities). Golder therefore adopted a simplified method to estimate material loss rate and used this to guide estimation of a defined replacement volume to meet a minimum 5-year lifespan.

Additionally, the initial Phase 1 placement area footprint was approximately 3,000 m^2 (Ecofish, 2020). Golder proposes to roughly double the footprint within the optimized area of sediment stability (see Section 2.5) to further address the uncertainty in sediment mobility. By optimizing and enlarging the proposed placement area to approximately 5,880 m^2, the placement allows for half the placed material (the upstream half) to serve as a sediment source for the downstream half. This approach provides redundancy in design because the area downstream of dams are typically areas of sediment recruitment through scour due to the break in sediment transport from the lower velocity regime of the headpond to the higher velocity regime of the tailwater. This design approach will contribute to minimizing the rate of loss from the desired area (the downstream 3,000 m^2) by building half the placement as an intended sacrificial section to address this anticipated scour. Between the larger area and the planned replenishment described above, Golder anticipates that the desired longevity can be achieved.

It is understood that the maximum substrate layer thickness should be 600 mm (2 x D_{100} of GSD5) to minimize the probability of juvenile White Sturgeon entombment (Crossman and Hildebrand 2012; Ecofish 2020). It is assumed that the minimum substrate layer thickness will be 300 mm (D_{100} of GSD5). It is recommended that BC Hydro plans for an initial design longevity of five years on the basis that any placed substrate will move and that an allowance of 10% loss of placed substrate will occur annually due to sediment transport action under typical flows. This 10% annual loss was estimated with the understanding that the D_{50} particle size of the GSD5 substrate mixture is largely stable within the placement area for the K09 (worst case scour) flow scenario. If no large scour events occur over the five-year design life, only the size fraction smaller than D_{50} of the GSD5 mixture will displace.

The 10% annual allowance is based on Golder's experience with similar projects, an understanding of sediment entrainment processes and the GSD5 substrate mixture gradation. While larger flow events than K09 have occurred in the past (K06 and K08, see Table 1), flows through HLK tend to reduce shear stresses within the substrate placement area as demonstrated in Figure 1 to Figure 5. Applying the 10% annual allowance, approximately 50% of the material can be expected to be mobilized in 5 years, and the substrate layer thickness is assumed to be eroded to the minimum thickness of 300 mm.

Development of a physical and biological monitoring program is key to informing maintenance (renourishment) of the placed substrate layer. These details are provided in Section 5.0.

To consider maintenance into the design, Golder proposes to budget for the following scenarios:

- Scenario 1: Place full substrate blanket in Year 1 and allow for 25% renourishment in each of Year 2, Year 3, Year 4 and Year 5.
- Scenario 2: Place full substrate blanket in Year 1 and allow for 50% renourishment in each of Year 3 and Year 5.
- Scenario 3: Place full substrate blanket in Year 1 and allow for 100% renourishment in Year 5.

2.5 Placement Area

The substrate blanket placement area was selected based on an optimized area of sediment stability for the GSD5 substrate mixture and egg trajectory zones (Ecofish 2020). To minimize backwater effects along the ALH tailrace, to support the desired longevity for the initial area (Ecofish, 2020) of approximately 3,000 m^2 (see Section 2.4), and to simplify construction by avoiding islands and long skinny placement areas, this optimized area was reduced and simplified to a roughly hexagonal substrate blanket placement area, roughly 5,880 m^2 (see Issued-for-Information [IFI] drawings in Attachment A).

2.6 Hydraulic Effects at Tailrace

A hydraulic assessment of the effect of bed elevation increases of between 0.5 and 1.5 m was conducted using the River2D (Steffler 2000) hydraulic model (Ecofish 2020). The bed elevation increases simulated a hypothetical placement of substrate along the ALH tailrace, further upstream than Golder's selected placement area.
The resulting water level changes were found to be less than or equal to 10 cm. The hydraulic conveyance of the tailrace where Ecofish (2020) hypothetically placed sediment is understood to be lower than the hydraulic conveyance of Golder's selected placement area. Placement of a substrate blanket along the selected placement area will not result in a reduction in hydraulic conveyance compared with the existing critical hydraulic conveyance upstream at the ALH tailrace (where a bathymetric ridge exists). The hydraulic effect of placing the 0.6 m thick GSD5 substrate blanket along the selected placement area is expected to be insignificant (nil or close to nil).

2.7 Summary of Design Criteria

The selected design criteria are as follow:

- Substrate Mixture = GSD5 (see Ecofish 2020 and IFI drawings in Attachment A)
- Design Longevity of Substrate Blanket = five years (plus maintenance as specified in Scenarios 1, 2 or 3 in Section 2.4)
- Substrate Blanket Thickness = 0.6 m
- Placement Area = 5,880 m^2 (see IFI drawings in Attachment A)

3.0 SELECTED DESIGN

3.1 Description of Design Concept

Golder developed a restoration concept based on the conclusions and recommendations of Ecofish (2020) and discussions with BC Hydro. The IFI drawings, which include technical specifications, are provided in Attachment A. The design includes placement of a 0.6 m thick blanket of GSD5 substrate within a prescribed hexagonal placement area (5,880 m^2) located downstream of the ALH tailrace.

3.2 Site Access

Construction access will be via an existing access road off Arrow Lakes Drive, which runs along the south bank of the Columbia River from Castlegar, BC. From Arrow Lakes Drive, the short access road leads to the laydown area at the base of HLK as shown in the Site Plan (see IFI drawings in Attachment A).

3.3 Laydown and Staging Area

The laydown and staging areas are located on the East side of HLK along the south bank of the Columbia River (see IFI drawings in Attachment A).

3.4 Site Preparation

Prior to construction, the laydown area shall be prepared, and construction access shall be established. Preparation of the laydown area may require site grading, and the installation of erosion and sediment control measures (e.g., silt fencing). Site preparation shall occur following the established Construction Environmental Management Plan.

During construction, the barge will be stabilized at the shore during loading activities with a ramp that the loader will use to load the barge. No in-water site preparation would be required, and no machines would be working in the water.

3.5 Vegetation

It is assumed that there will be no disturbance of vegetated areas. No revegetation works are planned for the laydown and staging areas.

3.6 Regulatory Requirements

White Sturgeon in the Canadian portion of the Columbia River are listed as Endangered under the *Species at Risk Act* (2006). The Project occurs in the Lower Columbia River immediately downstream of the HLK which is designated as Critical Habitat for White Sturgeon under SARA (Department of Fisheries and Oceans [DFO] 2014). This section of Critical Habitat is identified as the Robson Reach, which extends downstream of HLK for approximately 7.6 km to the Castlegar Robson Bridge. Because the Project is located in Critical Habitat under SARA, BC Hydro will be applying for a SARA permit to DFO to complete the Project within the Critical Habitat and will also submit a Request for Review under the *Fisheries Act*.

A *Water Sustainability Act* Section 11 Change Approval from the Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRORD) will also be required for changes in and about a stream.

The Project will also require a review by Transport Canada's Navigation Protection Program (NPP) under the *Canadian Navigable Waters Act* to determine if the Project will be considered an interference to navigation. The proposed work will occur within a Scheduled Navigable Water (i.e., the Columbia River from Kinbasket Lake to the Canada/US border) and does not readily qualify under any of the Minor Works categories, which are permitted to occur without an Approval. Other Federal, Provincial, and municipal statutes and guidelines that may be potentially applicable to the Project include:

- *BC Environmental Management Act*
- *BC Wildlife Act*
- *BC Transport of Dangerous Goods Act*
- *BC Weed Control Act*
- *Federal Transportation of Dangerous Goods Act*
- *Federal Migratory Birds Convention Act*
- *Hazardous Waste Regulation*
- *Spill Reporting Regulation*
- *Water Sustainability Regulation*

4.0 EXPECTED PERFORMANCE

Some loss of material on an annual basis is to be expected through ongoing natural river processes related to the behaviour of a mixed size substrate under turbulent flow. This is natural. Golder has estimated an annual placed substrate loss of approximately 10% due to near-bed turbulence. If no large flow events (e.g., K06 or K08 scenario events, Table 1) occur within the five-year timeline, the substrate layer thickness will likely be eroded to the minimum thickness of 300 mm. Recent BC Hydro experience at Revelstoke, however, has seen 100% substrate loss within 1.5 years (Crossman and Hildebrand 2012). The Revelstoke experience is for a river with very different hydraulic characteristics, but it highlights the importance of the need to consider sediment loss and maintenance into the design. A physical and biological monitoring program is recommended to act as a trigger for maintenance when the performance of the placed substrate blanket falls below a set threshold.

5.0 MONITORING AND MAINTENANCE

Development of a physical and biological monitoring program is key to informing maintenance (renourishment) of the placed substrate layer. Development of such a monitoring plan was excluded from Golder's scope of work. However, based on the design concept, and our experience with similar river projects, it should include consideration of the following elements:

- Annual detailed bathymetric surveys of the substrate placement area and at least 100 m downstream of the placement area to occur immediately before and immediately after spawning season. This will help BC Hydro track movement of the placed substrate layer between each year and during each spawning season. This will also help track whether any part of the placed substrate layer has thinned to the minimum thickness, and therefore requiring maintenance placement of additional substrate.
- Underwater photographic surveys during the spawning season to determine evolution of the substrate layer's gradation (i.e., have the smaller size fractions been displaced) and to assess the White Sturgeon's preference for varying substrate mixtures as the smaller size fraction of the placed substrate is displaced. This can help inform modification of the gradation of any substrate placed for maintenance and will also inform whether there are particular areas and hydraulic conditions White Sturgeon may prefer that were not identified by Ecofish (2020).
- Detailed bathymetric surveys and underwater photographic surveys of the substrate placement area following large flow events (e.g., 2-year flood or higher). The selected GSD5 substrate mixture is not designed to resist large flow events and will likely displace. Substrate mixtures designed to resist large flow events would not have habitat value to White Sturgeon.

The following are potential triggers for maintenance (renourishment) of the placed substrate layer that BC Hydro may consider when developing the physical and biological monitoring program:

- The bathymetric surveys suggest that the placed substrate layer has thinned to the minimum 300 mm thickness, or less, along 25%, 50% or 100% of the placement area. Plan for maintenance immediately prior

to the next spawning season to maximize the probability that White Sturgeon will benefit from the maintenance work.

- The underwater photographic surveys suggest that all the smaller size fraction of the placed substrate has displaced along 25%, 50% or 100% of the placement area. This has resulted in White Sturgeon no longer preferentially using the substrate blanket for spawning in favor of areas where the smaller size fraction material has not displaced. Plan for maintenance immediately prior to the next spawning season to maximize the probability that White Sturgeon will benefit from the maintenance work.

6.0 ASSUMPTIONS

This engineering design memorandum assumes the following:

- The substrate placement location will not lead to significant backwatering at ALH.
- Hydraulic analysis conducted by Ecofish (2020) may be relied upon.
- Placed substrate will be lost at a rate of 10% per year if there are no large flow events (e.g., 2-year flood and greater).

7.0 CLOSURE

We trust this document meets your present requirements. Please direct any questions, comments, or concerns to the undersigned.

Golder Associates Ltd.

Prepared by:

Richard Cunningham, MASc, EIT
Junior Water Resources Engineer

Gaven Tang, MASc, PEng
Senior River Engineer

Reviewed by:

Chris Coles, MASc, PEng
Associate, Senior Hydrotechnical Engineer

RC/GT/CC/lih

Attachments: Important Information and Limitations of this Report
Attachment A – Issued-for-Information Drawings

https://golderassociates.sharepoint.com/sites/139832/project files/6 deliverables/issued to client_for wp/20449674-005-tm-rev1/20449674-005-tm-rev1-engineering design rpt 11aug_22.docx

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Engineers & Geoscientists BC

8.0 REFERENCES

Golder Associates Ltd. (Golder). 2021. BC Hydro Phase 2 CLBWORKS-27 Lower Columbia White Sturgeon Physical Works. Construction Design and Basis of Estimate. A technical memorandum submitted to BC Hydro.

Hatten JR, Parsley MJ, Barton GJ, Batt TR, Fosness RL. 2018. Substrate and flow characteristics associated with White Sturgeon recruitment in the Columbia River Basin. Heliyon 4.

Shields A. 1936. Application of similarity principles and turbulence research to bed-load movement (translated version). Pasadena CA: Soil Conservation Service.

Steffler P. 2000. River2D [software]. Edmonton AB: University of Alberta.

United States Army Corps of Engineers (USACE). 2006. Coastal Engineering Manual. Document No. EM1110-2-1100.

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Wilcock PR, Crowe JC. 2003. Surface-based transport model for mixed-size sediment. Journal of Hydraulic Engineering 129(2).

IMPORTANT INFORMATION AND LIMITATIONS OF THIS REPORT

Standard of Care: Golder Associates Ltd. (Golder) has prepared this report in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practising under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this report. No other warranty expressed or implied is made.

Basis and Use of the Report: This report has been prepared for the specific site, design objective, development and purpose described to Golder by the Client. The factual data, interpretations and recommendations pertain to a specific project as described in this report and are not applicable to any other project or site location. Any change of site conditions, purpose, development plans or if the project is not initiated within eighteen months of the date of the report may alter the validity of the report. Golder cannot be responsible for use of this report, or portions thereof, unless Golder is requested to review and, if necessary, revise the report.

The information, recommendations and opinions expressed in this report are for the sole benefit of the Client. No other party may use or rely on this report or any portion thereof without Golder's express written consent. If the report was prepared to be included for a specific permit application process, then upon the reasonable request of the client, Golder may authorize in writing the use of this report by the regulatory agency as an Approved User for the specific and identified purpose of the applicable permit review process. Any other use of this report by others is prohibited and is without responsibility to Golder. The report, all plans, data, drawings and other documents as well as all electronic media prepared by Golder are considered its professional work product and shall remain the copyright property of Golder, who authorizes only the Client and Approved Users to make copies of the report, but only in such quantities as are reasonably necessary for the use of the report by those parties. The Client and Approved Users may not give, lend, sell, or otherwise make available the report or any portion thereof to any other party without the express written permission of Golder. The Client acknowledges that electronic media is susceptible to unauthorized modification, deterioration and incompatibility and therefore the Client cannot rely upon the electronic media versions of Golder's report or other work products.

The report is of a summary nature and is not intended to stand alone without reference to the instructions given to Golder by the Client, communications between Golder and the Client, and to any other reports prepared by Golder for the Client relative to the specific site described in the report. In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the whole of the report. Golder cannot be responsible for use of portions of the report without reference to the entire report.

Unless otherwise stated, the suggestions, recommendations and opinions given in this report are intended only for the guidance of the Client in the design of the specific project. The extent and detail of investigations, including the number of test holes, necessary to determine all of the relevant conditions which may affect construction costs would normally be greater than has been carried out for design purposes. Contractors bidding on, or undertaking the work, should rely on their own investigations, as well as their own interpretations of the factual data presented in the report, as to how subsurface conditions may affect their work, including but not limited to proposed construction techniques, schedule, safety and equipment capabilities.

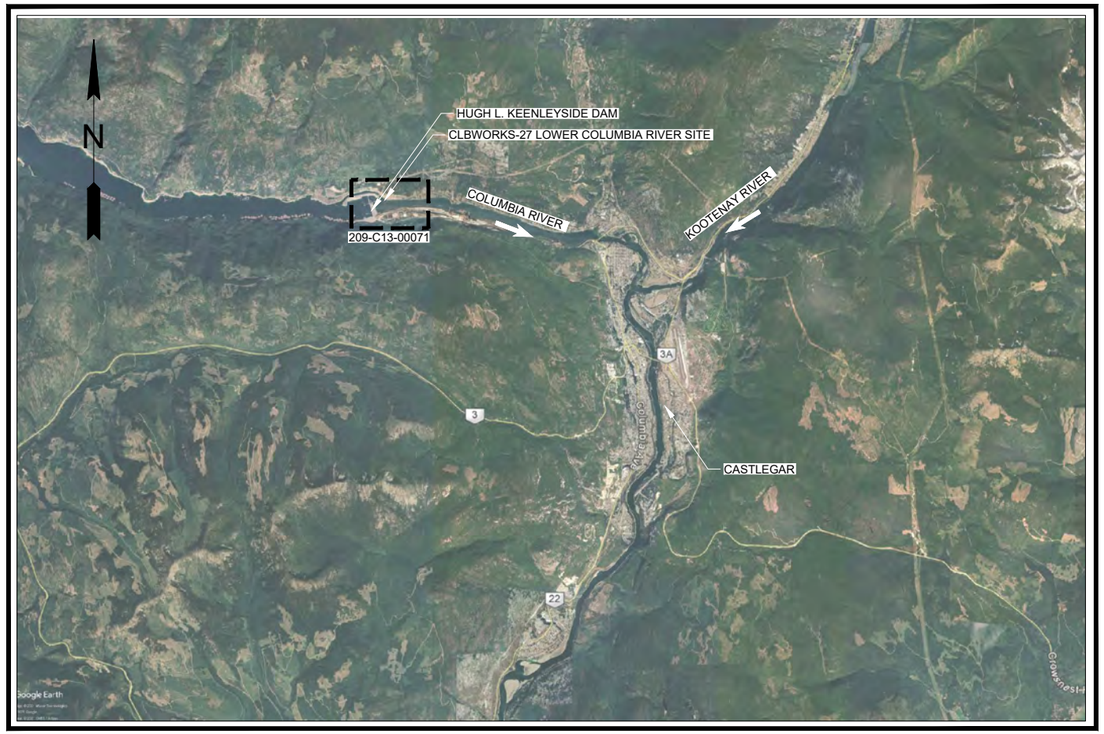
ATTACHMENT A

Issued-for-Information Drawings

BC HYDRO - CLBWORKS-27 LOWER COLUMBIA
RIVER WHITE STURGEON PHYSICAL WORKS (PHASE 2)

DRAWING INDEX			
DRAWING No.	DRAWING TITLE	REVISION	DATE
209-C13-00070	PROJECT LOCATION AND DRAWING INDEX	0	2021-09-02
209-C13-00071	SITE PLAN	0	2021-09-02
209-C13-00072	CROSS SECTIONS	0	2021-09-02
209-C13-00073	CONSTRUCTION SPECIFICATION	0	2021-09-02

KEY PLAN
NOT TO SCALE



PROJECT LOCATION PLAN
NOT TO SCALE

NOTES:

1. IMAGE ©2021 GOOGLE, OBTAINED FROM GOOGLE EARTH PRO, USED UNDER LICENSE. GOOGLE EARTH IMAGE IS NOT TO SCALE.

DRAWING IS NOT TO SCALE

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Engineers & Geoscientists BC

-

BC Hydro Contract No .....

ISSUED FOR INFORMATION ONLY

By..... Date.....
Hydro's Representative

NOT FOR CONSTRUCTION

GOLDER
MEMBER OF WSP

REFERENCE DRAWINGS

NO	REMARKS
0	ISSUED FOR INFORMATION ONLY

REVISIONS

DESIGN NUMBER	
WORK ORDER NUMBER	
CSA S250 ACCURACY NAD 83 - 11UTM	
BASE ACCURACY LEVEL:	
ASB ACCURACY LEVEL:	

DSGN	R.CUNNINGHAM
INDEP CHK	G.TANG
DFTG	A.DONG
DFTG CHK	S.REDDY
INSP	-
REV	C.COLES
ACPT	C.COLES

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA G. TANG # 47193 2021-SEPTEMBER-02

BC Hydro

HUGH KEENLEYSIDE (ARROW DAM)

DOWNSTREAM SUBSTRATE PLACEMENT
WHITE STURGEON PHYSICAL WORKS (PHASE 2)
PROJECT LOCATION AND DRAWING INDEX

DATE	DIST	DRAWING NUMBER	REPORT NUMBER	FIGURE NUMBER	SIZE	REV
2021-09-02		209-C13-00070		1	D	0

SETOUT POINTS

POINT No.	EASTING (m)	NORTHING (m)
1	444281.73	5465766.21
2	444350.82	5465733.86
3	444423.03	5465656.42
4	444415.72	5465645.81
5	444334.35	5465689.86
6	444265.86	5465740.11

LEGEND:

- EXISTING RIVER BED SURFACE
- SUBSTRATE PLACEMENT AREA
- TOPOGRAPHIC EXTENTS

NOTES:

1. ALL UNITS ARE IN METRES UNLESS OTHERWISE NOTED.
2. COORDINATE SYSTEM IS UTM NAD 83, ZONE 11.
3. EXISTING GROUND CONTOURS ARE SHOWN AT 1 m INTERVAL RELATIVE TO CGVD 2013.
4. CONSTRUCTION ACCESS SHALL BE VIA ARROW LAKES DR AND THE EXISTING ACCESS ROAD TO THE PROPOSED LAYDOWN AREA.
5. SUBSTRATE MATERIAL SHALL BE STOCKPILED IN THE LAYDOWN AREA AS-NEEDED.

REFERENCE:

1. IMAGE ©2021 GOOGLE, OBTAINED FROM GOOGLE EARTH PRO, USED UNDER LICENSE. GOOGLE EARTH IMAGE IS NOT TO SCALE.
2. BATHYMETRY SURVEY CONDUCTED BY GRANT LAND SURVEYING INC, ON JULY 01, 2019.

PERMIT TO PRACTICE #1003064
Engineers & Geoscientists BC

BC Hydro Contract No .....

ISSUED FOR INFORMATION ONLY

By ..... Date .....
Hydro's Representative

NOT FOR CONSTRUCTION

SCALE: 1:2500 0 100m

GOLDER
MEMBER OF WSP

REFERENCE DRAWINGS

NO	REMARKS
0	ISSUED FOR INFORMATION ONLY

REVISIONS

DESIGN NUMBER	
WORK ORDER NUMBER	
CSA S250 ACCURACY	NAD 83 - 11UTM
BASE ACCURACY LEVEL:	
ASB ACCURACY LEVEL:	

DSGN	R.CUNNINGHAM
INDEP CHK	G.TANG
DFTG	A.DONG
DFTG CHK	S.REDDY
INSP	-
REV	C.COLES
ACPT	C.COLES

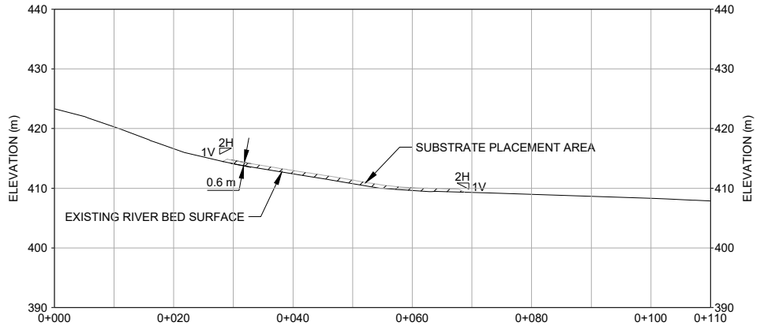
PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA G. TANG # 47193 2021-SEPT-12

BC Hydro

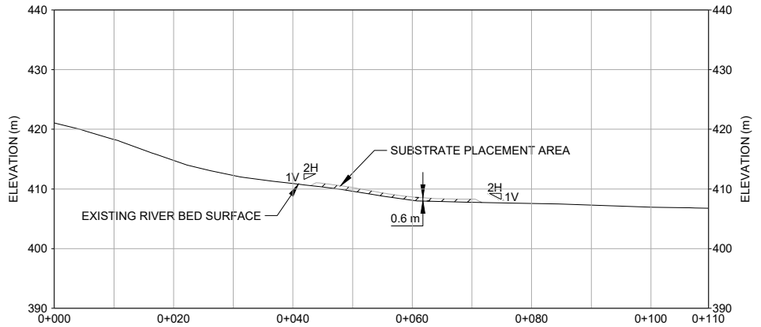
HUGH KEENLEYSIDE (ARROW DAM)

DOWNSTREAM SUBSTRATE PLACEMENT
WHITE STURGEON PHYSICAL WORKS (PHASE 2)
SITE PLAN

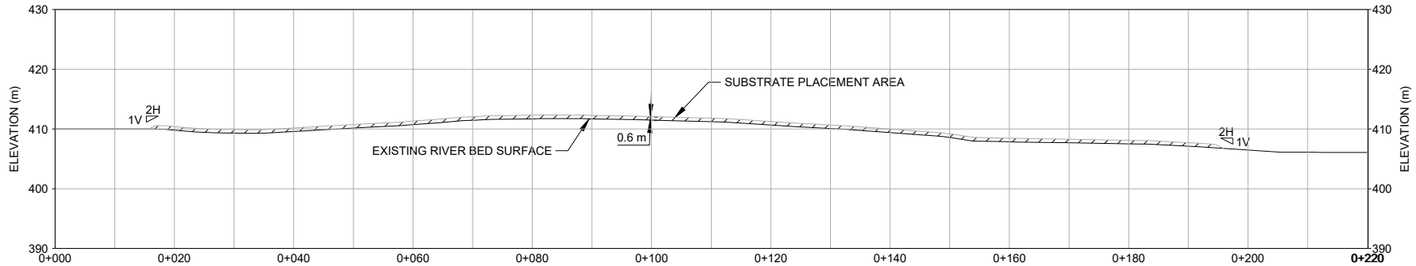
DATE	DIST	DRAWING NUMBER	REPORT NUMBER	FIGURE NUMBER	SIZE	REV
2021-09-02		209-C13-00071		2	D	0



SECTION A (2)
SCALE:1:500



SECTION B (2)
SCALE:1:500



SECTION C (2)
SCALE:1:500

LEGEND:

SUBSTRATE PLACEMENT AREA

EXISTING RIVER BED SURFACE

NOTES:

1. ALL UNITS ARE IN METRES UNLESS OTHERWISE NOTED.
2. COORDINATE SYSTEM IS UTM NAD 83, ZONE 11 ELEVATIONS RELATIVE TO CGVD 2013.
3. SUBSTRATE LAYER SIDE SLOPES ARE ASSUMED TO BE 2:1 (H:V) BASED ON ASSUMED ANGLES OF REPOSE.
4. CROSS-SECTIONS ARE SHOWN WITH NO VERTICAL EXAGGERATION.

REFERENCE:

1. BATHYMETRY SURVEY CONDUCTED BY GRANT LAND SURVEYING INC, ON JULY 01, 2019.

PERMIT TO PRACTICE #1003064
Engineers & Geoscientists BC

BC Hydro Contract No .....

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By ..... Date .....
Hydro's Representative

SCALE: 1:500 0 25m

NOT FOR CONSTRUCTION

GOLDER
MEMBER OF WSP

NO	REMARKS
0	ISSUED FOR INFORMATION ONLY

REFERENCE DRAWINGS

REVISIONS

DESIGN NUMBER	
WORK ORDER NUMBER	
CSA S250 ACCURACY NAD 83 - 11UTM	
BASE ACCURACY LEVEL:	
ASB ACCURACY LEVEL:	

DSGN	R.CUNNINGHAM
INDEP CHK	G.TANG
DFTG	A.DONG
DFTG CHK	S.REDDY
INSP	-
REV	C.COLES
ACPT	C.COLES

PROFESSIONAL ENGINEER PROVINCE OF G. TANG # 47193 REGISTERED 2022 AUG 12

BC Hydro

HUGH KEENLEYSIDE (ARROW DAM)

DOWNSTREAM SUBSTRATE PLACEMENT
WHITE STURGEON PHYSICAL WORKS (PHASE 2)
CROSS SECTIONS

DATE	DIST	DRAWING NUMBER	REPORT NUMBER	FIGURE NUMBER	SIZE	REV
2021-09-02		209-C13-00072		3	D	0

GENERAL NOTES:

PROJECT WORKS

1. BC HYDRO REQUIRES THE PLACEMENT OF SUBSTRATE FILL MATERIAL DOWNSTREAM OF THE TAILRACE OF THE ARROW LAKES GENERATING STATION TO IMPROVE STURGEON HABITAT IN THE COLUMBIA RIVER.

GENERAL REQUIREMENTS

1. CONSTRUCT ALL WORK IN ACCORDANCE WITH THE DRAWINGS AND SPECIFICATIONS, AND AS DIRECTED BY THE PROJECT ENGINEER.
2. DETAILED BATHYMETRIC SURVEYS ARE REQUIRED BEFORE AND AFTER SUBSTRATE MATERIAL PLACEMENT.

DIMENSIONS, ELEVATIONS AND COORDINATES

1. ALL DIMENSIONS SHOWN ARE IN METRES, UNLESS NOTED OTHERWISE. ELEVATIONS ARE IN METRES RELATIVE TO CGVD 2013. STATION VALUES ARE IN METRES.
2. ALL COORDINATES SHALL BE REFERENCED TO THE NAD83 UTM ZONE 11 GRID DATUM.

MATERIALS:

SUBSTRATE FILL MATERIAL

1. THE SUBSTRATE FILL MATERIAL MIXTURE SHALL CONSIST OF COURSE, SUB-ROUNDED MATERIAL MEETING THE FOLLOWING GRADATION.

MATERIAL SIZE (mm)	PERCENT PASSING
300	100
200	80
125	50
100	40
20.0	0

PERMIT TO PRACTICE #1003064
Engineers & Geoscientists BC

BC Hydro Contract No .....

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By ..... Date .....
Hydro's Representative

NOT FOR CONSTRUCTION

GOLDER
MEMBER OF WSP

BC Hydro

HUGH KEENLEYSIDE (ARROW DAM)

DOWNSTREAM SUBSTRATE PLACEMENT
WHITE STURGEON PHYSICAL WORKS (PHASE 2)
GENERAL NOTES

DESIGN NUMBER	
WORK ORDER NUMBER	
CSA S250 ACCURACY NAD 83 - 11UTM	
BASE ACCURACY LEVEL:	
ASB ACCURACY LEVEL:	

DSGN	R.CUNNINGHAM
INDEP CHK	G.TANG
DFTG	A.DONG
DFTG CHK	S.REDDY
INSP	-
REV	C.COLES
ACPT	C.COLES

PROFESSIONAL ENGINEER PROVINCE OF G. TANG # 47193 2022-AUG-12

NO	REMARKS
0	ISSUED FOR INFORMATION ONLY

REFERENCE DRAWINGS

REVISIONS

DATE	DIST	DRAWING NUMBER	REPORT NUMBER	FIGURE NUMBER	SIZE	REV
2021-09-02		209-C13-00073		4	D	0

APPENDIX B

Construction Design and Basis of Estimate Memorandum

GOLDER
MEMBER OF WSP

TECHNICAL MEMORANDUM

DATE 2 September 2021 **Reference No.** 20449674-006-TM-Rev0

TO Teri Neighbour and James Crossman
BC Hydro and Power Authority

CC Gaven Tang and Chris Coles

FROM Aleicia Sharp and John Smith **EMAIL Aleicia_Sharp@golder.com**

BC HYDRO PHASE 2 CLBWORKS-27 LOWER COLUMBIA WHITE STURGEON PHYSICAL WORKS CONSTRUCTION DESIGN AND BASIS OF ESTIMATE

1.0 INTRODUCTION

Golder Associates Ltd. (Golder) was engaged by BC Hydro to provide design, construction planning, and regulatory permitting support for the Phase 2 CLBWORKS-27 Lower Columbia White Sturgeon Physical Works Project (the Project). The Project objective is to enhance White Sturgeon (Acipenser transmontanus) spawning substrate at the Keenleyside White Sturgeon spawning area by placing a mixture of multiple grain size substrate that will be stable and resistant to infilling by sedimentation. The enhancement of spawning substrate is required due to the insufficient level of natural recruitment of the White Sturgeon population residing in the Transboundary Reach of the Lower Columbia River to maintain a self-sustaining population.

The Project involves restoring spawning substrate in the Columbia River at the Keenleyside spawning area by placing a graded mixture of sub-rounded gravel and cobble consisting of different proportions of material within a range (20 to 300 mm) suitable for sturgeon spawning.

As part of the construction planning services, Golder has carried out a constructability review of the proposed restoration design, taking into consideration access for marine equipment, suitable laydown areas, material availability, equipment requirements, construction schedule, and environmental controls. Additionally, Golder has completed a Class 3 construction cost estimate in order to provide a preliminary project budget.

This construction design and basis of estimate (BOE) memorandum provides a summary of the constructability review, recommended construction methods, potential constraints, and an overview of the elements of the cost estimate.

This technical memorandum should be read in conjunction with the “Important Information and Limitations of This Report” section, as it forms an integral part of the document.

2.0 PROJECT UNDERSTANDING AND SCOPE OF WORK

Phase 1 of the Project was completed by Ecofish Research Ltd. in 2020 (Ecofish 2020), and included a review of existing conditions in the Lower Columbia River and an assessment and recommendation of potential sites and restoration approaches for sturgeon habitat. The recommended site for spawning substrate restoration was selected as the area downstream of the Hugh L. Keenleyside dam (HLK) and Arrow Lakes Generating Station (ALH). The most suitable substrate gradation for White Sturgeon was identified as GSD5.

For Phase 2 of the project, Golder relied on the recommendations from the Phase 1 report (Ecofish 2020) as a starting point to develop the engineering design for the sturgeon habitat restoration (Golder 2021a). The design proposed by Golder is for the placement of a 0.6 m thick blanket of spawning substrate over an area of 5,880 m^2, for a total volume of 3,540 m^3. The selected spawning substrate (GSD5) has a D_{50} of 125 mm and the following gradation (Ecofish 2020, Golder 2021a):

- 20-100mm: 40%
- 100-200mm: 40%
- 200-300 mm: 20%

The substrate placement area and specific details are provided in the Issued-for-Information (IFI) drawings in Attachment 1. For the purposes of cost planning, and considering that this project is an initial placement trial which could be used to guide future substrate enhancement projects, Golder has proposed three maintenance scenarios for achieving the assumed a 5-year design life (Golder 2021a). The three renourishment scenarios that Golder proposes to budget for are as follows:

- Scenario 1: Place full substrate blanket in Year 1 and allow for 25% renourishment in each of Year 2, Year 3, Year 4 and Year 5.
- Scenario 2: Place full substrate blanket in Year 1 and allow for 50% renourishment in each of Year 3 and Year 5.
- Scenario 3: Place full substrate blanket in Year 1 and allow for 100% renourishment in Year 5.

3.0 CONSTRUCTABILITY REVIEW

Golder conducted a constructability review of the proposed engineering design to identify construction challenges and their potential solutions. A Golder construction specialist carried out a site visit of the Project site on February 12, 2021 to assist with the constructability review. This included an assessment of the physical conditions of the site, identification of construction access, and staging/laydown areas. Following the site visit, Golder contacted a local barge operator, Doug Haines, who provided further insight into construction access and details on locally available marine equipment. Golder also contacted Jack Kabatoff of Kabatoff Sand and Gravel, which operates a pit in Castlegar, to confirm availability of the specified spawning substrate material and to obtain preliminary budgetary pricing. The below sections provide details on potential construction methods developed by Golder as part of the constructability review.

3.1 Equipment Requirements

Golder has identified the following equipment spread that could be used to construct the substrate blanket:

- Barge, complete with anchors and winches to control barge positioning, capable of carrying at a minimum a load consisting of an excavator and 40 tonne of substrate material.
- Tugboat.
- Long reach excavator, such as a CAT 330 LR or similar (or, alternatively, a crane with a clamshell bucket).
- Front end loader, such as a CAT 966 or similar.
- Miscellaneous small equipment including work trucks, work boats, dive gear and small tools.

The proposed construction methodology was developed assuming that locally available marine equipment would be used, as the mobilization and setup of marine equipment from outside the local area would represent a significant additional cost to the project. In Golder's correspondence with Doug Haines, he indicated that a barge, tugboat and long reach excavator are locally available; however, preparation of the locally available barge would be required to outfit it with winches and side walls. The preparation would be required for each mobilization to site for renourishment. This equipment spread could vary if marine equipment were mobilized to site from outside the local area.

3.2 Laydown Area and Equipment Access

During the site visit, Golder visited four locations that were identified as potential sites for a laydown area and marine equipment access. The four locations were as follows:

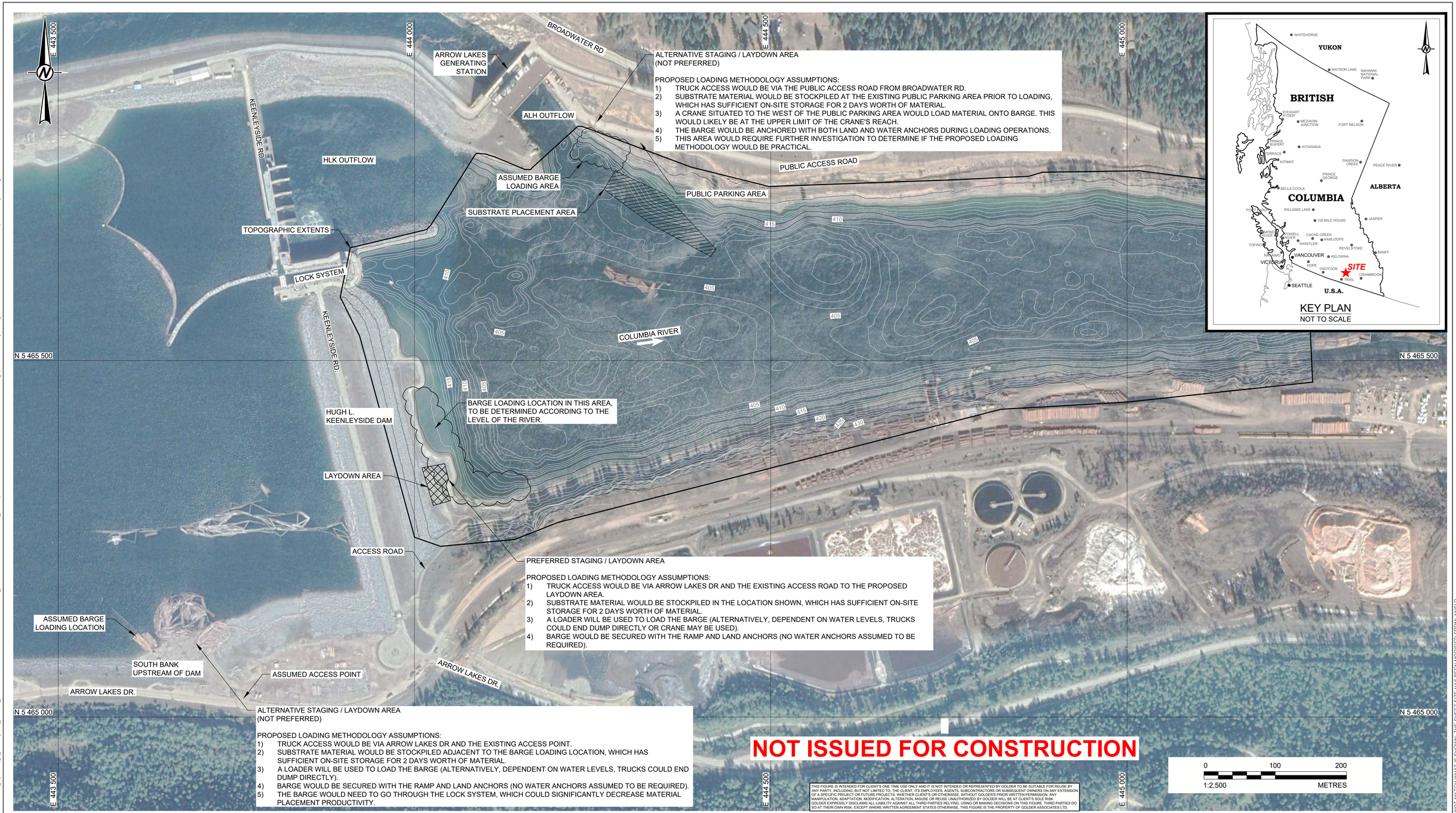
- Location 1 - North bank of the river, downstream of ALH and adjacent to the gravel placement area
- Location 2 - South bank of the river, immediately downstream of HLK
- Location 3 - South bank of the river, immediately upstream of HLK
- Location 4 - South bank of the river, at the Interfor Log Dump

Location 2 (south bank of the river immediately downstream of HLK, shown on Figure 1) was selected as the preferred laydown area and barge loading location. This location was selected due to its proximity to the gravel placement area, availability of space for a laydown area, and existing access for trucks. Additionally, Doug Haines indicated in his correspondence with Golder that this location would be suitable for loading the substrate material onto the barge.

Locations 1 and 3 were identified as potential secondary laydown and loading locations. At Location 1, a crane on land could be used to load substrate material onto the barge, which would require further investigation to determine if this methodology would be practical as this would be at the upper limits of the crane's reach. Location 3 has the disadvantage that the loaded barge would need to travel through HLK's lock system, which could significantly decrease material placement productivity. However, these secondary locations could be investigated by the construction contractor should unforeseen issues arise with the preferred location.

Location 4 was eliminated from further consideration due to the limited availability of space for a laydown area and potential challenges with coordinating access with Interfor.

A map showing the preferred and potential secondary locations is provided in Figure 1 below.



NOT ISSUED FOR CONSTRUCTION

0 100 200
1:2,500 METRES

LEGEND

- EXISTING RIVER BED SURFACE
- SUBSTRATE PLACEMENT AREA
- TOPOGRAPHIC EXTENTS

NOTES

1. ALL UNITS ARE IN METRES UNLESS OTHERWISE NOTED.
2. COORDINATE SYSTEM IS UTM NAD 83, ZONE 11.
3. EXISTING GROUND CONTOURS ARE SHOWN AT 1 m INTERVAL RELATIVE TO CGVD 2013.

REFERENCES

1. IMAGE ©2021 GOOGLE, OBTAINED FROM GOOGLE EARTH PRO, USED UNDER LICENSE. GOOGLE EARTH IMAGE IS NOT TO SCALE.
2. BATHYMETRY SURVEY CONDUCTED BY GRANT LAND SURVEYING INC, ON JULY 01, 2019.

CLIENT
BC HYDRO

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2021-09-02
DESIGNED	RC
PREPARED	GB
REVIEWED	GT
APPROVED	CC

PROJECT
CLBWORKS-27 LOWER COLUMBIA RIVER WHITE STURGEON PHYSICAL WORKS (PHASE 2)

TITLE
SITE PLAN

PROJECT NO.	PHASE/TASK	REV.	FIGURE
20449674	1000/1400	0	1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI D

0 25 mm

Path: \\golder.gds\complexdata\office\Vancouver\CAD-GIS\Client\BC_Hydro\Hugh_Keenleyside_Dam\99_PROJECTS\20449674\1000\1400\Doc: xxx\02_PRODUCTION\DWG\REPORT_EMP\ | File Name: 20449674-1000-1400-REPORT-01.dwg | Last Edited By: adong Date: 2021-08-31 Time:3:10:39 PM | Printed By: ADong Date: 2021-09-02 Time:8:45:16 AM

3.3 Construction Schedule

Year 1 construction is assumed to take place in February to March of 2022 in order to prevent impacts to the spawning of white sturgeon, as per the Project Environmental Assessment (EA) (Golder 2021b).

The estimated duration for Year 1 construction is 6 working days for site setup, 45 working days for gravel placement, and 6 working days for takedown and cleanup, for a total of 57 working days (or 10 weeks, assuming 6 working days per week). The preliminary Year 1 construction schedule is provided in Attachment 2. The schedule for subsequent renourishment would be similar, but with fewer days required for gravel placement depending on the volume of gravel for renourishment. Additionally, Golder recommends considering a schedule contingency for material placement time, to account for possible delays due to winter construction. Although this total duration exceeds two months, not all the setup and cleanup activities would require in-water work.

The schedule was developed based on the equipment requirements and proposed construction methodology detailed in this memorandum, therefore changes to this assumed methodology would affect the construction schedule and duration. Should construction be completed with a larger barge with spuds mobilized to site from outside the local area, it is expected the material placement could be completed in a shorter duration (although at a greater cost).

3.4 Environmental Controls

The Project Environmental Management Plan (EMP) (Golder 2021c) identified several environmental mitigation measures to be implemented during construction:

- Erosion and sediment control measures, including:
  - Installation of silt fencing at the laydown area.
  - Washing the spawning substrate at the source quarry to remove fine sediments prior to haul and placement.
  - Limiting soil disturbance, soil compaction and vegetation removal at the laydown area to only the required areas to complete the works.
- Taking turbidity measurements prior to Project implementation as a baseline to compare to ongoing turbidity monitoring during construction.
- Spill prevention measures, including:
  - Fuelling land equipment at least 30 m from the Columbia River.
  - Providing spill containment/drip trays for equipment on board the barge.
  - Maintaining spill kits on site.
- Using a drop-camera or a remotely operated vehicle to inspect the immediate area where gravel will be placed to determine if any fish are present.
- Placing substrate material by lowering the bucket slowly through the water column and placing the material on the bed.

3.5 Construction Methodology

The proposed construction methodology for gravel placement developed by Golder is as follows:

- Complete general construction setup activities, including:
  - Laydown area preparation, including establishing equipment access and installing ESC measures.
  - Barge preparation, including outfitting with anchor system, winches, fairleads, sidewalls, and equipment spill containment.
  - Pre-construction bathymetric survey.
  - Setting anchors. Golder has assumed a typical four-point anchor system with anchors on the barge corners (two on the bow and two on the stern). Anchors are assumed to consist of lock blocks, with two in the river and two on the shore. River anchors will be installed by a dive crew.
    - Anchor details are responsibility of the contractor and should be provided in advance.
- Wash substrate material with a hose and water truck at the pit/quarry prior to delivery to site.
- Deliver substrate material to the proposed laydown area by truck, and stockpile prior to barge loading.
- Use a loader to load gravel material from the stockpile to the barge at the proposed loading location.
- Use tugboat to transport the barge from the loading area on the south river bank to the gravel placement area.
- Place gravel using a long reach excavator (or crane with clamshell) located on the barge. The barge will be anchored in place during placement activities.
  - In order to confirm the accuracy of placement, bathymetric survey will be performed regularly during construction.
  - Alternatively, survey could be substituted with instrumentation on the excavator.
- Complete construction takedown and cleanup activities, including:
  - Removing anchors, with river anchors to be removed by a dive crew.
  - Post-construction bathymetric survey
  - Clean up laydown area and barge.

The construction methodology will be the same for both the initial placement of substrate material in Year 1 and the renourishment in subsequent years. Since the detailed construction methodology is ultimately the responsibility of the construction contractor, the actual construction methodology may vary from the above methodology proposed by Golder.

4.0 COST ESTIMATE

As part of the construction design, Golder has prepared a Class 3 cost estimate for the Project, based on the scope of work and proposed construction methodology detailed in this memorandum. Separate cost estimates have been prepared for each of the renourishment scenarios described in Section 2.0 of this memorandum. The below sections provide an overview of the elements of the estimate, recommended estimate contingency, and the assumptions and exclusions that were considered during estimate development.

4.1 Estimate Classification

The estimate has been classified as a Class 3 cost estimate, as per the Association for the Advancement of Cost Engineering International (AACEI) and BC Hydro's in-house estimating standards. Class 3 estimates are generally prepared based on completed design documents (drawings and outline specifications) and a preliminary project schedule.

Under BC Hydro's standards, a Class 3 estimate typically carries an expected accuracy range of -10% to +15%; however, due to the uncertainty of the marine construction market and the project location, Golder has targeted the estimate accuracy to be within the -20% to +30% range (which is within the acceptable accuracy range of a Class 3 estimate under AACEI and BC Hydro standards). The level of accuracy can be influenced by many factors, including: number of bidders, market conditions, project location, schedule constraints, and project complexity, which can markedly affect this range.

4.2 Estimate Contingency

Contingency is a cost element of the estimate used to cover the uncertainty and variability within a cost estimate, and for unforeseeable elements of cost within the defined project scope.

Due to the complexity of marine installations and the winter construction schedule, Golder recommends including a contingency of at least 20% applied to the overall project value to cover any project unknowns.

Items identified as having the greatest potential for impacting costs due to variation in design and constructability include, but are not limited to the following:

- Potential schedule delays resulting from winter weather or other unforeseen issues.
- Wastage of spawning material from spillage and overbuild associated with marine placement.
- Availability of local marine equipment for the initial placement and any subsequent renourishment. The risk that local equipment will be unavailable for any part of the project increases with the number of renourishments required.

4.3 Estimate Basis

A number of cost factors for productivity, equipment and labour were used. These include, but are not limited to, the following:

- Direct and indirect construction costs have been developed using a first principles estimating methodology, where productivity factors have been applied to the crews required for each construction activity to develop unit rates.
- Local barge operator Doug Haines provided rates for locally available barges, operated tugboat, and operated long reach excavator.
- Other labour and equipment pricing has been based on recent contractor rates from local contractors, published equipment rental rates (BC Blue Book), and estimator's experience. Equipment unit rates are operated and inclusive of fuel, maintenance, and insurance costs.
- Kabatoff Sand and Gravel provided a budgetary quote for supply, washing, and delivery of the specified substrate material.
- The labour hours and production rates are based on working six (6) days per week at ten (10) hours per day.
- Contractor's overhead and profit is included at 15%.
- For renourishment of substrate in years following the initial placement, an escalation of 1.5% per year has been added to the estimated cost.

4.4 Assumptions

The following assumptions have been made during the development of the estimate:

- Construction will take place in a single mobilization for the initial placement in Year 1 and an additional mobilization for each renourishment in subsequent years.
- The construction methodology for each renourishment will be the same as for the initial placement in Year 1. It is assumed equipment and spawning substrate will still be available locally.
- The equipment spread used for construction will be as described in Section 3.1. All major equipment (barge, tugboat, excavator and loader) is assumed to be local.
- The excavator operator and tugboat skipper will be local and the remaining crew members will mobilize from the Lower Mainland.
- Bathymetric survey will be completed prior to construction, once weekly during material placement activities, and once following construction to confirm the accuracy of material placement.
- The system for anchoring the barge during material placement is assumed to be comprised of four anchors, two on land and two in the river, using lock blocks.
- A dive crew will be required for installation and removal of the river anchors and will therefore mobilize to site twice.
- An allowance of $200/day has been included for living out allowance (LOA) for crew assumed to be mobilizing from the Lower Mainland.

4.5 Exclusions

The following items have been specifically excluded from the cost estimate:

- Environmental monitoring costs, including turbidity monitoring.
- Engineering design and on-site engineering during construction.
- Costs associated with the physical and biological monitoring program for informing maintenance (renourishment) requirements.
- Obtaining any permits, authorizations or permissions to undertake the work. It has been assumed that all required permits will be obtained by others.
- Costs or contingency allowance related to COVID-19, such as delays, quarantining, or other COVID-19 safety measures.
- GST.

4.6 Cost Estimate

The cost estimate has been developed based on the scope, estimate basis, assumptions and exclusions outlined in this memorandum. The total estimated construction costs for each renourishment scenario are as follows:

- Scenario 1 (25% renourishment in each of Year 2, 3, 4 and 5): $5.2 million.
- Scenario 2 (50% renourishment in Years 3 and 5): $4.3 million.
- Scenario 3 (100% renourishment in Year 5): $3.8 million.

The above costs are inclusive of contingency and have an expected accuracy range of -20% to +30%. Details of the estimated construction costs are presented in Tables 1-3 below.

Table 1: Class 3 Cost Estimate for Scenario 1

ITEM	DESCRIPTION - CONSTRUCTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ITEM TOTAL PRICE*
Year 1 - Initial Placement					
1	Mobilization and demobilization	1	LS	$84,000.00	$84,000.00
2	Site setup	1	LS	$146,500.00	$146,500.00
3	Setting anchors	1	LS	$46,900.00	$46,900.00
4	Gravel placement	3540	m^3	$330.00	$1,168,200.00
5	Site takedown and cleanup	1	LS	$103,100.00	$103,100.00
				Initial Placement Subtotal:	**$1,549,000.00**
Years 2, 3, 4 and 5 - 25% Renourishment					
7	Mobilization and demobilization	4	LS	$84,000.00	$336,000.00
8	Site setup	4	LS	$130,000.00	$520,000.00
9	Setting anchors	4	LS	$46,900.00	$187,600.00
10	Gravel placement (885 m^3 each year)	3540	m^3	$344.00	$1,217,760.00
11	Site takedown and cleanup	4	LS	$103,100.00	$412,400.00
13	Escalation of 1.5% per year	1	LS	$101,800.00	$101,800.00
				Renourishment Subtotal:	**$2,776,000.00**
				Contingency @20%:	$865,000.00
				Total Construction Costs:	**$5,190,000.00**

*Subtotals have been rounded to the nearest $1000

Table 2: Class 3 Cost Estimate for Scenario 2

ITEM	DESCRIPTION - CONSTRUCTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ITEM TOTAL PRICE*
Year 1 - Initial Placement					
1	Mobilization and demobilization	1	LS	$84,000.00	$84,000.00
2	Site setup	1	LS	$146,500.00	$146,500.00
3	Setting anchors	1	LS	$46,900.00	$46,900.00
4	Gravel placement	3540	m^3	$330.00	$1,168,200.00
5	Site takedown and cleanup	1	LS	$103,100.00	$103,100.00
				Initial Placement Subtotal:	**$1,549,000.00**
Year 3 and Year 5 - 50% Renourishment					
7	Mobilization and demobilization	2	LS	$84,000.00	$168,000.00
8	Site setup	2	LS	$146,500.00	$293,000.00
9	Setting anchors	2	LS	$46,900.00	$93,800.00
10	Gravel placement (1770 m^3 each year)	3540	m^3	$333.00	$1,178,820.00
11	Site takedown and cleanup	2	LS	$103,100.00	$206,200.00
13	Escalation of 1.5% per year	1	LS	$88,800.00	$88,800.00
				Renourishment Subtotal:	**$2,029,000.00**
				Contingency @20%:	$716,000.00
				Total Construction Costs:	**$4,294,000.00**

*Subtotals have been rounded to the nearest $1000

Table 3: Class 3 Cost Estimate for Scenario 3

ITEM	DESCRIPTION - CONSTRUCTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ITEM TOTAL PRICE*
Year 1 - Initial Placement					
1	Mobilization and demobilization	1	LS	$84,000.00	$84,000.00
2	Site setup	1	LS	$146,500.00	$146,500.00
3	Setting anchors	1	LS	$46,900.00	$46,900.00
4	Gravel placement	3540	m^3	$330.00	$1,168,200.00
5	Site takedown and cleanup	1	LS	$103,100.00	$103,100.00
				Initial Placement Subtotal:	**$1,549,000.00**
Year 5 - 100% Renourishment					
7	Mobilization and demobilization	1	LS	$84,000.00	$84,000.00
8	Site setup	1	LS	$146,500.00	$146,500.00
9	Setting anchors	1	LS	$46,900.00	$46,900.00
10	Gravel placement	3540	m^3	$330.00	$1,168,200.00
11	Site takedown and cleanup	1	LS	$103,100.00	$103,100.00
13	Escalation of 1.5% per year	1	LS	$95,000.00	$95,000.00
				Renourishment Subtotal:	**$1,644,000.00**
				Contingency @20%:	$639,000.00
				Total Construction Costs:	**$3,832,000.00**

*Subtotals have been rounded to the nearest $1000

5.0 CLOSURE

We trust that the information provided above is sufficiently detailed to meet your present needs.

Please contact the undersigned if any additional information is required or if there are any questions concerning the information presented.

Golder Associates Ltd.

Prepared by:

Aleicia Sharp, PEng
Estimator

John Smith
Operations Manager - Marine Services

Reviewed by:

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA G. TANG # 47193
2021.09.04

Gaven Tang, MASc, PEng
River Engineer

Chris Coles, PEng
Associate, Senior Hydrotechnical Engineer

initials

Attachments: Attachment 1 - Issued For Information Drawings
Attachment 2 - Preliminary Construction Schedule

https://golderassociates.sharepoint.com/sites/139832/project files/6 deliverables/issued to client_for wp/20449674-006-tm-rev0/20449674-006-tm-rev0-bch cbworks 27 basis estimate 02sep 21.docx

6.0 REFERENCES

Ecofish Research Ltd (Ecofish). 2020. CLBWORKS-27 – Lower Columbia White Sturgeon Habitat Restoration Alternatives – Final Report. Prepared for BC Hydro and Power Authority. Courtenay BC: Ecofish Research Ltd. 27 July 2020.

Golder (Golder Associates Ltd.). 2021a. CLBWORKS-27 Lower Columbia River White Sturgeon Physical Works (Phase 2): Engineering Design Basis Memorandum. Prepared for BC Hydro and Power Authority. Golder Reference No. 20449674-001-TM-RevA. Dated 11 June 2021.

Golder (Golder Associates Ltd.). 2021b. Environmental Assessment - Lower Columbia White Sturgeon Habitat Restoration CLBWORKS-27 (Phase 2). Prepared for BC Hydro and Power Authority. Golder Reference No. 20449674-004-R-RevB. Dated 10 June 2021.

Golder (Golder Associates Ltd.). 2021c. Environmental Management Plan - Lower Columbia White Sturgeon Habitat Restoration CLBWORKS-27 (Phase 2). Prepared for BC Hydro and Power Authority. Golder Reference No. 20449674-003-R-RevB. Dated 10 June 2021.

IMPORTANT INFORMATION AND LIMITATIONS OF THIS REPORT

Standard of Care: Golder Associates Ltd. (Golder) has prepared this report in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practising under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this report. No other warranty expressed or implied is made.

Basis and Use of the Report: This report has been prepared for the specific site, design objective, development and purpose described to Golder by the Client. The factual data, interpretations and recommendations pertain to a specific project as described in this report and are not applicable to any other project or site location. Any change of site conditions, purpose, development plans or if the project is not initiated within eighteen months of the date of the report may alter the validity of the report. Golder cannot be responsible for use of this report, or portions thereof, unless Golder is requested to review and, if necessary, revise the report.

The information, recommendations and opinions expressed in this report are for the sole benefit of the Client. No other party may use or rely on this report or any portion thereof without Golder's express written consent. If the report was prepared to be included for a specific permit application process, then upon the reasonable request of the client, Golder may authorize in writing the use of this report by the regulatory agency as an Approved User for the specific and identified purpose of the applicable permit review process. Any other use of this report by others is prohibited and is without responsibility to Golder. The report, all plans, data, drawings and other documents as well as all electronic media prepared by Golder are considered its professional work product and shall remain the copyright property of Golder, who authorizes only the Client and Approved Users to make copies of the report, but only in such quantities as are reasonably necessary for the use of the report by those parties. The Client and Approved Users may not give, lend, sell, or otherwise make available the report or any portion thereof to any other party without the express written permission of Golder. The Client acknowledges that electronic media is susceptible to unauthorized modification, deterioration and incompatibility and therefore the Client cannot rely upon the electronic media versions of Golder's report or other work products.

The report is of a summary nature and is not intended to stand alone without reference to the instructions given to Golder by the Client, communications between Golder and the Client, and to any other reports prepared by Golder for the Client relative to the specific site described in the report. In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the whole of the report. Golder cannot be responsible for use of portions of the report without reference to the entire report.

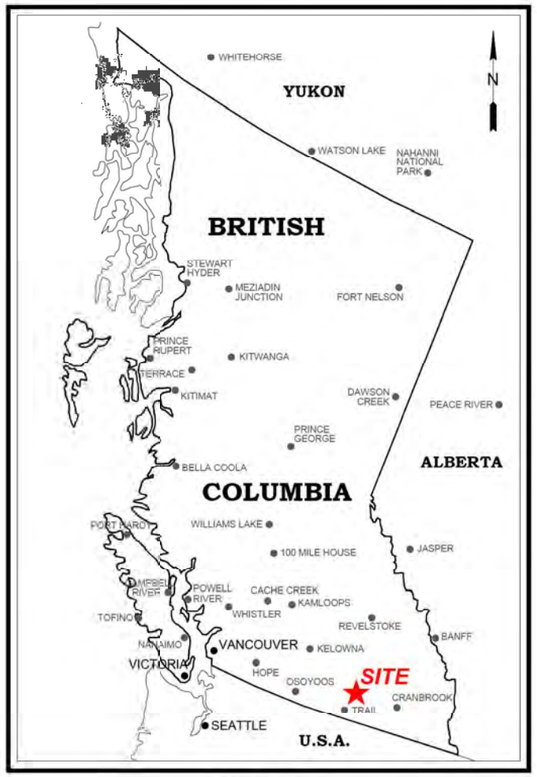
Unless otherwise stated, the suggestions, recommendations and opinions given in this report are intended only for the guidance of the Client in the design of the specific project. The extent and detail of investigations, including the number of test holes, necessary to determine all of the relevant conditions which may affect construction costs would normally be greater than has been carried out for design purposes. Contractors bidding on, or undertaking the work, should rely on their own investigations, as well as their own interpretations of the factual data presented in the report, as to how subsurface conditions may affect their work, including but not limited to proposed construction techniques, schedule, safety and equipment capabilities.

ATTACHMENT 1

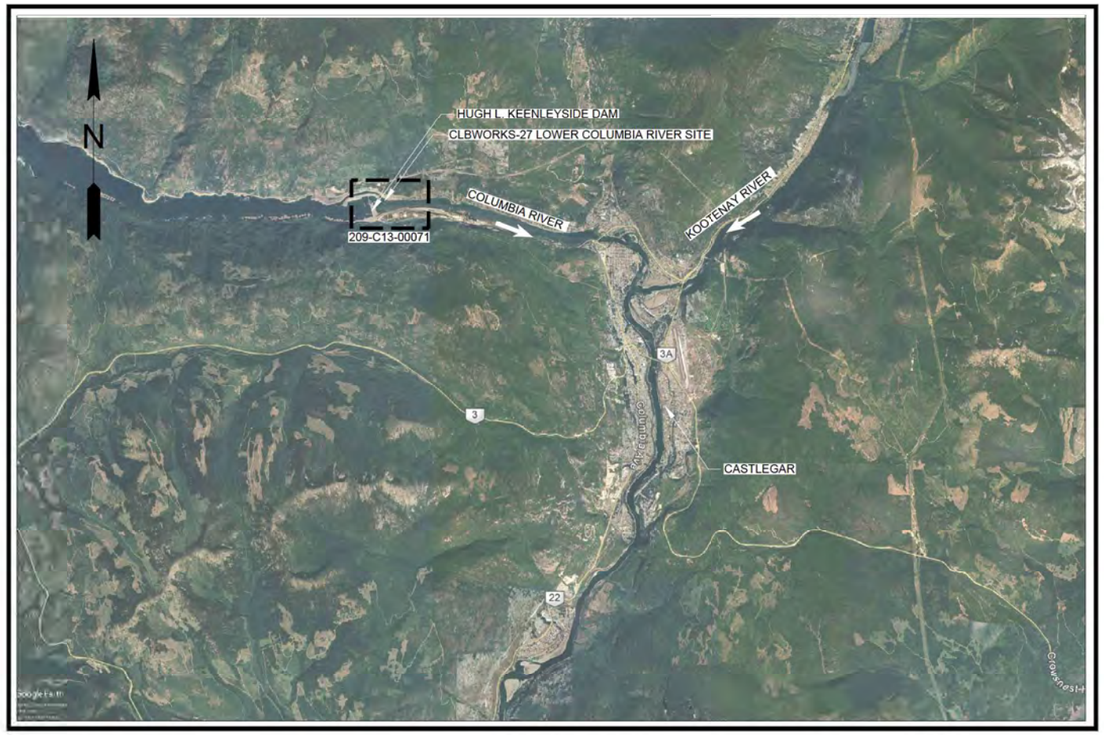
Issued For Information Drawings

BC HYDRO - CLBWORKS-27 LOWER COLUMBIA
RIVER WHITE STURGEON PHYSICAL WORKS (PHASE 2)

DRAWING INDEX			
DRAWING No.	DRAWING TITLE	REVISION	DATE
209-C13-00070	PROJECT LOCATION AND DRAWING INDEX	0	2021-09-02
209-C13-00071	SITE PLAN	0	2021-09-02
209-C13-00072	CROSS SECTIONS	0	2021-09-02
209-C13-00073	CONSTRUCTION SPECIFICATION	0	2021-09-02



KEY PLAN
NOT TO SCALE



PROJECT LOCATION PLAN
NOT TO SCALE

NOTES:

1. IMAGE ©2021 GOOGLE, OBTAINED FROM GOOGLE EARTH PRO, USED UNDER LICENSE. GOOGLE EARTH IMAGE IS NOT TO SCALE.

DRAWING IS NOT TO SCALE

BC Hydro Contract No .....

ISSUED FOR INFORMATION ONLY

By _____ Date _____
Hydro's Representative

NOT FOR CONSTRUCTION

GOLDER
MEMBER OF WSP

BC Hydro

HUGH KEENLEYSIDE (ARROW DAM)

DOWNSTREAM SUBSTRATE PLACEMENT
WHITE STURGEON PHYSICAL WORKS (PHASE 2)
PROJECT LOCATION AND DRAWING INDEX

DESIGN NUMBER		DSGN	R.CUNNINGHAM
WORK ORDER NUMBER		INDEP CHK	G.TANG
CSA S250 ACCURACY NAD 83 - 11UTM		DFTG	A.DONG
		DFTG CHK	S.REDDY
BASE ACCURACY LEVEL:	-	INSP	-
ASB ACCURACY LEVEL:	-	REV	C.COLES
		ACPT	C.COLES

PROFESSIONAL ENGINEER — PROVINCE OF — G. TANG # 47193 — REGISTERED — 2021.09.04

NO	REMARKS	DATE	DIST
0	ISSUED FOR INFORMATION ONLY	2021-09-02	

REFERENCE DRAWINGS | REVISIONS

DRAWING NUMBER	REPORT NUMBER	FIGURE NUMBER	SIZE	REV
209-C13-00070		1	D	0

SETOUT POINTS		
POINT No.	EASTING (m)	NORTHING (m)
1	444281.73	5465766.21
2	444350.82	5465733.86
3	444423.03	5465656.42
4	444415.72	5465645.81
5	444334.35	5465689.86
6	444265.86	5465740.11

LEGEND:

- EXISTING RIVER BED SURFACE
- SUBSTRATE PLACEMENT AREA
- TOPOGRAPHIC EXTENTS

NOTES:

1. ALL UNITS ARE IN METRES UNLESS OTHERWISE NOTED.
2. COORDINATE SYSTEM IS UTM NAD 83, ZONE 11.
3. EXISTING GROUND CONTOURS ARE SHOWN AT 1 m INTERVAL RELATIVE TO CGVD 2013.
4. CONSTRUCTION ACCESS SHALL BE VIA ARROW LAKES DR AND THE EXISTING ACCESS ROAD TO THE PROPOSED LAYDOWN AREA.
5. SUBSTRATE MATERIAL SHALL BE STOCKPILED IN THE LAYDOWN AREA AS-NEEDED.

REFERENCE:

1. IMAGE ©2021 GOOGLE, OBTAINED FROM GOOGLE EARTH PRO, USED UNDER LICENSE. GOOGLE EARTH IMAGE IS NOT TO SCALE.
2. BATHYMETRY SURVEY CONDUCTED BY GRANT LAND SURVEYING INC, ON JULY 01, 2019.

BC Hydro Contract No .....

ISSUED FOR INFORMATION ONLY

By _____ Date _____
Hydro's Representative

SCALE: 1:2500 0 100m

NOT FOR CONSTRUCTION

GOLDER
MEMBER OF WSP

BC Hydro

HUGH KEENLEYSIDE (ARROW DAM)

DOWNSTREAM SUBSTRATE PLACEMENT
WHITE STURGEON PHYSICAL WORKS (PHASE 2)
SITE PLAN

NO	REMARKS	DATE
0	ISSUED FOR INFORMATION ONLY	2021-09-02

REFERENCE DRAWINGS

REVISIONS

DESIGN NUMBER	
WORK ORDER NUMBER	
CSA S250 ACCURACY NAD 83 - 11UTM	
BASE ACCURACY LEVEL:	
ASB ACCURACY LEVEL:	

DSGN	R.CUNNINGHAM
INDEP CHK	G.TANG
DFTG	A.DONG
DFTG CHK	S.REDDY
INSP	-
REV	C.COLES
ACPT	C.COLES

PROFESSIONAL ENGINEER — PROVINCE OF — G. TANG # 47193 — BRITISH COLUMBIA — 2021-09-04

DATE	DIST	DRAWING NUMBER	REPORT NUMBER	FIGURE NUMBER	SIZE	REV
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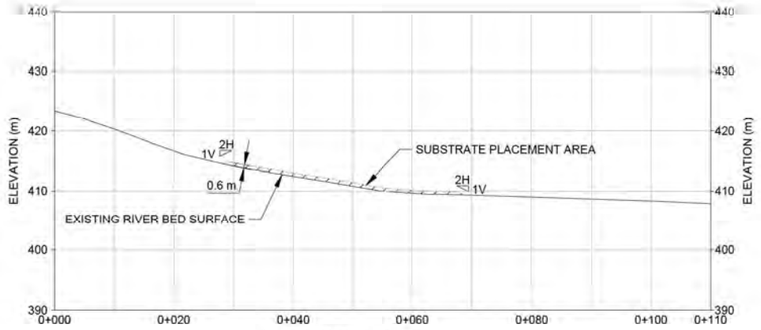

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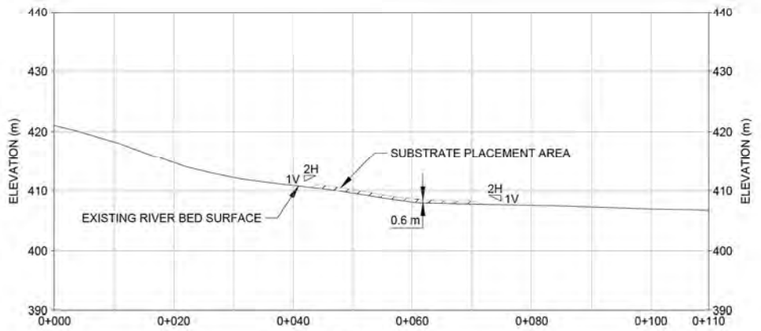

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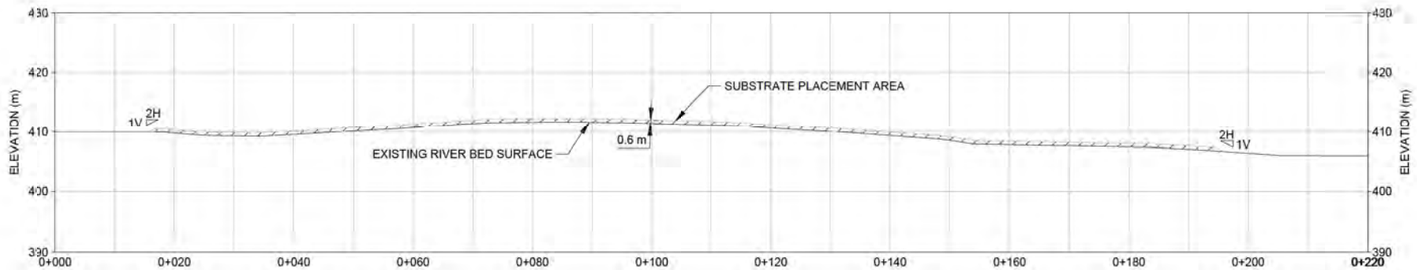

SECTION C
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LEGEND:

SUBSTRATE PLACEMENT AREA

EXISTING RIVER BED SURFACE

NOTES:

1. ALL UNITS ARE IN METRES UNLESS OTHERWISE NOTED.
2. COORDINATE SYSTEM IS UTM NAD 83, ZONE 11 ELEVATIONS RELATIVE TO CGVD 2013.
3. SUBSTRATE LAYER SIDE SLOPES ARE ASSUMED TO BE 2:1 (H:V) BASED ON ASSUMED ANGLES OF REPOSE.
4. CROSS-SECTIONS ARE SHOWN WITH NO VERTICAL EXAGGERATION.

REFERENCE:

1. BATHYMETRY SURVEY CONDUCTED BY GRANT LAND SURVEYING INC, ON JULY 01, 2019.

BC Hydro Contract No .....

ISSUED FOR INFORMATION ONLY

By _____ Date _____
Hydro's Representative

SCALE: 1:500 0 25m

NOT FOR CONSTRUCTION

GOLDER
MEMBER OF WSP

BC Hydro

HUGH KEENLEYSIDE (ARROW DAM)

DOWNSTREAM SUBSTRATE PLACEMENT
WHITE STURGEON PHYSICAL WORKS (PHASE 2)
CROSS SECTIONS

NO	REMARKS	REVISIONS
0	ISSUED FOR INFORMATION ONLY	

REFERENCE DRAWINGS:

DESIGN NUMBER	
WORK ORDER NUMBER	
CSA S250 ACCURACY NAD 83 - 11UTM	
BASE ACCURACY LEVEL:	
ASB ACCURACY LEVEL:	

DSGN	R.CUNNINGHAM
INDEP CHK	G.TANG
DFTG	A.DONG
DFTG CHK	S.REDDY
INSP	-
REV	C.COLES
ACPT	C.COLES

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA G. TANG # 47193 2021-09-04

DATE	DIST	DRAWING NUMBER	REPORT NUMBER	FIGURE NUMBER	SIZE	REV
2021-09-02		209-C13-00072		3	D	0

GENERAL NOTES:

PROJECT WORKS

1. BC HYDRO REQUIRES THE PLACEMENT OF SUBSTRATE FILL MATERIAL DOWNSTREAM OF THE TAILRACE OF THE ARROW LAKES GENERATING STATION TO IMPROVE STURGEON HABITAT IN THE COLUMBIA RIVER.

GENERAL REQUIREMENTS

1. CONSTRUCT ALL WORK IN ACCORDANCE WITH THE DRAWINGS AND SPECIFICATIONS, AND AS DIRECTED BY THE PROJECT ENGINEER.
2. DETAILED BATHYMETRIC SURVEYS ARE REQUIRED BEFORE AND AFTER SUBSTRATE MATERIAL PLACEMENT.

DIMENSIONS, ELEVATIONS AND COORDINATES

1. ALL DIMENSIONS SHOWN ARE IN METRES, UNLESS NOTED OTHERWISE. ELEVATIONS ARE IN METRES RELATIVE TO CGVD 2013. STATION VALUES ARE IN METRES.
2. ALL COORDINATES SHALL BE REFERENCED TO THE NAD83 UTM ZONE 11 GRID DATUM.

MATERIALS:

SUBSTRATE FILL MATERIAL

1. THE SUBSTRATE FILL MATERIAL MIXTURE SHALL CONSIST OF COURSE, SUB-ROUNDED MATERIAL MEETING THE FOLLOWING GRADATION.

MATERIAL SIZE (mm)	PERCENT PASSING
300	100
200	80
125	50
100	40
20.0	0

BC Hydro Contract No ....

ISSUED FOR INFORMATION ONLY

By ____ Hydro's Representative Date ____

NOT FOR CONSTRUCTION

GOLDER
MEMBER OF WSP

BC Hydro

REFERENCE DRAWINGS

NO	REMARKS
0	ISSUED FOR INFORMATION ONLY

REVISIONS

DESIGN NUMBER		DSGN	R.CUNNINGHAM
WORK ORDER NUMBER		INDEP CHK	G.TANG
CSA S250 ACCURACY NAD 83 - 11UTM		DFTG	A.DONG
		DFTG CHK	S.REDDY
BASE ACCURACY LEVEL:		INSP	-
		REV	C.COLES
ASB ACCURACY LEVEL:		ACPT	C.COLES

PROFESSIONAL PROVINCE OF BRITISH COLUMBIA G. TANG # 47193 ENGINEER 2021-09-04

HUGH KEENLEYSIDE (ARROW DAM)

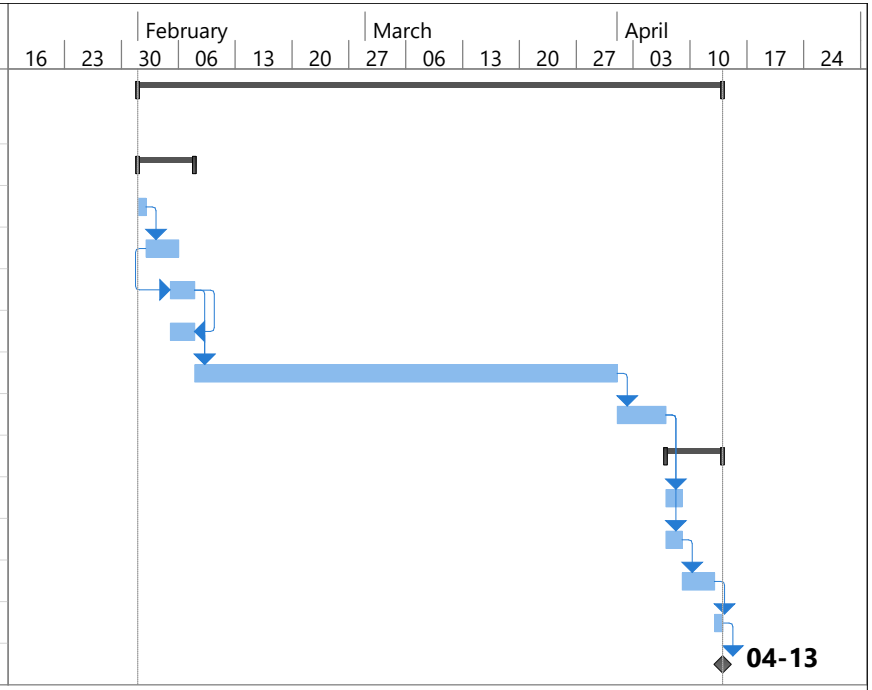
DOWNSTREAM SUBSTRATE PLACEMENT
WHITE STURGEON PHYSICAL WORKS (PHASE 2)
GENERAL NOTES

DATE	DIST	DRAWING NUMBER	REPORT NUMBER	FIGURE NUMBER	SIZE	REV
2021-09-02		209-C13-00073		4	D	0

ATTACHMENT 2

Preliminary Construction Schedule

ID	Task Name	Duration	Start	Finish
1	**CLBWORKS-27 White Sturgeon Habitat Restoration - Construction**	**62 days**	**Tue 22-02-01**	**Wed 22-04-13**
2	**Site setup**	**6 days**	**Tue 22-02-01**	**Mon 22-02-07**
3	Mobilization and laydown area preparation	1 day	Tue 22-02-01	Tue 22-02-01
4	Barge preparation	4 days	Wed 22-02-02	Sat 22-02-05
5	Set anchors - land and river	2 days	Sat 22-02-05	Mon 22-02-07
6	Preconstruction bathymetric survey	2 days	Sat 22-02-05	Mon 22-02-07
7	**Gravel placement**	45 days	Tue 22-02-08	Thu 22-03-31
8	**Gravel placement - schedule contingency**	5 days	Fri 22-04-01	Wed 22-04-06
9	**Takedown and Cleanup**	**6 days**	**Thu 22-04-07**	**Wed 22-04-13**
10	Post-construction bathymetric survey	2 days	Thu 22-04-07	Fri 22-04-08
11	Takedown anchors - land and river	2 days	Thu 22-04-07	Fri 22-04-08
12	Barge cleanup	3 days	Sat 22-04-09	Tue 22-04-12
13	Site cleanup and demobilization	1 day	Wed 22-04-13	Wed 22-04-13
14	Project completion	0 days	Wed 22-04-13	Wed 22-04-13



APPENDIX C

Issued-for-Tender Package

GOLDER
MEMBER OF WSP

TRANSMITTAL

DATE 11 February 2022 **Reference No.** 20449674-011-TR-Rev1

TO Teri Neighbour
BC Hydro

CC Gaven Tang (Golder)

FROM Curtis VanWerkhoven **EMAIL Curtis_VanWerkhoven@golder.com**

SUBMISSION OF BC HYDRO CLBWORKS-27 TENDER PACKAGE COMPONENTS (DRAWINGS, CONSTRUCTION SPECIFICATIONS AND SCHEDULE OF QUANTITIES AND PRICES)

On the behalf of BC Hydro, Golder Associates Ltd. (Golder) has prepared the following Tender Package Components for BC Hydro's CLBWORKS-27 Project:

- 9 February 2022 Rev0 Issued for Tender Design Drawings
- 9 February 2022 Rev0 Construction Specifications
- 9 February 2022 Rev0 Schedule of Quantities and Prices

Should BC Hydro have any questions or concerns, please contact the undersigned.

Yours very truly,

Golder Associates Ltd.

Curtis VanWerkhoven, M.A.Sc., P.Eng.
Senior Water Resources Engineer

Chris Coles, M.A.Sc., P.Eng.
Associate, Senior Water Resources Engineer

CV/CC/syd/anr

Attachments: Appendix A – Issued for Tender Drawings
Appendix B – Construction Specifications (named BC Hydro Appendix G)
Appendix C – Schedule of Quantities and Prices (named BC Hydro Appendix E)

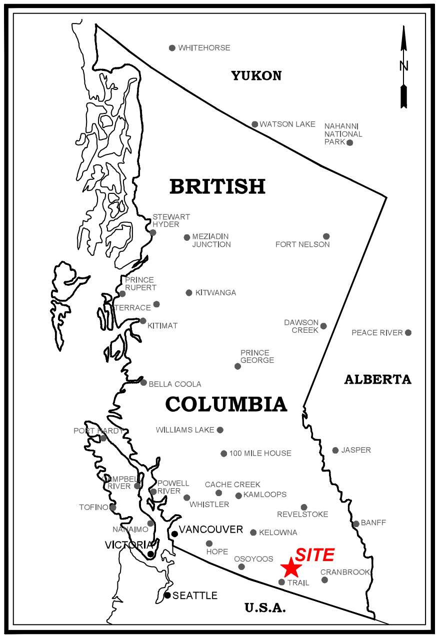
https://golderassociates.sharepoint.com/sites/139832/project files/6 deliverables/issued to client_for wp/20449674-011-tr-rev1/20449674-011-tr-rev1-clbworks 27 11feb_22.docx

APPENDIX A

Issued for Tender Drawings

BC HYDRO - CLBWORKS-27 LOWER COLUMBIA
RIVER WHITE STURGEON PHYSICAL WORKS (PHASE 2)

DRAWING INDEX			
DRAWING No.	DRAWING TITLE	REVISION	DATE
209-C13-00070	PROJECT LOCATION AND DRAWING INDEX	0	2022-02-02
209-C13-00071	SITE PLAN	0	2022-02-02
209-C13-00072	CROSS SECTIONS	0	2022-02-02
209-C13-00073	CONSTRUCTION SPECIFICATION	0	2022-02-02



KEY PLAN
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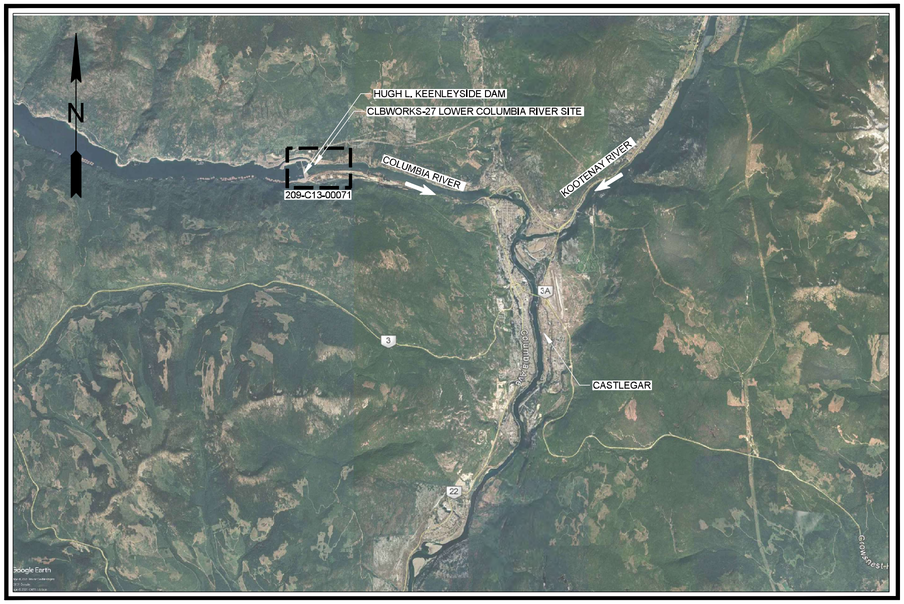

PROJECT LOCATION PLAN
NOT TO SCALE

NOTES:

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DRAWING IS NOT TO SCALE

PERMIT TO PRACTICE #1003064
Engineers & Geoscientists BC

GOLDER
MEMBER OF WSP

BC Hydro Contract No RFP 17141
ACCEPTED
This review was for observing general conformity to contract only. B.C. Hydro accepts no legal responsibility for the content, accuracy of completness of this document even if it nad been accepted with or without revision based on B.C. Hydro's observations.
By ______ Hydro's Representative Date Feb. 3, 2022

BC Hydro Contract No RFP 17141
ISSUED FOR TENDER
By ______ Hydro's Representative Date Feb 3/22

NOT FOR CONSTRUCTION

NO	REMARKS
0	ISSUED FOR TENDER

REFERENCE DRAWINGS

REVISIONS

DESIGN NUMBER	
WORK ORDER NUMBER	
CSA S250 ACCURACY NAD83 - 11UTM	
BASE ACCURACY LEVEL:	- -
ASB ACCURACY LEVEL:	

DSGN	R.CUNNINGHAM
INDEP CHK	G.TANG
DFTG	A.DONG
DFTG CHK	J.KOWNACKI
INSP	-
REV	C.COLES
ACPT	C.COLES

PROFESSIONAL ENGINEER — PROVINCE OF BRITISH COLUMBIA — G. TANG #47193 — 2022-Feb-08

BC Hydro

HUGH KEENLEYSIDE (ARROW DAM)

DOWNSTREAM SUBSTRATE PLACEMENT
WHITE STURGEON PHYSICAL WORKS (PHASE 2)
PROJECT LOCATION AND DRAWING INDEX

DATE	DIST	DRAWING NUMBER	REPORT NUMBER	FIGURE NUMBER	SIZE	REV
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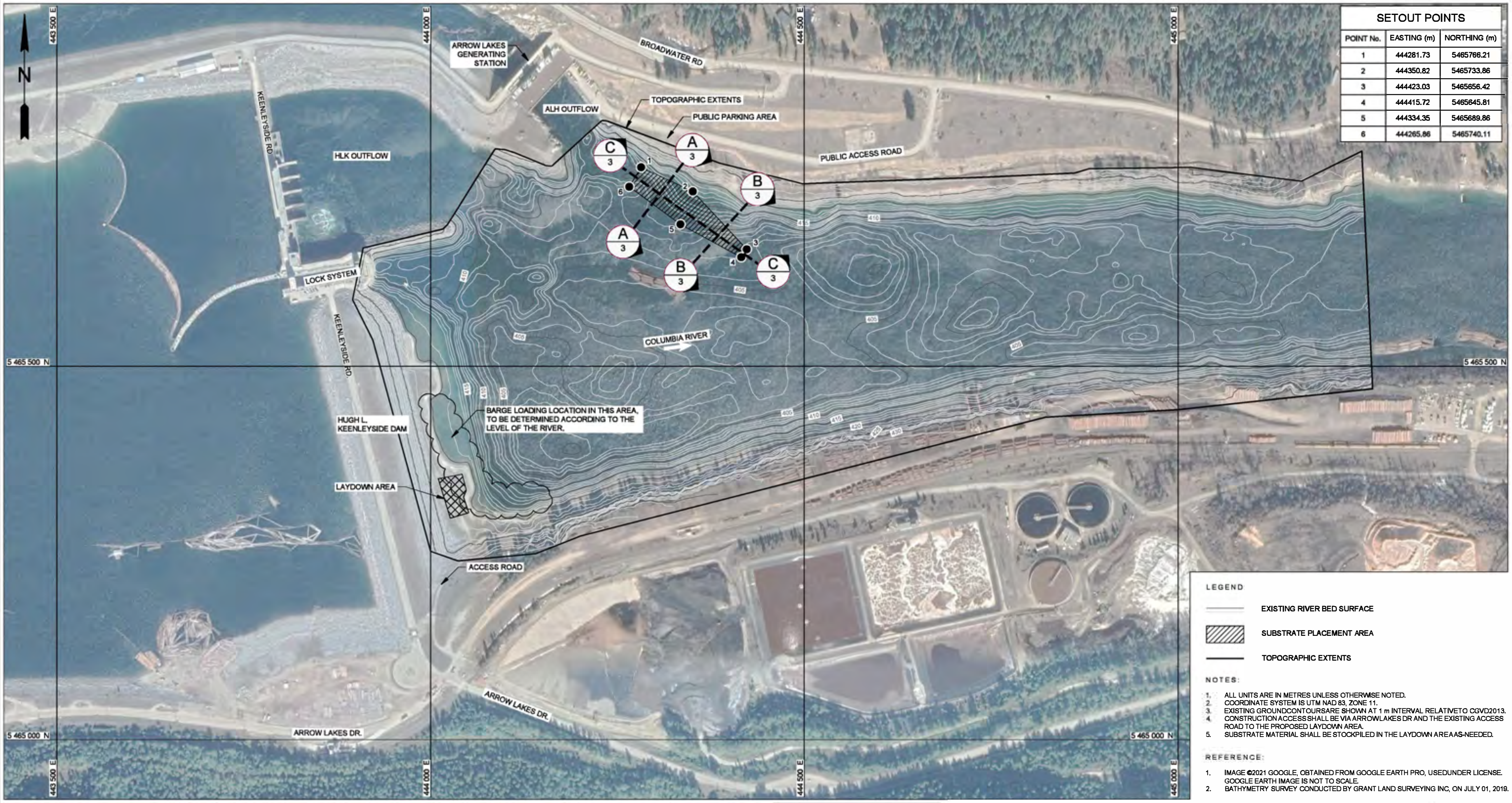

SETOUT POINTS

POINT No.	EASTING (m)	NORTHING (m)
1	444281.73	5465766.21
2	444350.82	5465733.86
3	444423.03	5465656.42
4	444415.72	5465645.81
5	444334.35	5465689.86
6	444265.86	5465740.11

LEGEND

- EXISTING RIVER BED SURFACE
- SUBSTRATE PLACEMENT AREA
- TOPOGRAPHIC EXTENTS

NOTES:

1. ALL UNITS ARE IN METRES UNLESS OTHERWISE NOTED.
2. COORDINATE SYSTEM IS UTM NAD 83, ZONE 11.
3. EXISTING GROUNDCONTOURSARE SHOWN AT 1 m INTERVAL RELATIVETO CGVD2013.
4. CONSTRUCTION ACCESS SHALL BE VIA ARROWLAKES DR AND THE EXISTING ACCESS ROAD TO THE PROPOSED LAYDOWN AREA.
5. SUBSTRATE MATERIAL SHALL BE STOCKPILED IN THE LAYDOWN AREAAS-NEEDED.

REFERENCE:

1. IMAGE ©2021 GOOGLE, OBTAINED FROM GOOGLE EARTH PRO, USEDUNDER LICENSE. GOOGLE EARTH IMAGE IS NOT TO SCALE.
2. BATHYMETRY SURVEY CONDUCTED BY GRANT LAND SURVEYING INC, ON JULY 01, 2019.

BC Hydro Contract No RFP 17141
ACCEPTED
This review was for observing general conformity to contract only. B.C. Hydro accepts no legal responsibility for the content, accuracy of completeness of this document even if it had been accepted with or without revision based on B.C. Hydro's observations.
By ______ Hydro's Representative Date Feb. 3, 2022

BC Hydro Contract No RFP 17141
ISSUED FOR TENDER
By Teri Neighbour Hydro's Representative Date Feb 3/22

SCALE 1:2500 0 100m

NOT FOR CONSTRUCTION

PERMIT TO PRACTICE #1003064
Engineers & Geoscientists BC

GOLDER
MEMBER OF WSP

DESIGN NUMBER	
WORK ORDER NUMBER	
CSA S250 ACCURACY NAD 83-11 UTM	
BASE ACCURACY LEVEL:	
ASB ACCURACY LEVEL:	

DSGN	R.CUNNINGHAM
INDEP CHK	G.TANG
DFTG	A.DONG
DFTG CHK	J.KOWNACKI
INSP	-
REV	C.COLES
ACPT	C.COLES

NO	REMARKS
0	ISSUED FOR TENDER

REVISIONS

REFERENCE DRAWINGS

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA G. TANG # 47193 2022-Feb-02

BC Hydro

HUGH KEENLEYSIDE (ARROW DAM)

DOWNSTREAM SUBSTRATE PLACEMENT
WHITE STURGEON PHYSICAL WORKS (PHASE 2)
SITE PLAN

DATE	DIST	DRAWING NUMBER	REPORT NUMBER	FIGURE NUMBER	SIZE	REV
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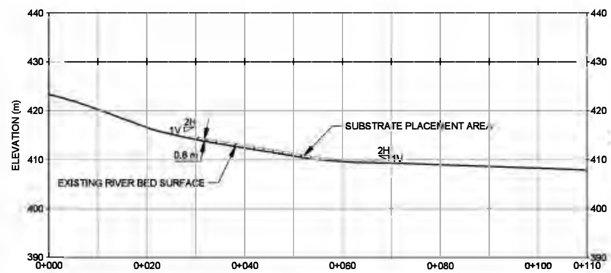

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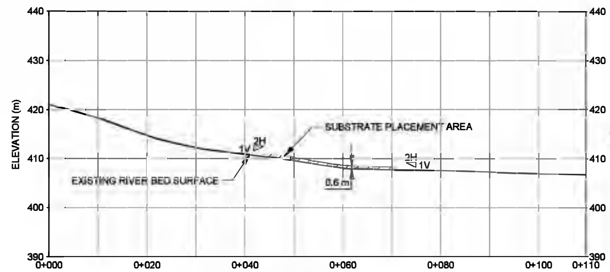

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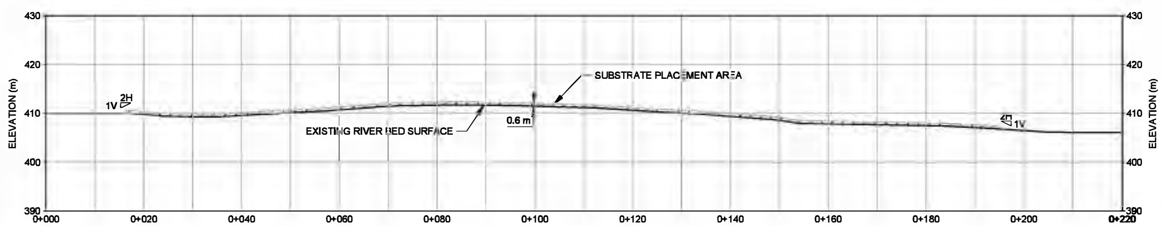

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SCALE 1:500

LEGEND

SUBSTRATE PLACEMENT AREA

EXISTING RIVER BED SURFACE

NOTES

1. ALL UNITS ARE IN METRES UNLESS OTHERWISE NOTED.
2. COORDINATE SYSTEM IS UTM NAD 83, ZONE 11 ELEVATIONS RELATIVE TO CGVD 2013.
3. SUBSTRATE LAYER SIDESLOPES ARE ASSUMED TO BE 2:1 (H:V) BASED ON ASSUMED ANGLES OF REPOSE.
4. CROSS-SECTIONS ARE SHOWN WITH NO VERTICAL EXAGGERATION.

REFERENCE

1. BATHYMETRY SURVEY CONDUCTED BY GRANT LAND SURVEYING INC, ON JULY 01, 2019.

BC Hydro Contract No RFP 17141
ACCEPTED
This review was for observing general conformity to contract only. B.C. Hydro accepts no legal responsibility for the content, accuracy of completness of this document even if it had been accepted with or without revision based on B.C. Hydro's observations.
By Hydro's Representat Date Feb. 3, 2022

BC Hydro Contract No RFP 17141
ISSUED FOR TENDER
By Teri Neighbour Hydro's Representa Date Feb 3/22

SCALE 1:500 0 25m

NOT FOR CONSTRUCTION

PERMIT TO PRACTICE #1003064
Engineers & Geoscientists BC

GOLDER
MEMBER OF WSP

DESIGN NUMBER	
WORK ORDER NUMBER	
CSA S250 ACCURACY NAD83 - 11UTM	
BASE ACCURAC YLEVEL	
ASB ACCURACY LEVEL	

DSGN	R.CUNNINGHAM
INDEP CHK	G.TANG
DFTG	A.DONG
DFTG CHK	J.KOWNACKI
INSP	-
REV	C.COLES
ACPT	C.COLES

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA G. TANG # 47193 2022-Feb-03

0	ISSUED FOR TENDER
NO	REMARKS

REFERENCE DRAWINGS — REVISIONS

BC Hydro

HUGH KEENLEYSIDE (ARROW DAM)

DOWNSTREAM SUBSTRATE PLACEMENT
WHITE STURGEON PHYSICAL WORKS (PHASE 2)
CROSS SECTIONS

DATE	DIST	DRAWING NUMBER	REPORT NUMBER	FIGURE NUMBER	SIZE	REV
2022-02-02		209-C13-00072		3	D	0

GENERAL NOTES:

PROJECT WORKS

1. BC HYDRO REQUIRES THE PLACEMENT OF SUBSTRATE FILL MATERIAL DOWNSTREAM OF THE TAILRACE OF THE ARROW LAKES GENERATING STATION TO IMPROVE STURGEON HABITAT IN THE COLUMBIA RIVER.

GENERAL REQUIREMENTS

1. CONSTRUCT ALL WORK IN ACCORDANCE WITH THE DRAWINGS AND SPECIFICATIONS, AND AS DIRECTED BY THE PROJECT ENGINEER.
2. DETAILED BATHYMETRIC SURVEYS ARE REQUIRED BEFORE AND AFTER SUBSTRATE MATERIAL PLACEMENT.

DIMENSIONS, ELEVATIONS AND COORDINATES

1. ALL DIMENSIONS SHOWN ARE IN METRES, UNLESS NOTED OTHERWISE. ELEVATIONS ARE IN METRES RELATIVE TO CGVD 2013. STATION VALUES ARE IN METRES.
2. ALL COORDINATES SHALL BE REFERENCED TO THE NAD83 UTM ZONE 11 GRID DATUM.

MATERIALS:

SUBSTRATE FILL MATERIAL

1. THE SUBSTRATE FILL MATERIAL MIXTURE SHALL CONSIST OF COURSE, SUB-ROUNDED MATERIAL MEETING THE FOLLOWING GRADATION.

MATERIAL SIZE (mm)	PERCENT PASSING
300	100
200	80
125	50
100	40
20.0	0

BC Hydro Contract No RFP 17141
ACCEPTED
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By ________ Hydro's Representative Date Feb. 3, 2022

BC Hydro Contract No RFP 17141
ISSUED FOR TENDER
By ________ Hydro's Representative Date Feb 3/22

NOT FOR CONSTRUCTION

PERMIT TO PRACTICE #1003054
Engineers & Geoscientists BC

GOLDER
MEMBER OF WSP

DESIGN NUMBER		DSGN	R.CUNNINGHAM
WORK ORDER NUMBER		INDEP CHK	G.TANG
CSA S250 ACCURACY NAD83-11UTM		DFTG	A.DONG
		DFTG CHK	J.KOWNACKI
BASE ACCURACY LEVEL:		INSP	-
		REV	C.COLES
ASB ACCURACY LEVEL:		ACPT	C.COLES

PROFESSIONAL ENGINEER, PROVINCE OF BRITISH COLUMBIA — G. TANG # 47193 — 2022 Feb 03

NO	REMARKS
0	ISSUED FOR TENDER

REFERENCE DRAWINGS

REVISIONS

BC Hydro

HUGH KEENLEYSIDE (ARROW DAM)

DOWNSTREAM SUBSTRATE PLACEMENT
WHITE STURGEON PHYSICAL WORKS (PHASE 2)
GENERAL NOTES

DATE	DIST	DRAWING NUMBER	REPORT NUMBER	FIGURE NUMBER	SIZE	REV
2022-02-02		209-C13-00073		4	D	0

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KOWNACKI, JAREK
2/2/2022 12:05 PM

APPENDIX B

Construction Specifications

APPENDIX G – SPECIFICATIONS
BC HYDRO - CLBWORKS-27 LOWER COLUMBIA RIVER WHITE STURGEON HABITAT RESTORATION

Construction Specifications		
Document	Prepared by	Checked by
Appendix G – Specifications, all sections.	PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA C. T. VANWERKHOVEN # 46227 11 FEB 2022	CT Coles 11 February 2022
	Curtis VanWerkhoven, M.A.Sc., P.Eng. *Senior Water Resources Engineer* Golder Associates Ltd.	Chris Coles, M.A.Sc., P.Eng. *Associate, Senior Water Resources Engineer* Golder Associates Ltd.

PERMIT TO PRACTICE #1003064
Engineers & Geoscientists BC

APPENDIX G – SPECIFICATIONS

SP1 GENERAL REQUIREMENTS 3
SP1.1 DEFINITIONS 3
SP1.2 USE OF THE SITE 3
SP1.3 PROTECTION OF WORK AND PROPERTY 3
SP1.4 MATERIALS AND EQUIPMENT SUPPLIED BY CONTRACTOR 3
SP1.5 DELIVERY OF EQUIPMENT AND MATERIALS 3
SP1.6 NOTICE OF STATUTORY HOLIDAY WORK 3
SP1.7 QUALITY, INSPECTION AND TESTING 4
SP1.8 SITE LAYOUT, PREPARATION AND SURVEYS 4
1.8.1 CONSTRUCTION LAYOUT AND SITE PREPARATION 4
1.8.2 SITE SURVEYS 4
SP1.9 DRAWINGS 5
SP2 CONSTRUCTION REQUIREMENTS 6
SP2.1 ENVIRONMENTAL 6
2.1.1 PERMITS AND FEES 6
2.1.2 ENVIRONMENTAL PROTECTION PLAN 6
SP2.2 SAFETY 6
SP2.3 MOBILIZATION 6
SP2.4 DEMOBILIZATION 6
SP2.5 SHIPPING AND HANDLING 6
SP2.6 ACCESS AND CONSTRUCTION ROADS 7
2.6.1 SITE ACCESS 7
2.6.2 PARKING AND LAYDOWN 7
SP2.7 ACCOMMODATION 7
SP2.8 PROGRESS MEETINGS 7
SP2.9 CONSTRUCTION SERVICES 7
2.9.1 SITE ARRANGEMENT PLANS 8
2.9.2 OFFICE AND STORAGE 8
2.9.3 SECURITY 8
2.9.4 ELECTRIC POWER SUPPLY 8
2.9.5 LIGHTING 8
2.9.6 REFUSE DISPOSAL 8
2.9.7 TEMPORARY PROTECTION 8
2.9.8 MATERIALS HANDLING AND CLEAN-UP 8

SP2.10 WATER MANAGEMENT AND HANDLING 9
SP2.11 TRAFFIC CONTROL 9
SP2.12 RENTAL EQUIPMENT 9
SP2.13 SITE RESTORATION 9
SP3 SPAWNING SUBSTRATE MIXTURE PRODUCTION 11
SP3.1 GENERAL 11
3.1.1 SCOPE OF WORK 11
3.1.2 DEFINITIONS 11
SP3.2 MATERIALS 11
3.2.1 GENERAL 11
3.2.2 SPAWNING SUBSTRATE MIXTURE QUALITY 11
SP3.3 EXECUTION 12
3.3.1 GENERAL 12
3.3.2 SPAWNING SUBSTRATE MIXTURE SCREENING AND WASHING 12
3.3.3 SPAWNING SUBSTRATE MIXTURE GRADATION LIMITS 12
3.3.4 INSPECTION OF SPAWNING SUBSTRATE MIXTURE PRODUCTION 13
SP4 SUBSTRATE PLACEMENT AREA CONSTRUCTION 14
SP4.1 GENERAL 14
4.1.1 SCOPE OF WORK 14
4.1.2 DEFINITIONS 14
SP4.2 MATERIALS 14
SP4.3 EXECUTION 14
4.3.1 GENERAL 14
4.3.2 WORK SEQUENCE 14
4.3.3 SUBSTRATE PLACEMENT AREA 15
4.3.4 STOCKPILING MATERIALS 16

SP1 GENERAL REQUIREMENTS

SP1.1 Definitions

"**Spawning Substrate Mixture**" means the gravel mixture as described in SP3 that makes up the Substrate Blanket to be placed in the Substrate Placement Area.

"**Substrate Blanket**" means a uniformly thick layer of Spawning Substrate Mixture.

"**Substrate Placement Area**" means the aerial location of what shall be covered by the Substrate Blanket.

SP1.2 Use of the Site

The Contractor will not have exclusive use or possession of the Site and will cooperate with Other Contractors and coordinate Contractor's Work with the work of the Other Contractors as contemplated in GC.4.7. Contractor will confine its equipment, tools and materials to areas designated by Hydro's Representative. Contractor will not interfere with the access and use of the Site or adjacent areas by BC Hydro and Other Contractors.

SP1.3 Protection of Work and Property

The Contractor will protect the Work and use and protect BC Hydro Property in accordance with GC.13.2.

SP1.4 Materials and Equipment Supplied by Contractor

All materials and equipment necessary for the completion of the Work shall be supplied by the Contractor in accordance with GC.19.2.

Any materials and equipment required to complete the Work but not specified in the Contract Document, will be considered an incidental to the work with no additional payment made. These materials and equipment will be subject to acceptance by Hydro's Representative.

All materials used in the Work shall conform to the latest applicable CSA, ANSI and ASTM standards or equivalent accepted by Hydro's Representative.

SP1.5 Delivery of Equipment and Materials

The Contractor shall arrange and pay for transportation and delivery of all equipment and materials to the Site in accordance to GC.4.26. Further to GC. 22, if the Contractor imports any non-Canadian equipment or materials all customs duties, fees, taxes, licences and permits arising from that importation shall be the responsibility of the Contractor.

SP1.6 Notice of Statutory Holiday Work

Normal operating hours are Monday to Saturday, between hours of 07:00 to 17:00. A written request shall be submitted to BC Hydro's Representative for review and

acceptance for any desire to work outside of these normal operating hours.

SP1.7 Quality, Inspection and Testing

All materials shall be installed as per the manufacturer's directions. The Spawning Substrate Mixture shall be provided and installed by the Contractor in accordance with SP3 and SP4.

The Contractor shall provide enough direction and oversight so that the work gets completed as specified.

Material substitutions require prior approval from Hydro's Representative. BC Hydro reserves the right to inspect all work at any time.

SP1.8 Site Layout, Preparation and Surveys

1.8.1 Construction Layout and Site Preparation

The construction layout and site preparation shall be completed by the Contractor immediately prior to construction Work. The construction layout and site preparation shall include:

.1 Staking, flagging or alternative delineation of laydown area and perimeter of the Substrate Placement Area.

.2 Identification of pre-identified hazard or danger trees that require removal as directed by the Environmental Monitor or Hydro's Representative.

.3 Installation of erosion and sediment control measures.

.4 Any laydown area preparation required.

.5 Barge preparation and anchor setting.

.6 Contractor site supervisor and crew members will have completed BC Hydro's online training for i) Working in & Around Water ENV-020, ii) Spill Management & Disposal ENV-005 iii) Heritage & Archaeology Awareness ENV-028; iv) Wildlife Awareness ENV-041. The successful bidder will be advised regarding instructions for accessing BC Hydro online training modules.

Hydro's Representative will provide the Contractor with the AutoCAD file or geometry to assist with layout of the Work.

1.8.2 Site Surveys

The Contractor shall be responsible for and carry out a set out (pre-placement) survey before, and intermediate survey(s) during the Work as required to construct the Substrate Blanket within the Substrate Placement Area to the designed thickness as shown on the drawings in Appendix L and within the tolerances specified in SP4.3.3.4.

A minimum of one intermediate survey shall be performed when placement is

approximately 50% complete, based on quantities provided in SP3.1.1. In addition, a record survey shall be performed following completion of the placement.

When carrying out all surveys, the Contractor shall:

.1 Supply equipment as required for laying out of Work.

.2 Use survey equipment and methods acceptable to and approved by Hydro's Representative before commencement of surveys. Methods shall be provided in delivery of the survey data.

.3 Complete all surveys in accordance with the controls and coordinate system established by the Contract Documents.

.4 Complete all surveys with an accuracy within +/- 0.05 m (vertical and horizontal) of the point measurements of the Substrate Blanket.

.5 Common benchmarks shall be established and referenced for all surveys.

.6 Provide collected point data and generated surface of the Substrate Blanket within 5 days of the survey date to Hydro's Representative as digital files. Generated surfaces for intermediate or record surveys shall be compared to the set out survey, with the total Spawning Substrate Mixture quantity placed calculated from the calculated difference between the generated surfaces from the surveys within the tolerances specified in SP4.3.3.4.

The Contractor shall provide for inspection of the layout by Hydro's Representative prior to the start of any construction associated with the Work. Hydro's Representative may carry out quality assurance surveys at any time during the Work to verify the Contractor's surveys.

SP1.9 Drawings

Pursuant to GC.4.22, BC Hydro will provide four complete copies of the Issued for Construction Drawings (IFC) as listed in Appendix L - Drawings. Two copies of the IFC Drawings shall be maintained by Hydro's Representative, and two copies of the IFC Drawings shall be maintained by the Contractor on the Site to be used to record any changes, additions, omissions and other pertinent information not contained in the original drawings. These notes shall be accurately marked thereon in red ink by the Contractor in accordance with GC.4.23.

One copy of the above marked sets including accepted shop drawings shall be provided by the Contractor on completion of the Work shown on the particular drawings. These drawings shall be clearly identified with the notation "REVISED FOR RECORD".

SP2 CONSTRUCTION REQUIREMENTS

SP2.1 Environmental

2.1.1 Permits and Fees

Pursuant to GC.4.6, the Contractor shall be responsible for obtaining any required Permits, approvals, licenses and fees in connection with the Work (i.e. substrate wash water).

BC Hydro will obtain and hold the other environmental Permits for the duration of this project. All conditions of Permit must be adhered to while undertaking Work. The Contractor will adhere to all environmental performance measures as per the EMP in Appendix I – Environmental Requirements.

2.1.2 Environmental Protection Plan

In addition to the requirement in GC.13.5(a), The EPP will be written and signed by a qualified professional (e.g. R.P. Bio.) in good standing. Work will not begin until an EPP has been accepted by Hydro's Representative.

SP2.2 Safety

The Contractor will comply with GC.13.1 Site Safety, BC Hydro's Safety Standards and Regulations in Appendix C and Appendix H – Safety Requirements.

SP2.3 Mobilization

Mobilization will be considered complete when Contractor has set up the main items of equipment ready to commence the Work, and all early Submittals listed in Section 2.1.1 of Appendix E have been submitted by the Contractor and were reviewed and accepted by Hydro's Representative.

SP2.4 Demobilization

Demobilization will be considered complete when the following requirements have been met to the satisfaction of Hydro's Representative:

.1 Removal of all equipment and temporary buildings and restoring the site to a clean and tidy state to the satisfaction of Hydro's Representative.

.2 Ensuring all debts and obligations have been made and paid out to suppliers, employees, agents and businesses.

SP2.5 Shipping and Handling

Contractor shall provide secure and protective transportation such that all materials arrive undamaged and without loss on arrival at the Site.

Packaging shall include, where necessary, the provision of adequate cover, tarping, shoring, dunnage, wooden crating, strapping, banding, and containerizing.

SP2.6 Access and Construction Roads

2.6.1 Site Access

While the Contractor is using any public or private road or property whatsoever, it shall comply with the requirements of the *Highway Act* and amendments thereto, and with all applicable safety and traffic regulations, load limitations and clearances, whether implemented by the owner of any such road or property, the B.C. Ministry of Transportation and Highways, or the municipal or other lawful authority having jurisdiction over such roads or property, and shall create a minimum of interference and inconvenience to others.

BC Hydro will not be responsible for any delays incurred by Contractor resulting from any restrictions or limitations imposed or caused by the B.C. Ministry of Transportation and Highways, the municipality or other lawful authority in the use of public or private roads and Contractor shall plan and schedule its traffic in accordance with such restrictions and limitations.

The Contractor shall access the site via Arrow Lakes Drive and the existing access road. The Contractor shall exercise care in mobilizing equipment to Site, moving equipment on the Site and shall use measures to minimize disturbance to the Site, including but not limited to swamp mats, corduroy roads, and low-impact equipment, as required. Any damage or disturbance that occurs shall be restored by the Contractor to the existing condition or better.

2.6.2 Parking and Laydown

The Contractor will be entitled to have use or joint use of certain working areas and laydown areas as agreed with Hydro's Representative. The Contractor shall cooperate with others as may be required by Hydro's Representative in the use of all areas.

SP2.7 Accommodation

The Contractor is responsible for any accommodation required for its workforce. The Contractor shall not install any accommodation facilities on BC Hydro property.

SP2.8 Progress Meetings

Hydro's Representative will hold progress meetings during the Work as when required, and shall be attended by Contractor's Representative. A pre-job meeting will be held within 28 days of the Effective Date.

Throughout the duration of the work the Contractor shall provide daily written notice to Hydro's Representative of any facts or conditions which may affect the Contractor's ability to maintain the Contract Schedule, within 24 hours after the occurrence of the applicable event.

SP2.9 Construction Services

The Contractor shall provide and maintain the following construction services and pay all

costs associated therewith:

2.9.1 Site Arrangement Plans

Contractor shall propose the locations for temporary structures and facilities such as office, workshop, storage and parking, and shall be submitted for approval to the Hydro's representative within 14 days prior to mobilization at Site.

2.9.2 Office and Storage

The Contractor shall provide all temporary storage areas and facilities required for the Work upon approval of the Site arrangement plan in SP2.9.1. Site storage of fuels and other hydrocarbons will not be allowed.

2.9.3 Security

The Contractor shall be responsible for the security of the Work as well as for maintaining the security of BC Hydro's and Contractor's buildings, equipment, and materials in the assigned Work areas. Security shall include the provision of additional temporary barriers, gates, lights, signs, and other measures necessary for the protection of the Work or buildings, equipment, and materials in the assigned work areas against theft, damage, and entry of unauthorized personnel.

2.9.4 Electric Power Supply

The Contractor shall be responsible to supply any electrical power required for temporary construction facilities.

2.9.5 Lighting

The Contractor shall furnish all plant, equipment, labour and materials to ensure adequate illumination for all of its operations. Adequate illumination shall mean the minimum lighting required to provide safe working conditions and to permit the Work to be performed and inspected in accordance with the requirements of the Contract.

2.9.6 Refuse Disposal

The Contractor shall collect and dispose of refuse from all premises and Work centres provided and/or staffed and operated for the Work. The Contractor shall collect and dispose of collected materials off-site and dispose at a licensed facility. Disposal documentation is to be provided to Hydro's Representative within 10 business days.

2.9.7 Temporary Protection

The Contractor shall provide and use facilities, as required, to protect the Work and to enable the Work to proceed during inclement weather.

2.9.8 Materials Handling and Clean-Up

All materials shall be suitably packaged for selected transportation options

observing all applicable rules and regulations.

The Contractor shall provide adequate personnel with properly scheduled equipment to affect the unloading and handling of materials.

Debris removal shall be accomplished by Contractor on a planned basis and as directed. All Work areas are to be maintained clean and organized on a daily basis to allow for proper “housekeeping” on the Site.

SP2.10 Water Management and Handling

The Contractor shall be solely responsible for the management and handling of surface and groundwater outside of the wetted perimeter of the Columbia River. All surface water management plans and procedures shall be reviewed and accepted by Hydro’s Representative.

The Contractor shall investigate, design, construct, supply, operate, maintain and subsequently remove such dikes, fills, pumps, conduits, filter fabric, drains, surface and underground dewatering, water treatment, and drainage facilities as are necessary to manage all surface and groundwater entering the Work areas including, but not limited to, surface water from precipitation run-off or ground water percolation. The Contractor may divert water entering the Work area by berms, as accepted by Hydro’s Representative.

The Contractor shall take every precaution to ensure that all water removed from the Work areas is disposed of in such a manner that will not endanger public health or the environment. The Contractor is not permitted to discharge its water or effluent into any existing permanent drainage systems, creeks or the Columbia River.

Any discharge of water from the Work shall be in accordance with the Environmental Management Plan (EMP) provided in Appendix I – Environmental Requirements.

All run off and erosion that may be a result of the laydown area must be managed to prevent siltation of any watercourse.

SP2.11 Traffic Control

The Contractor shall barricade and maintain traffic control in accordance with the requirements of the B.C. Traffic Control Manual and WorkSafeBC regulations. The Contractor shall provide the appropriate signs, fencing and barricades surrounding the trench areas for vehicular and pedestrian protection.

SP2.12 Rental Equipment

The Contractor shall provide rental equipment required for the Work. Rental equipment may include, but is not limited to, pumps, generators, piping, excavators, dump trucks, skid steer loaders, barges, and mobile cranes.

SP2.13 Site Restoration

The Contractor will control the introduction and spread of invasive plants as per the *BC*

Weed *Control Act*.

Waste materials from worksites will be removed, and subsequently disposed of at appropriately authorized facilities.

At the completion of the Work the Contractor shall ensure that Site is left clean and free of all debris and fully restored to its original state or better and to the satisfaction of Hydro's Representative and as shown on the drawings in Appendix L and outlined in the EMP in Appendix I.

The Contractor shall ensure any disturbed areas are restored according to the EMP and seed mix to be accepted by Hydro’s Representative and according to the EMP.

SP3 SPAWNING SUBSTRATE MIXTURE PRODUCTION

SP3.1 General

3.1.1 Scope of Work

This section pertains to the obtaining, screening, washing, handling and storage of approximately 3,540 m^3 of Spawning Substrate Mixture.

3.1.2 Definitions

- **D_{50}**: Particle diameter of which 50% of the particles in a given granular sediment sample are smaller in size.

- **D_{100}:** Particle diameter of which 100% of the particles in a given granular sediment sample are smaller in size (largest size in the gradation).

SP3.2 Materials

3.2.1 General

The Contractor shall provide all materials required for the Work described in SP2 and in accordance with the requirements specified on the drawings in Appendix L.

3.2.2 Spawning Substrate Mixture Quality

.1 The gravel source shall be alluvial and glacio-fluvial deposits, free of clays and fines, consisting of naturally rounded gravel. Broken rock and colluvium is not acceptable.

.2 Gravel for the Spawning Substrate Mixture shall not be from a saltwater environment, and shall be tested for Acid Rock Drainage (ARD) and Metal Leachate (ML) Management. The Contractor shall provide test results to Hydro's Representative for review and approval before the material is used for the Work.

.3 Gravel for Spawning Substrate Mixture shall be graded and thoroughly washed, as per SP3.3.2 prior to delivery to the Site.

.4 Suitability test and/or service records shall be used to determine durability of the gravel. In the absence of service records and where there is a doubt as to suitability, resistance to disintegration will be determined by any or all of the following tests. All tests shall be accepted by Hydro's Representative:

a. The density of individual rock stones shall be not less than 2.6 g/cm^3 (2.6 tonnes/cubic metre or 160 pounds per cubic foot).

b. As a guide to resistance to abrasive action, the abrasion test in the Los Angeles machine (ASTM Test C131) shall be used. The stone

shall have a weight loss not more than 50% after 500 revolutions.

c. As a guide to resistance to weathering, the freezing and thawing test (AASHO Test T103 for ledge weight rock procedure A) shall be used.

SP3.3 Execution

3.3.1 General

Production of Spawning Substrate Mixture will be conducted off-site at the source and shall include:

.1 Supply of a Spawning Substrate Mixture raw source (gravel/alluvial pit).

.2 Supply, operation, and maintenance of a washing and screening plant capable of manufacturing Spawning Substrate Mixture to the gradations and specification as detailed in these requirements.

.3 Local storage of the Spawning Substrate Mixture will be required until ready to be transported and installed at the project site at an agreed upon date.

3.3.2 Spawning Substrate Mixture Screening and Washing

.1 Screening

a. All Spawning Substrate Mixture must be screened and mixed off site at the production site in order to satisfy the grading limits in Table 1 of SP3.3.3.

b. The Spawning Substrate Mixture shall not contain any crushed stones or clay lumps. Spawning Substrate Mixture with crushed stones or clay lumps delivered to Site may be rejected by Hydro's Representative.

.2 Washing

a. All silt, clay, sand, and other deleterious material must be removed from the Spawning Substrate Mixture.

b. Natural material may require washing to achieve this specification. This shall be conducted off site.

c. Reuse of wash water is not accepted.

3.3.3 Spawning Substrate Mixture Gradation Limits

Spawning Substrate Mixture shall consist of washed natural rounded stones free of deleterious material and graded within the sieve size limits specified in **Table 1.**

Table 1. Grading Limits for Spawning Substrate Mixture

Sieve Size (mm)	% Pass by mass	Tolerance

20	0	0%
100	40	+/- 10%
125	50	+/- 10%
200	80	+/- 10%
300	100	0%

If the test screening of the material results in an inordinately unbalanced gradation and in the estimation of Hydro's Representative needs correction, the screening process will be reviewed with the Contractor to correct the problem.

3.3.4 Inspection of Spawning Substrate Mixture Production

.1 Hydro's Representative reserves the right to inspect the plant and sample the gravel during manufacture and any time during construction.

.2 The Contractor will provide sieve analyses of the Spawning Substrate Mixture at a frequency of 1 per 500 m^3 and the results of these tests may be the Hydro's Representative's basis for acceptance or rejection of the Spawning Substrate Mixture prior-to and any time during construction.

.3 The Contractor will bear the inspection costs as well as costs to reprocess or manufacture additional Spawning Substrate Mixture to meet the specifications and no additional cost to BC Hydro other than included in the Contract Price.

SP4 Substrate Placement Area Construction

SP4.1 General

4.1.1 Scope of Work

The scope of Work is the placement of the Spawning Substrate Mixture to the lines, grades, and limits shown on the drawings in Appendix L.

4.1.2 Definitions

.1 **River Channel:** Shall mean any area below the top of bank of the Columbia River or as defined by Hydro's representative.

.2 **Temporary Access:** Temporary access trails constructed to facilitate construction, and decommissioned at the end of construction, including site restoration specified by the construction EMP.

.3 **Archaeological Artifact:** As defined by BC Hydro's Field Reference Guide for Heritage Resources included in BC Hydro's EMP in Appendix I. All site personnel will follow the BC Hydro Chance Find Procedure.

SP4.2 Materials

All materials required for use and supplied by the Contractor shall conform to the following and be approved by Hydro's Representative prior to use:

.1 **Spawning Substrate Mixture:** Spawning Substrate Mixture will be all gravels produced and supplied as per SP3 for use in the Substrate Placement Area as shown on the drawings in Appendix L.

.2 **Reject Material:** Any material that is not acceptable for reuse on-site and deleterious material, as determined by Hydro's Representative, that shall be excavated and disposed of off-site.

SP4.3 Execution

4.3.1 General

The sequence, staging and use of equipment to undertake the Work as shown on the drawings, shall be submitted as part of the Work Program and Schedule Submittal for review and approval of Hydro's Representative. No Work shall be undertaken until this approval.

4.3.2 Work Sequence

The sequence of Work is generally as follows:

.1 Mobilization to the Site of the Contractor's equipment and resources.

.2 Completion of set out and site preparation activities as per SP1.8.

.3 Spawning Substrate Mixture production, as per SP3.

.4 Delivery of Spawning Substrate Mixture to the laydown area by truck and stockpiling.

.5 Loading of Spawning Substrate Mixture onto barge and transportation to the Substrate Placement Area.

.6 Anchoring of barge and placement of Spawning Substrate Mixture.

.7 Confirmation of placement accuracy by the intermediate survey(s) and record survey as per SP1.8.

.8 Completion of site restoration activities as per SP2.13.

.9 Demobilization of the Contractor, their equipment and resources from the Site on approval of Hydro's Representative.

4.3.3 Substrate Placement Area

.1 Limits of Work

The Contractor shall not modify the River Channel beyond the specified Substrate Placement Area as shown on the drawings in Appendix L and without prior written acceptance from Hydro's Representative.

.2 Site Preparation

Following the set out survey, the Contractor shall confirm that the River Channel over the Substrate Placement Area has sufficient depth to install the Substrate Blanket at the specified thickness as shown on the drawings in Appendix L without the removal of materials from the River Channel.

Any excavation of materials from the River Channel or modification of the River Channel may only be completed as directed by Hydro's Representative.

.3 Spawning Substrate Mixture Placement

The Contractor shall haul sufficient gravel to fill and extend the full width of the Substrate Placement Area.

The Contractor will sequence the placement of the Spawning Substrate Mixture to conform to the elevations and extents as shown on the drawings in Appendix L. Placement of the Spawning Substrate Mixture shall be in accordance with the EMP.

.4 Finished Substrate Placement Area Surface

The actual finished Substrate Blanket thickness shall not deviate by more than +/-0.1 m from the thickness shown on the drawings in Appendix L and shall not be consistently high or low, unless directed by Hydro's Representative.

The quantity for payment shall be determined based on material placed within the Substrate Placement Area within a horizontal tolerance of +/-1.0 m as shown on the drawings in Appendix L.

Prior to Substantial Completion of the Work, the finished surface shall require a written approval from Hydro's Representative. The approval shall be based on the difference between the digital surfaces determined from the set out and record surveys falling within the tolerance limits specified.

4.3.4 Stockpiling Materials

.1 Stockpiling of Spawning Substrate Mixture on site will be permitted in the designated laydown area and as specified in the BC Hydro accepted Contractor's EPP.

.2 Rejected Spawning Substrate Mixture materials shall be removed from Site at no cost to BC Hydro.

.3 The Contractor shall immediately transport any excavated reject material from the River Channel to designated areas off site or to a facility accepted by the Hydro's Representative.

APPENDIX C

Schedule of Quantities and Prices

APPENDIX E – SCHEDULE OF QUANTITIES AND PRICES

1. All prices are in Canadian dollars and include all applicable duties and all costs of performing the Work and all applicable taxes, except only GST.

2. The abbreviations in the Schedule of Quantities and Prices are defined as follows:

   LS: lump sum
   m^3: cubic metre

3. Terms of Payment are provided in GC.5 of Appendix A – General Conditions (Construction) and Appendix E – Schedule of Quantities and Prices, to the Contract Documents.

Payment Item	Description	Approx. Quantity	Unit	Unit Price	Amount
1	Mobilization	LS	1		
2	Site Preparation	LS	1		
3	Supply and Placement of Spawning Substrate Mixture	m^3	3,540		
4	Site Restoration	LS	1		
5	Demobilization	LS	1		
				SUBTOTAL PAYMENT ITEMS 1 TO 5	
				QUOTATION PRICE (aggregate of the above)	
				GST	

MEASUREMENT AND PAYMENT

Payment Item 1	Mobilization includes mobilization of all equipment and site facilities as described in SP2.3. Payment for mobilization shall be the lump sum price entered in Payment Item 1.
Payment Item 2	Site preparation includes all construction layout, installation of erosion and sediment control measures, laydown area preparation, barge preparation, and anchor setting as described in SP1.8. Payment for site preparation shall be the lump sum price entered in Payment Item 2.
Payment Item 3	Supply of Spawning Substrate Mixture to site includes the supply, screening, washing, handling, storage, and transport to site of all Spawning Substrate Mixture required for Substrate Blanket construction as described in SP3. Placement of Spawning Substrate Mixture includes all equipment, labour and measures required for Substrate Blanket construction within the Substrate Placement Area as described in SP4. Total payment for both supply and placement shall be made on the basis of the unit price entered in Payment Item 3. Quantity for payment shall be determined based on material placed within the Substrate Placement Area (as shown on the Drawings) and within the Finished Substrate Placement Area Surface specified tolerances as described in SP4.3.3.4. No payment will be made for material placed outside the construction area and outside of the specified tolerances. The basis of measurement shall be the calculated volume between the digital surfaces determined from the Set Out and the Intermediate and Record bathymetric surveys as described in SP1.8.2 within the tolerance limits specified. One (1) progress payment will be made based on the calculated volume between the digital surfaces determined from the Set Out and the Intermediate near 50% completion survey, with the total payment for Payment Item 3 based on the calculated volume between the digital surfaces determined from the Set Out and record surveys within the tolerance limits specified.
Payment Item 4	Site Restoration includes restoration/reclamation work required to restore the site condition as described in SP2.13. Payment shall be the lump sum price entered in Payment Item 4.
Payment Item 5	Demobilization includes demobilization of all equipment and site facilities as described in SP2.4. Payment for demobilization shall be the lump sum price entered in Payment Item 5.

1. Labour, Material and Equipment Rates

Description	**Unit of Measure**	**Markup** (if applicable)	**Unit Price**		
			Standby Rate	***Straight Time*** Monday to Friday first 8 hours	***Overtime*** Monday to Friday after 8 hours, Weekends, Holidays
Site Superintendent	HR				
Safety Representative	HR				
Foreman	HR				
Labourer	HR				
Barge	HR				
Tugboat with operator	HR				
Excavator with operator	HR				
Front end loader with operator	HR				

APPENDIX D

Environmental Assessment

REPORT

Environmental Assessment

Lower Columbia White Sturgeon Habitat Restoration CLBWORKS-27 (Phase 2)

Submitted to:

BC Hydro and Power Authority

6911 Southpoint Drive
Burnaby, BC V3N 4X8

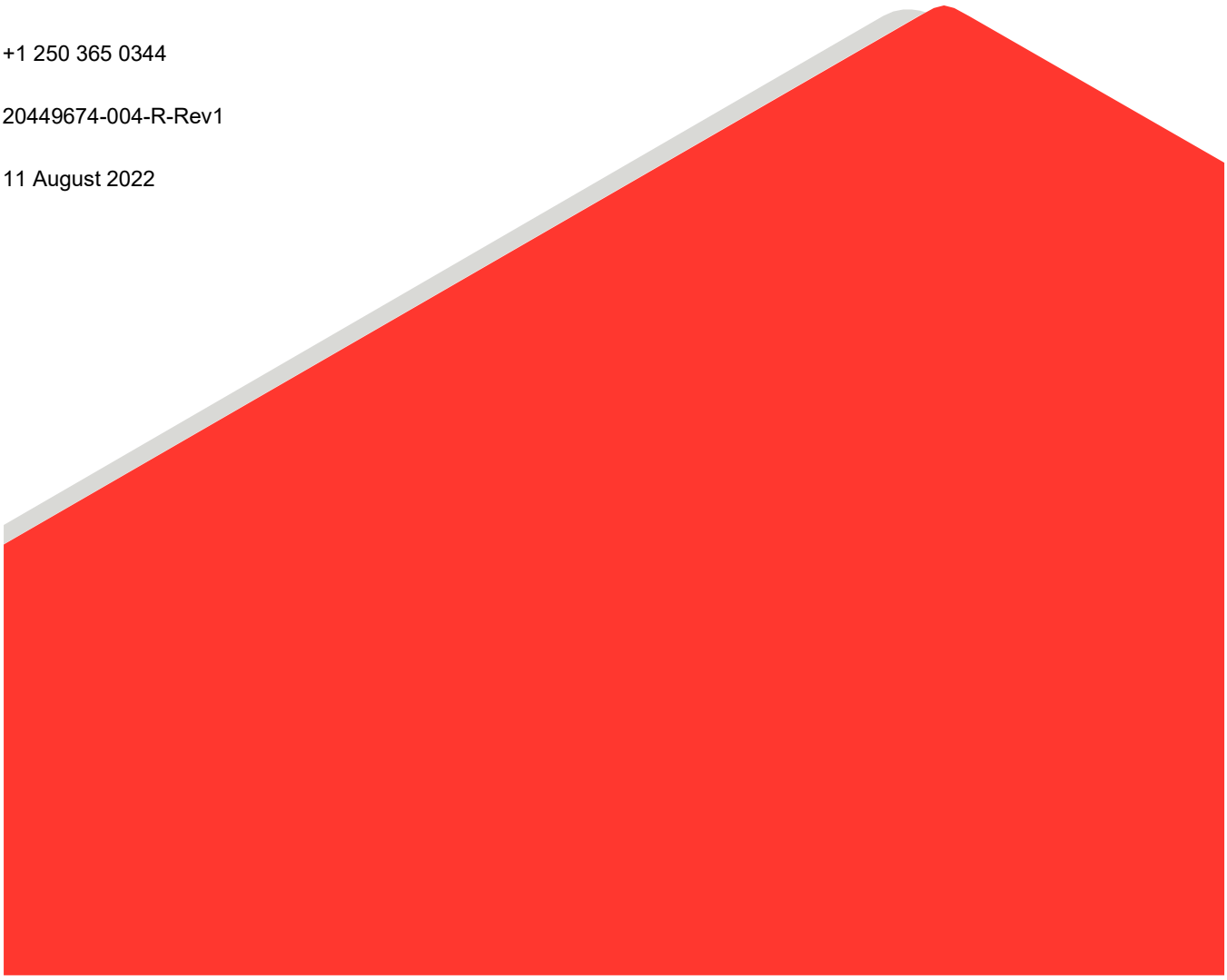
Submitted by:

Golder Associates Ltd.
201 Columbia Avenue, Castlegar, British Columbia, V1N 1A8, Canada

+1 250 365 0344

20449674-004-R-Rev1

11 August 2022



Distribution List

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Unless otherwise stated, the suggestions, recommendations and opinions given in this report are intended only for the guidance of the Client in the design of the specific project. The extent and detail of investigations, including the number of test holes, necessary to determine all of the relevant conditions which may affect construction costs would normally be greater than has been carried out for design purposes. Contractors bidding on, or undertaking the work, should rely on their own investigations, as well as their own interpretations of the factual data presented in the report, as to how subsurface conditions may affect their work, including but not limited to proposed construction techniques, schedule, safety and equipment capabilities.

Table of Contents

1.0 INTRODUCTION 1

2.0 PROJECT DESCRIPTION AND DEATAILED WORK METHODS 1

2.1 Hauling and Stockpiling of Substrate Material 2

2.2 Vegetation Clearing for Temporary Access Path 2

2.3 Temporary Access 2

2.4 Installation of Spawning Substrate 3

2.5 Site Clean-up and Restoration 4

3.0 REGULATORY CONTEXT 4

4.0 ENVIRONMENTAL ASSESSMENT METHODS 6

4.1 Review of Existing Information 6

4.2 Field Reconnaissance 6

4.3 Effects Assessment 7

5.0 RESULTS 7

5.1 Enhancement Area 7

5.2 Riparian Vegetation 8

5.3 Species at Risk 8

5.3.1 White Sturgeon 9

5.3.2 Other Fish 10

6.0 DISCUSSION OF POTENTIAL EFFECTS 14

6.1 Fish and Fish Habitat 14

6.2 Riparian Vegetation 17

7.0 MITIGATION MEASURES 17

8.0 RESIDUAL EFFECTS ASSESSMENT 19

8.1 Fish and Fish Habitat and Riparian Vegetation Assessment 19

8.2 Residual Effects Discussion 25

8.2.1 Water Quality – Change in Sediment Concentrations 26

8.2.2 Potential Mortality of White Sturgeon from Equipment Operation 26
8.2.3 Potential Mortality of Fish or Eggs from Gravel Placement 27
9.0 LONG TERM EFFECTIVENESS MONITORING 29
10.0 CONCLUSION 29
11.0 ACKNOWLEDGEMENTS 30
12.0 REFERENCES 31

TABLES

Table 1: Provincial and Federal Conservation Status Definitions 9
Table 2: Habitat requirements and life history information of aquatic species at risk in the Columbia River 13
Table 3: White Sturgeon Habitat in Upper Columbia River - from DFO Recovery Strategy (DFO 2014 McPhail 2007, Potential Effects of Project, and Mitigation 16
Table 4: Pathways of Effects, Stressors, Mitigation and Potential for Residual Effects for the Project 20
Table 5: Definitions of Components used to Characterize Predicted Residual Effects of the Project 25
Table 6: Ratings of the potential effect of stressors 27

FIGURES

Figure 1 Site Plan 3
Figure 2: Location of White Sturgeon Critical Habitat immediately downstream of the Hugh L Keenleyside Dam 5

APPENDICES

APPENDIX A
Issued-for-Review Drawings

APPENDIX B
Environmental Management Plan

APPENDIX C
Site Photos

1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been contracted by BC Hydro to provide an Environmental Assessment (EA) for the Phase 2 CLBWORKS-27 Lower Columbia White Sturgeon Physical Works project (the Project). The Project objective is to enhance White Sturgeon (*Acipenser transmontanus*) spawning substrate at the Keenleyside White Sturgeon spawning area by placing substrate with a range of grain sizes that will enhance spawning and be stable and resistant to infilling by sedimentation (Figure 1).

White Sturgeon in the Columbia River between HLK Dam and Grand Coulee Dam (Transboundary Reach) have been extensively studied since the 1990's when their population decline was first identified (Hildebrand and Parsley 2013). The Upper Columbia White Sturgeon Recovery Initiative (UCWSRI) was formed in 2000 to aid in focusing monitoring efforts and develop recovery plans for this population (Gregory and Long 2008). The UCWSRI Technical Working Group (TWG) examined several hypotheses regarding the causes of the Transboundary Reach population decline and released a recovery plan in 2002. Unfortunately, recovery efforts directed by the plan did not correct the apparent insufficient level of natural recruitment of the population (Gregory and Long 2008).

The Upper Columbia population of White Sturgeon was designated as Endangered under the *Species at Risk Act* in 2006 as a result of recruitment failure (DFO 2014). This designation was the impetus for the TWG initiated a recruitment failure hypothesis review in 2006, and in 2007 the Comptroller of Water Rights in British Columbia ordered the Upper Columbia River Water Use Plan (WUP; Gregory and Long 2008). In 2008, the TWG identified realistic in-river mitigation and research options to address key recruitment failure hypotheses. The modification/restoration of spawning substrate in key spawning areas was identified as one of the realistic options to address recruitment failure.

White Sturgeon spawning substrate restoration is a research and mitigation option that may result in a positive effect on recruitment (Gregory and Long 2008, West et al 2020), while posing very low risks to other fish species and resulting in little to no impacts on aquatic and riparian environments. An evaluation of potential enhancement projects was completed under Phase 1 of this WUP Project (West et al. 2020) and included a detailed assessment of the biological and technical feasibility of White Sturgeon spawning substrate restoration at various spawning locations on the Lower Columbia River (West et al. 2020). In Phase 1, the following three known spawning locations for White Sturgeon were assessed.:

- Keenleyside (river km 0.1) at the Hugh L. Keenleyside Dam (HLK) – The Keenleyside White Sturgeon spawning area extends from HLK and the adjacent Arrow Lake Generating Station (ALH), to approximately 1.25 km downstream to the confluence with Rialto Creek.
- Kinnaird (river km 13.4 to 18.4) – The exact location of White Sturgeon spawning in the Kinnaird area is unknown, but the assessed area was the approximately 5 km section of river downstream from the Highway 3 bridge (river km 13.4).
- Waneta (river km 56.0 to 57.2) – The Waneta White Sturgeon spawning area extends approximately 1 km downstream of the Waneta Dam to the Canada/USA Border.

The TWG selected the Keenleyside location as the preferred location and as part of Phase 2 of the Project. Golder has developed a detailed design and construction methodology for placement of the spawning substrate, and an Environmental Management Plan (EMP) for a Contractor to follow to mitigate potential adverse effects on the sensitive White Sturgeon habitat during the implementation of the Project. A long-term monitoring program will also be developed to evaluate the effectiveness of the enhancement program.

The Okanagan Nation Alliance (ONA) has been involved with TWG through Phase I of the Project and in Phase 2 provided technical support to Golder in preparing this EA. Specifically, Amy Duncan of ONA prepared Section 5.3, fish species at risk.

The following sections of this EA document present:

- a description of enhancement area and proposed construction methods
- an assessment of potential effects of the enhancement project
- and mitigations for any residual adverse effects.

NOT ISSUED FOR CONSTRUCTION

LEGEND

- EXISTING RIVER BED SURFACE
- SUBSTRATE PLACEMENT AREA
- TOPOGRAPHIC EXTENTS

NOTES

1. ALL UNITS ARE IN METRES UNLESS OTHERWISE NOTED.
2. COORDINATE SYSTEM IS UTM NAD 83, ZONE 11.
3. EXISTING GROUND CONTOURS ARE SHOWN AT 1 m INTERVAL RELATIVE TO CGVD 2013.

REFERENCES

1. IMAGE ©2021 GOOGLE, OBTAINED FROM GOOGLE EARTH PRO, USED UNDER LICENSE. GOOGLE EARTH IMAGE IS NOT TO SCALE.
2. BATHYMETRY SURVEY CONDUCTED BY GRANT LAND SURVEYING INC, ON JULY 01, 2019.

CLIENT
BC HYDRO

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2021-06-10
DESIGNED	RC
PREPARED	GB
REVIEWED	GT
APPROVED	RA

PROJECT
CLBWORKS-27 LOWER COLUMBIA RIVER WHITE STURGEON PHYSICAL WORKS (PHASE 2)

TITLE
SITE PLAN

PROJECT NO.	PHASE/TASK	REV.	FIGURE
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2.0 PROJECT DESCRIPTION AND DEATAILED WORK METHODS

The proposed work methods for completion of the Project are described below, and the Project design can be found in Appendix A. The placement of spawning substrate is proposed to take place in February to March 2022. Discussion on potential aquatic effects of the Project to fish and fish habitat are provided in Section 6.1 and a summary of mitigation measures are provided in Section 7.0. Detailed site-specific mitigation measures are provided in the Environmental Management Plan (EMP) in Appendix B. Detailed descriptions of each work task are provided in Sections 2.1 to 2.5.

The proposed construction methodology for gravel placement is as follows:

- Complete general construction setup activities, including laydown area preparation, pre-construction bathymetric survey, setting anchors.
- Deliver substrate material to the proposed laydown area by truck, and stockpile prior to barge loading.
- Use a front-end loader to load substrate material from the stockpile to the barge at the proposed loading location.
- Use a tugboat to transport the barge from the loading area on the south riverbank to the substrate placement area.
- Place substrate using a long reach excavator (or a crane with a clamshell bucket) located on the barge. The barge will be securely anchored in place during substrate placement activities.
- Complete construction takedown and clean-up activities, post-construction bathymetric survey, and laydown area restoration (if required).

The estimated duration construction is 6 working days for site setup, 45 working days for gravel placement, and 6 working days for takedown and cleanup, for a total of 57 working days (or 10 weeks in total, 8 weeks in-water works, assuming 6 working days per week). Additionally, Golder recommends considering a schedule contingency for material placement time of 5 working days, to account for possible delays due to winter construction. Although this total duration exceeds two months, not all of the setup and cleanup activities would require in-water work.

The preferred laydown area and barge loading location, on the south bank of the river immediately downstream of HLK (Figure1), were selected due to the suitability for barge loading, proximity to the gravel placement area, availability of space for a laydown area, and existing access for trucks. Potential secondary laydown and loading locations were identified on the south bank of the river immediately upstream of HLK, and on the north bank of the river adjacent to the gravel placement area. These secondary locations may still be considered if unforeseen issues arise with use of the preferred location.

2.1 Hauling and Stockpiling of Substrate Material

The substrate material required for the Project consists of approximately 3,540 m³ of a graded grain size mixture of sub-rounded gravel and cobble that will be stable and resistant to infilling by fines (sand-sized and smaller) and consisting of different proportions of material within a range suitable for sturgeon spawning between 20 mm and 300 mm (West et al. 2020). Further details and material specification of the substrate material are provided in the Issued-for-Review (IFR) drawings in Appendix A.

Substrate material will preferably be supplied by a local quarry. Hauling will be via highway dump trucks. The preferred hauling route will be along Highway 3A to the Robson Access Road to Columbia Avenue and Lower Arrow Lakes Road. A laydown area located at the south downstream bank of HLK will be used to stockpile substrate material until it is loaded on the barge. Hauling will be completed throughout the Project duration. During construction, a front-end loader will load the material from the stockpile in the laydown area on to the barge. A tugboat will transport the barge from the loading area on the south riverbank to the gravel placement area where the barge will be anchored and secured. A long reach excavator (or crane with clamshell) located on the barge will place the substrate on the riverbed. Accurate placement of substrate will be accomplished through the use of survey grade RTK GNSS/GPS paired with echosounders mounted on the excavator, crane, and/or barge. The substrate will be thoroughly washed at the quarry before it is transported to the Project Area to reduce the mobilization of sediment during in-water placement.

2.2 Vegetation Clearing for Temporary Access Path

The existing access road will be used at the preferred laydown location at the south shore of the Columbia River at the upstream boundary of the Project area, immediately downstream of HLK Dam. The south shore downstream of HLK Dam is the primary access and laydown area; however, the north shore downstream of the dam or the south shore upstream of HLK Dam may be used as a contingency laydown area(s) to stockpile material. The riparian conditions at the identified potential laydown and access locations are described in Section 5.2. The access road, laydown area and barge loading areas have previously been disturbed during historical construction of the HLK Dam and ALH. There is minimal vegetation present in these areas and for this reason, minimal restoration or revegetation is anticipated after construction is complete. Should vegetation require clearing for access, it will be completed in advance of the bird nesting period in early April to mid-August (Government of Canada 2018).

A pre-clearing vegetation assessment will be completed prior to Project start up for the portions of the selected access path and laydown areas located within 30 m of the Columbia River high water mark (HWM). Results of the pre-clearing surveys will be used as a baseline for any post Project restoration.

2.3 Temporary Access

Although there is an existing vehicle access road to the river access and laydown area, temporary improvements such as the importation of gravel and grading may be required to create a more suitable roadbed. Rig mats or similar may also be used if required to support equipment.

2.4 Installation of Spawning Substrate

The installation of the spawning substrate is proposed for February to March 2022. This construction period is being proposed to avoid overlap with the White Sturgeon spawning period that is generally between May and July, depending on the water temperature. Additionally, placement immediately prior to the spawning period should allow for White Sturgeon to benefit from the newly placed substrate in 2022. Further discussion of potential effects to fish and fish habitat from are in Section 6.0.

Substrate will be placed to minimize sedimentation by using a long reach excavator (or a crane with a clamshell bucket) and releasing the substrate as close to the riverbed as possible by lowering the bucket slowly and carefully through the water column. The duration of the in-water works is anticipated to be approximately eight weeks. Temporary anchor piles and/or tugboats will be used to stabilize the barge in-place during the placement of substrate. The proposed detailed construction methodology for gravel placement developed by Golder is as follows:

- Complete general construction setup activities, including:
  - Laydown area preparation, including establishing equipment access and installing ESC measures.
  - Barge preparation, including outfitting with anchor system, winches, fairleads, sidewalls, and equipment spill containment.
  - Pre-construction bathymetric survey.
  - Setting anchors. Golder has assumed a typical four-point anchor system with anchors on the barge corners (two on the bow and two on the stern). Anchors are assumed to consist of lock blocks, with two in the river and two on the shore. River anchors will be installed by a dive crew.
    - Anchor details are responsibility of the contractor and should be provided in advance.
- Wash substrate material with a hose and water truck at the pit/quarry prior to delivery to site.
- Deliver substrate material to the proposed laydown area by truck, and stockpile prior to barge loading.
- Use a loader to load gravel material from the stockpile to the barge at the proposed loading location.
- Use tugboat to transport the barge from the loading area on the south river bank to the gravel placement area.
- Place gravel using a long reach excavator (or crane with clamshell) located on the barge. The barge will be anchored in place during placement activities.
  - In order to confirm the accuracy of placement, bathymetric survey will be performed regularly during construction.
  - Alternatively, survey could be substituted with instrumentation on the excavator.
- Complete construction takedown and cleanup activities, including:
  - Removing anchors, with river anchors to be removed by a dive crew.
  - Post-construction bathymetric survey
  - Clean up laydown area and barge.

2.5 Site Clean-up and Restoration

Following completion of construction, gravel, rig mats, and other material from the temporary access and laydown area will be removed. If required, exposed soils will be seeded with a suitable, certified weed-free grass seed mix to be confirmed as appropriate by a qualified environmental professional (QEP) (e.g., RPBio, or, RBTech). Seeding will be completed immediately after decommissioning of laydown areas to help prevent surface erosion and discourage encroachment by invasive and weed species.

3.0 REGULATORY CONTEXT

White Sturgeon in the Canadian portion of the Columbia River are listed as Endangered under the *Species at Risk Act* (2006). The Project occurs in the Lower Columbia River immediately downstream of the HLK which is designated as Critical Habitat for White Sturgeon under SARA (Department of Fisheries and Oceans [DFO] 2014) (Figure 2). This section of Critical Habitat is identified as the Robson Reach, which extends downstream of HLK for approximately 7.6 km to the Castlegar Robson Bridge. Because the Project is located in Critical Habitat under SARA, BC Hydro will be applying for a SARA permit to DFO to complete the Project within the Critical Habitat and will also submit a Request for Review under the *Fisheries Act*.

A *Water Sustainability Act* Section 11 Change Approval from the Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRORD) will also be required for changes in and about a stream.

The Project will also require a review by Transport Canada's Navigation Protection Program (NPP) under the *Canadian Navigable Waters Act* to determine if the Project will be considered an interference to navigation. The proposed work will occur within a Scheduled Navigable Water (i.e., the Columbia River from Kinbasket Lake to the Canada–U.S. border) and does not readily qualify under any of the Minor Works categories, which are permitted to occur without an Approval.

Figure 2: Location of White Sturgeon Critical Habitat immediately downstream of the Hugh L Keenleyside Dam

4.0 ENVIRONMENTAL ASSESSMENT METHODS

4.1 Review of Existing Information

A review of existing information was conducted using data collected from government databases as well as other Project studies completed as part of Phase I to document existing information on fish and fish habitat. The review considered information from the following resources:

- BC Hydro Columbia River Water Use Plan: Lower Columbia White Sturgeon Habitat Restoration Alternatives (Ecofish 2020).
- Province of British Columbia (BC) Habitat Wizard (Government of BC 2021a).
- BC Ministry of Environment Species and Ecosystem Explorer (BC CDC 2021).
- Federal *Species at Risk Act* Public Registry (Government of Canada 2021) and individual species Committee on the Status of Endangered Wildlife in Canada (COSEWIC) Conservation Reports and Recovery Strategies.
- Recovery strategy for White Sturgeon (DFO 2014).
- Columbia Power Corporation and BC Hydro: Evaluation of Substrate in the White Sturgeon Spawning Area Below Arrow Lakes Generating Station (Golder 2014a).
- BC Hydro Columbia River Water Use Plan: Lower Columbia River Whitefish Life History and Egg Mat Monitoring Program: Year 5 Interpretive Report (Golder 2014b).
- BC Hydro Columbia River Water Use Plan: Lower Columbia River Whitefish Spawning Ground Topographic Survey – Year 3 Summary Report (Golder 2014c).

4.2 Field Reconnaissance

A field investigation was completed by a Golder Biologist on 12 February 2021 to document conditions at the Project area including the enhancement area and potential laydown areas and equipment access routes. Collected site photos are provided in Appendix C.

A supplementary site assessment will also be conducted during the spring growing season to identify terrestrial resources that could be impacted by the Project (e.g., species at risk, rare plants, raptor nests).

If rare plants or active nests are identified they will be flagged, and a species-specific no-disturbance buffer will be established around the perimeter. Active nests will have a no disturbance perimeter established around them and will be checked periodically to confirm when they are no longer active. Vegetation removal and ground disturbance within the flagged area can only occur once nests are confirmed to be inactive. The biologist conducting the assessment will document evidence of wildlife use (e.g., individuals, nests, burrows, feathers, scat and tracks) and habitat conditions. Features that should be avoided when determining the alignment of the access road will be recorded.

4.3 Effects Assessment

An assessment was conducted to determine potential pathways of effects of the Project on fish and fish habitat and riparian vegetation. General mitigation measures to be implemented to minimize or eliminate potential impacts were also developed and are provided in Section 7.0 and are more fully detailed in the updated EMP (Appendix B) for the Project.

The Pathways of Effects diagrams created by DFO (2018) were used to assess the potential effects on fish and fish habitat and riparian vegetation from the Project. These diagrams describe the relationship between a specific construction activity, the stressor, and the likely associated effect. Each pathway was considered, and mitigation measures have been applied to determine whether individual effects pathways could be reduced or whether the potential for residual effects remained post-mitigation. Pathways and stressors that could be eliminated with mitigation or were not applicable were ranked as “Nil”. Pathways and stressors that remained but could be effectively mitigated were ranked as “Negligible”. Pathways and stressors that could be mitigated, but still posed a potential for residual effects were ranked as “Low, Moderate or High” and will be further assessed during long term effectiveness monitoring programs (Section 9.0).

5.0 RESULTS

The following section describes the Project area, and the provincially and federally listed fish species that may be present during the proposed instream activities.

5.1 Enhancement Area

Water depths within the Project area range from 3 to 13 m. Surveys conducted below HLK Dam and the ALH in 2000 showed high velocities of 1.0 to 1.7 m/s near bottom at respective discharges of 497 m^3/s and 1,060 m^3/s, respectively (West et al. 2020). Within the Project area the substrate size is mainly small cobble near the upstream extent of the Project area that tapers to gravel further downstream, but the left downstream bank had substrate ranging from fines near the left bank downstream of the ALH high velocity outflow to boulders located in the outflow and adjacent to it on the river left bank (West et al. 2020). Fines account for nearly half of the substrate composition outside of the focal areas (West et al. 2020). High suitability White Sturgeon spawning substrates with appropriate interstitial spaces have been observed approximately 500 m downstream of ALH and generally coincide with higher bottom velocities (Golder 2014a). Alternatively, the Keenleyside White Sturgeon spawning area (river left downstream) is highly embedded approximately 300 m downstream of the ALH tailrace despite having dominant/subdominant cobble substrate. A significant amount of armouring/compaction was observed in the Keenleyside White Sturgeon spawning area, including boulder fields interlocked with cobble. The current substrate conditions appear more conducive to White Sturgeon spawning requirements on the far river right downstream of Keenleyside Dam, within 300 m from the tailrace (West et. al 2020).

Observations from the initial Site assessment found that riparian areas on the north and south banks within the Project area consisted of anthropogenic alterations that result in previously disturbed riparian vegetation of sparse shrubs and grasses and riprap shoreline. The timing of the initial Site assessment in February 2021, was outside of the active growing season and sub-optimal for plant and wildlife surveys, which is why an additional pre-construction field assessment will be completed.

5.2 Riparian Vegetation

The Site of the proposed laydown area and river access on the south bank, downstream of the HLK Dam does not contain unique habitat features or riparian vegetation that could provide important habitat for mammals such as potential large mammal denning sites (i.e., under trees), coarse woody debris, or dense shrub cover. The laydown area on the south bank consists of sparse vegetation of dispersed grasses; no trees or shrubs were noted within the laydown or river access areas. Riparian vegetation in the south bank laydown and river access is primarily grasses with sparsely located willow shrubs. Riprap has been placed on the shoreline up to the high-water mark with negligible functioning riparian vegetation to provide shading or allochthonous inputs of nutrients or terrestrial invertebrates. Approximately 20 m back from the high-water mark there are some cottonwood trees (*Populus tricocarpa*) and coniferous trees that could provide some nesting opportunities for raptors and smaller birds.

The north bank of the river adjacent to the gravel placement area may be used as a secondary loading area. This area has also been previously modified similarly to the south bank, and consists of a riprap shoreline, sparsely vegetated with shrubs and grasses with few young cottonwood trees lining the top of bank. The paved access road to the ALH parallels the top of bank. The proposed laydown area on the south bank and the north bank loading area were both used and modified during the construction of the HLK Dam, and subsequent construction of ALH.

The secondary (alternate) laydown location on the south bank of the river immediately upstream of the HLK Dam consists of a cleared area actively used for log storage. The southern edge of the clearing is bordered by the access road and train tracks. Sparse vegetation consisting of grasses and shrubs was noted here, the area generally is void of riparian vegetation as it is an active log storage yard and industrial access to Arrow Lake log storage area (barge and loader access for logs).

5.3 Species at Risk

Species at Risk (SAR) information in British Columbia is available from both provincial and federal sources. Provincially, data on known species at risk occurrences (referred to as element occurrences) are available through the BC Conservation Data Centre (CDC).

The BC CDC assigns a provincial rank or listing of red, blue, or yellow to a species based on its status within BC. Species on the provincial Red List are considered endangered or threatened in BC. Species on the Blue List are considered vulnerable (Special Concern) in BC. Species on the Yellow List are apparently secure and not at risk of extinction (BC CDC 2020). The BC CDC also assigns these rankings to plant communities.

Federal species ranking is conducted by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), established under Section 14 of the federal *Species at Risk Act* (SARA). Schedule 1 of SARA provides the official list of species at risk. Under the COSEWIC system, species are ranked as Extinct, Extirpated, Endangered, Threatened, Special Concern, Data Deficient, or Not at Risk. A definition of each federal and provincial conservation status for species at risk that appears in this report is provided in Table 1.

Table 1: Provincial and Federal Conservation Status Definitions

Agency	Status	Definition
COSEWIC and SARA (Federal)[a]	Endangered (E)	A species facing imminent extirpation (no longer exists in Canada) or extinction (no longer exists).
	Threatened (T)	A species likely to become endangered if limiting factors are not reversed.
	Special Concern (SC)	A species that is particularly sensitive to human activities or natural events but is not endangered or threatened.
	Not at Risk (NAR)	A species that has been evaluated and found to be not at risk.
	Data Deficient (DD)	A species for which there is insufficient scientific information to support status designation.
BC CDC (Provincial)[1]	Red	Any indigenous species, subspecies, or plant community that is extirpated, endangered, or threatened in BC.
	Blue	Any indigenous species, subspecies, or plant community considered to be of special concern in BC. Blue-listed elements are at risk, but are not extirpated, endangered, or threatened.
	Yellow	Any indigenous species, subspecies, or plant community considered to be secure in BC. Encompasses all those not listed as red or blue.

Source: BC CDC 2021.

a) COSEWIC – Committee on the Status of Endangered Wildlife in Canada. Sara = federal *Species at Risk Act*. BC CDC = British Columbia Conservation Data Centre.

A search of the BC CDC was completed to identify the species at risk (i.e., species with either federal designation as Endangered, Threatened, or Special Concern, or provincial red- or blue- listed designation) that may occur in the vicinity of Project. The query was conducted to filter for potential aquatic and terrestrial species occurring within 1 km of the Project boundary. Mapping of Critical Habitat parcels was also considered to determine the presence of proposed or final Critical Habitat parcels for SARA-listed wildlife or plant species within the Study Area.

5.3.1 White Sturgeon

White Sturgeon are a long-lived, prehistoric fish that are slow growing and of special significance (COSEWIC 2003). In Canada, White Sturgeon are found only within British Columbia, comprising six “Designatable Units”: the lower, mid and upper Fraser populations, the Nechako population, the upper Columbia population and the upper Kootenay population. The Columbia River population of White Sturgeon was designated as Endangered under the *Species at Risk Act* in 2006 as a result of recruitment failure (DFO 2014b). The failure to recruit in this system is associated with changes to the habitat, flows and ecological community due to river regulation.

In the Columbia River, White Sturgeon show intermediate growth rates compared to the other populations in BC and tend to reach sexual maturity around 25-30 years of age (Hildebrand and Parsley 2013). Female White Sturgeon are broadcast spawners that spawn intermittently between years and whose fecundity is proportional to body size. Columbia River female White Sturgeon utilize sites with fast flows and coarse substrates such as tributary confluences or near the tailrace of dams (Hildebrand and Parsley 2013). Spawning occurs between 10°C

to 18°C on the descending limb of the hydrograph at four known locations in the Canadian Columbia River, three of which are below HLK Dam (COSEWIC 2003). The Waneta and Kinnaird spawning locations are used annually, and spawning has been detected at the intermittently between years at the ALH spawning site (BC Hydro 2020).

Although spawning occurs at all locations within the Columbia River, survival to early life stages is low (DFO 2014b). In 2019, BC Hydro (2020) reported that embryos survived to hatch at all known spawning locations in the Lower Columbia River; it is the stage from hatch (endogenous larvae) to free-swimming (exogenous larvae) that is suspected to be the most critical period for White Sturgeon survival (Hildebrand and Parsley 2013). One hypothesis for the recruitment failure in the lower Columbia River White Sturgeon population is a lack of suitable substrate available for larvae needing to hide (Gregory and Long 2008). Exogenous larvae and young of year Sturgeon require substrates with intermediate interstitial spaces for hiding (DFO 2014). In a review of the existing conditions at all three spawning sites in the lower Columbia River, West et al. (2020) identified that the spawning area below ALH was the best candidate for restoration and suggested increasing the substrate diversity using a mixture of stone size and classes within and downstream of the existing “egg deposition zone” to reduce sediment infilling.

5.3.2 Other Fish

The following five fish species were documented to occur in the Columbia River and could occur within the Project area.

Columbia Sculpin – COSEWIC Special Concern; Blue-listed (Provincial)

Columbia Sculpin (*Cottus hubbsi*) are small, sedentary fish found only in the Columbia River drainage within BC (COSEWIC 2010a). Although specific population sizes are unknown, there are 21 identified populations of Columbia Sculpins across BC, spanning the Columbia, Kootenay/Slocan, Bonnington, Kettle and Similkameen rivers. They are nocturnal and shelter during the day in riffles and runs with large rocks and boulders (COSEWIC 2010a). In the Columbia River below HLK Dam, adult Columbia Sculpin can be found in riverine sections dominated by boulders and cobbles with a water velocity of 0.2 to 0.3 m/s and water depth of 0.1 to 0.7 m (AMEC 2014). Juveniles prefer habitat similar to adults, however young-of-year Columbia Sculpin can be found in pool habitats up to 4 m from shore with cobble/boulder substrates and low velocities (AMEC 2014).

Columbia Sculpin can live up to five years and are sexually mature between two to three years. Females lay eggs from late May – mid-July when water temperatures are between 9.5°C to 15°C under rocks in cobble/boulder-dominated habitats and males protect the nests by guarding (AMEC 2014). Columbia Sculpin nests found in the Columbia River downstream of HLK Dam were 0.5-3 m from shore in run and pool habitats at depths between 0.25 to 1.15 m with low flows (0.04-0.34 m/s) in substrates with low embeddedness (5-10%). Nests can contain multiple egg masses each consisting of up to 220 eggs. Columbia Sculpin nests in unregulated tributaries to the Similkameen River were found in similar habitats although with higher water velocities (0.36 to 0.74 m/s) and more embedded substrate (10% to 50%; AMEC 2014). Stranding surveys conducted annually from 2000 to 2020 following reductions in discharge from HLK Dam and ALH, recorded a total of 49 stranded Columbia Sculpin within 10 river kms of HLK Dam (Kevin Little – Project Manager of CLBMON-42A pers comm.) Based on their documented habitat preference, Columbia Sculpin could potentially be present in the Project area during the proposed construction period, but the overall risk to the species is considered low.

Shorthead Sculpin – COSEWIC Special Concern

Shorthead Sculpin (*Cottus confusus*) are small fish with large heads and cone-shaped bodies and are distinguishable from other Sculpin species by the single dense patch of prickles found behind their pectoral fins and an incomplete lateral line (COSEWIC 2010b). The Canadian distribution of Shorthead Sculpins is limited to the Columbia River drainage and is comprised of three populations: Columbia, Kootenay/Slocan and Kettle River. Shorthead Sculpins prefer the cool waters of riffle and run habitats near the mouths of tributary streams. They are a benthic, sedentary and nocturnal species (DFO 2019b). They utilize large gravel/boulder/cobble substrates for shelter and breeding and opportunistically use seasonally flooded vegetated areas (COSEWIC 2010b).

Similar to the Columbia Sculpin, the Shorthead Sculpin lives an average of five years and spawns around two years of age (COSEWIC 2010b). Male Shorthead Sculpins will excavate a nest cavity under rocks and then court females by changing colour and using acoustic and visual signals. Females will deposit their eggs on the roof of the nest cavity and then males will fertilize them; males then guard and protect the eggs until they hatch. Once hatched, young of year Sculpins will use shallow run habitats with high velocities and cobble substrates in spring and move to deeper pool habitat with cobble/boulder substrates in summer (AMEC 2014). Since 2000, stranding surveys in the Lower Columbia have recorded a total of 25 Shorthead Sculpin found stranded within 10 river kms of HLK Dam (Kevin Little – Project Manager of CLBMON-42A pers comm.) following discharge reductions. Based on habitat preference and historical capture data, Shorthead Sculpin may potentially be present in the Project area during the proposed construction period, the overall risk to the species is considered low.

Umatilla Dace – COSEWIC Threatened; Red-listed (Provincial)

Umatilla Dace (*Rhinichthys umatilla*) are a small minnow species whose Canadian distribution is exclusive to the Columbia River basin (COSEWIC 2010c). Umatilla Dace are small-bodied and heavily marked with dark and irregular markings on their back and sides, resembling both the Speckled Dace and Leopard Dace of whom they are thought to have originated from though hybridization. What is interesting about this species is that it is a valid biological species, despite being a hybrid, based on the fact that it's ecologically segregated from the other two species having adapted to under-utilized habitat within the Columbia River basin.

Adult Umatilla Dace generally prefer depths of 1.3 – 2.0 m and in the Columbia River, Umatilla Dace were found in shallow water habitat, less than 1 m in depth (COSEWIC 2010c). Juveniles prefer shallower waters (0.1 to 0.7 m) predominated by silt or gravel/cobble substrates with flooded vegetation and low velocities (0.05 m/s) within the Columbia River basin (AMEC 2014, Porto and Lawrence 2016). They are short-lived (up to 5 years) and achieve maturity in either their second (males) or third (females) year (COSEWIC 2010c). Habitat requirements for spawning are unknown however AMEC (2014) captured adults in spawning condition in the Slocan River between mid-July and mid-September when water temperatures were between 12-21°C. Mature spawning Umatilla Dace have not been recorded in the Columbia River downstream of HLK Dam; however, it is assumed Umatilla Dace do spawn within this section of river based on the presence of young of year Umatilla Dace (AMEC 2014). Population abundance of Umatilla Dace is undetermined in the Columbia River mainstem; however, high densities exist approximately 15 km downstream of HLK Dam and individuals have been found up to 3 km downstream of HLK Dam (COSEWIC 2010c, AMEC 2014). During annual stranding assessments conducted between 2000 and 2020, a total of 2,391 Umatilla Dace have been recorded between HLK Dam and the Canada/US border, with only 10 of these documented within 10 river kms of HLK Dam (Golder 2020 and Kevin Little – Project Manager of CLBMON-42A pers. comm.) Umatilla Dace could potentially be present along the margins in the shallower sections of the Project area during the proposed construction period, but due to their low documented densities within 10 river kms of HLK Dam, the risk to this species is considered low.

Westslope Cutthroat Trout – COSEWIC Special Concern, Blue-listed (Provincial)

Westslope Cutthroat Trout (*Oncorhynchus clarkii lewisi*) are a salmonid species native to North America that are present in British Columbia as a Designatable Unit separate from the population found in Alberta (COSEWIC 2006). Westslope Cutthroat Trout exhibit extensive phenotypic variation across the species and currently there are 14 subspecies recognized by taxonomists. The BC population of Westslope Cutthroat Trout inhabit large rivers, lakes and mountain streams; they have strict habitat requirements [cold, clean water with cover such as undercut banks and riparian vegetation] to maintain population and are considered an indicator species of ecosystem health as a result.

Westslope Cutthroat Trout reach sexual maturity anywhere between two and six years of age and tend to spawn between April and August (Bennett 2004). Cutthroat spawn in small, low-gradient streams with clean gravels and cold, highly oxygenated water with ample access to overhead cover (COSEWIC 2006). Juveniles also utilize this habitat to rear, and young of year will migrate to shallow riffle or backwater habitat with lower velocities. All life stages of Westslope Cutthroat Trout tend to utilize cold-water environments and do not utilize streams that exceed 22°C (COSEWIC 2006).

Based on data obtained over a 17-year period (between 2001 and 2018) from BC Hydro's CLBMON-45 Large River Fish Indexing Program, only 45 Cutthroat Trout have been recorded within the Columbia River between HLK Dam and the Canada/US border and 3 have been recorded within 10 river kms of HLK Dam (Golder et al. 2020). It is unknow if any of these individuals captured were the Westslope subspecies. Based on its low overall abundance in the Project area, the risk to this species is considered low.

Bull Trout (Pacific population) – COSEWIC Not at Risk; Blue-listed (Provincial)

Bull Trout (*Salvelinus confluentus*) are a freshwater char that are broadly distributed throughout British Columbia comprising more than 78 different populations (COSEWIC 2012). They are not listed federally but are provincially recognized as blue listed due to habitat fragmentation. Bull Trout have very specific habitat requirements including clean, well-oxygenated, cold water with overhead cover; they are sensitive to habitat disturbance and degradation resulting in fragmented populations and displacement by other species (Hammond 2004). However, as a species Bull Trout do show some adaptability given the development of four life history strategies: stream-resident, migratory adfluvial, migratory fluvial and anadromous (Hammond 2004, COSEWIC 2012).

Bull Trout spawn between three to eight years of age and females can carry up to 5000 eggs depending on their body size (COSEWIC 2012). They travel to tributaries between mid-August and October and spawn in water around 9°C; females will excavate a nest and the process of courtship and spawning is completed over several days (McPhail and Baxter 1996). They prefer coarse gravel-cobble substrates with little fine sediment to ensure aeration, mainly by ground water influence, for eggs over winter. Fry are usually seen emerging from redds from April to June. Juveniles remain near substrate for the first two to three weeks and then move to side channels and low velocity areas, using locations with coarse substrates and cover in shallow, slow-moving streams (COSEWIC 2012). Although Bull Trout have been occasionally found within the Project Area, only 167 individuals have been captured between 2001 and 2018 (Golder et al. 2020). To date, Bull trout spawning has not been documented in the mainstem Columbia River in the vicinity of the Project footprint. As Bull Trout typically migrate to tributaries in late summer/early fall to spawn, the occurrence of spawning within or near the Project footprint is highly unlikely. The substrate present within the proposed instream works has a high degree of armouring and compaction due to boulder fields interlocked with cobble (West et al. 2020) which is not considered favourable for Bull Trout spawning or rearing. Therefore, there is no risk to this species from Project activities as the available data suggest it would be unlikely that Bull Trout or spawned eggs would be present in the Project area during the proposed construction period.

Table 2 outlines the habitat requirements and life histories of the aquatic species at risk in the Columbia River. Table 2 also summarizes the estimated probability of each species to occur in the Project area during the proposed construction period.

Table 2: Habitat requirements and life history information of aquatic species at risk in the Columbia River

Species and SARA Designation	Habitat Requirements	Spawning Requirements	# Captured on LCR Fish Sampling Programs	Probability of Occurrence in Project Area	Risk Timing
Umatilla Dace – Schedule 3, Special Concern	Flooded vegetation made available during high water periods is important for Umatilla Dace; predominantly in areas with silt and flooded vegetation except in fall when they utilize areas with cobble	Early-July to mid-September (16°C to 21°C)	2,400	Possible	During spawning, incubation and early rearing period May – August in the LCR (AMEC 2014).
Columbia Sculpin – Schedule 1, Special Concern	Nearshore habitats with higher velocities (summer)	Late May-mid-July; at temperatures between 9.5°C to 15°C in Columbia system (AMEC 2014)	278	Possible	During spawning, incubation and early rearing period (May – August in the LCR; AMEC 2014). Egg loss due to dewatering documented in the Kootenay River following flow reductions the Brilliant Dam in 2013 (AMEC 2014).
Shorthead Sculpin – Schedule 1, Special Concern	Shallow, low velocity pool habitats (winter), nearshore habitat (fall); run habitat (deeper) with faster velocities; cobble substrates (all seasons)	Late May-late July; water temperatures between 9.5°C to 15°C (AMEC 2014). Nests found 1.5 to 5 m from the wetted edge in run and pool habitats approximately 0.3 to 1.3 m in depth and 0 to 0.53 m/s velocity. Cobble/boulder substrate with little embeddedness.	30	Possible	During spawning, incubation and early rearing period (May – August in the LCR (AMEC 2014).
Bull Trout – Not at Risk (Provincially Blue Listed)	very specific habitat requirements including clean, well-oxygenated, cold water with overhead cover; they are sensitive to habitat disturbance and degradation resulting in fragmented populations and displacement by other species	Spawn in tributaries when water reaches 9°C in gravel-cobble substrates with little fines to ensure aeration over winter	110	Low	During spawning and early rearing period Mid-August – June; (COSEWIC 2012).

Species and SARA Designation	Habitat Requirements	Spawning Requirements	# Captured on LCR Fish Sampling Programs	Probability of Occurrence in Project Area	Risk Timing
Westslope Cutthroat Trout – Schedule 1, Special Concern	Require cold, clean water in streams with ample overhead cover (undercut banks, pool-riffle habitat, riparian vegetation)	Cutthroat spawn in small, low-gradient streams with clean gravels and cold, highly oxygenated water with ample access to overhead cover. Juveniles also utilize this habitat to rear, and young of year will migrate to shallow riffle or backwater habitat with lower velocities	37	Low	March to August (spawning)

LCR = Lower Columbia River; SARA =*Species at Risk Act.*

6.0 DISCUSSION OF POTENTIAL EFFECTS

The total Project area, which includes the spawning enhancement area, and barge loading, and laydown area is 26,347 m^2, consisting of 24,809 m^2 of instream habitat and 1,538 m^2 of temporary riparian area disturbance.

Detailed information on relevant pathways of effects on these types of habitats, as well as the fish species within these habitats, is provided in sections 8.1 and 8.2.

6.1 Fish and Fish Habitat

Construction activities affecting aquatic and riparian habitat include the placement of substrate below the HWM of the Columbia River, as well as the construction of a temporary river access road for loading the barge within 30 m of the HWM of the Columbia River, which may require the temporary addition of gravel and re-grading.

Spawning enhancement involving the placement of substrate in the Columbia River will result in the temporary disturbance of 24,809 m^2 of instream habitat and suspend solids in the water as the silts are displaced by cobble and gravel.

There is potential that resident fish may be present in and around the Project area during the construction works, and the potential for accidental mortality or injury from being struck with placed substrate or the bucket of an excavator is discussed in more detail in Section 7.1 and 7.2 below as it pertains to species of concern.

Preparation of shoreline slopes (i.e., removal of loose soil and vegetation prior to placement of matting and loading ramps from the barge) and placement of substrate may temporarily increase sedimentation within the Columbia River during periods of work. Use of construction equipment on the bank of the Columbia River (excavators, loader) has the potential to introduce contaminants into the Columbia River.

Based on the DFO Pathways of Effects diagrams (DFO 2018), the primary pathways of effects on aquatic and riparian habitat and fish that require mitigation include the following:

- Increase in sediment concentrations - may occur during the use of construction equipment, construction of access roads, and placement of substrate in water, which can affect fish by damaging gills, and can reduce the quality and availability of fish habitat.
- Increase in contaminant concentrations – may occur from the accidental release of oil, grease, fuel, or other pollutants from construction equipment and placement of spawning gravel in water, which can cause lethal or sublethal effects to fish and their food sources.
- Reduction in food supply – may occur from placement of materials in water, temporarily restricting access to invertebrates which could be used a food source and temporary clearing of riparian vegetation, which can adversely affect fish health.
- Change in fish habitat structure and cover – will occur from direct instream placement of substrate in water, which can affect fish health and habitat quality.
- Fish mortality – may occur from the use of construction equipment and the placement of materials in-stream that could result in the physical damage or death of fish or fish eggs. The Project is within Critical Habitat for White Sturgeon and is proposed to occur in February or March, prior to the onset of White Sturgeon spawning (typically occurs between June and August in the Columbia River spawning locations). Five other SARA listed fish species (Columbia Sculpin, Shorthead Sculpin, Umatilla Dace, Westslope Cutthroat Trout and Bull Trout) also have the potential to occur in the Columbia River and could potentially be present in the Project area during construction and could be susceptible to physical harm during the placement of substrate. The Project is proposed to occur when Mountain Whitefish (*Prosopium williamsoni*) could potentially be present in the instream work area or immediate downstream areas and could negatively be affected by potential increases in turbidity.

Despite the overall enhancement benefits of the Project, the effects listed above have potential to adversely affect the Lower Columbia River White Sturgeon population if not properly mitigated. Specific consideration for potential effects of the Project on the Lower Columbia River population of White Sturgeon is described in Table 3.

The potential for the construction activities to affect holding sub-adult or adult White Sturgeon is a pathway of effect that requires further mitigation. In this case, White Sturgeon is an indicator species for the fish that could be holding within the instream portion of the Project area. Consideration of mitigation measures that would be protective of White Sturgeon will also be protective of all holding adult fish that may be affected by in-water construction activities.

Table 3: White Sturgeon Habitat in Upper Columbia River - from DFO Recovery Strategy (DFO 2014 McPhail 2007, Potential Effects of Project, and Mitigation

Life Stage	Function	Potential Pathway of Effect	Avoidance and Mitigation Measures	Likelihood of Residual Effect
Sub-adult (>2 years) / Adult	Holding	▪ Potential for effects on adults or sub-adult individuals if using the Project footprint or areas near the Project for winter holding habitat	▪ A drop-camera or a remotely-operated vehicle (ROV) will be used to visually inspect sections of enhancement area to determine if there is any fish present just prior to placement. This visual inspection will repeated in a grid pattern throughout the enhancement area just in advance of the excavator placing the material to minimize the potential for fish being directly affected by gravel placement. Following visual confirmation with the camera that fish are not in the immediate area, and only then, will the excavator proceed. ▪ Substrate material to be placed below the waterline will be lowered slowly through the water column and placed on the bed and not dumped from the barge.	Possible
Sub-adult (>2 years) / Adult	Migration	▪ Alteration of migration route based on material placement. ▪ Disturbance of migrating individuals	▪ The timing of the works is not within the period of known migration, so active gravel placement is not expected to adversely affect migrating sub-adult and adult individuals. ▪ The project is immediately downstream of HLK Dam which is a migration barrier and marks the upstream extent of fish use for this section of the Columbia River. The Project timing is such that the work will be completed prior to spawning and is not anticipated to effect spawning related movements.	Unlikely
Mature	Spawning (eggs and larvae collected mid-June to late July)	▪ Sediment release from working in or near water. ▪ Potential for infilling of interstitial spaces of mainstem spawning habitat caused by riprap placement. ▪ Potential for smothering incubating eggs or affecting recently emerged young-of-year.	▪ Timing of works should occur outside the time period when eggs and larvae will be present. ▪ Velocity in the vicinity of the substrate placement area would be expected to be high enough to prevent the settlement of fines that could be mobilized during the placement of the gravel and cobble substrate. ▪ Previous years emerged young-of-year would be free-swimming and dispersed by the time works occur (February to March)	Unlikely

6.2 Riparian Vegetation

Construction activities in the Project area are anticipated to result in limited disturbance to riparian vegetation during re-grading of the river access road from the laydown area.

Potential effects on vegetation from the proposed work are anticipated to include:

- Loss of shrubs and grasses within the footprint of the river access and laydown area.
- Accidental introduction and/or proliferation of invasive, non-native plant species during the proposed work that may lower the quality of remaining vegetation.

Largely temporary effects on vegetation will occur as a result of clearing for the temporary river access and will be mitigated through implementation of restoration at the end of the Project.

There will be a total of 1,538 m^2 of riparian area (i.e., <30 m from the HWM of the Columbia River) disturbed by the Project. Following the completion of substrate placement, the temporary access path will be returned to pre-construction condition and the disturbed riparian area will be seeded and replanted with native shrubs. The native soil material will be prepared as “rough and loose” for replanting and reseeding.

7.0 MITIGATION MEASURES

Potential effects of the Project on terrestrial and aquatic ecosystems can be avoided, mitigated, or managed through implementation of standard Best Management Practices (BMPs) and implementation of an EMP.

An EMP has been developed which provides site-specific mitigation measures to reduce potential effects of the Project on aquatic, riparian and wildlife resources (Appendix B). The EMP will contain detailed construction methods, for implementation by the contractors.

For cross-reference, the primary sections of the EMP are as follows:

- **Erosion and Sediment Control –** An Erosion and Sediment Control Plan is included as a component of the EMP to be implemented during Project construction activities. The Erosion and Sediment Control Plan will provide site-specific mitigation measures intended to achieve compliance with applicable legislation and regulations.[1]
- **Water Quality Management –** The Environmental Monitor (EM) will monitor turbidity and will have the authority to temporarily stop in-water work if turbidity readings or exceed the BC Water Quality Guidelines for Freshwater Aquatic Life (BC MOE 2019). Halting of in-water work will allow for determination of the source and rectifying the cause prior to resuming construction activities. The substrate that is to be placed in the instream enhancement area will be thoroughly washed at the quarry location prior to being brought to the Project Area and placed instream. This will reduce the mobilization of sediment during instream placement of substrate.
- **Spill Prevention and Emergency Response –** A site-specific Spill Prevention and Emergency Response Plan will be prepared as a component of the EMP and implemented during Project construction activities.

[1] Such as*: Fisheries Act, Species at Risk Act, BC Water Sustainability Act and Regulations, BC Waste Management Act* and *BC Fish Protection Act*

- **Material Storage and Waste Management –** Contractor(s) will be responsible for keeping the work site free from accumulations of waste materials. Garbage and recycling containment will be in animal proof containers. Upon completion of work activities, the Contractor(s) will remove and properly dispose of all temporary structures, rubbish, and waste materials resulting from the operation. Temporary sanitary facilities in the form of portable toilets will be provided during the works and will be placed more than 30 m from the Columbia River.
- **Fisheries and Aquatic Habitat Management –** Measures to mitigate potential impacts on fish and fish habitat and to avoid introduction and proliferation of invasive aquatic species to the river will be outlined. Any equipment used in conducting work will be in good mechanical condition and, when operating in close proximity to the wetted perimeter of a stream, the operator will prevent entry of any substance, sediment, debris or material (e.g., hydrocarbons, silt) into the stream so as to prevent harm to fish, wildlife or the aquatic ecosystem of a stream. Readily biodegradable hydraulic fluids will be used in equipment working within or above water.
- **Riparian Habitat Management –** Riparian habitat disturbance reduced by restricting access to those areas required to complete the works. Disturbance to habitat areas outside the footprint of the works will be avoided by establishing no-go zones with the work crew and flagging riparian areas. Instream works is a low-risk activity to non- aquatic wildlife, in particular bird species. Nesting is not likely to be a factor in the location of the described activities given the time of year (i.e., outside Regional passerine nesting periods). This Region is classified as A2 for nesting birds, and the Regional nesting period has been identified from early April to mid-August (Government of Canada 2018.) Pre-work surveys for active nests, burrows, and wildlife activity within the areas to be cleared (including searches for ground nesting species) will be conducted by a Golder biologist. If active nests are identified they will be flagged, and a species-specific no-disturbance buffer will be flagged around the perimeter of the nest. Vegetation removal and ground disturbance within the flagged area can only occur once nests are confirmed to be inactive.
- **Air Quality and Dust Control –** Engine idling will be avoided. Dust will be managed by covering vehicle loads to reduce the potential to create dust, particularly on windy days.
- **Acid Rock Drainage and Metal Leachate –** Imported substrate material will be sourced from a local quarry and washed thoroughly prior to placement to reduce turbidity. Substrate materials will have been previously analysed for Acid Rock Drainage and Metal Leachate Management (ARD/ ML).

8.0 RESIDUAL EFFECTS ASSESSMENT

Potential impacts to fish and fish habitat and riparian vegetation are discussed in Section 6.0 and mitigation measures that are recommended to be implemented to limit potential effects are discussed in Section 7.0 and the EMP (Appendix B). The evaluation of potential residual effects to fish and fish habitat and riparian vegetation are shown below in Table 4. Pathways and stressors that could be eliminated with mitigation or were not applicable were ranked as “Nil”, pathways and stressors that remained but could be effectively mitigated were ranked as “Negligible”. Pathways and stressors that could be mitigated, but still posed a potential for residual effects were ranked as “Low, Moderate, or High” and will be further assessed.

8.1 Fish and Fish Habitat and Riparian Vegetation Assessment

Part of the potential impacts to fish and fish habitat and riparian vegetation assessment includes reviewing the potential Project activities that may occur in or near water to identify applicable Pathways of Effects (DFO 2018). The Pathways of Effects were then evaluated relative to the applicable stressors, and mitigation measures, including DFO’s *Measures to Protect Fish and Fish Habitat* (DFO 2019). Residual effects, if any, were evaluated to determine the potential for the harmful alteration, disruption or destruction (HADD) of fish habitat, or the death of fish, could occur considering the implementation of the proposed mitigation measures.

Table 4: Pathways of Effects, Stressors, Mitigation and Potential for Residual Effects for the Project

Stressor	Pathway of Effect				Mitigation Measures	Direction of Effect	Residual Effect
	Grading	Placement of material in water	Use of industrial equipment	Vegetation clearing			
Change in sediment concentrations	Yes	Yes	Yes	Yes	■ An Erosion and Sediment Control (ESC) Plan (described in the EMP; Appendix B) will be implemented to reduce generation and mobilization of sediment-laden water during construction. A suitably trained and qualified Environmental Monitor will be on-site during work within 30 m of the Columbia River to monitor the effectiveness of the ESC plan and will direct the contractor to maintain or adjust the measures, as necessary, during and after construction in accordance with permits and approvals, BMPs, and current field conditions. ■ Clearing for temporary access path construction will take place immediately prior to temporary access road construction to reduce the length of time that soils are exposed. ■ Ground disturbance will be reduced to the extent practical, particularly the removal of trees and shrubs within the riparian area of the Columbia River, and will be limited to clearing required for construction of the temporary access route. ■ Construction materials will be stockpiled at a laydown area at the south bank just downstream of the dam and will be contained by appropriate sediment and erosion control measures. ■ The substrate placed in the water will be clean and free of fine sediments to reduce or prevent the introduction of deleterious substances into the river. ■ Substrate material will be delivered in highway dump trucks directly to the work area and will be placed near the shoreline within the footprint of the laydown area. Substrate will be washed of sediment prior to being hauled to the Project area. ■ Excavator will remain on the barge while placing substrate into the water. ■ Weather advisories will be monitored to avoid wet and rainy periods that may result in increases in erosion and sedimentation. ■ Upon completion of the substrate installation works, disturbed areas will be seeded using an approved grass seed mix.	Negative	Low

Stressor	Pathway of Effect				Mitigation Measures	Direction of Effect	Residual Effect
	Grading	Placement of material in water	Use of industrial equipment	Vegetation clearing			
Change in sediment concentrations	Yes	Yes	Yes	Yes	■ Post-construction inspections and/or monitoring will be completed to determine if any additional erosion and sediment control or planting/ restoration is required.	Negative	Low
Introduction of contaminants (i.e., spills)	Yes	Yes	Yes	Yes	■ A Spill Reduction Plan (described in the EMP; Appendix B) will be implemented to reduce the potential for spills. A suitably trained and qualified EM will be on-site during work within 30 m of the Columbia River to monitor the effectiveness of the Spill Reduction Plan and will direct the contractor to maintain or adjust the measures, as necessary, during and after construction in accordance with permits and approvals, BMPs, and current field conditions. ■ Machinery and equipment will be in clean condition, well maintained and free of fluid leaks. Any leaks identified will be brought to the machine operator's attention and dealt with immediately, or at the discretion of the environmental monitor; a pre-operation inspection of machinery will be carried out by the operator in advance of operating on or near water; a spill kit will be located near the work. ■ The substrate used for placement into the river will be clean and free of sediments, organic material and deleterious substances when placed to reduce or prevent the introduction of deleterious substances into the river. ■ Refuelling and servicing of machinery will be conducted at an approved facility, with secondary containment, or in an area greater than 30 m from the Columbia River to prevent any spilled fuel or other fluids from entering the Columbia River. When refueling of equipment on the barge, personnel should be present during fueling at all times, fueling should not occur around the perimeter of the barge and spill absorption materials should be used to absorb any spill or over fills. ■ Fuel, motor lubricants, other hazardous substances, and washrooms must be stored on or in secondary containment that must be capable of holding at least 110% of the product's volume. Material storage and washrooms will be located at the proposed laydown area which is greater than 30 m away from the Columbia River.	Negative	Nil

Stressor	Pathway of Effect				Mitigation Measures	Direction of Effect	Residual Effect
	Grading	Placement of material in water	Use of industrial equipment	Vegetation clearing			
Introduction of contaminants (i.e., spills)	Yes	Yes	Yes	Yes	■ In the event of a spill, an appropriate soil remediation program will be implemented that addresses site-specific conditions (e.g., soil type, chemical properties of the spill material).If suspected contaminated materials are encountered during construction based on observation of visual staining or odours a Qualified Environmental Professional (QEP) will develop a contaminated materials management plan in accordance with BC Ministry of Environment (MOE) guidance under the Contaminated Sites Regulation.	Negative	Nil
Change in base flow	No	No	No	No	■ Not applicable. The proposed Project is not expected to alter the quantity of surface or groundwater entering the Columbia River therefore, this is not considered a pathway of effect.	Negative	Nil
Change in nutrient concentrations	No	No	No	Yes	■ Construction activities and the presence of substrate itself are not expected to change nutrient concentrations within the Columbia River. ■ Riparian vegetation clearing will be minor, and no trees will be removed during construction. All riparian areas to be cleared for construction of the access path and laydown area will be restored. The loss of allochthonous carbon input will therefore be negligible.	Negative	Nil
Change in aquatic habitat structure and cover	No	Yes	No	Yes	■ The intent of the substrate placement is habitat creation and enhancement. As such, it is anticipated that the substrate placement will provide spawning substrate and suitable habitat for egg and larval development of White Sturgeon ■ Removal of riparian vegetation for the construction of the temporary access path from the main access road running parallel to the Columbia River will be minor and will result in the temporary disturbance of approximately 1,538 m^2 of riparian area within 30 m of the HWM of the river. ■ If vegetation is removed, the disturbed areas will be revegetated with an assemblage of, grasses and shrubs that is in keeping with the expected composition of the native species observed within the Project Area.	Positive	24,809 m^2 of in water habitat will be enhanced for White Sturgeon spawning

Stressor	Pathway of Effect				Mitigation Measures	Direction of Effect	Residual Effect
	Grading	Placement of material in water	Use of industrial equipment	Vegetation clearing			
Change in food supply	No	Yes	No	Yes	■ Use of the access route and laydown area will result in the temporary disturbance of approximately 1,538 m^2 of riparian area within 30 m of the HWM of the river. This area is currently disturbed and there is minimal riparian vegetation present in these areas. ■ The instream placement of substrate will have potential to cover benthic invertebrates that could be a food source for fish. The areas where substrate is proposed to be placed would be expected to re-colonize quickly and sources of benthic invertebrates would be accessible on the perimeter of the substrate placement areas. ■ Minor removal of riparian vegetation is not expected to have a long-term effect on external nutrient and energy inputs to the Columbia River.	Negative	Nil
Change in water temperature	Yes	Yes	No	Yes	■ Temporary riparian vegetation clearing, and substrate placement is not expected to significantly impact shading of aquatic habitat and is not expected to change water temperature. ■ Placement of substrate is not expected to alter the quantity or temperature of groundwater entering the Columbia River, which could affect water temperature in the river during low flow periods.	Negative	Nil
Potential mortality of fish or eggs from gravel placement	No	Yes	Yes	No	■ A drop-camera or a remotely-operated vehicle (ROV) will be used to visually inspect sections of enhancement area to determine if there is any fish present just prior to placement. It is expected that this will also act as a deterrent for fish that may be present. This visual inspection will repeated in a grid pattern throughout the enhancement area just in advance of the excavator placing the material to minimize the potential for fish being directly affected by gravel placement. Following visual confirmation with the camera that fish aren't in the immediate area, and only then, will the excavator proceed. ■ Following the visual observation and confirmation of fish absence, the substrate material can be lowered slowly into the water and placed on the riverbed.	Negative	Low

Stressor	Pathway of Effect				Mitigation Measures	Direction of Effect	Residual Effect
	Grading	Placement of material in water	Use of industrial equipment	Vegetation clearing			
					■ Direct injury or mortality of free-swimming fish or other life stages (eggs, larvae) is not anticipated from equipment operation based on the habitat conditions within the substrate footprint and timing of works. Prior to the placement of substrate, the bucket of the excavator should be lowered to the bottom of the river and moved over top of the area where substrate will be placed to scare fish out of the immediate area of influence during in-water work. The primary species of consideration for this potential is White Sturgeon (discussed in more detail above in Table 3 and considered separately below in section 8.2.2).		
Potential for physical harm or mortality of White Sturgeon from equipment operation	No	Yes	Yes	No	■ Work proposed to occur below the high-water mark will be completed between February and March during low water levels. There will be no incubating White Sturgeon eggs present in the Project area during the works. ■ A drop-camera or a remotely-operated vehicle (ROV) will be used to visually inspect sections of enhancement area to determine if there is any fish present just prior to placement. This visual inspection will repeated in a grid pattern throughout the enhancement area just in advance of the excavator placing the material to minimize the potential for fish being directly affected by gravel placement. Following visual confirmation with the camera that fish aren't in the immediate area, and only then, will the excavator proceed. Prior to the placement of substrate, the bucket of the excavator should be lowered to the bottom of the river and moved over top of the area where substrate will be placed to scare fish (if present) out of the immediate area of influence during in-water work. ■ Following the visual observation and confirmation of fish absence, the substrate material can be lowered slowly into the water and placed on the riverbed.	Negative	Low

8.2 Residual Effects Discussion

The objective of the Project is to enhance the quality and quantity of spawning and larval rearing habitat for White Sturgeon in the Lower Columbia River. To achieve this objective, instream construction is required that has the potential to create pathways and stressors that could result in residual effects to fish and fish habitat. Stressors were evaluated in Section 8.1. The following stressors were evaluating as having a low potential to have residual effects to fish and fish habitat and were further assessed and characterized using the components in Table 5. Stressors that were determined to have Nil or Negligible effects are not discussed further.

The stressors with the potential of having low level residual effects were:

- Potential physical or mortality of White Sturgeon from equipment operation and material placement.
- Potential mortality of fish or eggs from gravel placement.
- Change in sediment concentrations.

Pathways and stressors that could be mitigated, but still have potential to pose residual effects were ranked as “Low, Moderate, or High” and are further assessed and characterized in Section 8.1 using the criteria in Table 5.

Table 5: Definitions of Components used to Characterize Predicted Residual Effects of the Project

Effect Component	Definition	Description
Magnitude	Magnitude is the intensity of the effect or a measure of the degree of change from existing (baseline) conditions expected to occur.	▪ Magnitude determined to reflect specific characteristics or stressor.
Geographic extent	Geographic extent refers to the spatial area over which an effect will occur/can be detected (distance covered or range).	▪ Project footprint – effect is limited to the direct physical disturbance from the Project. ▪ Local – the effect is confined to the local area. ▪ Regional – the effect extends beyond the local area. ▪ Beyond regional – the effect extends beyond the regional area.
Duration/reversibility	Duration is the period of time over which the environmental effect will be present. The amount of time between the start and end of an activity or stressor (which relates to Project development phases), plus the time required for the effect to be reversed. Duration and reversibility are functions of the length of time a criterion is exposed to activities. Reversibility is an indicator of the potential for recovery from the effect. Reversible implies that the effect will not be present at a future predicted period in time. For effects that are permanent, the effect is determined to be irreversible.	▪ Short-term – the effect is reversible before the end of construction. ▪ Medium-term – the effect occurs during construction and is reversible soon after construction ends begins. ▪ Long-term – the effect occurs during construction and persists, but is reversible. ▪ Permanent – the effect occurs during construction and is irreversible.

Effect Component	Definition	Description
Frequency/timing	Frequency refers to the occurrence of the environmental effect over the duration of the assessment. Discussions on seasonal considerations are made when they are important in the evaluation of the effect.	▪ Once – the effect is expected to occur one time. ▪ Infrequent – the effect is expected to occur rarely. ▪ Frequent – the effect is expected to occur intermittently. ▪ Continuous – the effect is expected to occur continually.
Likelihood	Likelihood is a measure of the probability that an activity will result in an effect.	▪ Unlikely – the effect is not likely to occur. ▪ Possible – the effect may occur, but is not likely. ▪ Probable – the effect is likely to occur. ▪ Certain – the effect will occur.

8.2.1 Water Quality – Change in Sediment Concentrations

During of placement of substrate into the water, mobilization of sediment will occur in the Project Area and that mobilized sediment may be transported into downstream habitats. Due to the generally high velocities and general coarse nature of the riverbed substrate in the placement area turbidity is expected to quickly dissipate downstream, and the turbidity will diminish with distance from the instream work area. Turbidity monitoring will occur downstream of the Project area to document turbidity and to implement additional mitigation or slow the placement of substrate should turbidity levels become elevated.

Turbidity mobilized during February or March does have potential to effect incubating Mountain Whitefish eggs that could be present immediately downstream of the Project area. Golder (2014) has documented Mountain Whitefish to start spawning in early November, peak in early to mid-January and be completed by mid-February. Larval emergence was documented to occur between late April to mid-May (Golder 2014). Golder (2014) completed a five-year study of Mountain Whitefish spawning in the Lower Columbia and did not identify key spawning or rearing areas immediately downstream of HLK Dam. The closest downstream key spawning and larval rearing location was identified near Norns Creek which is approximately 8 km downstream of the HLK Dam. Turbidity levels mobilized during the placement of substrate are expected to be low based on the relatively high near bottom flow velocities in the substrate deposition area and the scarcity of fine sediment sources within the placement area and upstream of the dam. Sediments resuspended during substrate placement would be rapidly redeposited within a short distance downstream in a section of the river that is already dominated by fine substrates. As such, negative effects on incubating eggs at Norns Creek, approximately 8 km downstream of HLK Dam, are not anticipated.

8.2.2 Potential Mortality of White Sturgeon from Equipment Operation

Construction equipment operating in-stream has a low potential to impact fish and cause physical harm or mortality of White Sturgeon while the bucket of the excavator is placing substrate onto the bed of the river. If accidental impact with a White Sturgeon did occur, it could result in mortality. However, with mitigation such as fish scares using the bucket of the excavator, combined with the underwater noise levels that would be created by construction equipment, and the slow placement of substrate would likely cause White Sturgeon of all ages to vacate the instream enhancement area and significantly reduce the likelihood of negative interactions with the equipment placing substrate in the water.

8.2.3 Potential Mortality of Fish or Eggs from Gravel Placement

Construction equipment placing substrate in-stream have the potential to impact resident fish and cause physical harm or mortality to eggs that could be present within the instream work area during instream construction. As discussed in Section 8.1 it would be expected that juvenile or adult White Sturgeon would respond to the sensory disturbance of the equipment and placement of substrate by swimming out of the area where instream activities were occurring. This same behaviour would be expected for other adult and juvenile fish species such as Mountain Whitefish, Bull Trout and Rainbow Trout (*Oncorhynchus mykiss*). It is also expected that because Westslope Cutthroat Trout are a more mobile species that are less likely to use substrate as cover, these species would respond to the drop camera/ROV and general noise of the excavator on top of the barge and would swim out of the area where substrate is proposed to be placed. Umatilla Dace could be present along the margins of the instream work area, in shallower water during substrate placement and would be less susceptible to being harmed by the placement of substrate which will predominantly occur in the deeper sections on the river which range from 3 to 13 m in depth (West et al. 2020).

Species that exhibit the greatest potential risk of harm or mortality are juvenile or adult Sculpin species such as Shorthead Sculpin (*Cottus confuses*) and Mottled Sculpin (*Cottus bairdii*) that use substrate for cover and could use interstitial spaces of substrate as refuge as opposed to swimming away from the sensory disturbance. R. L. and L (1995) conducted a study of Columbia Sculpins in the Columbia River and found that Columbia Sculpins were predominantly found at average water depths of less than 50 cm. This preference for shallower habitat could reduce the potential for physical injury or mortality from instream construction activities as the water depths within the known White Sturgeon spawning area where substrate placement is proposed, ranges from approximately 3 to 13 m.

Section 8.2.1 discusses that key spawning and larval rearing locations for Mountain Whitefish are not located in the vicinity of HLK Dam and the Project would unlikely cause mortality of Mountain Whitefish eggs or larvae.

Table 6 summaries the rating and potential effect of each stressor that was carried forward in the residual effects assessment.

Table 6: Ratings of the potential effect of stressors

Stressor	Effect Component	Rating / Effect Size
Potential of physical harm or mortality of White Sturgeon from equipment operation	Magnitude	Low
	Geographic Extent	Project footprint
	Duration / Reversibility	Short-term
	Frequency / Timing	Infrequent
	Likelihood	Unlikely
Potential mortality of fish or eggs from equipment operation	Magnitude	Low
	Geographic Extent	Project footprint
	Duration / Reversibility	Short-term
	Frequency / Timing	Infrequent
	Likelihood	Unlikely
Change in sediment concentrations	Magnitude	Low
	Geographic Extent	Local
	Duration / Reversibility	Short term
	Frequency/Timing	Frequent
	Likelihood	Certain

The ratings of the project stressors in Table 6 shows that the potential for physical harm to White Sturgeon from equipment operation could potentially have a low magnitude should it occur; however, with mitigation in place, any impacts would be unlikely to occur.

The potential for mortality of fish or eggs from the operations of equipment is unlikely to occur because fish spawning or in-situ eggs would not be expected to occur immediately downstream of HLK Dam during the time when then construction is proposed. The mortality of fish such as sculpin and dace species would be unlikely due to the shallow depth preferences of these species that do not coincide with the deep water present in the majority of the substrate placement area.

Localized and short-term changes in sediment concentration are expected to occur; however, the magnitude of effect from these temporary sediment concentration changes are expected to be low and are not expected to disturb fish completing sensitive stages of their life history, as no sensitive habitats for Mountain Whitefish, Bull Trout or Westslope Cutthroat Trout were identified within the expected zone of influence of the sediment concentration changes.

With the implementation of mitigation, it is not expected that this Project will cause the harmful alteration, disruption or destruction (HADD) to fish habitat, or the death of fish and an Authorization under the *Fisheries Act* is not expected to be required for this Project.

9.0 LONG TERM EFFECTIVENESS MONITORING

Currently monitoring approaches for the Project Area are in development under the White Sturgeon Management Plan for the Columbia River (BCH 2021). As these programs are still in development specific factors for examination during post-spawning substrate restoration monitoring have not been determined but may include:

- Suitable site selection to effectively represent river morphology over the study area and for the purpose of the survey (i.e., a proportional number for each channel feature to capture changes).
- Monitoring site conditions over a wide range of scenarios including low/high water, channel feature stability/migration, possible human interaction, location relative to potential sources of sedimentation, and size of substrate of interest that is anticipated to change.
- Consistency in timing of annual surveys (i.e., surveys should take place at the same time/season annually to capture river conditions under similar seasonal regimes).
- Adaptability of survey methodology to changing site conditions; (i.e., altering bathymetric survey paths to account for differing water levels between years without compromising study conclusions).
- Changes in White Sturgeon spawner abundance due to chance and/or increased rapid recruitment of hatchery females to the population.
- Changes in predator populations.
- Changes in white sturgeon larval drift related to retention and survival rates.
- White Sturgeon larval survival as a result of the spawning substrate restoration; including both egg and larval abundance.
- Changes in juvenile white sturgeon recruitment resulting from other spawning sites.
- Changes in HLK Dam /ALH operations due to policy and climate.
- Determining appropriate sample sizes for monitoring programs (i.e., conducting power analyses using existing data from other sites to determine samples sizes and if resulting effect sizes would meet the requirements of determining a successful project).

10.0 CONCLUSION

The objective of the Project is to enhance the quality and quantity of spawning and larval rearing habitat for White Sturgeon in the Lower Columbia River. The placement of substrate downstream of the HLK requires in stream work that has low potential to place stressors on fish and fish habitat immediately downstream of the HLK with the mitigation measures outlined in the EA and EMP. The benefits to the Upper Columbia River White Sturgeon population as a result of substrate enhancement are considered to outweigh the potential impacts to fish and fish habitat in the Project area. With appropriate planning and implementation of mitigation measures during construction, these stressors are not expected to cause a HADD and the Project is expected to provide a net gain in the quality and quantity of White Sturgeon spawning habitat and larval rearing habitat in this reach of the Columbia River for White Sturgeon

11.0 ACKNOWLEDGEMENTS

The Project was managed by Gaven Tang and Rowland Atkins. The EA and EMP are components of the overall project and was prepared by Bobby Bedingfield and Emma-Jane Hennings, and reviewed by Drew Kaiser and Brad Hildebrand, all of whom are with Golder. The authors give special thanks to Larry Hildebrand from RiverRun Consulting and Amy Duncan from the Okanagan Nation Alliance (ONA) for their input and contributions.

Golder Associates Ltd.

Prepared by:

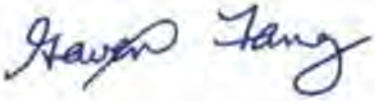
Emma-Jane Hennings, Tech, Dpl, RBTech
Fisheries Technician

Drew Kaiser, B.Sc., RPBio
Associate, Senior Environmental Assessment Manager

Bobby Bedingfield, B.Sc., P.Biol.
Aquatic Biologist

Brad Hildebrand, B.Sc.
Fisheries Biologist

Reviewed by:



Gaven Tang, M.A.Sc., P.Eng.
Lead River Engineer

EH/DK/BB/BH/lih

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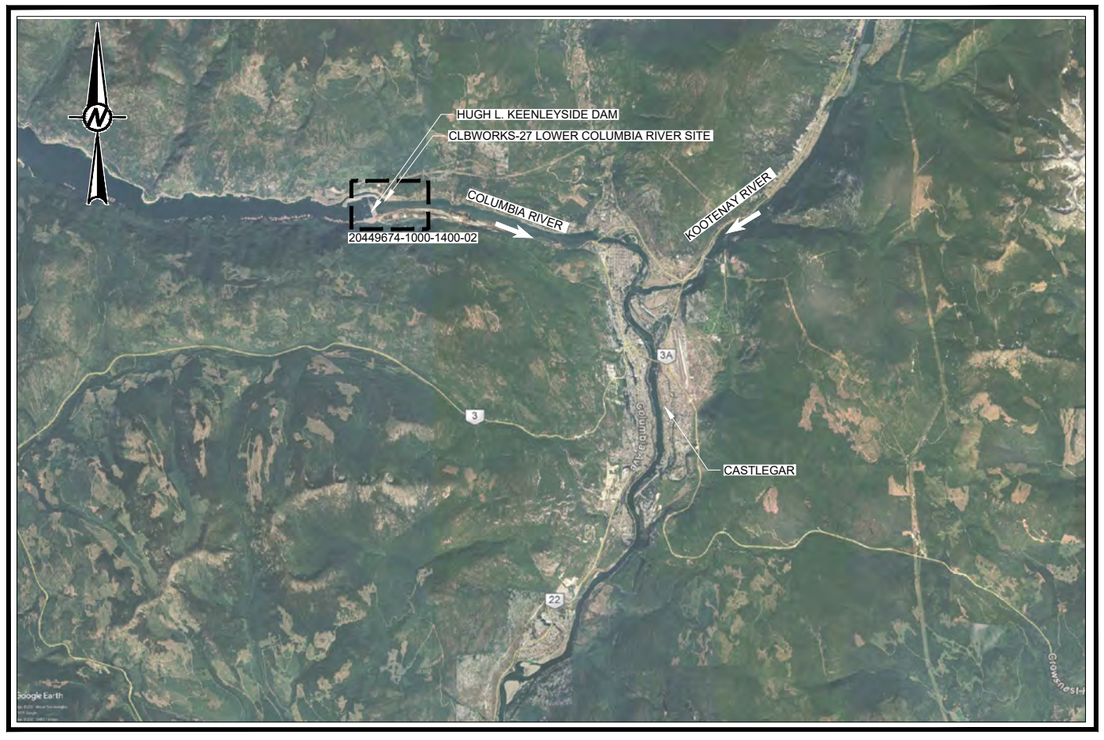
APPENDIX A

Issued-for-Review Drawings

BC HYDRO - CLBWORKS-27 LOWER COLUMBIA
RIVER WHITE STURGEON PHYSICAL WORKS (PHASE 2)

DRAWING INDEX			
DRAWING No.	DRAWING TITLE	REVISION	DATE
20449674-1000-1400-01	PROJECT LOCATION AND DRAWING INDEX	A	2021-06-07
20449674-1000-1400-02	SITE PLAN	A	2021-06-07
20449674-1000-1400-03	CROSS SECTIONS	A	2021-06-07
20449674-1000-1400-04	CONSTRUCTION SPECIFICATION	A	2021-06-07

KEY PLAN
NOT TO SCALE



PROJECT LOCATION PLAN
NOT TO SCALE

ISSUED FOR REVIEW

NOT ISSUED FOR CONSTRUCTION

REFERENCE

1. IMAGE ©2021 GOOGLE, OBTAINED FROM GOOGLE EARTH PRO, USED UNDER LICENSE. GOOGLE EARTH IMAGE IS NOT TO SCALE.

REF#	DRAWING NUMBER	TITLE

REFERENCE DRAWINGS

REF#	DRAWING NUMBER	TITLE

REFERENCE DRAWINGS

NO	REMARKS	DATE	DESIGNED	INDEP CHK	DFTG	DFTG CHK	INSP	REV	ACPT
A	NOT ISSUED FOR CONSTRUCTION	2021-06-09	R. CUNNINGHAM	G.T.	G.B.	-	-	R.A.	R.A.

REVISIONS

DSGN	R. CUNNINGHAM
INDEP CHK	G. TANG
DFTG	G. BETTOSCHI
DFTG CHK	–
INSP	–
REV	R. ATKINS
ACPT	R. ATKINS

GOLDER
MEMBER OF WSP

BC hydro

CLBWORKS-27 LOWER COLUMBIA RIVER
WHITE STURGEON PHYSICAL WORKS (PHASE 2)

PROJECT LOCATION AND DRAWING INDEX

DATE	DIST	DWG NO	SIZE	R
2021-06-09	-	20449674-1000-1400-01	D	A

D

SETOUT POINTS		
POINT No.	EASTING (m)	NORTHING (m)
1	444281.73	5465766.21
2	444350.82	5465733.86
3	444423.03	5465656.42
4	444415.72	5465645.81
5	444334.35	5465689.86
6	444265.86	5465740.11

LEGEND

- EXISTING RIVER BED SURFACE
- SUBSTRATE PLACEMENT AREA
- TOPOGRAPHIC EXTENTS

NOTES

1. ALL UNITS ARE IN METRES UNLESS OTHERWISE NOTED.
2. COORDINATE SYSTEM IS UTM NAD 83, ZONE 11.
3. EXISTING GROUND CONTOURS ARE SHOWN AT 1 m INTERVAL RELATIVE TO CGVD 2013.
4. CONSTRUCTION ACCESS SHALL BE VIA ARROW LAKES DR AND THE EXISTING ACCESS ROAD TO THE PROPOSED LAYDOWN AREA.
5. SUBSTRATE MATERIAL SHALL BE STOCKPILED IN THE LAYDOWN AREA AS-NEEDED.

REFERENCES

1. IMAGE ©2021 GOOGLE, OBTAINED FROM GOOGLE EARTH PRO, USED UNDER LICENSE. GOOGLE EARTH IMAGE IS NOT TO SCALE.
2. BATHYMETRY SURVEY CONDUCTED BY GRANT LAND SURVEYING INC, ON JULY 01, 2019.

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0 100 200

1:2,500 METRES

REF#	DRAWING NUMBER	TITLE

REFERENCE DRAWINGS

REF#	DRAWING NUMBER	TITLE

REFERENCE DRAWINGS

NO	REMARKS	DATE	DESIGNED	INDEP CHK	DFTG	DFTG CHK	INSP	REV	ACPT
A	NOT ISSUED FOR CONSTRUCTION	2021-06-09	R. CUNNINGHAM	G.T.	G.B.	-	-	R.A.	R.A.

REVISIONS

DSGN	R. CUNNINGHAM
INDEP CHK	G. TANG
DFTG	G. BETTOSCHI
DFTG CHK	–
INSP	–
REV	R. ATKINS
ACPT	R. ATKINS

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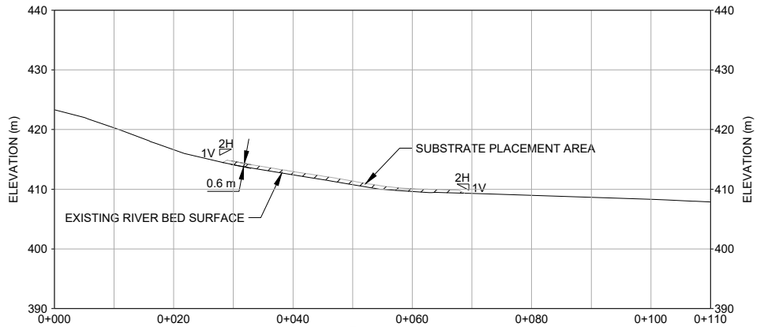
CLBWORKS-27 LOWER COLUMBIA RIVER
WHITE STURGEON PHYSICAL WORKS (PHASE 2)

SITE PLAN

DATE	DIST	DWG NO	SIZE	R
2021-06-09	-	20449674-1000-1400-02	D	A



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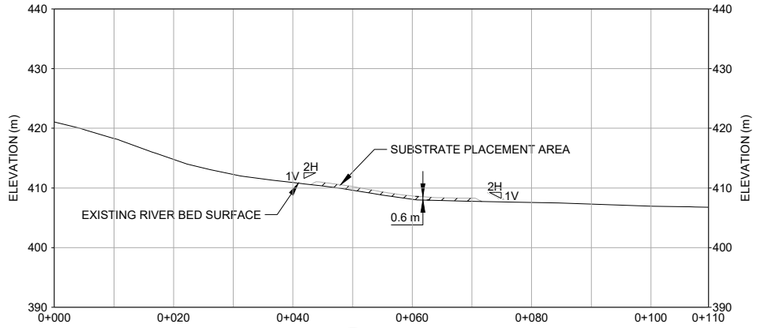

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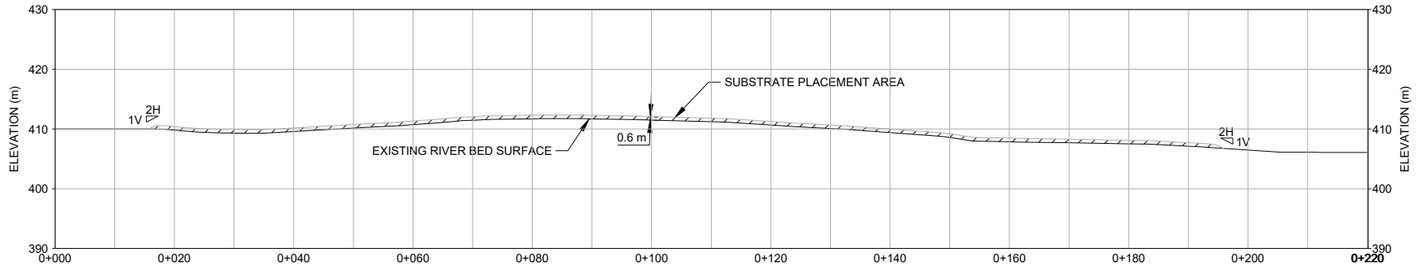

SCALE 1:500 C 2 SECTION C

LEGEND

SUBSTRATE PLACEMENT AREA

EXISTING RIVER BED SURFACE

NOTES

1. ALL UNITS ARE IN METRES UNLESS OTHERWISE NOTED.
2. COORDINATE SYSTEM IS UTM NAD 83, ZONE 11 ELEVATIONS RELATIVE TO CGVD 2013.
3. SUBSTRATE LAYER SIDE SLOPES ARE ASSUMED TO BE 2:1 (H:V) BASED ON ASSUMED ANGLES OF REPOSE.
4. CROSS-SECTIONS ARE SHOWN WITH NO VERTICAL EXAGGERATION.

REFERENCE

1. BATHYMETRY SURVEY CONDUCTED BY GRANT LAND SURVEYING INC, ON JULY 01, 2019.

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0 20 40
1:500 METRES

REF #	DRAWING NUMBER	TITLE

REFERENCE DRAWINGS

REF #	DRAWING NUMBER	TITLE

REFERENCE DRAWINGS

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REVISIONS

DSGN	R. CUNNINGHAM
INDEP CHK	G. TANG
DFTG	G. BETTOSCHI
DFTG CHK	–
INSP	–
REV	R. ATKINS
ACPT	R. ATKINS

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CLBWORKS-27 LOWER COLUMBIA RIVER
WHITE STURGEON PHYSICAL WORKS (PHASE 2)

CROSS SECTIONS

DATE	DIST	DWG NO	SIZE	R
2021-06-09	-	20449674-1000-1400-03	D	A

PROJECT DESCRIPTION

PROJECT WORKS

1. BC HYDRO REQUIRES THE PLACEMENT OF SUBSTRATE FILL MATERIAL DOWNSTREAM OF THE TAILRACE OF THE ARROW LAKES GENERATING STATION TO IMPROVE STURGEON HABITAT IN THE COLUMBIA RIVER.

GENERAL REQUIREMENTS

1. CONSTRUCT ALL WORK IN ACCORDANCE WITH THE DRAWINGS AND SPECIFICATIONS, AND AS DIRECTED BY THE PROJECT ENGINEER.
2. DETAILED BATHYMETRIC SURVEYS ARE REQUIRED BEFORE AND AFTER SUBSTRATE MATERIAL PLACEMENT.

DIMENSIONS, ELEVATIONS AND COORDINATES

1. ALL DIMENSIONS SHOWN ARE IN METRES, UNLESS NOTED OTHERWISE. ELEVATIONS ARE IN METRES RELATIVE TO CGVD 2013. STATION VALUES ARE IN METRES.
2. ALL COORDINATES SHALL BE REFERENCED TO THE NAD83 UTM ZONE 11 GRID DATUM.

MATERIALS

1. SUBSTRATE FILL MATERIAL
   THE SUBSTRATE FILL MATERIAL MIXTURE SHALL CONSIST OF COURSE, SUB-ROUNDED MATERIAL MEETING THE FOLLOWING GRADATION.

MATERIAL SIZE (mm)	PERCENT PASSING
300	100
200	80
125	50
100	40
20.0	0

ISSUED FOR REVIEW

NOT ISSUED FOR CONSTRUCTION

REF #	DRAWING NUMBER	TITLE

REFERENCE DRAWINGS

REF #	DRAWING NUMBER	TITLE

REFERENCE DRAWINGS

NO	REMARKS	DATE	DESIGNED	INDEP CHK	DFTG	DFTG CHK	INSP	REV	ACPT
A	NOT ISSUED FOR CONSTRUCTION	2021-06-09	R. CUNNINGHAM	G.T.	G.B.	-	-	R.A.	R.A.

REVISIONS

DSGN	R. CUNNINGHAM
INDEP CHK	G. TANG
DFTG	G. BETTOSCHI
DFTG CHK	–
INSP	–
REV	R. ATKINS
ACPT	R. ATKINS

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CLBWORKS-27 LOWER COLUMBIA RIVER
WHITE STURGEON PHYSICAL WORKS (PHASE 2)

CONSTRUCTION SPECIFICATION

DATE	DIST	DWG NO	SIZE	R
2021-06-09	-	20449674-1000-1400-04	D	A

D

APPENDIX B

Environmental Management Plan

GOLDER
MEMBER OF WSP

REPORT

Environmental Management Plan

Lower Columbia White Sturgeon Habitat Restoration CLBWORKS-27 (Phase 2)

Submitted to:

BC Hydro and Power Authority

6911 Southpoint Drive
Burnaby, BC V3N 4X8

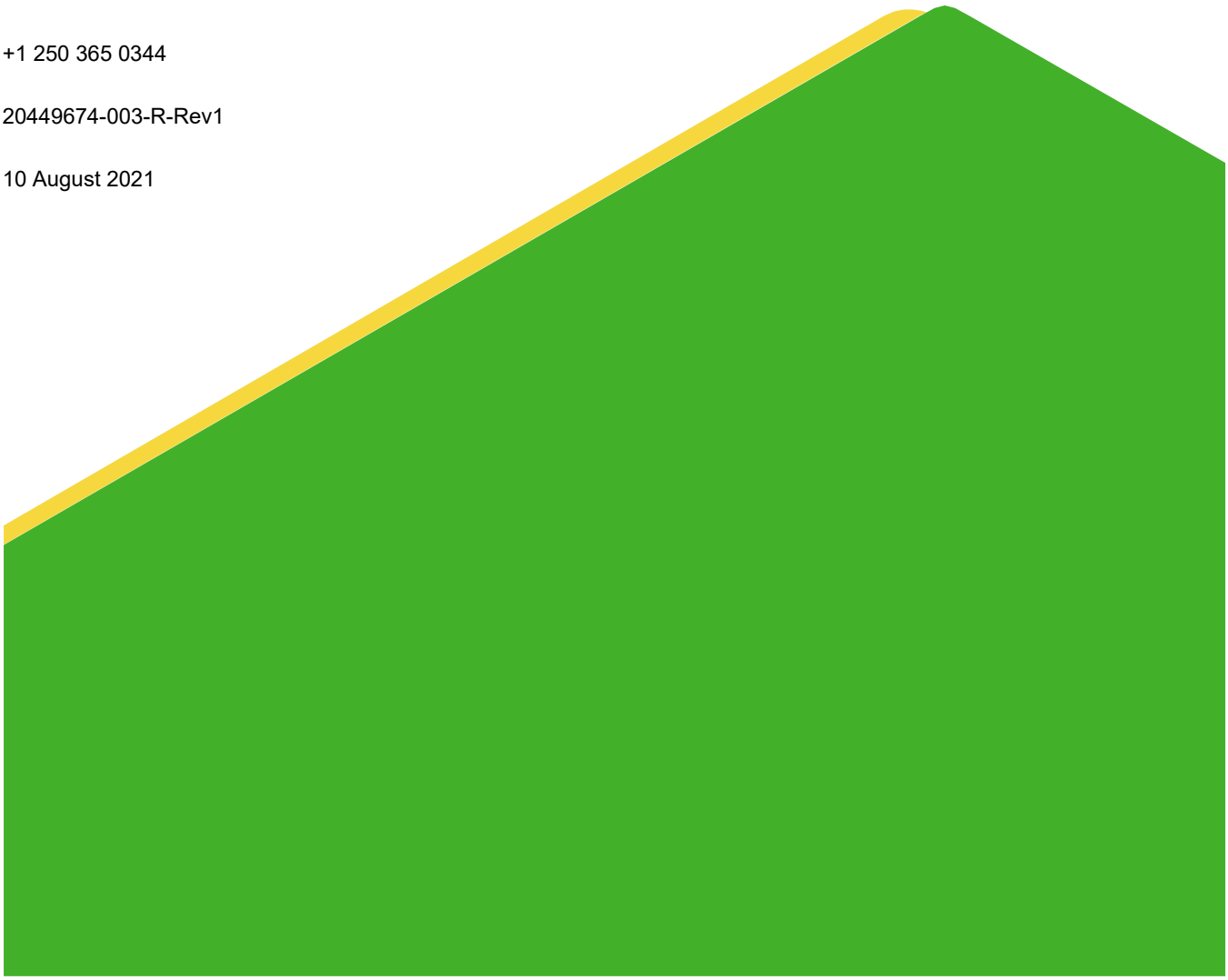
Submitted by:

Golder Associates Ltd.
201 Columbia Avenue, Castlegar, British Columbia, V1N 1A8, Canada

+1 250 365 0344

20449674-003-R-Rev1

10 August 2021



Distribution List

e-copy: BC Hydro

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Unless otherwise stated, the suggestions, recommendations and opinions given in this report are intended only for the guidance of the Client in the design of the specific project. The extent and detail of investigations, including the number of test holes, necessary to determine all of the relevant conditions which may affect construction costs would normally be greater than has been carried out for design purposes. Contractors bidding on, or undertaking the work, should rely on their own investigations, as well as their own interpretations of the factual data presented in the report, as to how subsurface conditions may affect their work, including but not limited to proposed construction techniques, schedule, safety and equipment capabilities.

Table of Contents

1.0 INTRODUCTION 1

1.1 Overview 1

1.2 Environmental Management Plan Objectives 1

2.0 PLANNED WORK 3

3.0 APPLICABLE LEGISLATION 3

4.0 ROLES AND RESPONSIBILITIES 4

4.1 BC Hydro 4

4.2 Contractor(s) 5

4.3 Environmental Monitor (QEP) 5

5.0 POTENTIAL ENVIRONMENTAL EFFECTS 6

6.0 ENVIRONMENTAL MITIGATION MEASURES 6

6.1 Erosion and Sediment Control 7

6.2 Water Quality Monitoring 7

6.3 Spill Prevention and Emergency Response Plan 8

6.3.1 Spill Prevention 8

6.3.2 Spill Response Equipment 9

6.3.3 Emergency Response Procedures 10

6.4 Material Storage and Handling, and Waste Management Plan 13

6.4.1 Hydrocarbon Products 13

6.5 Fisheries and Aquatic Habitat Management and Mitigation 14

6.5.1 Protection from Aquatic Invasive Species 15

6.6 Terrestrial Resource Protection and Mitigation 16

6.6.1 Wildlife 16

6.6.2 Vegetation 17

6.7 Air Quality and Dust Control 17

6.8 Acid Rock Drainage and Metal Leachate Management 18

6.9 Site Restoration 18

7.0 CLOSURE 19

8.0 REFERENCES 20

TABLES

Table 1: BC Water Quality Guidelines for Turbidity (BC MOE 2001) 8

Table 2: Spill Reporting Matrix 11

Table 3: Emergency Contact List 12

FIGURES

Figure 1: Site Plan 2

ATTACHMENTS

Attachment A
Spill Reporting Procedure

Attachment B
BC Hydro Chance Find Procedure

Attachment C
Watercraft Inspection Checklist

Attachment D
Equipment Disinfection Procedure

1.0 INTRODUCTION

1.1 Overview

This Environmental Management Plan (EMP) was prepared for BC Hydro's Lower Columbia White Sturgeon habitat restoration CLBWORKS-27 (the Project) to enhance White Sturgeon (*Acipenser transmontanus pop. 2*) spawning substrate at the Keenleyside White Sturgeon spawning area. The enhancement of spawning substrate is being placed because the level of natural recruitment of the White Sturgeon population residing in the Transboundary Reach of the Lower Columbia River is insufficient to maintain a self-sustaining population. The Project consists of hauling substrate, storing the substrate material in the laydown area, and loading it onto a barge for placement in the instream Enhancement Area. These activities will occur in the Project Area and are shown in Figure 1.

1.2 Environmental Management Plan Objectives

Environmental protection through adherence to applicable legislation, regulatory approvals, and standard management practices are required for the Project. The objective of this EMP is to assist Project personnel in adhering to applicable environmental legislation and recommend environmental mitigation specific to installation of the spawning substrate. The EMP provides performance-based environmental requirements, standard protocols, and mitigation measures that are intended to reduce potential for adverse environmental effects during Project implementation. The EMP describes how environmental risks are to be managed and, in the event of an environmental incident, how emergency response procedures, mitigation measures, and reporting protocols are to be implemented.

In general, the EMP:

- Describes the environmental management responsibilities for the work.
- Describes the necessary organizational lines of reporting and communication.
- Outlines applicable environmental legislation requirements, guidance documents, and best management practices (BMPs).
- Provides an overview of key environmental issues related to the Project.
- Recommends mitigation measures to manage potential adverse effects on fish including species at risk, and their habitats within the Columbia River during implementation of the Project.

NOT ISSUED FOR CONSTRUCTION

LEGEND

- EXISTING RIVER BED SURFACE
- SUBSTRATE PLACEMENT AREA
- TOPOGRAPHIC EXTENTS

NOTES

1. ALL UNITS ARE IN METRES UNLESS OTHERWISE NOTED.
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3. EXISTING GROUND CONTOURS ARE SHOWN AT 1 m INTERVAL RELATIVE TO CGVD 2013.

REFERENCES

1. IMAGE ©2021 GOOGLE, OBTAINED FROM GOOGLE EARTH PRO, USED UNDER LICENSE. GOOGLE EARTH IMAGE IS NOT TO SCALE.
2. BATHYMETRY SURVEY CONDUCTED BY GRANT LAND SURVEYING INC, ON JULY 01, 2019.

CLIENT
BC HYDRO

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2021-06-10
DESIGNED	RC
PREPARED	GB
REVIEWED	GT
APPROVED	RA

PROJECT
CLBWORKS-27 LOWER COLUMBIA RIVER WHITE STURGEON PHYSICAL WORKS (PHASE 2)

TITLE
SITE PLAN

PROJECT NO.	PHASE/TASK	REV.	FIGURE
20449674	1000/1400	A	1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI D

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Path: \\golder.gds\gal\Vancouver\CAD-GIS\Client\BC_Hydro\Castlegar\09_PROJECTS\20449674\1000\1400\Doc. xxx\02_PRODUCTION\DWG\REPORT_EAB\ | File Name: 20449674-1000-1400-REPORT-01.dwg | Last Edited By: gbettoschi Date: 2021-06-10 Time:11:08:16 AM | Printed By: GBettoschi Date: 2021-06-10 Time:11:18:39 AM

2.0 PLANNED WORK

An existing access road will be used to access the preferred laydown area location at the south shore of the Columbia River at the upstream boundary of the Project Area, immediately downstream of HLK Dam (Figure 1). The south shore downstream of HLK Dam is the preferred access and laydown area; however, there is potential that the north shore downstream of the dam or the south shore upstream of HLK Dam may be used as a contingency laydown area to stockpile material and load the barge.

Although there is an existing path to the river access and laydown areas, temporary improvements such as the importation of gravel and grading may be required to create a suitable roadbed. Rig mats or similar may also be used if required to support equipment. The access road, laydown area and barge loading area are previously disturbed from historical dam construction activities and contain minimal riparian vegetation.

The material required for the Project consists of approximately 3,540 m³ of a multiple grain size mixture of gravel and cobble that will be stable and resistant to infilling by fines and consisting of different proportions of material within a range suitable for sturgeon spawning (20 to 300 mm). The substrate will be placed from a barge using long reach excavator or a crane with a clam shell attachment to a thickness of approximately 0.6 m

Substrate material will preferably be supplied by a local quarry. Hauling will be via highway dump trucks. The preferred hauling route will be along Highway 3A to the Robson Access Road to Columbia Avenue and Lower Arrow Lakes Road. A laydown area located at the south downstream bank will be used to stockpile substrate material until it is loaded to the barge. Hauling will be completed throughout the Project duration.

During construction, a front-end loader will load gravel material from the stockpile to the barge, a tugboat will transport the barge from the loading area on the south riverbank to the gravel Enhancement Area where the barge will be anchored, and a long reach excavator (or crane with clamshell) located on the barge will place the substrate on the riverbed. Temporary anchor piles and/or tugboats will be used to stabilize the barge in place during the placement of substrate.

3.0 APPLICABLE LEGISLATION

A summary of the federal, provincial and municipal statutes and guidelines that are potentially applicable to the Project are provided below. Mitigation measures outlined in Section 6.0 have been developed in accordance with the following federal and provincial guidelines and will be adhered during Project works:

- Develop with Care: Environmental Guidelines for Urban and Rural Land Development (BC MFLNRO and BC MOE 2014),
- Standards and Best Management Practices for Instream Works (BC MWLAP 2004),
- A Field Guide to Fuel Handling, Transportation and Storage (BC Ministry of Water, Land, and Air Protection (MWLAP 2002),
- British Columbia Approved Water Quality Guidelines (MOE 2018), and
- Canadian Environmental Quality Guidelines (Canadian Council of Ministers of the Environment [CCME] 2013).

Applicable regulations and guidelines may include:

- *BC Water Sustainability Act*

- *BC Environmental Management Act*
- *BC Wildlife Act*
- *BC Transport of Dangerous Goods Act*
- *BC Weed Control Act*
- *Federal Transportation of Dangerous Goods Act*
- *Federal Fisheries Act*
- *Federal Migratory Birds Convention Act*
- *Federal Species at Risk Act*
- *Hazardous Waste Regulation*
- *Spill Reporting Regulation*
- *Water Sustainability Regulation*

4.0 ROLES AND RESPONSIBILITIES

4.1 BC Hydro

BC Hydro has overall responsibility for the administration of contracts, including their environmental requirements which includes the following:

- Overall responsibility for compliance with terms and conditions of regulatory permits, approvals, and authorizations.
- Delegates authority and communicates requirements as required on all aspects of the Project.
- Communicates directly with regulatory agencies, interested, and potentially affected First Nations, and public stakeholders, as required.
- Oversees technical quality control, adherence to and performance of engineering requirements of contract specifications, schedules, and costs.
- Appoints a Qualified Environmental Professional (QEP) to evaluate and report on compliance of the Contractor(s) work procedures and practices with environmental requirements established in this EMP.
- Ensure that field crews and Contractor(s) show proof that they have taken BC Hydro environmental and safety training and are aware of the environmental requirements of the work and are trained and competent to implement them.
- Conduct an environmental orientation to review the Environmental Management Plan and ensure effective environmental communication with work crews and subcontractors so that environmental responsibilities and requirements are understood prior to the commencement of the Project and are implemented through tailboard and other meetings.
- Implement appropriate work procedures, instructions, and controls to prevent and/or reduce adverse environmental impacts.

- Adhere to requirements set out in this EMP and Contract documents.
- Have taken BC Hydro Heritage Awareness Training.
- Contact the QEP should the scope or schedule of the Project change. Identify the timing, limits of the construction zones, and changes in conditions of the environment or construction practices.

4.2 Contractor(s)

Contractor(s) will be responsible for adhering to proposed environmental mitigation measures and regulatory requirements outlined in this EMP. In meeting the environmental requirements of the Project, Contractor(s) will be required to:

- Participate in a Project Kick-off meeting to review the work plan and objectives, health and safety, environmental mitigation and confirm the onsite crew have an appropriate level of training and competency to perform the work.
- Evaluate effective communication to confirm the onsite crew are aware of the environmental issues and requirements, and their responsibilities are understood prior to the commencement of work.
- Implement appropriate work procedures and controls to prevent and/or reduce the potential for adverse environmental impacts.
- Inspect the work practices to evaluate adherence to regulatory and EMP requirements.
- Have taken BC Hydro Heritage Awareness Training.
- Verify that emergency spill response materials are available on site for immediate use and appropriately stocked.
- Respond immediately and effectively to environmental incidents including leaks and spills.

4.3 Environmental Monitor (QEP)

A suitably qualified, trained and experienced Environmental Monitor (EM) be retained to oversee the works. The primary roles and responsibilities of the EM are to promote protection of the environment and to monitor compliance with environmental laws, permits, and approvals, and effective implementation of mitigation measures employed by the work crew. The EM will work closely with the Contractor crew to suspend activities or operations which are in contravention of environmental legislation, permits, and approvals; or have the potential to cause environmental damage.

The responsibilities of the EM include the following:

- Attend the pre-construction meeting and/or tailboard meetings and communicate environmental sensitivities and environmental requirements of the work to on site crew including Contractor(s) personnel.
- Available to be on site during the construction period and present during high risk or environmentally sensitive activities.
- Communicate with BC Hydro representative during construction activities providing regular updates and inform immediately in the case of an incident.

- Conduct biological field surveys (i.e., terrestrial wildlife and bird nest sweeps), as required.
- Supervise implementation of the mitigation measures and BMPs outlined in this EMP. Assist the contractor with these measures and recommend additional mitigation measures, as required.
- Evaluate the effectiveness of the mitigation measures being applied.
- Confirm Contractor(s) are implementing mitigation measures and complying with regulatory requirements.
- Have taken BC Hydro Heritage Awareness Training.
- Make visual observations during Project works and conduct water quality monitoring (as needed).
- Oversee the installation of erosion and sediment controls and other mitigation measures as specified in the EMP.
- Monitor water quality during the works. Turbidity levels exceeding provincial water quality criteria will result in a temporary work stoppage until the cause of turbidity is identified and corrective actions are taken.
- The EM will prepare a final summary report for submission to the provincial government and DFO that summarizes the work completed and includes a summary of environmental incidents, if any, mitigation measures implemented, and the corrective actions taken or to be taken, such as environmental mitigation or enhancement works.
- In the unlikely event of an environmental incident, the EM will provide a report to the client, and if warranted, to applicable regulatory agencies as soon as practicable but within 24 hours of their response to an incident. See guidance in Attachment A.

The EM has the authority to modify or halt any activity that is causing, or potentially causing, damage to fish and wildlife populations or their habitats.

5.0 POTENTIAL ENVIRONMENTAL EFFECTS

Based on the nature of the work activities involved, potential environmental effects include:

- Spills to the environment from vehicles and equipment.
- Surface water quality effects related to pathway access activities adjacent to the Columbia River.
- Fish and aquatic habitat effects due to instream work activities.
- Air quality effects from heavy equipment.
- Accidental impacts to archaeological artifacts (refer to BC Hydro Chance Find Procedure in Attachment B).
- Transport and spread of invasive species.
- Wildlife and wildlife habitat effects related to work activities.

6.0 ENVIRONMENTAL MITIGATION MEASURES

The following environmental mitigation measures may be implemented during the work activities to achieve compliance with the Project's environmental requirements.

6.1 Erosion and Sediment Control

Surface water quality and sediment management activities must be in compliance with associated environmental legislation, regulations, standards, and guidelines. Release of suspended sediment to the Columbia River from Project-related activities is considered a deleterious substance that can adversely affect fish and fish habitat. The crews will make all practical efforts to implement sound measures of erosion control.

The EM will continuously monitor the effectiveness of erosion and sediment control measures and general mitigation measures described below.

- Limit the speed of vehicles and equipment working onsite to reduce dust disturbance. Apply dust suppressants as required to areas where mobile equipment will be operating, particularly during dry weather periods or high wind events. Water sprayed for dust suppression will be accessed from a local source.
- Ensure that all vehicles hauling materials to or from the Site use appropriate measures to prevent dust dispersion and loss of fine material such as covers or protective devices. All sediment tracked out of the Site and on to adjacent roadways shall be removed so that it does not have the potential to enter watercourses.
- As part of their Site setup activities, the contractor will install silt fencing around the perimeter of the on-shore work area. The EM will inspect the layout of the silt fencing as well as inspect the effectiveness of the silt fencing throughout the Project duration. Silt fencing shall be installed, as required, in locations that prevent sediment from work areas or sediment-laden runoff from entering the Columbia River.
- To reduce turbidity during placement, the substrate that is to be placed in the Enhancement Area should be thoroughly washed at the source quarry to remove sand size and finer sediments prior to being hauled to the Project Area.
- Limit soil disturbance, soil compaction, and vegetation removal at the Site to only those areas required to complete the works. Re-vegetate the Site where necessary as soon as possible following works to limit the potential for erosion and dust generation.
- Halt works during periods of heavy precipitation and runoff to minimize soil disturbance. Ensure that erosion and sediment control measures are capable of continuous function during both working and non-working hours.
- Store additional erosion and sediment control materials (i.e., silt fencing) onsite for immediate use in case of an emergency event. All stored and used erosion and sediment control measures shall be removed from the Site once the Project is complete.

6.2 Water Quality Monitoring

Turbidity measurements in the Columbia River will be taken prior to Project implementation and will be used as a baseline level for comparison purposes to Project related generation of turbidity. The EM will conduct turbidity monitoring at two locations:

- Upstream: Approximately 100 m or as far as practicable, up to 100 m upstream of where works are occurring.
- Downstream: Approximately 100 m downstream from where works are occurring.

At the downstream location, turbidity measurements will be collected throughout the entire water column. The frequency of monitoring will be determined based on the EM's judgement; at a minimum, turbidity measurements will be taken at hourly intervals whenever work is occurring below the high water mark (HWM) of the Columbia River. The frequency of water quality sampling should be increased to every half hour if a visible sediment plume is identified.

Three turbidity measurements will be taken from a single sample using a turbidity meter and the average of the three turbidity readings used as the reported turbidity value. During environmental monitoring, visual observations will also be made to identify the potential for mobilization of sediment.

The Contractor must temporarily pause work if turbidity in the Columbia River at the downstream sampling location exceeds the values listed in Table 1 (compared to background turbidity levels), and the EM and contractor should take immediate steps to control the source of the turbidity and attempt to rectify the situation prior to restarting work. Work should not be restarted until turbidity has decreased to background levels.

Table 1: BC Water Quality Guidelines for Turbidity (BC MOE 2001)

Water Use	Maximum Induced Turbidity (NTU or% of Background)	Maximum Induced Suspended Sediments (mg/L or% of Background)
Aquatic Life	Change from background of 8 NTU at any one time for a duration of 24 hrs in all waters during clear flows or in clear waters.	Change from background of 25 mg/L at any one time for a duration of 24 hrs in all waters during clear flows or in clear waters.
	Change from background of 2 NTU at any one time for a duration of 30 days in all waters during clear flows or in clear waters.	Change from background of 5 mg/L at any one time for a duration of 30 days in all waters during clear flows or in clear waters.
	Change from background of 5 NTU at any time when background is 8-50 NTU during high flows or in turbid waters.	Change from background of 10 mg/L at any time when background is 25 to 100 mg/L during high flows or in turbid waters.
	Change from background of 10% when background is >50 NTU at any time during high flows or in turbid waters.	Change from background of 10% when background is >100 mg/L at any time during high flows or in turbid waters.

6.3 Spill Prevention and Emergency Response Plan

The release of deleterious substances, such as hydrocarbons, can impact soil and water quality, aquatic birds, mammals, and fish as well as vegetation and other wildlife found in the Project Area. The Spill Prevention and Emergency Response Plan is intended to satisfy, among others, the *British Columbia Fire Code*, National Fire Code, Occupational Health & Safety Regulations, and *Transportation of Dangerous Goods Act*. The following spill prevention and emergency response measures will be implemented, where appropriate or as requested by the QEP.

6.3.1 Spill Prevention

- Prior to the commencement of Project activities, the Emergency Response Procedures should be identified including the names and telephone numbers of persons and organizations that may be contacted in the event of an environmental incident. The Emergency Response Procedures will be made available in the Project Area, and will be posted in a location that is visible and accessible nearby the emergency response equipment in the event of an environmental incident.

- All field personnel will be made aware of the location of Emergency Spill Response equipment and the procedures necessary to contain spills of any fluid.
- The barge surface and sides must be free of holes or cracks so that any accidental spills on the surface do not runoff and enter the water.
- Equipment will be inspected prior to use and daily for signs of leakage. Daily visual inspections will include confirming that all personal protective equipment and other emergency response equipment are in place.
- Where on site fuelling or maintenance of vehicles, the tub boat and equipment is required, the following mitigation measures will be implemented:
  - Transportation of fuels will be conducted in accordance with Transportation of Dangerous Goods Regulations. Fuel storage and handling will comply with A Field Guide to Fuel Handling, Transportation and Storage (MWLAP 2002).
  - All fuelling of land equipment and vehicles must occur more than 30 m from the Columbia River.
  - Refuelling of land based mobile equipment that is working on the barge should be completed in the laydown area, greater than 30 m form the edge of the river.
  - All equipment on the barge using hydrocarbons requires spill containment (i.e., spill containment/drip trays) that has the capacity to contain 110% of the amount of liquids in the equipment.
  - Nozzles will be equipped with automatic shut offs or a drip-free dispensing nozzle will be used; A drip tray or pan will be used to collect excess fuel, oil, or other hazardous materials to avoid contamination of soils.
  - Spill kits will be readily available during refuelling and personnel will be knowledgeable in the use of spill response materials.
  - No ignition sources will be permitted within the fuelling area.
  - Vehicles will not be left running during refuelling. Fire extinguishers and spill kits must be kept in the area of fuel storage and handling. Fuelling tanks, hoses, pipes and fittings will be inspected daily and any leaks repaired immediately.
  - The Contractor's Site Lead will verify that there are personnel stationed at both the fuel source and the equipment receiving the fuel during equipment refuelling, and effective communication protocols shall be followed to prevent accidental release or overfilling of the equipment.
- Any equipment that is stationary for more than two hours should have spill containment placed under it and all vehicles should be inspected daily for leaks.
- At the end of each working day, land construction equipment containing hydrocarbon fluids or grease will be removed more than 30 m from any stream or other body of water. Spill containment / drip trays on the barge will be provided under equipment on board with the potential to release oils.

6.3.2 Spill Response Equipment

- Spill containment kits must be available on every piece of portable or heavy equipment and contain sufficient materials for addressing the anticipated maximum spill from a given piece of equipment. Equipment containing ethylene glycol (antifreeze) or other water-soluble chemicals will carry an appropriate number of water soluble chemical absorbent pads in addition to absorbent pads used for petroleum products.

- Inspections will be completed by the QEP at regular intervals throughout the Project to compare current contents of spill containment kits with required contents, whenever a spill kit is used, and whenever a new piece of equipment comes on site.
- A fully stocked large spill containment kit must be present on site at all times, located within the laydown area and on the barge, and be easily accessible.
- Spill containment kit contents shall be consistent with requirement outlined in Table 9.3 of A Field Guide to Fuel handling, Transportation and Storage (MWLAP 2002).
- A fully stocked large spill containment kit must be present on the barge at all times, and easily accessible.
- Spill kits will be maintained on site during Project works and located on the barge and next to the instream work area. The spill kits will include aquatic containment booms readily available for easy deployment in the event of a spill or leak of hydraulic fluids, fuel, or other deleterious material.
- Employees will be trained in the use of spill response equipment, including the location, type, and correct deployment of spill response equipment relating to the nature and location of work and potential for on site spills, and distinguishing between grey absorbent pads used for water soluble chemicals and white pads used for petroleum products.

6.3.3 Emergency Response Procedures

The Contractor should review the document “6 Steps of Spill” prior to commencing the work. If an environmental incident occurs, including a spill of fuels, oils, lubricants or other harmful substances, the following procedures will be implemented, as described below:

1) **MAKE THE AREA SAFE**
2) **STOP THE FLOW/ENVIRONMENTAL EFFECTS (when possible and safe to do so)**
3) **REPORT THE SPILL**
4) **SECURE THE AREA**
5) **CONTAIN SPILLS**
6) **NOTIFICATION (EMBC 1-800-663-3456)**
7) **CLEAN-UP**
8) **INCIDENT REPORT**

1. MAKE THE AREA SAFE

- Evaluate risk to personnel/public and environmental safety.
- Wear appropriate Personal Protective Equipment.
- Never rush in, always determine the product spilled before taking action.
- Warn people in the immediate vicinity.
- Verify that no ignition sources are present if a spill of a flammable material has occurred.

2. STOP THE FLOW/ENVIRONMENTAL EFFECTS (when possible and safe to do so)

- Act quickly to reduce the risk of environmental effects.

- Close valves shut off pumps or plug holes/leaks.
- If a spill has occurred, stop the flow or the spill at its source.

3. REPORT THE SPILL

- Notify BC Hydro, the Environmental Lead and the Lead Environmental Monitor or alternate of incident (provide details).

4. SECURE THE AREA

- Limit access to the area of the environmental incident.
- Prevent unauthorised entry onto the Project Area.

5. CONTAIN SPILLS

- Block off and protect drains and culverts, if present.
- Prevent spilled material from entering drainage watercourses, wetlands, ditches, or known or potential painted turtle nesting sites.
- Use spill sorbent material to contain the spill. Spill response equipment on-site is listed below.
- If necessary, use a dyke or other method to prevent discharge on-site.
- Make every effort to reduce contamination.

6. NOTIFICATION – as per Table 2 below and the attached Emergency Contact List (Table 3)

Within 24 hours of discovery, determine appropriate internal and regulatory notification obligations and notify appropriate personnel.

When necessary, the first external call will be made to Environmental Emergency Program (1-800-663-3456) (24 Hour). Spills would then be reported to the appropriate ministries/agencies according to Table 2 below to allow for immediate response (as required) by appropriate staff. For spills to aquatic habitat, collection of water samples will be required to characterize the nature and extent of the release.

Table 2: Spill Reporting Matrix

Substance	Quantity	External Reporting Requirements	Internal Reporting Requirements
Any Spill	Any amount that enters or likely to enter aquatic habitat	Environmental Emergency Program (EEP)	Environmental Incident Report (EIR), BC Hydro
Oil and oil waste	>100 litres (L)	EEP	EIR, BC Hydro
Oil with >50 ppm PCB (PCB Wastes)	>25 kilograms (kg) or L	EEP	EIR, BC Hydro
Flammable or Non-Flammable Gas	10 kg	EEP	EIR, BC Hydro
Flammable Liquids	100 L	EEP	EIR, BC Hydro

Note: Adapted from the spill reporting schedule provided in the Spill Reporting Regulation of the BC *Environmental Management Act* (Government of BC 2017); PCB – polychlorinated biphenyls. ppm – parts per million.

7. CLEAN-UP

- Determine cleanup options.
- Mobilize recovery equipment and cleanup crew and direct cleanup activities. Clean-up procedures and residue sampling should be in compliance with BC Ministry of Environment and Climate Change Strategy (BC ENV) regulations.
- Dispose of all equipment and/or material used in clean up (e.g., used sorbent, oil containment materials, etc.) in accordance with BC MOE requirements. Disposal of hazardous wastes (e.g., material with >3% oil by mass) and contaminated soil must comply with the *Environmental Management Act* and Regulations
- Replenish spill response kits and equipment.

8. INCIDENT REPORT

Provide the required information about the incident to BC Hydro and the Environmental Monitor, including mitigation to be put in place to avoid further incidents. A template for spill reporting can be found in Attachment A. A list of emergency contacts is summarized in Table 3.

Emergency Contact List

An emergency contact list will be posted in a visible and accessible location on the Project site. General emergency contact numbers are outlined in Table 3 below. Once the Contractor is selected additional contacts will be added to this preliminary list.

Table 3: Emergency Contact List

Organization	Contact Number(s)
Emergency Management BC (EMBC)	1-800-663-3456
Spill Reporting Line ECCC	604-666-6100
Emergency Response Services	911
WorkSafeBC	1-888-621-7233 1-866-922-4357 (after hours)

Emergency Response Equipment

Emergency Response Equipment to be available on-site will consist of the following:

- Fire Extinguisher
- First-aid Kit
- Spill Kit (Located in all vehicles and in containers present in work areas)
- Portable Water Pump

At a minimum, spill kits will be maintained and fully stocked with materials suitable to respond to the volumes of hazardous substances on the barge and within the laydown and barge loading areas (hydrocarbons, lubricants, toxic substances, etc.). Spill kits are to be made available in suitable locations and stored within known, readily available containers.

6.4 Material Storage and Handling, and Waste Management Plan

Mitigation measures for material storage, handling, and waste management related to proposed work activities include:

- Wastes and hazardous materials (such as sorbent material, air and oil filters, hydraulic fluids and petroleum products generated during the servicing of equipment) will be stored in an environmentally acceptable location greater than 30 m away from the Columbia River until disposal at a qualified facility is coordinated. Maintenance of mobile equipment should also be conducted greater than 30 m away from the Columbia River.
- Reasonable efforts will be made to reduce, reuse, and/or recycle to limit the amount of material being disposed of. All wastes will be disposed of in compliance with applicable legislation such as the *Environmental Management Act*.
- Food waste and domestic garbage will be collected daily from work and access areas and will be disposed of off-site in an appropriate and safe manner. Other construction waste will be collected daily and placed in the appropriate receptacle.
- Hazardous waste registration, storage, permitting, and transportation requirements will be met, if applicable, and waste materials will be removed from the site as soon as possible in accordance with applicable standards and regulations.
- The Ministry's Representative will be responsible for maintaining Safety Data Sheets (SDS) for all potentially hazardous products used during the work.
- On site burial or burning of wastes will not occur.
- Temporary sanitary facilities in the form of portable toilets will be provided, secured so they do not fall over, located more than 30 m from any waterbody, and locked at the end of each shift.

6.4.1 Hydrocarbon Products

The excavator operating on the barge should contain environmental friendly hydraulic oil and fluids. However, hydrocarbon products are expected to be required to complete the Project. The following mitigation measures will be implemented to reduce potential for spills of hydrocarbon products:

- Plastic containers used to carry petroleum products will be designed for that purpose and will not be more than 5 years old.
- Containers will be fitted with a proper fitting cap or lid.
- All containers containing hydrocarbon products will be labelled and transported according to the Transportation of Dangerous Goods Regulations.
- Containers under 23 litres (5 gallons) will be stored and transported in the equipment box of a vehicle that is capable of containing the total quantity of the fuel in the container should it leak or spill.
- Containers greater than 23 L (5 gallons), including 205 L (45 gallon) drums, must be transported upright and secured to prevent shifting and toppling.

- Tanks, barrels, and containers greater than 23 L (5 gallons) containing hydrocarbon products must be stored within impermeable containment area(s) designed to contain 110% of the volume of the largest container. Impermeable containment is required for stationary fuel storage as well as mobile fuel storage (i.e., fuel trucks) when remaining on site overnight.

6.5 Fisheries and Aquatic Habitat Management and Mitigation

The construction schedule is proposed for February to March 2022 when the water level in the river is low giving the substrate placement has the best chance to successfully meet the objectives. Additionally, completing the work in February to March will avoid the time of the year when White Sturgeon would be spawning and will be in advance of spawning so that there is an opportunity for spawning to occur at the enhancement area in 2022.

It is unlikely that the Project area currently provides suitable spawning habitat for salmonids based on the specific habitat requirements of the individual species as outlined in the Environmental Assessment (Golder 2021); however, there is the possibility that other fish species may be present in the enhancement area during the preferred construction period (February – March). Therefore, the following mitigation measures are recommend to avoid direct impacts to fish:

- A drop-camera or a remotely operated vehicle (ROV) will be used to visually inspect the immediate area where gravel will be placed to determine if there are any fish present. This action will be repeated in a grid pattern throughout the enhancement area just in advance of the excavator placing the material.
- Following the visual observation and confirmation of fish absence, substrate material to be placed below the waterline will be lowered slowly through the water column and placed on the bed and not dumped from the barge.

Additionally, the following mitigation measures will be implemented to reduce potential impacts to fish and fish habitat:

- Any work associated with the proposed changes in and about a stream must not cause stream channel instability or increase the risk of sedimentation into the stream. Substrate material must be washed and clean and free from fines.
- Biodegradable hydraulic fluids will be used in equipment working within or above water (on the barge).
- Work activities will be conducted in accordance with *A Users' Guide to Working In and Around Water* (BC MOE 2009).
- During work on site, erosion and sediment control materials will be available on site at all times and will be installed if sedimentation is likely to occur into the stream.
- Any equipment used in conducting work will be in good mechanical condition and, when operating in close proximity to the wetted perimeter of a stream, the operator will prevent entry of any substance, sediment, debris or material (e.g., hydrocarbons, silt) into the stream so as to prevent harm to fish, wildlife or the aquatic ecosystem of a stream (additional mitigation for Protection from Aquatic Invasive Species is in Section 6.5.1).
- The instream component of the work will be completed as quickly and efficiently as possible to minimize the length of disturbance to aquatic species.

- Sediment control provisions implemented (see Section 6.1) will be in accordance with DFO's *Measures to Protect Fish and Fish Habitat* (DFO 2019) and *Land Development Guidelines for the Protection of Aquatic Habitat* (DFO and BC MOE 1993).
- The stream channel width must not change as a result of the work.
- Any materials placed within the stream will be clean and not contain substances that could be harmful to fish, wildlife or the aquatic ecosystem of the stream.
- Riparian vegetation, particularly trees and shrubs, will be retained as much as possible. Any areas disturbed as part of the work will be restored as close as possible to their pre-disturbance condition. Any soil exposed near the watercourse will be promptly re-vegetated.

6.5.1 Protection from Aquatic Invasive Species

In order to avoid introduction and proliferation of invasive aquatic species to the river, all vessels and equipment should be cleaned prior to being transported to site and entering the lake. All equipment including hand tools and machinery should be inspected, cleaned, drained and dried properly following the "Don't Move a Mussel" protocols (Okanagan Basin Waterboard 2021) (Attachment C). The vessel inspection checklist includes:

- Prop
- Anchor
- Dock lines
- Hull
- Rollers
- Trailer
- Bunks
- Axel
- Live wells
- Bilge
- Motor
- Ballast

Additionally, personal protective equipment and any hand tools or sampling equipment (i.e., dive suits, footwear, underwater cameras etc.) that may have been used between watersheds should be cleaned and inspected for functionality, safety and disinfected prior to sampling according to the Equipment Disinfection Procedures to Prevent the Accidental Spread of Aquatic Invasive Species (BC Ministry of Environment 2009) (Attachment D). Disinfection procedures include:

- When leaving a waterbody, remove any visible plants and animals from equipment and boat.

- Remove any mud and dirt since they might contain Dydimo (*Didymosphenia geminata*) or New Zealand mud snails (*Potamopyrgus antipodarum*).
- Eliminate water that may be pooled or stored in any boats or equipment.
- Submerge all gear in hot water (45ºC - uncomfortable to touch) for at least 10 minutes, or until soaked through. Felt-soled waders or other absorbent materials need to soak for 40 minutes.

or

- Freeze all gear until solid (>4hrs).

or

- Soak in a 2% solution of household bleach for 1 minute.

or

- Soak in a 5% household bleach solution and soak for 15 minutes.

6.6 Terrestrial Resource Protection and Mitigation

6.6.1 Wildlife

Consideration of the effects of site preparation and Project works on terrestrial wildlife is required to avoid contravention of Section 34 of the BC *Wildlife Act*, and the federal *Migratory Birds Convention Act* which protects migratory birds and their nests. Any vegetation removal that may required will be completed in advance of the bird nesting period April through mid-August.

Based on the anthropogenic disturbed conditions (previously disturbed riparian vegetation of sparse shrubs and grasses, riprap shoreline etc.) of the laydown area, shoreline and riparian area it is unlikely that vegetation removal will be required. However, if it is required and it can not be completed in advance of the nesting period Golder recommends a suitably trained and experienced biologist should conduct surveys for active nests, burrows and wildlife activity within the areas to be used for construction activities (including searches for ground nesting species). If active nests are identified they will be flagged and a species-specific no-disturbance buffer will be flagged around the perimeter of the nest. Active nests will be checked periodically to confirm they are no longer active. Vegetation removal and ground disturbance within the flagged area can only occur once nests are confirmed to be inactive.

The following mitigation measures will be implemented to reduce effects to wildlife during the Project:

- Habitat loss will be minimized by restricting access to areas required to complete the works. Disturbance to important habitat areas outside the footprint of the works will be avoided by discussing no-go zones with the work crew and flagging riparian areas, if required;
- According to the construction schedule, Project activities are outside of the provincial least-risk timing window for bald eagle (*Haliaeetus leucocephalus*), osprey (*Pandon haliaetus*), heron (*Ardea herodias*) and passerines (BC MFLNRO and BC MOE 2014). The least risk window for other raptors is 1 October to 28 February. Osprey, bald eagle, heron, and peregrine falcon (*Falco peregrinus*) nests are protected year-round under the BC *Wildlife Act*, whether occupied or not. Construction activities will be avoided in the vicinity of osprey, falcon, eagle, heron and/or other raptor nests. If a stick nest is observed, it will be reported to the QEP to

determine further action. If required, appropriate setbacks will be established in accordance with *Develop with Care 2014: Environmental Guidelines for Urban and Rural Land Developments in British Columbia* (BC MFLNRO and BC MOE 2014).

- Implement standard construction practices to minimize noise generation and air emissions.
- Food waste, garbage, refuse, and construction materials that could attract wildlife will be stored in an appropriate containment or removed from the Project area daily.

6.6.2 Vegetation

The following measures will be followed to mitigate the potential effects on riparian vegetation at the Site:

- Sediment and erosion control measures such as silt fencing shall be installed where necessary to protect the existing surface water resources at the Site.
- The limits of vegetation clearing, if required, will be delineated with fencing or flagging.
- It is unlikely that trees or shrubs will be removed. Where possible, pruning of trees should occur as opposed to removal.
- Where possible consider transplanting existing, native vegetation that will be removed; species like tall Oregon grape, rose spp. and saskatoon are hardy and demonstrate transplanting success.
- Any noxious weeds (i.e., those listed by the BC *Weed Control Act*) that are present at the Site should be removed from the Site and disposed of appropriately. Take measures to reduce the spread of noxious weeds to and from the Site.
- If areas vegetated with grass will be disturbed. These areas will be seeded immediately upon completion of works to prevent erosion or colonization of invasive weed species.
- Any topsoil or other erodible materials that are temporarily stockpiled onsite shall be secured to prevent sediment, erosion, and dust generation.
- Inspect vehicles and equipment for weeds and mud that may contain seeds prior to mobilizing to the Project, and if required, clean them prior to entering the area to reduce the potential for introduction and proliferation of invasive plants.
- Educate Contractor(s) to identify invasive plants that have the potential to move between locations within the Project area.

6.7 Air Quality and Dust Control

Contractor(s) will apply the following mitigation measures to control fugitive dust and other airborne emissions arising from movement of vehicles between the quarry and the laydown area and machinery at the laydown area and on the barge.

- Reduce equipment emissions by operating equipment at optimum rated loads, following routine equipment maintenance procedures, and turning off equipment (i.e., avoid idling), when not in use.

- If required, water will be used to control dust for the duration of the Project works. Water, as a dust suppressant, will be used sparingly to avoid turbid water from entering the Columbia River. Chemicals will not be used in dust suppressants.
- Remove and/or properly store debris and materials.
- Construction vehicles travelling through the access road and laydown area will be monitored for excess mud and dirt which will be removed prior to entering / exiting the Project area.
- Construction vehicles used for hauling material will have loads covered during hauling.
- Vehicle speeds will be controlled in the work area to reduce fugitive dust.

6.8 Acid Rock Drainage and Metal Leachate Management

Imported substrate material will be sourced from a local quarry and washed thoroughly prior to mobilizing to the Site. All materials will have been previously tested for Acid Rock Drainage (ARD) and Metal Leachate (ML) Management. The test results are to be evaluated and the substrate material is to be approved by a QEP prior to use on the Project.

6.9 Site Restoration

Site restoration will include:

- Temporarily disturbed areas (i.e., laydown area, access to barge loading area) will be restored to their pre-construction condition once construction is complete to reduce potential for erosion, facilitate optimal seed germination, and deter establishment of invasive species. Areas that were disturbed by Project activities and were vegetated with grass prior to Project activities will be seeded with annual ryegrass. If it is impractical to seed disturbed areas then areas that have a high likelihood of erosion will be covered or otherwise protected to minimize the risk of runoff and the resulting deposition of sediment.
- If the native topsoil has been substantially disturbed or compacted, the soil will be re-established similar to the pre-existing condition sufficient to support native vegetation. Ripping and scarifying will be completed to reduce surface compaction and surface water runoff.
- The *BC Weed Control Act* imposes a duty of all landowners and occupiers to control designated noxious plants found within particular regions of the Province. Contractor(s) will control the introduction and spread of invasive plants.
- Waste materials from worksites will be removed, and subsequently disposed of at appropriately authorized facilities.

7.0 CLOSURE

We trust the information contained in this report is sufficient for your present needs. If you require any further information, please do not hesitate to contact us.

Golder Associates Ltd.

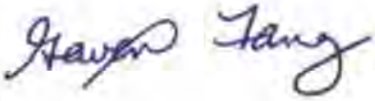
Prepared by:

Emma-Jane Hennings, Tech Dipl., RBTech
Fisheries Technician

Bobby Bedingfield, B.Sc., PBiol
Aquatic Biologist

Drew Kaiser, B.Sc., RPBio, P.Biol.
Associate, Environmental Assessment Project Manager

Reviewed by:



Gaven Tang, M.A.Sc., P.Eng.
Lead River Engineer

EJH/BB/DK/GT/syd

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ATTACHMENT A

Spill Reporting Procedure

Ministry of Environment and Climate Change Strategy

January 2019

Spill Reporting

Report spills immediately

If a spill occurs, or is at imminent risk of occurring, responsible persons (spillers) must ensure that it is immediately reported to the Provincial Emergency Program (PEP)/ Emergency Management British Columbia (EMBC) by calling **1-800-663-3456.**

Division 2.1 Spill Preparedness, Response and Recovery of the *Environmental Management Act 2003* (EMA) is effective as of October 2017. Section 91.2 of EMA identifies the requirements for spill reporting. The Spill Reporting Regulation prescribes the information that is required, as well as the time and manner in which it is required, when reporting spills.

This fact sheet is designed to provide information for responsible persons on their reporting obligations should they be in possession, charge, or control of a substance when it spills or is at imminent risk of spilling.

Responsible Person

A responsible person has possession, charge, or control of a substance or thing when a spill of the substance or thing occurs or is at imminent risk of occurring.

Definition of a Spill

A spill is defined by EMA as the introduction into the environment, other than as authorized and whether intentional or unintentional, of a substance or thing that has the potential to cause adverse impacts to the environment, human health, or infrastructure.

The Spill Reporting Regulation identifies three reports that responsible persons must make based on specific criteria: (1) Initial Report, (2) Update to Minister Report, and (3) End-of-Spill Report. Responsible persons may also be required to make a forth report, a (4) Lessons-Learned Report, if ordered to do so by a director. The purpose of these four reports is to ensure that the Ministry of Environment and Climate Change Strategy (the ministry) has the appropriate information necessary to assess spill impacts and fulfil oversight and regulatory roles and responsibilities.

Initial Report

Section 4 of the Spill Reporting Regulation outlines the information required in the Initial Report. An Initial Report must be made immediately if any of the following occur or is at imminent risk of occurring:

1. **If the volume spilled, or likely to be spilled, is equal to or greater than the minimum quantity outlined in the Spill Reporting Regulation, the spill is reportable**. A list of substances and their reportable quantities is available in Appendix 2: Prescribed substances and quantities for immediate spill reporting of this fact sheet.

2. **If the spill enters, or is likely to enter, a body of water, the spill is reportable.** A body of water is defined in the Spill Reporting Regulation and includes both marine and fresh bodies of water

whether or not they usually contain water or ice, as well as streams, lakes, ponds, rivers, creeks, springs, aquifers, ravines, gulches, wetlands, and glaciers. The requirement to report a spill of a listed substance of any quantity also includes spills that enter a ditch that is not self-contained and connects to a body of water.

The Initial Report must be made immediately to Emergency Management British Columbia (EMBC) by calling 1-800-663-3456. Anyone can make the Initial Report, however, the responsible person must ensure that the report has been made and that all of the information outlined in section 4 of the Spill Reporting Regulation has been reported. Appendix 1 of this fact sheet specifies the information that must be provided in the Initial Report.

Natural Gas

A release of natural gas is reportable if:

1. The spill is caused by a breakage in a pipeline or fitting operated above 100 pounds per square inch (psi) that results in a sudden release of natural gas; and
2. The amount of the spill is, or is likely to be, equal to or greater than 10 kilograms (kg).

Update to Minister Report

Section 5 of the Spill Reporting Regulation outlines the requirement for the submission of Update to Minister Reports. Responsible persons must provide an Update to Minister Report:

1. **As soon as possible on request of the minister**

2. **At least once every 30 days after the date that the spill began** until such time that an End-of-Spill Report is required

3. **At any time that the responsible person has reason to believe that information that was previously reported as part of the Initial Report was or has become inaccurate or incomplete –** any component of the Initial Report, as outlined in Appendix 1, changes or is not specified

If the Update to Minister Report is requested by the Minister or if the spill lasts more than 30 days and the Update to Minister Report is required, an email will be sent by the ministry to the responsible person with instructions on how to complete the report form and how it must be submitted.

If the responsible person believes that information that was previously reported as part of the Initial Report was or has become inaccurate or incomplete, the responsible person can contact the Environmental Emergency Program at SpillReports@gov.bc.ca, stating the DGIR in the subject line, to advise that an Update to Minister Report is required. Instructions on how to complete the report form and how it must be submitted will be sent to the responsible person by email.

End-of-Spill Report

Section 6 of the Spill Reporting Regulation outlines the requirement for the submission of End-of-Spill Reports. Responsible persons must submit a written report to the ministry within 30 days following the emergency response completion date of a spill, see information box below. An End-of-Spill Report is required when:

1. **The volume spilled is equal to or greater than the minimum quantity outlined in the Spill Reporting Regulation** - a list of substances and their reportable quantities is available in this fact sheet in Appendix 2: Prescribed substances and quantities for immediate spill reporting

2. **The spill enters, or is likely to enter, a body of water -** 'body of water' is defined in the Spill Reporting Regulation

Although the accountability to adhere to the requirements set out in the Spill Reporting Regulation is that of the responsible person, in most cases, an email will be sent to responsible persons by the ministry with instructions on how to complete the report form and the date that the End-of-Spill Report is due. All reports, other than the Initial Report, are to be sent to the Environmental Emergency Program at SpillReports@gov.bc.ca.

Emergency Response Completion Date

The emergency response completion date is defined in section 8 of the Spill Reporting Regulation as the date that all of the following criteria are met:

1. The Incident Command Post is disestablished
2. The source of the spill is under control and is neither spilling nor at imminent risk of spilling
3. Emergency actions to stabilize, contain, and remove the spill have been taken
4. The waste has been removed from the spill site
5. All evacuation notices have expired or been rescinded
6. All equipment, personnel, and other resources used in emergency spill response actions have been removed from the spill site, other than resources required for sampling, testing, monitoring, assessing the spill site, or for recovery and restoration of the spill site

Lessons-Learned Report

Section 7 of the Spill Reporting Regulation outlines the requirements of a Lessons-Learned Report. Within six months following the emergency response completion date of a spill, a director may order a Lessons-Learned Report from the responsible person. This report must be submitted to the director in the manner and form specified by the director. For additional information on the Lessons-Learned Report, please see the 04 Lessons-Learned fact sheet.

Oil and Gas Exemption

The Oil and Gas Commission (OGC) supports the one window regulation of provincially regulated oil and gas activities. Responsible persons regulated by the OGC under the B.C. Reg. 217/2017 Emergency Management

- Section 5 Update to Minister Report
- Section 6 End-of-Spill Report
- Section 7 Lessons-Learned Report

Fines and Penalties

It is the responsibility of regulated persons, responsible persons, and the owners of substances or things that have the potential to spill to understand and comply with EMA and its associated regulations.

This document is solely for the convenience of the reader and is intended to assist in understanding the legislation and regulations, not replace them. It does not contain and should not be construed as legal advice. Current legislation and regulations should be consulted for complete information.

Failure to be in compliance can result in convictions, fines, and/or imprisonment, as outlined in EMA and its associated regulations.

Additional Fact Sheets

Fact sheets on other relevant topics are published by the Environmental Emergency Program (EEP) and available at:

www.gov.bc.ca/spillresponse

The complete list of available fact sheets:

01 Regulated Person
02 Responsible Person
03 Spill Reporting
04 Lessons-Learned Report
05 Cost Recovery
06 Requirement to Provide Information
07 Spill Contingency Planning
08 Testing Spill Contingency Plans
09 Recovery Plan

For more information, contact the Environmental Emergency Program at: SpillReports@gov.bc.ca

Appendix 1: Initial Report content

Report information	Description
1. Contact information of the individual making the report	First and last name, phone number, and email address
2. Contact information of the responsible person	First and last name, phone number, and email address
3. Contact information for the owner of the substance spilled	First and last name, phone number, and email address
4. Location, date, and time of the spill	Provide as much location specific information as possible, including: general directions, description of how to approach the area, latitude and longitude if available, street address, and the date and time in 24-hour clock format
5. Description of the spill site and surrounding area	Provide a description of the receiving environment of the spilled material (for example, the area is wooded and the ground is soft; there are sensitive riparian areas that are at risk of contamination)
6. A description of the source of the spill	The container from which the material spilled (for example, fishing vessel, above- or below-ground storage tank, tanker truck, pipeline, or railcar)
7. Type and quantity of the substance spilled	An estimate of the amount of product spilled and a description of the product type, including product name, UN number, and Safety Data Sheet [SDS] (for example, diesel, UN 1202, 50 liters). If unknown, a description of the spill (for example, sheen or slick approximately 20 meters by 20 meters)
8. Cause and impact of the spill	The circumstances leading to the spill; the immediate cause as well as any contributing factors. May be a combination of the activity and the incident (for example, motor vehicle accident derailment, equipment failure, fire, human error, intentional/unauthorized release, natural occurrence, or unknown)
9. Details of the actions taken or proposed	Provide any necessary/ helpful details of the actions taken or planned (for example, what steps have been taken to contain the spill, which responders have been deployed, and when they will be on scene)
10. The details of further action contemplated or required	Provide any necessary/ helpful details regarding next steps, including response actions, deployment of additional resources, and monitoring activities

11. The names of agencies on scene	Any persons, government, federal government, local government, or Indigenous agencies
12. The names of other persons or agencies advised concerning the spill	Any persons, government, federal government, local government, or Indigenous agencies

Appendix 2: Prescribed substances and quantities for immediate spill reporting[1]

Item	Column 1 Substance Spilled	Column 2 Specified Amount
1	Class 1, Explosives as defined in section 2.9 of the Federal Regulations[2]	Any quantity that could pose a danger to public safety or 50 kg
2	Class 2.1, Flammable Gases, other than natural gas, as defined in section 2.14 (a) of the Federal Regulations	10 kg
3	Class 2.2 Non-Flammable and Non-Toxic Gases as defined in section 2.14 (b) of the Federal Regulations	10 kg
4	Class 2.3, Toxic Gases as defined in section 2.14 (c) of the Federal Regulations	5 kg
5	Class 3, Flammable Liquids as defined in section 2.18 of the Federal Regulations	100 L
6	Class 4, Flammable Solids as defined in section 2.20 of the Federal Regulations	25 kg
7	Class 5.1, Oxidizing Substances as defined in section 2.24 (a) of the Federal Regulations	50 kg or 50 L
8	Class 5.2, Organic Peroxides as defined in section 2.24 (b) of the Federal Regulations	1 kg or 1 L
9	Class 6.1, Toxic Substances as defined in section 2.27 (a) of the Federal Regulations	5 kg or 5 L
10	Class 6.2, Infectious Substances as defined in section 2.27 (b) of the Federal Regulations	1 kg or 1 L, or less if the waste poses a danger to public safety or the environment
11	Class 7, Radioactive Materials as defined in section 2.37 of the Federal Regulations	Any quantity that could pose a danger to public safety and an emission level greater than the emission level established in section 20 of the "Packaging and Transport of Nuclear Substances Regulations"
12	Class 8, Corrosives as defined in section 2.40 of the Federal Regulations	5 kg or 5 L

[1] If the spill enters, or is likely to enter, a body of water, it is reportable regardless of the quantity
'Federal regulations' refer to the Transportation of Dangerous Goods Regulations under the *Transportation of Dangerous Goods Act 1992*
'Hazardous Waste Regulation' refers to B.C. Reg. 63/88

13	Class 9, Miscellaneous Products, Substances or Organisms as defined in section 2.43 of the Federal Regulations	25 kg or 25 L
14	Waste containing dioxin as defined in section 1 of the Hazardous Waste Regulation	1 kg or 1 L, or less if the waste poses a danger to public safety or the environment
15	Leachable toxic waste as defined in section 1 of the Hazardous Waste Regulation	25 kg or 25 L
16	Waste containing polycyclic aromatic hydrocarbons as defined in section 1 of the Hazardous Waste Regulation	5 kg or 5 L
17	Waste asbestos as defined in section 1 of the Hazardous Waste Regulation	50 kg
18	Waste oil as defined in section 1 of the Hazardous Waste Regulation	100 L
19	Waste containing a pest control product as defined in section 1 of the Hazardous Waste Regulation	5 kg or 5 L
20	PCB Wastes as defined in section 1 of the Hazardous Waste Regulation	25 kg or 25 L
21	Waste containing tetrachloroethylene as defined in section 1 of the Hazardous Waste Regulation	50 kg or 50 L
22	Biomedical waste as defined in section 1 of the Hazardous Waste Regulation	1 kg or 1 L, or less if the waste poses a danger to public safety or the environment
23	A hazardous waste as defined in section 1 of the Hazardous Waste Regulation and not covered under items 1 – 22	25 kg or 25 L
24	A substance, not covered by items 1 to 23, that can cause pollution	200 kg or 200 L
25	Natural gas	10 kg, if there is a breakage in a pipeline or fitting operated above 100 psi that results in a sudden and uncontrolled release of natural gas

BRITISH COLUMBIA
Ministry of Environment and Climate Change Strategy

Update to Minister/End-of-spill Report Form

Environmental Emergency Program
SpillReports@gov.bc.ca

This report template can be completed to satisfy the requirements of either the End-of-Spill Report or the Update to Minister Report. Please specify which report you are completing in section I of this form. If any of the fields of this form are not applicable to the spill for which this form is being completed, indicate 'N/A' in the field; reports with incomplete fields will be sent back to the responsible person.

End-of-Spill Report: Section 6 of the Spill Reporting Regulation outlines the requirements for the End-of-Spill Report. Responsible persons must submit a written End-of-Spill Report to the Ministry of Environment and Climate Change Strategy within 30 days following the emergency response completion date of a spill as outlined in section 6 (1) of the Spill Reporting Regulation. Responsible persons must submit a written report to the Ministry of Environment and Climate Change Strategy as soon as practicable if either of the following two conditions are present:

1. The spill entered, or was likely to enter, a body of water as defined in the Spill Reporting Regulation
2. The quantity of the substance spilled was, or was likely to be, equal to or greater than the listed quantity for the listed substance as outlined in the Spill Reporting Regulation

Update to Minister Report: Section 5 of the Spill Reporting Regulation outlines the requirements for the Update to Minister Report. Responsible persons must submit a written report to the Ministry of Environment and Climate Change Strategy as soon as practicable if any of the following three conditions are present:

1. On request of the Minister
2. At least once every 30 days after the date that the spill began
3. At any time that the responsible person has reason to believe that information previously reported in the Initial Report has become inaccurate or incomplete

Complete this form and submit it by email to SpillReports@gov.bc.ca. For additional information, please visit the British Columbia Environmental Emergency Program Report a Spill webpage.

Dangerous Goods Incident Report (DGIR) number:

Section I: Type of report Sections 5 and 6 of Spill Reporting Regulation	
This form is completed to satisfy the requirements of the: ☐ Update to Minster Report	☐ End-of-Spill Report

Section II: Contact information Section 6 (2) (a) of the Spill Reporting Regulation	
Details for person filling put the report	Name of company representative:
	Company name:
	Email:
	Address:
	Telephone number:

Details for responsible person Same as above ☐	Name of company representative:
	Company name:
	Email:
	Address:
	Telephone number:
Details for owner of the substance spilled Same as above ☐	Name of company representative:
	Company name:
	Email:
	Address:
	Telephone number:

Section III: Timing of the spill
Section 6 (2) (b) of the Spill Reporting Regulation

Date of spill:	Time of spill:	Duration of the spill (days):
Date reported:	Emergency response completion date[1]:	

Section IV: Site description
Section 6 (2) (c) (d) of the Spill Reporting Regulation

Provide a description of the spill site and the sites affected by the spill. The description of the spill site may include a description of the receiving environment, the proximity to a nearby city/town/roadway, the type of vegetation in the area, how densely populated the area is, accessibility to spill site, nearby waterways, and any other defining characteristics of the area.

Latitude:	Degree	Minutes:	Seconds:
Latitude:	Degree	Minutes:	Seconds:
or Site civic address or location:		Street City:	Postal Code:
Or DLS or BCNTS (if applicable):		Site ID number (if applicable):	

[1] For the definition of the *emergency response completion date*, please refer to B.C. Reg. 187/2017 Spill Reporting Regulation

Section V: Description of the source, type, and quantity of the spill **Section 6 (2) (e) (f) of the Spill Reporting Regulation**
Description of the source of the spill (pipeline, rail, truck, facility, etc.):
Type of substance spilled (common name):
United Nations (UN) number of substance spilled (if applicable):
Item number from the table in the Schedule in the Spill Reporting Regulation:
Quantity (in litres or kilograms) of the substance spilled – if the quantity is unknown, provide a reasonable estimate and explain why the quantity is unknown and cannot be determined:
Description of the source of the spill (pipeline, rail, truck, facility, etc.):

Section VI: Description of the circumstances, cause, and impacts of the spill **Section 6 (2) (g) (i) (ii) (iii) of the Spill Reporting Regulation**
Provide a description of the activity during which the spill occurred (transportation, transfer of cargo, fuelling, cleaning, maintenance, etc.):
Provide a description of the incident leading to the spill (tank rupture, overfill, collision, rollover, derailment, fire, explosion, etc.):
Provide a description of the underlying cause of the spill (human error, external conditions, organizational or management failure, etc.):

Section VII: Impacts to human health, the environment, and infrastructure **Section 6 (2) (g) (iv) (v) of the Spill Reporting Regulation**		
Describe any adverse effects of the spill on human health (please state 'N/A' if there were no adverse effects on human health):		
Number of people evacuated:		
Number of fatalities:		
Number of people injured:		
Describe any adverse impacts on infrastructure [2] (please state 'N/A' if there were no adverse impacts to infrastructure):		
Impacts to water		
Was there an impact to a body of water?	☐ Yes	☐ No
Description of impact:		
Describe the body of water (stream, aquifer, fish habitat, naturally formed body of water, ditch, lake, etc.):		
Name of body of water:		
Impacts to the environment		
Was there an impact on flora (vegetation)? ☐ Yes ☐ No	If yes, list the common and species names:	
Provide a description of the impact on flora (oiled, removed, etc.):		
Was there an impact on fauna (animals)? ☐ Yes ☐ No	If yes, list the common and species names:	
Provide a description of impact on fauna (include injured, dead, etc.):		

[2] For the definition of *infrastructure,* refer to section 91.1 of the *Environmental Management Act 2003*

Was there an impact on aquatic and/or terrestrial habitats? ☐ Yes ☐ No	If yes, list the type of habitat (riparian, breeding ground, etc.):
Provide a description of impact on aquatic and terrestrial habitats, including response actions taken to restore any of the impacts listed:	

Section VIII: Spill response actions **Section 6 (2) (h) of the Spill Reporting Regulation**		
Action taken to comply with section 91.2 of the *Environmental Management Act 2003*	Who took the action (company, person, contractor, etc.)	Date that the action was taken (click the arrow or enter the date using the format YYYY-MM-DD)

Section IX: Waste disposal (please state 'N/A' if no waste was produced) **Section 6 (2) (i) of the Spill Reporting Regulation**		
List the type of waste	Method of disposal	Location of disposal

Section X: Attached reports, maps, and photographs **Section 6 (2) (j) (k) of the Spill Reporting Regulation**	
Report of results of sampling, testing, monitoring, and/or assessing carried out during spill response actions (including reports from Qualified Professionals), if applicable	Copy attached ☐
Map of the incident site and areas surrounding the incident site (required)	Copy attached ☐
Photographs of the spill (required)	Copy attached ☐

Section XI: Agencies on scene or notified **Section 6 (2) (l) (m) of the Spill Reporting Regulation**
List the names of all agencies that were at the incident site:
List the names of other persons or agencies that were advised about the spill:

Section XII: Additional comments

Section XIII: Verification of information provided	
I confirm that the above information is true and complete.	
Name of person completing form:	Date completed (YYYY-MM-DD)
Name of responsible person (person or company):	Date completed (YYYY-MM-DD)

Section XIV: Approval - For internal use only	
Reviewed by	Date completed (YYYY-MM-DD)

Save Resent Form

ATTACHMENT B

BC Hydro Chance Find Procedure

Heritage

Before work starts, environmental issues (including heritage) are identified by planners and designers by using the relevant checklist (e.g. DDEC, TEC, PIQ, etc.). In addition, the design drawing and the Work Order should include specific instructions for field crews.

Remember:
Heritage information must not be shared or redistributed without the permission of the Archaeology Branch.

The examples and procedures included in this guide are provided to help field crews understand and identify heritage resources in a field setting, before and during work. If work activities inadvertently uncover what are believed to be human remains, artifacts, or other kinds of heritage resources, ensure the Stop Work Procedures are followed.

The best practices for the field

1. Ensure all crew members (including contractors) have taken the BC Hydro Heritage Awareness Training.
2. Check design drawing and Work order for environmental/heritage instructions.
3. Follow all environmental/archaeological instructions provided in your work plans.
4. Check for any work conditions (e.g., notifications, permits, person on site requirements, etc.).
5. In the field watch for indicators/signs and artifacts or features.
6. Call your manager and your BC Hydro Environmental Representative if you come upon a chance find (suspected human remains or evidence of past human occupation) and follow Stop Work Procedures.

Stop work procedures:

If you find potential **human remains or evidence of past human occupation:**

1. Stop work immediately!
2. Call your Manager and Environmental Representative as soon as possible.
3. Avoid disturbing the site and erect barriers (pylons) or flag off the affected location to prevent further disturbance.

Additional requirements if human remains are found:

- **Your Manager should contact the police and/or coroner.**
- **If the site is a busy location, or has high visibility, assign an employee to stand watch until the police arrive.**
- **Ensure the remains are treated with full dignity and respect by all those at the scene.**

Filing an IMS report

Chance finds and near misses are internally reportable. The responsible BC Hydro manager/representative* is to complete an environmental incident report in the IMS (Incident Management System). The chance find or near miss must be entered within 24 hours.

Notifying BC Hydro Heritage Department

Notify the BC Hydro Heritage Department of all chance finds and near misses at **heritage@bchydro.com** as soon as possible.

On site safety

- Identify primary contractor who is responsible for on-site safety at all times.
- If required on site, the archaeology crew MUST be present for the tailboard.
- Ensure safe work procedures for working around electrical equipment are followed.

* Contractors must inform their BC Hydro contract representative

Local Environment Contact: _____

Heritage Resources
Field reference guide

The term heritage resources refers to places and objects associated with past human culture and history including:

Archaeological sites that contain physical evidence (artifacts or features) of past human activity.

Historical sites that contain architectural and other heritage material for which written documents are available.

It's the law! Heritage places and objects are protected under the Heritage Conservation Act.

BCH18-396 March 2018

BC Hydro
Power smart

Artifacts

An artifact is an object made or modified by humans such as works of art, tools, implements or weapons that indicate historic, ancient or prehistoric settlement or use of an area.

Bone Artifacts

Bone and antler were used to create a variety of tools and objects such as projectile points, chisels, harpoons, fishing lures, needles, spindle whorls, and objects of art and ornamentation.

5cm

Flaked Stone

Flakes or chips can be removed from stones to create stone tools such as projectile points, debitage, cores, cobble tools, microblades and retouched flake tools.

5cm

Pecked Stone Objects

Stones can be pecked or carved into a variety of items such as bowls, net weights and hand mauls.

5cm

Ground Stone Artifacts

Some stone types can be ground into a variety of items such as points, abraders, beads and clubs.

5cm

Wetsite Materials

Organic objects such as rope, cordage, basketry, mats, wooden fish weir stakes, house posts, leather, and bone can be preserved when submerged in water, clay, or any environment free of oxygen.

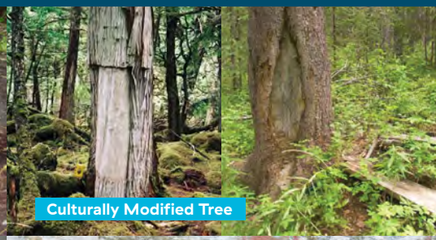
5cm

Features

Features are non-portable elements of historical or archaeological places. Some examples of these are shown below.

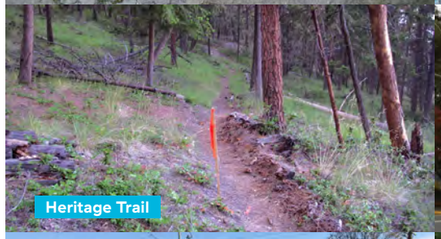
Photo Credit: Millennia Research Ltd., Cordillera Archaeology, Golder Associates, Darcy Mathews, Bert William, BC Hydro, Richard Bruce


Shell Midden


Culturally Modified Tree


Petroglyph


Pictograph


Heritage Trail


Heritage Building


Cemetery


Burial Mound/Cairn


Cultural Depressions


Cultural Stratigraphy

ATTACHMENT C

Watercraft Inspection Checklist

BOAT INSPECTION CHECKLIST

Check these common hiding spots for invasive species:

1) Prop
2) Anchor
3) Bait Bucket
4) Dock lines
5) Hull
6) Rollers
7) Trailer
8) Bunk
9) Axel
10) Live wells
11) Bilge
12) Motor
13) Ballast

1) ☐ _____
2) ☐ _____
3) ☐ _____
4) ☐ _____
5) ☐ _____
6) ☐ _____
7) ☐ _____
8) ☐ _____
9) ☐ _____
10) ☐ _____
11) ☐ _____
12) ☐ _____
13) ☐ _____

Help spread the message, not the mussel at
DON'TMOVEAMUSSEL.CA

OKANAGAN waterwise

CLEAN DRAIN DRY

ATTACHMENT D

Equipment Disinfection Procedure

Equipment Disinfection Procedures to Prevent the Accidental Spread of Aquatic Invasive Species – Version 1.1 June 2009

Contact:

Matthias Herborg, Aquatic Invasive Species Coordinator, Ministry of Environment, B.C.; email: Matthias.Herborg@gov.bc.ca; phone: 250 356 7683

Scope:

The procedures described here are intended to help reduce the risk of spread of the invasive freshwater algae Dydimo or 'rock snot' in B.C., and provide direction on how to prevent the spread of New Zealand mudsnail and zebra / quagga mussel.

Rationale:

The procedures outlined here are best management practises for fieldwork carried out by Ministry staff and its contractors. The introduction and spread of a whole range of non-native aquatic species is posing an increasing risk to fisheries and biodiversity of B.C.'s aquatic environment.

One major pathway for the spread for a range of these organisms is the accidental transport of these 'aquatic hitchhikers' on waders, boats, trailers, nets and other equipment moved between water bodies. Many of these organisms can grow from fragments hardly visible to the human eye, so proper disinfection procedures need to be followed to prevent the spread of aquatic invasive species between watersheds during fieldwork. These procedures describe methodologies which prevent the spread of Dydimo, a microscopic freshwater algae that can form large mats in rivers and streams. However, a range of the methods described here are also successful at preventing the transport of other freshwater species like New Zealand mud snail, Eurasian watermilfoil, and zebra / quagga mussels.

The approach described here is based on general watershed zones, since the distribution data for Dydimo in B.C. is too limited to target specific infested sites.

When to disinfect equipment:

- These procedures aim to prevent the spread of aquatic invaders from infested sites to un-infested sites, particularly if personnel are moving between watersheds which are not naturally connected.

- The current disinfection boundaries (see maps below) are based on ecological drainage units and delimit the minimum level of disinfection required. One exception is the additional disinfection area around the Somas River watershed and the Alberni Inlet area (Vancouver Island). Since this is the only know location of New Zealand mud snail, we request all gear to be cleaned when leaving this area. Whenever equipment is moved across a disinfection boundary, both general and field gear disinfection (Level 1 + 2) is to be conducted.

- Whenever possible a more prudent approach should be adopted, and at least the general procedures (Level 1) are to be used if you move between watersheds within 7 days.

- Additionally, field gear disinfection (Level 2) is to be conducted whenever field gear is returned to storage or a MoE office, and will be used within the next two weeks. As long as an immersion tank or other facilities are set aside for disinfection, this should require very little time.

- The Ministry strongly discourages the use of felt-soled waders, as they are a major pathway for the dispersal of aquatic hitchhikers, including Dydimo, and particularly difficult to disinfect. Newly developed rubber-soled alternatives are available on the market, and provide the same non-slip qualities, but are much easier to clean. Some regions have already moved to rubber-soled waders and are satisfied with their performance.

Procedures:

All removal of fragments or dirt should either take place when leaving the site or in a location where run-off is not going into a water body. DO NOT clean the gear with water from the site as you might just re-contaminate it, unless you use additional disinfection procedures afterwards.

Level 1: General disinfection procedures followed whenever possible as you move to a new site:

- When leaving a waterbody, remove any visible plants and animals from your gear and boat.
- Remove any mud and dirt since they might contain Dydimo or New Zealand mud snails
- Eliminate water from any conceivable item before you leave the visiting area

Level 2: Field gear disinfection procedures:
To disinfect your waders, nets, sieves, buckets, floats, gloves, etc., use **ONE** of the following procedures (see Table 1 for effectiveness). Make sure that all parts of the equipment get fully submerged for the whole time period required:

- Submerge all gear in hot water (45ºC - uncomfortable to touch) for at least 10 minutes, or until soaked through. Felt-soled waders or other absorbent materials need to soak for 40 minutes

OR

- Freeze all gear until solid (> 4hrs)

OR

- Soak in a 2% solution of household bleach for 1 minute

OR

- Soak in a 5% household bleach solution and soak for 15 minutes

Table 1: Effectiveness of different equipment disinfection procedures	Dydimo [1]	New Zealand mud snail[2]	Zebra / Quagga mussel[3]	Fish path ogen [4]	Amphibian pathogen[5]
Immersion in 45ºC water for 10mins (or 40mins for felt-soled waders or absorbent material)	Yes	Yes	Yes	?	?
Freeze until solid (4hrs or more)	Yes	Yes	Yes	?	?
Soak in a 2% solution of household bleach for 1min	Yes	?	Yes (larvae only)	?	?
Soak in a 5% household bleach solution and soak for 15mins	Yes	?	Yes (larvae only)	Yes	Yes

? Indicates that there is currently a lack of information on the effectiveness of this treatment for this species or pathogen

See for source information and more detail:
[1] http://www.biosecurity.govt.nz/didymo
[2]New Zealand mudsnail prevention guide:
http://seagrant.oregonstate.edu/sgpubs/onlinepubs/g06006.html
[3]Stop Aquatic Hitchhikers: http://www.protectyourwaters.net/hitchhikers/
[4]Standard operating procedures for research, evaluation, and development
[5]Hygene protocols for amphibian field staff and researchers, Ministry of Environment, B.C.

Figure 1: Disinfection boundaries for Vancouver Island. Note the additional zone around the Somass watershed to prevent the spread of New Zealand mud snail (green dot).

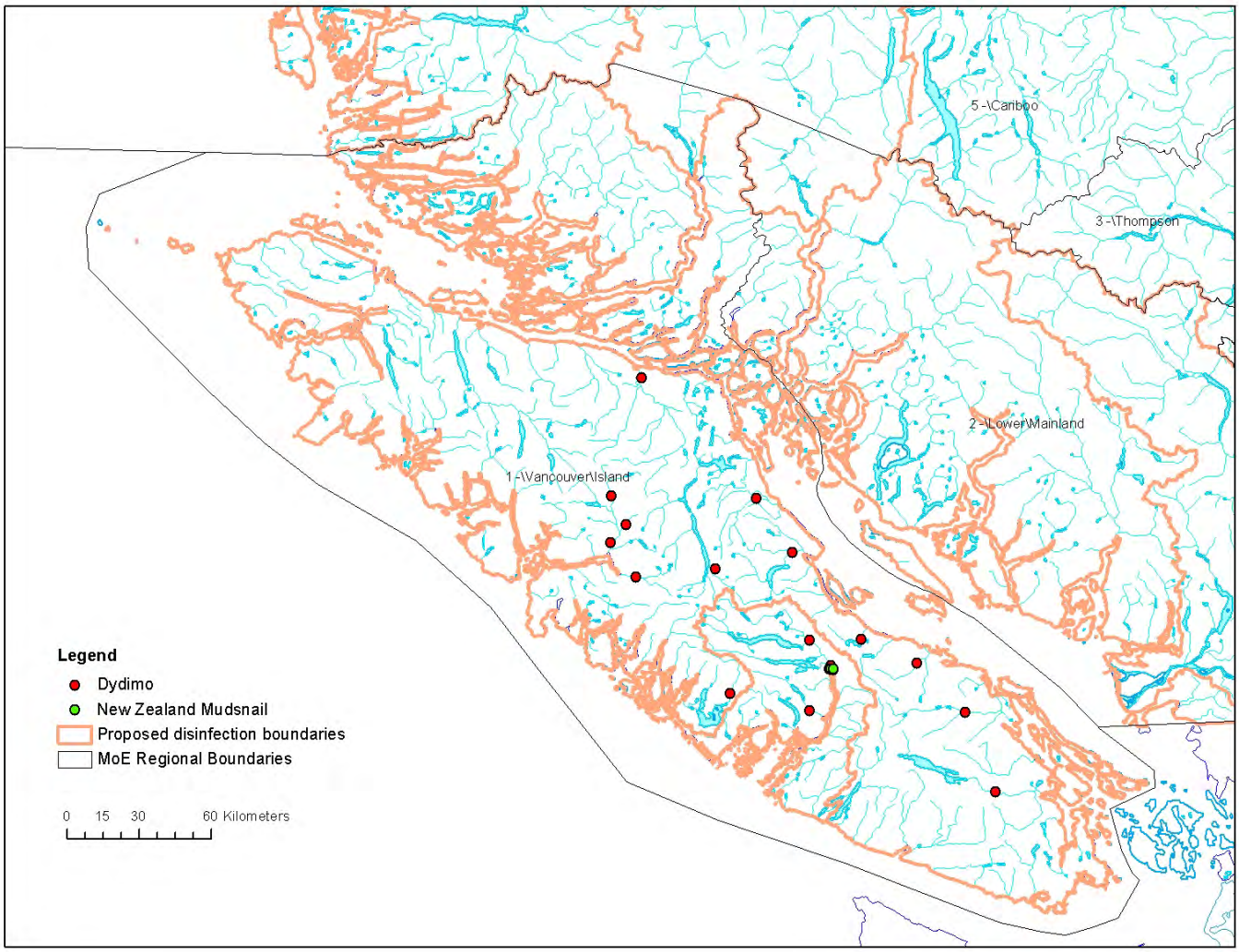


Figure 2: Disinfection boundaries for the Thompson, Lower Mainland, and Okanagan Regions.

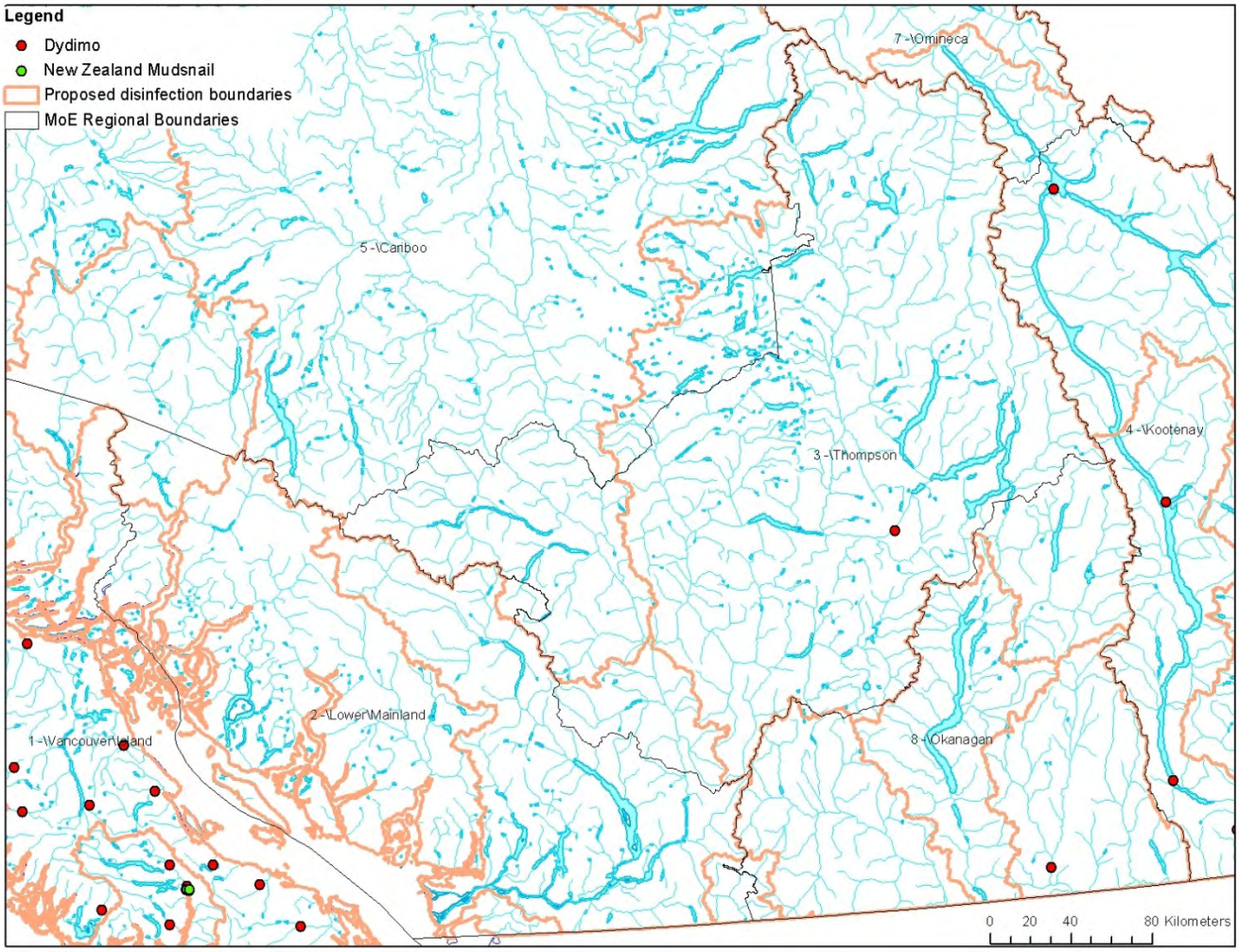


Figure 3: Disinfection boundaries for Kootenay Region.

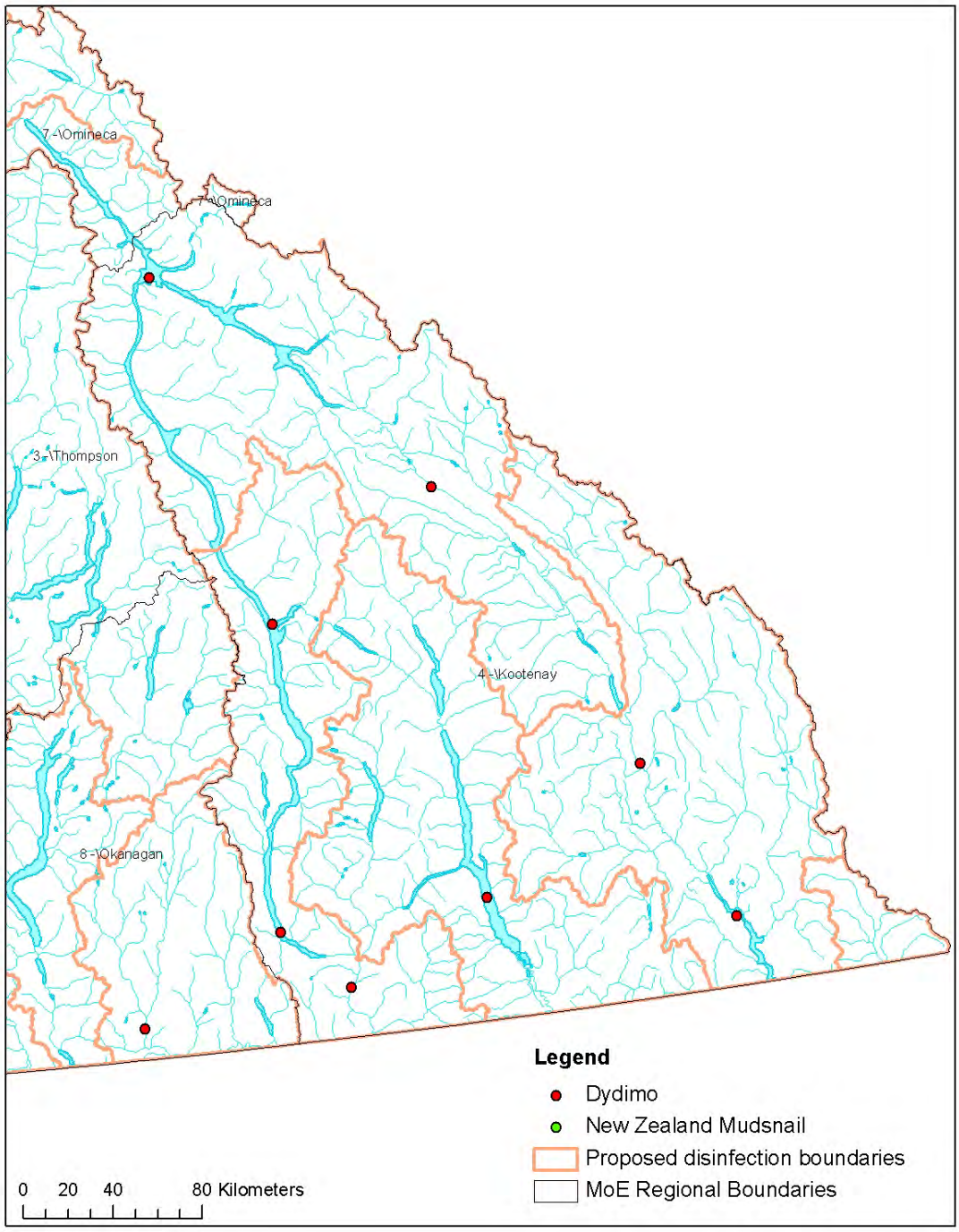


Figure 4: Disinfection boundaries for the Cariboo Region.

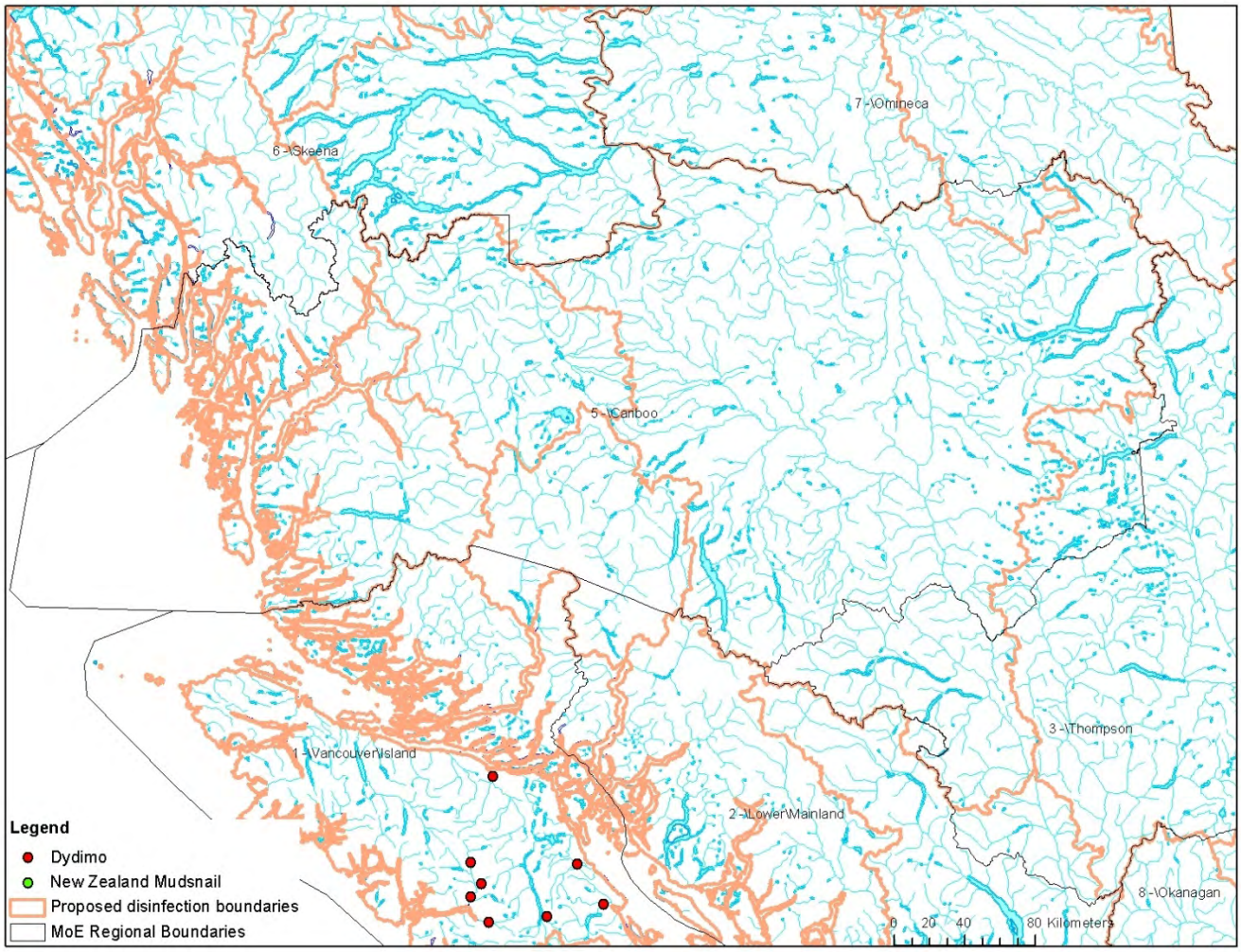


Figure 5: Disinfection boundaries for the Skeena Region.

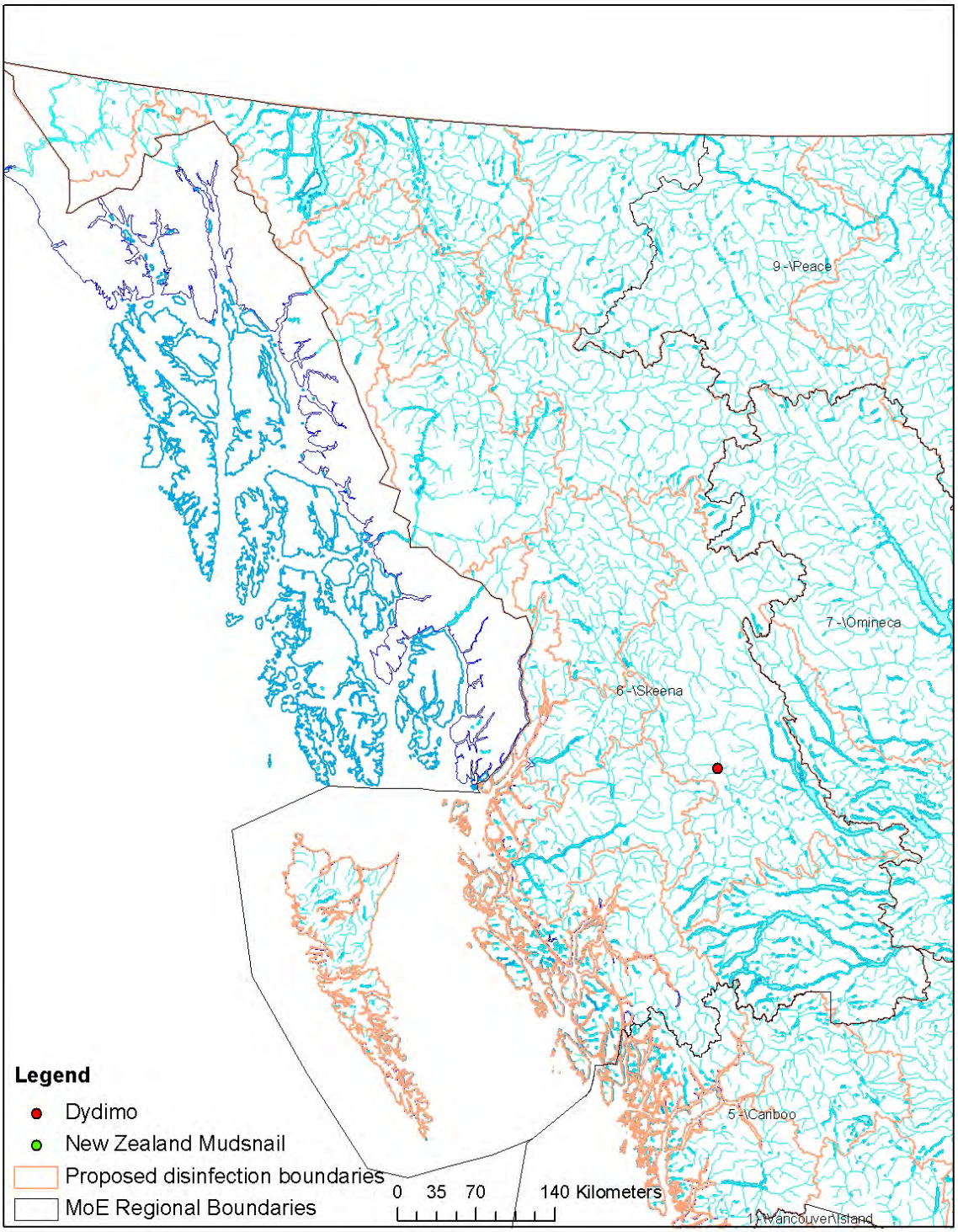
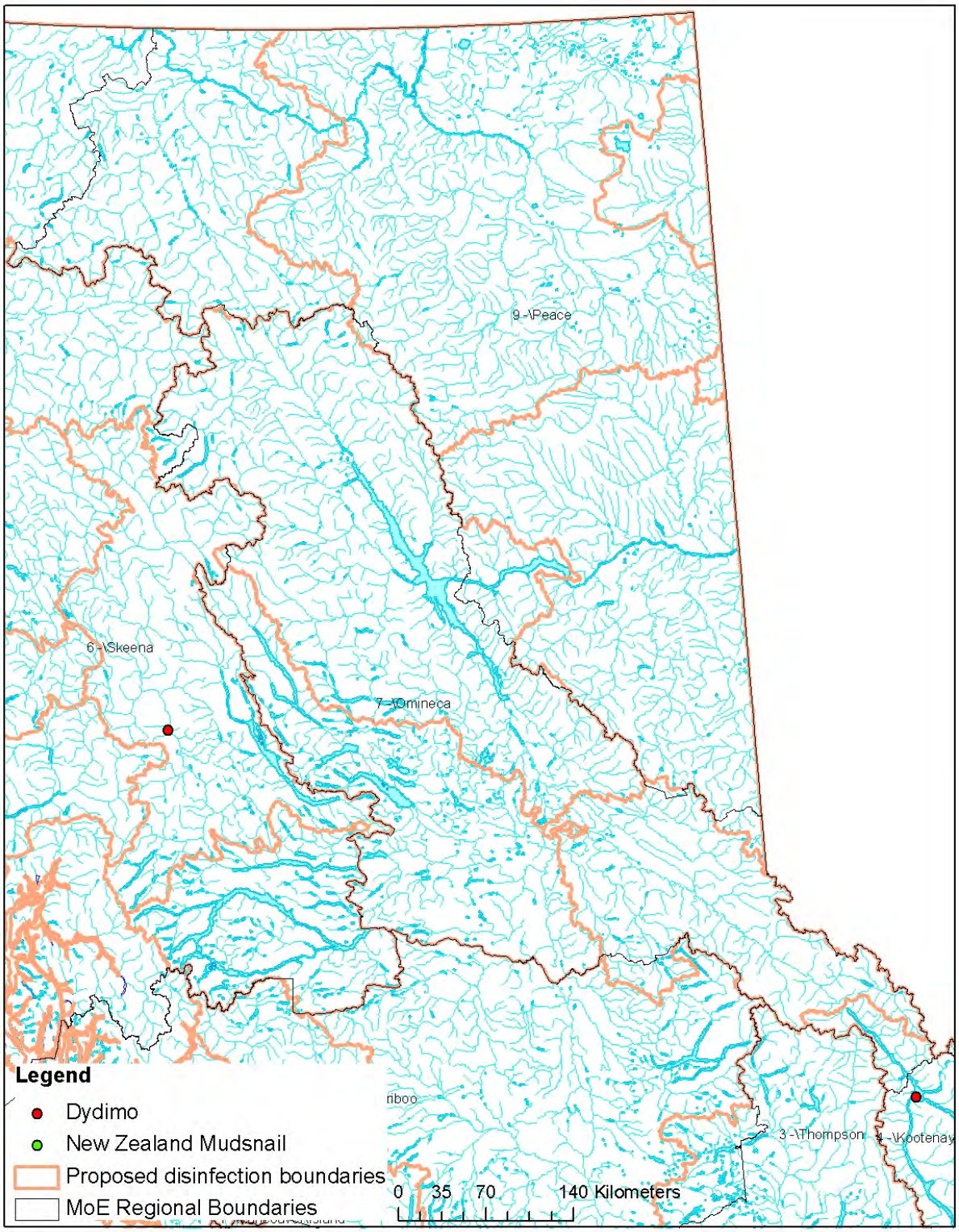


Figure 6: Disinfection boundaries for the Omineca and Peace Region.



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APPENDIX C

Site Photos

Photo 1: Looking upstream at substrate enhancement area from the north bank downstream of the Arrow Lakes Generating Station (12 February 2021).

Photo 2: Looking across the Columbia River at the substrate enhancement area from the south bank river access and laydown area (12 February 2021).

Photo 1: View east of the existing access road to the south bank laydown area and river access (12 February 2021).

Photo 4: View west of the south bank laydown area and river access (12 February 2021).

Photo 2: View west of the south bank riparian habitat below the existing access road and downstream of the south bank laydown area and river access (12 February 2021).

Photo 6: View east of the north bank riparian habitat at the secondary (alternate) laydown area and river access downstream of the Arrow Lake Pumpstation (12 February 2021).

Photo 3: View west of the south bank upstream of the dam, potential laydown/rock stockpile area (12 February 2021).

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APPENDIX E

Environmental Management Plan

GOLDER
MEMBER OF WSP

REPORT

Environmental Management Plan

Lower Columbia White Sturgeon Habitat Restoration CLBWORKS-27 (Phase 2)

Submitted to:

BC Hydro and Power Authority

6911 Southpoint Drive
Burnaby, BC V3N 4X8

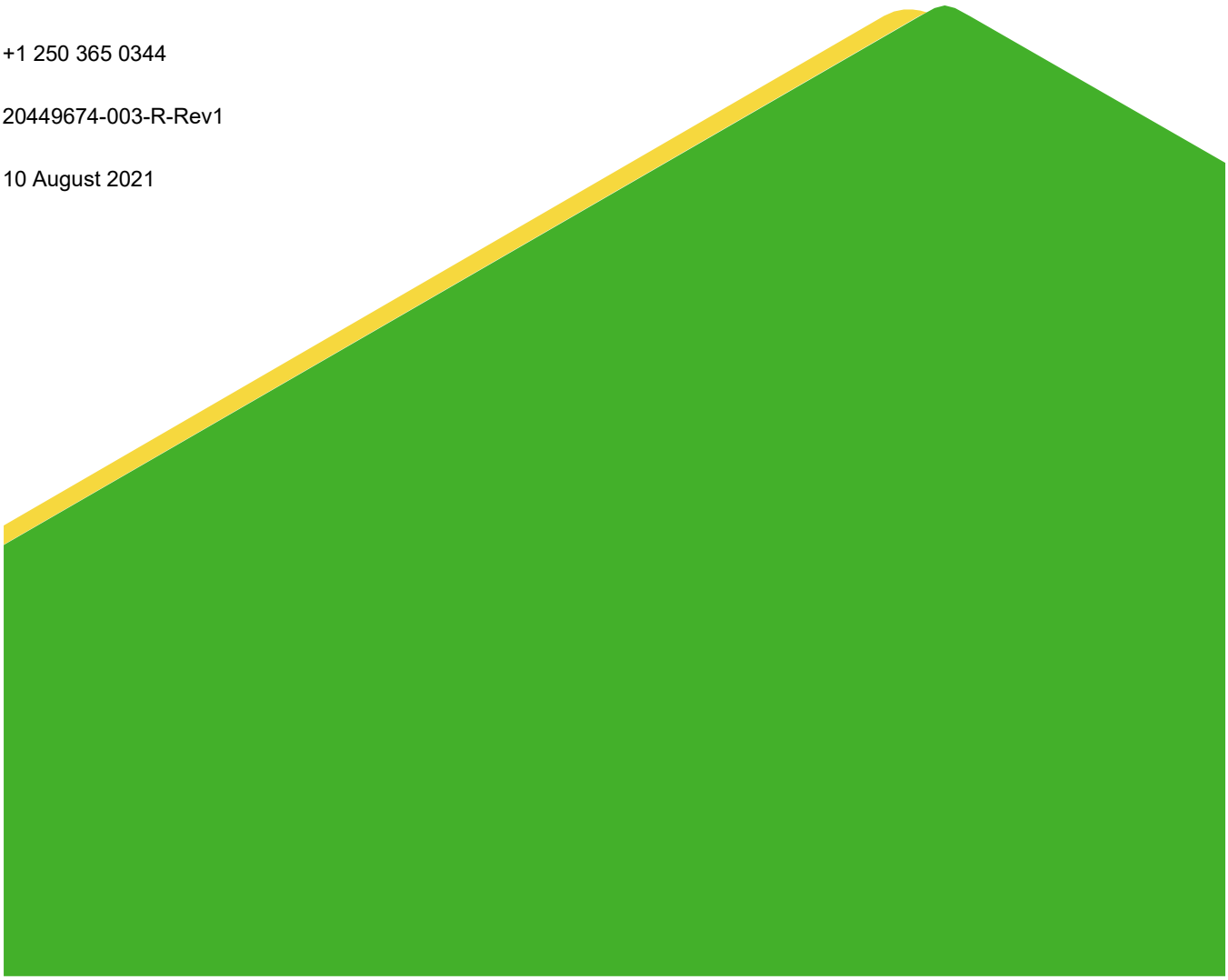
Submitted by:

Golder Associates Ltd.
201 Columbia Avenue, Castlegar, British Columbia, V1N 1A8, Canada

+1 250 365 0344

20449674-003-R-Rev1

10 August 2021



Distribution List

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Table of Contents

1.0 INTRODUCTION 1

1.1 Overview 1

1.2 Environmental Management Plan Objectives 1

2.0 PLANNED WORK 3

3.0 APPLICABLE LEGISLATION 3

4.0 ROLES AND RESPONSIBILITIES 4

4.1 BC Hydro 4

4.2 Contractor(s) 5

4.3 Environmental Monitor (QEP) 5

5.0 POTENTIAL ENVIRONMENTAL EFFECTS 6

6.0 ENVIRONMENTAL MITIGATION MEASURES 6

6.1 Erosion and Sediment Control 7

6.2 Water Quality Monitoring 7

6.3 Spill Prevention and Emergency Response Plan 8

6.3.1 Spill Prevention 8

6.3.2 Spill Response Equipment 9

6.3.3 Emergency Response Procedures 10

6.4 Material Storage and Handling, and Waste Management Plan 13

6.4.1 Hydrocarbon Products 13

6.5 Fisheries and Aquatic Habitat Management and Mitigation 14

6.5.1 Protection from Aquatic Invasive Species 15

6.6 Terrestrial Resource Protection and Mitigation 16

6.6.1 Wildlife 16

6.6.2 Vegetation 17

6.7 Air Quality and Dust Control 17

6.8 Acid Rock Drainage and Metal Leachate Management 18

6.9 Site Restoration 18

7.0 CLOSURE 19

8.0 REFERENCES 20

TABLES

Table 1: BC Water Quality Guidelines for Turbidity (BC MOE 2001) 8

Table 2: Spill Reporting Matrix 11

Table 3: Emergency Contact List 12

FIGURES

Figure 1: Site Plan 2

ATTACHMENTS

Attachment A
Spill Reporting Procedure

Attachment B
BC Hydro Chance Find Procedure

Attachment C
Watercraft Inspection Checklist

Attachment D
Equipment Disinfection Procedure

1.0 INTRODUCTION

1.1 Overview

This Environmental Management Plan (EMP) was prepared for BC Hydro's Lower Columbia White Sturgeon habitat restoration CLBWORKS-27 (the Project) to enhance White Sturgeon (*Acipenser transmontanus pop. 2*) spawning substrate at the Keenleyside White Sturgeon spawning area. The enhancement of spawning substrate is being placed because the level of natural recruitment of the White Sturgeon population residing in the Transboundary Reach of the Lower Columbia River is insufficient to maintain a self-sustaining population. The Project consists of hauling substrate, storing the substrate material in the laydown area, and loading it onto a barge for placement in the instream Enhancement Area. These activities will occur in the Project Area and are shown in Figure 1.

1.2 Environmental Management Plan Objectives

Environmental protection through adherence to applicable legislation, regulatory approvals, and standard management practices are required for the Project. The objective of this EMP is to assist Project personnel in adhering to applicable environmental legislation and recommend environmental mitigation specific to installation of the spawning substrate. The EMP provides performance-based environmental requirements, standard protocols, and mitigation measures that are intended to reduce potential for adverse environmental effects during Project implementation. The EMP describes how environmental risks are to be managed and, in the event of an environmental incident, how emergency response procedures, mitigation measures, and reporting protocols are to be implemented.

In general, the EMP:

- Describes the environmental management responsibilities for the work.
- Describes the necessary organizational lines of reporting and communication.
- Outlines applicable environmental legislation requirements, guidance documents, and best management practices (BMPs).
- Provides an overview of key environmental issues related to the Project.
- Recommends mitigation measures to manage potential adverse effects on fish including species at risk, and their habitats within the Columbia River during implementation of the Project.

NOT ISSUED FOR CONSTRUCTION

LEGEND

- EXISTING RIVER BED SURFACE
- SUBSTRATE PLACEMENT AREA
- TOPOGRAPHIC EXTENTS

NOTES

1. ALL UNITS ARE IN METRES UNLESS OTHERWISE NOTED.
2. COORDINATE SYSTEM IS UTM NAD 83, ZONE 11.
3. EXISTING GROUND CONTOURS ARE SHOWN AT 1 m INTERVAL RELATIVE TO CGVD 2013.

REFERENCES

1. IMAGE ©2021 GOOGLE, OBTAINED FROM GOOGLE EARTH PRO, USED UNDER LICENSE. GOOGLE EARTH IMAGE IS NOT TO SCALE.
2. BATHYMETRY SURVEY CONDUCTED BY GRANT LAND SURVEYING INC, ON JULY 01, 2019.

CLIENT
BC HYDRO

CONSULTANT
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2021-06-10
DESIGNED	RC
PREPARED	GB
REVIEWED	GT
APPROVED	RA

PROJECT
CLBWORKS-27 LOWER COLUMBIA RIVER WHITE STURGEON PHYSICAL WORKS (PHASE 2)

TITLE
SITE PLAN

PROJECT NO.	PHASE/TASK	REV.	FIGURE
20449674	1000/1400	A	1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI D

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2.0 PLANNED WORK

An existing access road will be used to access the preferred laydown area location at the south shore of the Columbia River at the upstream boundary of the Project Area, immediately downstream of HLK Dam (Figure 1). The south shore downstream of HLK Dam is the preferred access and laydown area; however, there is potential that the north shore downstream of the dam or the south shore upstream of HLK Dam may be used as a contingency laydown area to stockpile material and load the barge.

Although there is an existing path to the river access and laydown areas, temporary improvements such as the importation of gravel and grading may be required to create a suitable roadbed. Rig mats or similar may also be used if required to support equipment. The access road, laydown area and barge loading area are previously disturbed from historical dam construction activities and contain minimal riparian vegetation.

The material required for the Project consists of approximately 3,540 m³ of a multiple grain size mixture of gravel and cobble that will be stable and resistant to infilling by fines and consisting of different proportions of material within a range suitable for sturgeon spawning (20 to 300 mm). The substrate will be placed from a barge using long reach excavator or a crane with a clam shell attachment to a thickness of approximately 0.6 m

Substrate material will preferably be supplied by a local quarry. Hauling will be via highway dump trucks. The preferred hauling route will be along Highway 3A to the Robson Access Road to Columbia Avenue and Lower Arrow Lakes Road. A laydown area located at the south downstream bank will be used to stockpile substrate material until it is loaded to the barge. Hauling will be completed throughout the Project duration.

During construction, a front-end loader will load gravel material from the stockpile to the barge, a tugboat will transport the barge from the loading area on the south riverbank to the gravel Enhancement Area where the barge will be anchored, and a long reach excavator (or crane with clamshell) located on the barge will place the substrate on the riverbed. Temporary anchor piles and/or tugboats will be used to stabilize the barge in place during the placement of substrate.

3.0 APPLICABLE LEGISLATION

A summary of the federal, provincial and municipal statutes and guidelines that are potentially applicable to the Project are provided below. Mitigation measures outlined in Section 6.0 have been developed in accordance with the following federal and provincial guidelines and will be adhered during Project works:

- Develop with Care: Environmental Guidelines for Urban and Rural Land Development (BC MFLNRO and BC MOE 2014),
- Standards and Best Management Practices for Instream Works (BC MWLAP 2004),
- A Field Guide to Fuel Handling, Transportation and Storage (BC Ministry of Water, Land, and Air Protection (MWLAP 2002),
- British Columbia Approved Water Quality Guidelines (MOE 2018), and
- Canadian Environmental Quality Guidelines (Canadian Council of Ministers of the Environment [CCME] 2013).

Applicable regulations and guidelines may include:

- *BC Water Sustainability Act*

- *BC Environmental Management Act*
- *BC Wildlife Act*
- *BC Transport of Dangerous Goods Act*
- *BC Weed Control Act*
- *Federal Transportation of Dangerous Goods Act*
- *Federal Fisheries Act*
- *Federal Migratory Birds Convention Act*
- *Federal Species at Risk Act*
- *Hazardous Waste Regulation*
- *Spill Reporting Regulation*
- *Water Sustainability Regulation*

4.0 ROLES AND RESPONSIBILITIES

4.1 BC Hydro

BC Hydro has overall responsibility for the administration of contracts, including their environmental requirements which includes the following:

- Overall responsibility for compliance with terms and conditions of regulatory permits, approvals, and authorizations.
- Delegates authority and communicates requirements as required on all aspects of the Project.
- Communicates directly with regulatory agencies, interested, and potentially affected First Nations, and public stakeholders, as required.
- Oversees technical quality control, adherence to and performance of engineering requirements of contract specifications, schedules, and costs.
- Appoints a Qualified Environmental Professional (QEP) to evaluate and report on compliance of the Contractor(s) work procedures and practices with environmental requirements established in this EMP.
- Ensure that field crews and Contractor(s) show proof that they have taken BC Hydro environmental and safety training and are aware of the environmental requirements of the work and are trained and competent to implement them.
- Conduct an environmental orientation to review the Environmental Management Plan and ensure effective environmental communication with work crews and subcontractors so that environmental responsibilities and requirements are understood prior to the commencement of the Project and are implemented through tailboard and other meetings.
- Implement appropriate work procedures, instructions, and controls to prevent and/or reduce adverse environmental impacts.

- Adhere to requirements set out in this EMP and Contract documents.
- Have taken BC Hydro Heritage Awareness Training.
- Contact the QEP should the scope or schedule of the Project change. Identify the timing, limits of the construction zones, and changes in conditions of the environment or construction practices.

4.2 Contractor(s)

Contractor(s) will be responsible for adhering to proposed environmental mitigation measures and regulatory requirements outlined in this EMP. In meeting the environmental requirements of the Project, Contractor(s) will be required to:

- Participate in a Project Kick-off meeting to review the work plan and objectives, health and safety, environmental mitigation and confirm the onsite crew have an appropriate level of training and competency to perform the work.
- Evaluate effective communication to confirm the onsite crew are aware of the environmental issues and requirements, and their responsibilities are understood prior to the commencement of work.
- Implement appropriate work procedures and controls to prevent and/or reduce the potential for adverse environmental impacts.
- Inspect the work practices to evaluate adherence to regulatory and EMP requirements.
- Have taken BC Hydro Heritage Awareness Training.
- Verify that emergency spill response materials are available on site for immediate use and appropriately stocked.
- Respond immediately and effectively to environmental incidents including leaks and spills.

4.3 Environmental Monitor (QEP)

A suitably qualified, trained and experienced Environmental Monitor (EM) be retained to oversee the works. The primary roles and responsibilities of the EM are to promote protection of the environment and to monitor compliance with environmental laws, permits, and approvals, and effective implementation of mitigation measures employed by the work crew. The EM will work closely with the Contractor crew to suspend activities or operations which are in contravention of environmental legislation, permits, and approvals; or have the potential to cause environmental damage.

The responsibilities of the EM include the following:

- Attend the pre-construction meeting and/or tailboard meetings and communicate environmental sensitivities and environmental requirements of the work to on site crew including Contractor(s) personnel.
- Available to be on site during the construction period and present during high risk or environmentally sensitive activities.
- Communicate with BC Hydro representative during construction activities providing regular updates and inform immediately in the case of an incident.

- Conduct biological field surveys (i.e., terrestrial wildlife and bird nest sweeps), as required.
- Supervise implementation of the mitigation measures and BMPs outlined in this EMP. Assist the contractor with these measures and recommend additional mitigation measures, as required.
- Evaluate the effectiveness of the mitigation measures being applied.
- Confirm Contractor(s) are implementing mitigation measures and complying with regulatory requirements.
- Have taken BC Hydro Heritage Awareness Training.
- Make visual observations during Project works and conduct water quality monitoring (as needed).
- Oversee the installation of erosion and sediment controls and other mitigation measures as specified in the EMP.
- Monitor water quality during the works. Turbidity levels exceeding provincial water quality criteria will result in a temporary work stoppage until the cause of turbidity is identified and corrective actions are taken.
- The EM will prepare a final summary report for submission to the provincial government and DFO that summarizes the work completed and includes a summary of environmental incidents, if any, mitigation measures implemented, and the corrective actions taken or to be taken, such as environmental mitigation or enhancement works.
- In the unlikely event of an environmental incident, the EM will provide a report to the client, and if warranted, to applicable regulatory agencies as soon as practicable but within 24 hours of their response to an incident. See guidance in Attachment A.

The EM has the authority to modify or halt any activity that is causing, or potentially causing, damage to fish and wildlife populations or their habitats.

5.0 POTENTIAL ENVIRONMENTAL EFFECTS

Based on the nature of the work activities involved, potential environmental effects include:

- Spills to the environment from vehicles and equipment.
- Surface water quality effects related to pathway access activities adjacent to the Columbia River.
- Fish and aquatic habitat effects due to instream work activities.
- Air quality effects from heavy equipment.
- Accidental impacts to archaeological artifacts (refer to BC Hydro Chance Find Procedure in Attachment B).
- Transport and spread of invasive species.
- Wildlife and wildlife habitat effects related to work activities.

6.0 ENVIRONMENTAL MITIGATION MEASURES

The following environmental mitigation measures may be implemented during the work activities to achieve compliance with the Project's environmental requirements.

6.1 Erosion and Sediment Control

Surface water quality and sediment management activities must be in compliance with associated environmental legislation, regulations, standards, and guidelines. Release of suspended sediment to the Columbia River from Project-related activities is considered a deleterious substance that can adversely affect fish and fish habitat. The crews will make all practical efforts to implement sound measures of erosion control.

The EM will continuously monitor the effectiveness of erosion and sediment control measures and general mitigation measures described below.

- Limit the speed of vehicles and equipment working onsite to reduce dust disturbance. Apply dust suppressants as required to areas where mobile equipment will be operating, particularly during dry weather periods or high wind events. Water sprayed for dust suppression will be accessed from a local source.
- Ensure that all vehicles hauling materials to or from the Site use appropriate measures to prevent dust dispersion and loss of fine material such as covers or protective devices. All sediment tracked out of the Site and on to adjacent roadways shall be removed so that it does not have the potential to enter watercourses.
- As part of their Site setup activities, the contractor will install silt fencing around the perimeter of the on-shore work area. The EM will inspect the layout of the silt fencing as well as inspect the effectiveness of the silt fencing throughout the Project duration. Silt fencing shall be installed, as required, in locations that prevent sediment from work areas or sediment-laden runoff from entering the Columbia River.
- To reduce turbidity during placement, the substrate that is to be placed in the Enhancement Area should be thoroughly washed at the source quarry to remove sand size and finer sediments prior to being hauled to the Project Area.
- Limit soil disturbance, soil compaction, and vegetation removal at the Site to only those areas required to complete the works. Re-vegetate the Site where necessary as soon as possible following works to limit the potential for erosion and dust generation.
- Halt works during periods of heavy precipitation and runoff to minimize soil disturbance. Ensure that erosion and sediment control measures are capable of continuous function during both working and non-working hours.
- Store additional erosion and sediment control materials (i.e., silt fencing) onsite for immediate use in case of an emergency event. All stored and used erosion and sediment control measures shall be removed from the Site once the Project is complete.

6.2 Water Quality Monitoring

Turbidity measurements in the Columbia River will be taken prior to Project implementation and will be used as a baseline level for comparison purposes to Project related generation of turbidity. The EM will conduct turbidity monitoring at two locations:

- Upstream: Approximately 100 m or as far as practicable, up to 100 m upstream of where works are occurring.
- Downstream: Approximately 100 m downstream from where works are occurring.

At the downstream location, turbidity measurements will be collected throughout the entire water column. The frequency of monitoring will be determined based on the EM's judgement; at a minimum, turbidity measurements will be taken at hourly intervals whenever work is occurring below the high water mark (HWM) of the Columbia River. The frequency of water quality sampling should be increased to every half hour if a visible sediment plume is identified.

Three turbidity measurements will be taken from a single sample using a turbidity meter and the average of the three turbidity readings used as the reported turbidity value. During environmental monitoring, visual observations will also be made to identify the potential for mobilization of sediment.

The Contractor must temporarily pause work if turbidity in the Columbia River at the downstream sampling location exceeds the values listed in Table 1 (compared to background turbidity levels), and the EM and contractor should take immediate steps to control the source of the turbidity and attempt to rectify the situation prior to restarting work. Work should not be restarted until turbidity has decreased to background levels.

Table 1: BC Water Quality Guidelines for Turbidity (BC MOE 2001)

Water Use	Maximum Induced Turbidity (NTU or% of Background)	Maximum Induced Suspended Sediments (mg/L or% of Background)
Aquatic Life	Change from background of 8 NTU at any one time for a duration of 24 hrs in all waters during clear flows or in clear waters.	Change from background of 25 mg/L at any one time for a duration of 24 hrs in all waters during clear flows or in clear waters.
	Change from background of 2 NTU at any one time for a duration of 30 days in all waters during clear flows or in clear waters.	Change from background of 5 mg/L at any one time for a duration of 30 days in all waters during clear flows or in clear waters.
	Change from background of 5 NTU at any time when background is 8-50 NTU during high flows or in turbid waters.	Change from background of 10 mg/L at any time when background is 25 to 100 mg/L during high flows or in turbid waters.
	Change from background of 10% when background is >50 NTU at any time during high flows or in turbid waters.	Change from background of 10% when background is >100 mg/L at any time during high flows or in turbid waters.

6.3 Spill Prevention and Emergency Response Plan

The release of deleterious substances, such as hydrocarbons, can impact soil and water quality, aquatic birds, mammals, and fish as well as vegetation and other wildlife found in the Project Area. The Spill Prevention and Emergency Response Plan is intended to satisfy, among others, the *British Columbia Fire Code*, National Fire Code, Occupational Health & Safety Regulations, and *Transportation of Dangerous Goods Act*. The following spill prevention and emergency response measures will be implemented, where appropriate or as requested by the QEP.

6.3.1 Spill Prevention

- Prior to the commencement of Project activities, the Emergency Response Procedures should be identified including the names and telephone numbers of persons and organizations that may be contacted in the event of an environmental incident. The Emergency Response Procedures will be made available in the Project Area, and will be posted in a location that is visible and accessible nearby the emergency response equipment in the event of an environmental incident.

- All field personnel will be made aware of the location of Emergency Spill Response equipment and the procedures necessary to contain spills of any fluid.
- The barge surface and sides must be free of holes or cracks so that any accidental spills on the surface do not runoff and enter the water.
- Equipment will be inspected prior to use and daily for signs of leakage. Daily visual inspections will include confirming that all personal protective equipment and other emergency response equipment are in place.
- Where on site fuelling or maintenance of vehicles, the tub boat and equipment is required, the following mitigation measures will be implemented:
  - Transportation of fuels will be conducted in accordance with Transportation of Dangerous Goods Regulations. Fuel storage and handling will comply with A Field Guide to Fuel Handling, Transportation and Storage (MWLAP 2002).
  - All fuelling of land equipment and vehicles must occur more than 30 m from the Columbia River.
  - Refuelling of land based mobile equipment that is working on the barge should be completed in the laydown area, greater than 30 m form the edge of the river.
  - All equipment on the barge using hydrocarbons requires spill containment (i.e., spill containment/drip trays) that has the capacity to contain 110% of the amount of liquids in the equipment.
  - Nozzles will be equipped with automatic shut offs or a drip-free dispensing nozzle will be used; A drip tray or pan will be used to collect excess fuel, oil, or other hazardous materials to avoid contamination of soils.
  - Spill kits will be readily available during refuelling and personnel will be knowledgeable in the use of spill response materials.
  - No ignition sources will be permitted within the fuelling area.
  - Vehicles will not be left running during refuelling. Fire extinguishers and spill kits must be kept in the area of fuel storage and handling. Fuelling tanks, hoses, pipes and fittings will be inspected daily and any leaks repaired immediately.
  - The Contractor's Site Lead will verify that there are personnel stationed at both the fuel source and the equipment receiving the fuel during equipment refuelling, and effective communication protocols shall be followed to prevent accidental release or overfilling of the equipment.
- Any equipment that is stationary for more than two hours should have spill containment placed under it and all vehicles should be inspected daily for leaks.
- At the end of each working day, land construction equipment containing hydrocarbon fluids or grease will be removed more than 30 m from any stream or other body of water. Spill containment / drip trays on the barge will be provided under equipment on board with the potential to release oils.

6.3.2 Spill Response Equipment

- Spill containment kits must be available on every piece of portable or heavy equipment and contain sufficient materials for addressing the anticipated maximum spill from a given piece of equipment. Equipment containing ethylene glycol (antifreeze) or other water-soluble chemicals will carry an appropriate number of water soluble chemical absorbent pads in addition to absorbent pads used for petroleum products.

- Inspections will be completed by the QEP at regular intervals throughout the Project to compare current contents of spill containment kits with required contents, whenever a spill kit is used, and whenever a new piece of equipment comes on site.
- A fully stocked large spill containment kit must be present on site at all times, located within the laydown area and on the barge, and be easily accessible.
- Spill containment kit contents shall be consistent with requirement outlined in Table 9.3 of A Field Guide to Fuel handling, Transportation and Storage (MWLAP 2002).
- A fully stocked large spill containment kit must be present on the barge at all times, and easily accessible.
- Spill kits will be maintained on site during Project works and located on the barge and next to the instream work area. The spill kits will include aquatic containment booms readily available for easy deployment in the event of a spill or leak of hydraulic fluids, fuel, or other deleterious material.
- Employees will be trained in the use of spill response equipment, including the location, type, and correct deployment of spill response equipment relating to the nature and location of work and potential for on site spills, and distinguishing between grey absorbent pads used for water soluble chemicals and white pads used for petroleum products.

6.3.3 Emergency Response Procedures

The Contractor should review the document “6 Steps of Spill” prior to commencing the work. If an environmental incident occurs, including a spill of fuels, oils, lubricants or other harmful substances, the following procedures will be implemented, as described below:

1) **MAKE THE AREA SAFE**
2) **STOP THE FLOW/ENVIRONMENTAL EFFECTS (when possible and safe to do so)**
3) **REPORT THE SPILL**
4) **SECURE THE AREA**
5) **CONTAIN SPILLS**
6) **NOTIFICATION (EMBC 1-800-663-3456)**
7) **CLEAN-UP**
8) **INCIDENT REPORT**

1. MAKE THE AREA SAFE

- Evaluate risk to personnel/public and environmental safety.
- Wear appropriate Personal Protective Equipment.
- Never rush in, always determine the product spilled before taking action.
- Warn people in the immediate vicinity.
- Verify that no ignition sources are present if a spill of a flammable material has occurred.

2. STOP THE FLOW/ENVIRONMENTAL EFFECTS (when possible and safe to do so)

- Act quickly to reduce the risk of environmental effects.

- Close valves shut off pumps or plug holes/leaks.
- If a spill has occurred, stop the flow or the spill at its source.

3. REPORT THE SPILL

- Notify BC Hydro, the Environmental Lead and the Lead Environmental Monitor or alternate of incident (provide details).

4. SECURE THE AREA

- Limit access to the area of the environmental incident.
- Prevent unauthorised entry onto the Project Area.

5. CONTAIN SPILLS

- Block off and protect drains and culverts, if present.
- Prevent spilled material from entering drainage watercourses, wetlands, ditches, or known or potential painted turtle nesting sites.
- Use spill sorbent material to contain the spill. Spill response equipment on-site is listed below.
- If necessary, use a dyke or other method to prevent discharge on-site.
- Make every effort to reduce contamination.

6. NOTIFICATION – as per Table 2 below and the attached Emergency Contact List (Table 3)

Within 24 hours of discovery, determine appropriate internal and regulatory notification obligations and notify appropriate personnel.

When necessary, the first external call will be made to Environmental Emergency Program (1-800-663-3456) (24 Hour). Spills would then be reported to the appropriate ministries/agencies according to Table 2 below to allow for immediate response (as required) by appropriate staff. For spills to aquatic habitat, collection of water samples will be required to characterize the nature and extent of the release.

Table 2: Spill Reporting Matrix

Substance	Quantity	External Reporting Requirements	Internal Reporting Requirements
Any Spill	Any amount that enters or likely to enter aquatic habitat	Environmental Emergency Program (EEP)	Environmental Incident Report (EIR), BC Hydro
Oil and oil waste	>100 litres (L)	EEP	EIR, BC Hydro
Oil with >50 ppm PCB (PCB Wastes)	>25 kilograms (kg) or L	EEP	EIR, BC Hydro
Flammable or Non-Flammable Gas	10 kg	EEP	EIR, BC Hydro
Flammable Liquids	100 L	EEP	EIR, BC Hydro

Note: Adapted from the spill reporting schedule provided in the Spill Reporting Regulation of the BC *Environmental Management Act* (Government of BC 2017); PCB – polychlorinated biphenyls. ppm – parts per million.

7. CLEAN-UP

- Determine cleanup options.
- Mobilize recovery equipment and cleanup crew and direct cleanup activities. Clean-up procedures and residue sampling should be in compliance with BC Ministry of Environment and Climate Change Strategy (BC ENV) regulations.
- Dispose of all equipment and/or material used in clean up (e.g., used sorbent, oil containment materials, etc.) in accordance with BC MOE requirements. Disposal of hazardous wastes (e.g., material with >3% oil by mass) and contaminated soil must comply with the *Environmental Management Act* and Regulations
- Replenish spill response kits and equipment.

8. INCIDENT REPORT

Provide the required information about the incident to BC Hydro and the Environmental Monitor, including mitigation to be put in place to avoid further incidents. A template for spill reporting can be found in Attachment A. A list of emergency contacts is summarized in Table 3.

Emergency Contact List

An emergency contact list will be posted in a visible and accessible location on the Project site. General emergency contact numbers are outlined in Table 3 below. Once the Contractor is selected additional contacts will be added to this preliminary list.

Table 3: Emergency Contact List

Organization	Contact Number(s)
Emergency Management BC (EMBC)	1-800-663-3456
Spill Reporting Line ECCC	604-666-6100
Emergency Response Services	911
WorkSafeBC	1-888-621-7233 1-866-922-4357 (after hours)

Emergency Response Equipment

Emergency Response Equipment to be available on-site will consist of the following:

- Fire Extinguisher
- First-aid Kit
- Spill Kit (Located in all vehicles and in containers present in work areas)
- Portable Water Pump

At a minimum, spill kits will be maintained and fully stocked with materials suitable to respond to the volumes of hazardous substances on the barge and within the laydown and barge loading areas (hydrocarbons, lubricants, toxic substances, etc.). Spill kits are to be made available in suitable locations and stored within known, readily available containers.

6.4 Material Storage and Handling, and Waste Management Plan

Mitigation measures for material storage, handling, and waste management related to proposed work activities include:

- Wastes and hazardous materials (such as sorbent material, air and oil filters, hydraulic fluids and petroleum products generated during the servicing of equipment) will be stored in an environmentally acceptable location greater than 30 m away from the Columbia River until disposal at a qualified facility is coordinated. Maintenance of mobile equipment should also be conducted greater than 30 m away from the Columbia River.
- Reasonable efforts will be made to reduce, reuse, and/or recycle to limit the amount of material being disposed of. All wastes will be disposed of in compliance with applicable legislation such as the *Environmental Management Act*.
- Food waste and domestic garbage will be collected daily from work and access areas and will be disposed of off-site in an appropriate and safe manner. Other construction waste will be collected daily and placed in the appropriate receptacle.
- Hazardous waste registration, storage, permitting, and transportation requirements will be met, if applicable, and waste materials will be removed from the site as soon as possible in accordance with applicable standards and regulations.
- The Ministry's Representative will be responsible for maintaining Safety Data Sheets (SDS) for all potentially hazardous products used during the work.
- On site burial or burning of wastes will not occur.
- Temporary sanitary facilities in the form of portable toilets will be provided, secured so they do not fall over, located more than 30 m from any waterbody, and locked at the end of each shift.

6.4.1 Hydrocarbon Products

The excavator operating on the barge should contain environmental friendly hydraulic oil and fluids. However, hydrocarbon products are expected to be required to complete the Project. The following mitigation measures will be implemented to reduce potential for spills of hydrocarbon products:

- Plastic containers used to carry petroleum products will be designed for that purpose and will not be more than 5 years old.
- Containers will be fitted with a proper fitting cap or lid.
- All containers containing hydrocarbon products will be labelled and transported according to the Transportation of Dangerous Goods Regulations.
- Containers under 23 litres (5 gallons) will be stored and transported in the equipment box of a vehicle that is capable of containing the total quantity of the fuel in the container should it leak or spill.
- Containers greater than 23 L (5 gallons), including 205 L (45 gallon) drums, must be transported upright and secured to prevent shifting and toppling.

- Tanks, barrels, and containers greater than 23 L (5 gallons) containing hydrocarbon products must be stored within impermeable containment area(s) designed to contain 110% of the volume of the largest container. Impermeable containment is required for stationary fuel storage as well as mobile fuel storage (i.e., fuel trucks) when remaining on site overnight.

6.5 Fisheries and Aquatic Habitat Management and Mitigation

The construction schedule is proposed for February to March 2022 when the water level in the river is low giving the substrate placement has the best chance to successfully meet the objectives. Additionally, completing the work in February to March will avoid the time of the year when White Sturgeon would be spawning and will be in advance of spawning so that there is an opportunity for spawning to occur at the enhancement area in 2022.

It is unlikely that the Project area currently provides suitable spawning habitat for salmonids based on the specific habitat requirements of the individual species as outlined in the Environmental Assessment (Golder 2021); however, there is the possibility that other fish species may be present in the enhancement area during the preferred construction period (February – March). Therefore, the following mitigation measures are recommend to avoid direct impacts to fish:

- A drop-camera or a remotely operated vehicle (ROV) will be used to visually inspect the immediate area where gravel will be placed to determine if there are any fish present. This action will be repeated in a grid pattern throughout the enhancement area just in advance of the excavator placing the material.
- Following the visual observation and confirmation of fish absence, substrate material to be placed below the waterline will be lowered slowly through the water column and placed on the bed and not dumped from the barge.

Additionally, the following mitigation measures will be implemented to reduce potential impacts to fish and fish habitat:

- Any work associated with the proposed changes in and about a stream must not cause stream channel instability or increase the risk of sedimentation into the stream. Substrate material must be washed and clean and free from fines.
- Biodegradable hydraulic fluids will be used in equipment working within or above water (on the barge).
- Work activities will be conducted in accordance with *A Users' Guide to Working In and Around Water* (BC MOE 2009).
- During work on site, erosion and sediment control materials will be available on site at all times and will be installed if sedimentation is likely to occur into the stream.
- Any equipment used in conducting work will be in good mechanical condition and, when operating in close proximity to the wetted perimeter of a stream, the operator will prevent entry of any substance, sediment, debris or material (e.g., hydrocarbons, silt) into the stream so as to prevent harm to fish, wildlife or the aquatic ecosystem of a stream (additional mitigation for Protection from Aquatic Invasive Species is in Section 6.5.1).
- The instream component of the work will be completed as quickly and efficiently as possible to minimize the length of disturbance to aquatic species.

- Sediment control provisions implemented (see Section 6.1) will be in accordance with DFO's *Measures to Protect Fish and Fish Habitat* (DFO 2019) and *Land Development Guidelines for the Protection of Aquatic Habitat* (DFO and BC MOE 1993).
- The stream channel width must not change as a result of the work.
- Any materials placed within the stream will be clean and not contain substances that could be harmful to fish, wildlife or the aquatic ecosystem of the stream.
- Riparian vegetation, particularly trees and shrubs, will be retained as much as possible. Any areas disturbed as part of the work will be restored as close as possible to their pre-disturbance condition. Any soil exposed near the watercourse will be promptly re-vegetated.

6.5.1 Protection from Aquatic Invasive Species

In order to avoid introduction and proliferation of invasive aquatic species to the river, all vessels and equipment should be cleaned prior to being transported to site and entering the lake. All equipment including hand tools and machinery should be inspected, cleaned, drained and dried properly following the "Don't Move a Mussel" protocols (Okanagan Basin Waterboard 2021) (Attachment C). The vessel inspection checklist includes:

- Prop
- Anchor
- Dock lines
- Hull
- Rollers
- Trailer
- Bunks
- Axel
- Live wells
- Bilge
- Motor
- Ballast

Additionally, personal protective equipment and any hand tools or sampling equipment (i.e., dive suits, footwear, underwater cameras etc.) that may have been used between watersheds should be cleaned and inspected for functionality, safety and disinfected prior to sampling according to the Equipment Disinfection Procedures to Prevent the Accidental Spread of Aquatic Invasive Species (BC Ministry of Environment 2009) (Attachment D). Disinfection procedures include:

- When leaving a waterbody, remove any visible plants and animals from equipment and boat.

- Remove any mud and dirt since they might contain Dydimo (*Didymosphenia geminata*) or New Zealand mud snails (*Potamopyrgus antipodarum*).
- Eliminate water that may be pooled or stored in any boats or equipment.
- Submerge all gear in hot water (45ºC - uncomfortable to touch) for at least 10 minutes, or until soaked through. Felt-soled waders or other absorbent materials need to soak for 40 minutes.

or

- Freeze all gear until solid (>4hrs).

or

- Soak in a 2% solution of household bleach for 1 minute.

or

- Soak in a 5% household bleach solution and soak for 15 minutes.

6.6 Terrestrial Resource Protection and Mitigation

6.6.1 Wildlife

Consideration of the effects of site preparation and Project works on terrestrial wildlife is required to avoid contravention of Section 34 of the BC *Wildlife Act*, and the federal *Migratory Birds Convention Act* which protects migratory birds and their nests. Any vegetation removal that may required will be completed in advance of the bird nesting period April through mid-August.

Based on the anthropogenic disturbed conditions (previously disturbed riparian vegetation of sparse shrubs and grasses, riprap shoreline etc.) of the laydown area, shoreline and riparian area it is unlikely that vegetation removal will be required. However, if it is required and it can not be completed in advance of the nesting period Golder recommends a suitably trained and experienced biologist should conduct surveys for active nests, burrows and wildlife activity within the areas to be used for construction activities (including searches for ground nesting species). If active nests are identified they will be flagged and a species-specific no-disturbance buffer will be flagged around the perimeter of the nest. Active nests will be checked periodically to confirm they are no longer active. Vegetation removal and ground disturbance within the flagged area can only occur once nests are confirmed to be inactive.

The following mitigation measures will be implemented to reduce effects to wildlife during the Project:

- Habitat loss will be minimized by restricting access to areas required to complete the works. Disturbance to important habitat areas outside the footprint of the works will be avoided by discussing no-go zones with the work crew and flagging riparian areas, if required;
- According to the construction schedule, Project activities are outside of the provincial least-risk timing window for bald eagle (*Haliaeetus leucocephalus*), osprey (*Pandon haliaetus*), heron (*Ardea herodias*) and passerines (BC MFLNRO and BC MOE 2014). The least risk window for other raptors is 1 October to 28 February. Osprey, bald eagle, heron, and peregrine falcon (*Falco peregrinus*) nests are protected year-round under the BC *Wildlife Act*, whether occupied or not. Construction activities will be avoided in the vicinity of osprey, falcon, eagle, heron and/or other raptor nests. If a stick nest is observed, it will be reported to the QEP to

determine further action. If required, appropriate setbacks will be established in accordance with *Develop with Care 2014: Environmental Guidelines for Urban and Rural Land Developments in British Columbia* (BC MFLNRO and BC MOE 2014).

- Implement standard construction practices to minimize noise generation and air emissions.
- Food waste, garbage, refuse, and construction materials that could attract wildlife will be stored in an appropriate containment or removed from the Project area daily.

6.6.2 Vegetation

The following measures will be followed to mitigate the potential effects on riparian vegetation at the Site:

- Sediment and erosion control measures such as silt fencing shall be installed where necessary to protect the existing surface water resources at the Site.
- The limits of vegetation clearing, if required, will be delineated with fencing or flagging.
- It is unlikely that trees or shrubs will be removed. Where possible, pruning of trees should occur as opposed to removal.
- Where possible consider transplanting existing, native vegetation that will be removed; species like tall Oregon grape, rose spp. and saskatoon are hardy and demonstrate transplanting success.
- Any noxious weeds (i.e., those listed by the BC *Weed Control Act*) that are present at the Site should be removed from the Site and disposed of appropriately. Take measures to reduce the spread of noxious weeds to and from the Site.
- If areas vegetated with grass will be disturbed. These areas will be seeded immediately upon completion of works to prevent erosion or colonization of invasive weed species.
- Any topsoil or other erodible materials that are temporarily stockpiled onsite shall be secured to prevent sediment, erosion, and dust generation.
- Inspect vehicles and equipment for weeds and mud that may contain seeds prior to mobilizing to the Project, and if required, clean them prior to entering the area to reduce the potential for introduction and proliferation of invasive plants.
- Educate Contractor(s) to identify invasive plants that have the potential to move between locations within the Project area.

6.7 Air Quality and Dust Control

Contractor(s) will apply the following mitigation measures to control fugitive dust and other airborne emissions arising from movement of vehicles between the quarry and the laydown area and machinery at the laydown area and on the barge.

- Reduce equipment emissions by operating equipment at optimum rated loads, following routine equipment maintenance procedures, and turning off equipment (i.e., avoid idling), when not in use.

- If required, water will be used to control dust for the duration of the Project works. Water, as a dust suppressant, will be used sparingly to avoid turbid water from entering the Columbia River. Chemicals will not be used in dust suppressants.
- Remove and/or properly store debris and materials.
- Construction vehicles travelling through the access road and laydown area will be monitored for excess mud and dirt which will be removed prior to entering / exiting the Project area.
- Construction vehicles used for hauling material will have loads covered during hauling.
- Vehicle speeds will be controlled in the work area to reduce fugitive dust.

6.8 Acid Rock Drainage and Metal Leachate Management

Imported substrate material will be sourced from a local quarry and washed thoroughly prior to mobilizing to the Site. All materials will have been previously tested for Acid Rock Drainage (ARD) and Metal Leachate (ML) Management. The test results are to be evaluated and the substrate material is to be approved by a QEP prior to use on the Project.

6.9 Site Restoration

Site restoration will include:

- Temporarily disturbed areas (i.e., laydown area, access to barge loading area) will be restored to their pre-construction condition once construction is complete to reduce potential for erosion, facilitate optimal seed germination, and deter establishment of invasive species. Areas that were disturbed by Project activities and were vegetated with grass prior to Project activities will be seeded with annual ryegrass. If it is impractical to seed disturbed areas then areas that have a high likelihood of erosion will be covered or otherwise protected to minimize the risk of runoff and the resulting deposition of sediment.
- If the native topsoil has been substantially disturbed or compacted, the soil will be re-established similar to the pre-existing condition sufficient to support native vegetation. Ripping and scarifying will be completed to reduce surface compaction and surface water runoff.
- The *BC Weed Control Act* imposes a duty of all landowners and occupiers to control designated noxious plants found within particular regions of the Province. Contractor(s) will control the introduction and spread of invasive plants.
- Waste materials from worksites will be removed, and subsequently disposed of at appropriately authorized facilities.

7.0 CLOSURE

We trust the information contained in this report is sufficient for your present needs. If you require any further information, please do not hesitate to contact us.

Golder Associates Ltd.

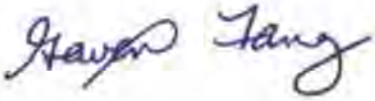
Prepared by:

Emma-Jane Hennings, Tech Dipl., RBTech
Fisheries Technician

Bobby Bedingfield, B.Sc., PBiol
Aquatic Biologist

Drew Kaiser, B.Sc., RPBio, P.Biol.
Associate, Environmental Assessment Project Manager

Reviewed by:



Gaven Tang, M.A.Sc., P.Eng.
Lead River Engineer

EJH/BB/DK/GT/syd

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ATTACHMENT A

Spill Reporting Procedure

Ministry of Environment and Climate Change Strategy

January 2019

Spill Reporting

Report spills immediately

If a spill occurs, or is at imminent risk of occurring, responsible persons (spillers) must ensure that it is immediately reported to the Provincial Emergency Program (PEP)/ Emergency Management British Columbia (EMBC) by calling **1-800-663-3456.**

Division 2.1 Spill Preparedness, Response and Recovery of the *Environmental Management Act 2003* (EMA) is effective as of October 2017. Section 91.2 of EMA identifies the requirements for spill reporting. The Spill Reporting Regulation prescribes the information that is required, as well as the time and manner in which it is required, when reporting spills.

This fact sheet is designed to provide information for responsible persons on their reporting obligations should they be in possession, charge, or control of a substance when it spills or is at imminent risk of spilling.

Responsible Person

A responsible person has possession, charge, or control of a substance or thing when a spill of the substance or thing occurs or is at imminent risk of occurring.

Definition of a Spill

A spill is defined by EMA as the introduction into the environment, other than as authorized and whether intentional or unintentional, of a substance or thing that has the potential to cause adverse impacts to the environment, human health, or infrastructure.

The Spill Reporting Regulation identifies three reports that responsible persons must make based on specific criteria: (1) Initial Report, (2) Update to Minister Report, and (3) End-of-Spill Report. Responsible persons may also be required to make a forth report, a (4) Lessons-Learned Report, if ordered to do so by a director. The purpose of these four reports is to ensure that the Ministry of Environment and Climate Change Strategy (the ministry) has the appropriate information necessary to assess spill impacts and fulfil oversight and regulatory roles and responsibilities.

Initial Report

Section 4 of the Spill Reporting Regulation outlines the information required in the Initial Report. An Initial Report must be made immediately if any of the following occur or is at imminent risk of occurring:

1. **If the volume spilled, or likely to be spilled, is equal to or greater than the minimum quantity outlined in the Spill Reporting Regulation, the spill is reportable**. A list of substances and their reportable quantities is available in Appendix 2: Prescribed substances and quantities for immediate spill reporting of this fact sheet.

2. **If the spill enters, or is likely to enter, a body of water, the spill is reportable.** A body of water is defined in the Spill Reporting Regulation and includes both marine and fresh bodies of water

whether or not they usually contain water or ice, as well as streams, lakes, ponds, rivers, creeks, springs, aquifers, ravines, gulches, wetlands, and glaciers. The requirement to report a spill of a listed substance of any quantity also includes spills that enter a ditch that is not self-contained and connects to a body of water.

The Initial Report must be made immediately to Emergency Management British Columbia (EMBC) by calling 1-800-663-3456. Anyone can make the Initial Report, however, the responsible person must ensure that the report has been made and that all of the information outlined in section 4 of the Spill Reporting Regulation has been reported. Appendix 1 of this fact sheet specifies the information that must be provided in the Initial Report.

Natural Gas

A release of natural gas is reportable if:

1. The spill is caused by a breakage in a pipeline or fitting operated above 100 pounds per square inch (psi) that results in a sudden release of natural gas; and
2. The amount of the spill is, or is likely to be, equal to or greater than 10 kilograms (kg).

Update to Minister Report

Section 5 of the Spill Reporting Regulation outlines the requirement for the submission of Update to Minister Reports. Responsible persons must provide an Update to Minister Report:

1. **As soon as possible on request of the minister**

2. **At least once every 30 days after the date that the spill began** until such time that an End-of-Spill Report is required

3. **At any time that the responsible person has reason to believe that information that was previously reported as part of the Initial Report was or has become inaccurate or incomplete –** any component of the Initial Report, as outlined in Appendix 1, changes or is not specified

If the Update to Minister Report is requested by the Minister or if the spill lasts more than 30 days and the Update to Minister Report is required, an email will be sent by the ministry to the responsible person with instructions on how to complete the report form and how it must be submitted.

If the responsible person believes that information that was previously reported as part of the Initial Report was or has become inaccurate or incomplete, the responsible person can contact the Environmental Emergency Program at SpillReports@gov.bc.ca, stating the DGIR in the subject line, to advise that an Update to Minister Report is required. Instructions on how to complete the report form and how it must be submitted will be sent to the responsible person by email.

End-of-Spill Report

Section 6 of the Spill Reporting Regulation outlines the requirement for the submission of End-of-Spill Reports. Responsible persons must submit a written report to the ministry within 30 days following the emergency response completion date of a spill, see information box below. An End-of-Spill Report is required when:

1. **The volume spilled is equal to or greater than the minimum quantity outlined in the Spill Reporting Regulation** - a list of substances and their reportable quantities is available in this fact sheet in Appendix 2: Prescribed substances and quantities for immediate spill reporting

2. **The spill enters, or is likely to enter, a body of water -** 'body of water' is defined in the Spill Reporting Regulation

Although the accountability to adhere to the requirements set out in the Spill Reporting Regulation is that of the responsible person, in most cases, an email will be sent to responsible persons by the ministry with instructions on how to complete the report form and the date that the End-of-Spill Report is due. All reports, other than the Initial Report, are to be sent to the Environmental Emergency Program at SpillReports@gov.bc.ca.

Emergency Response Completion Date

The emergency response completion date is defined in section 8 of the Spill Reporting Regulation as the date that all of the following criteria are met:

1. The Incident Command Post is disestablished
2. The source of the spill is under control and is neither spilling nor at imminent risk of spilling
3. Emergency actions to stabilize, contain, and remove the spill have been taken
4. The waste has been removed from the spill site
5. All evacuation notices have expired or been rescinded
6. All equipment, personnel, and other resources used in emergency spill response actions have been removed from the spill site, other than resources required for sampling, testing, monitoring, assessing the spill site, or for recovery and restoration of the spill site

Lessons-Learned Report

Section 7 of the Spill Reporting Regulation outlines the requirements of a Lessons-Learned Report. Within six months following the emergency response completion date of a spill, a director may order a Lessons-Learned Report from the responsible person. This report must be submitted to the director in the manner and form specified by the director. For additional information on the Lessons-Learned Report, please see the 04 Lessons-Learned fact sheet.

Oil and Gas Exemption

The Oil and Gas Commission (OGC) supports the one window regulation of provincially regulated oil and gas activities. Responsible persons regulated by the OGC under the B.C. Reg. 217/2017 Emergency Management

- Section 5 Update to Minister Report
- Section 6 End-of-Spill Report
- Section 7 Lessons-Learned Report

Fines and Penalties

It is the responsibility of regulated persons, responsible persons, and the owners of substances or things that have the potential to spill to understand and comply with EMA and its associated regulations.

This document is solely for the convenience of the reader and is intended to assist in understanding the legislation and regulations, not replace them. It does not contain and should not be construed as legal advice. Current legislation and regulations should be consulted for complete information.

Failure to be in compliance can result in convictions, fines, and/or imprisonment, as outlined in EMA and its associated regulations.

Additional Fact Sheets

Fact sheets on other relevant topics are published by the Environmental Emergency Program (EEP) and available at:

www.gov.bc.ca/spillresponse

The complete list of available fact sheets:

01 Regulated Person
02 Responsible Person
03 Spill Reporting
04 Lessons-Learned Report
05 Cost Recovery
06 Requirement to Provide Information
07 Spill Contingency Planning
08 Testing Spill Contingency Plans
09 Recovery Plan

For more information, contact the Environmental Emergency Program at: SpillReports@gov.bc.ca

Appendix 1: Initial Report content

Report information	Description
1. Contact information of the individual making the report	First and last name, phone number, and email address
2. Contact information of the responsible person	First and last name, phone number, and email address
3. Contact information for the owner of the substance spilled	First and last name, phone number, and email address
4. Location, date, and time of the spill	Provide as much location specific information as possible, including: general directions, description of how to approach the area, latitude and longitude if available, street address, and the date and time in 24-hour clock format
5. Description of the spill site and surrounding area	Provide a description of the receiving environment of the spilled material (for example, the area is wooded and the ground is soft; there are sensitive riparian areas that are at risk of contamination)
6. A description of the source of the spill	The container from which the material spilled (for example, fishing vessel, above- or below-ground storage tank, tanker truck, pipeline, or railcar)
7. Type and quantity of the substance spilled	An estimate of the amount of product spilled and a description of the product type, including product name, UN number, and Safety Data Sheet [SDS] (for example, diesel, UN 1202, 50 liters). If unknown, a description of the spill (for example, sheen or slick approximately 20 meters by 20 meters)
8. Cause and impact of the spill	The circumstances leading to the spill; the immediate cause as well as any contributing factors. May be a combination of the activity and the incident (for example, motor vehicle accident derailment, equipment failure, fire, human error, intentional/unauthorized release, natural occurrence, or unknown)
9. Details of the actions taken or proposed	Provide any necessary/ helpful details of the actions taken or planned (for example, what steps have been taken to contain the spill, which responders have been deployed, and when they will be on scene)
10. The details of further action contemplated or required	Provide any necessary/ helpful details regarding next steps, including response actions, deployment of additional resources, and monitoring activities

11. The names of agencies on scene	Any persons, government, federal government, local government, or Indigenous agencies
12. The names of other persons or agencies advised concerning the spill	Any persons, government, federal government, local government, or Indigenous agencies

Appendix 2: Prescribed substances and quantities for immediate spill reporting[1]

Item	Column 1 Substance Spilled	Column 2 Specified Amount
1	Class 1, Explosives as defined in section 2.9 of the Federal Regulations[2]	Any quantity that could pose a danger to public safety or 50 kg
2	Class 2.1, Flammable Gases, other than natural gas, as defined in section 2.14 (a) of the Federal Regulations	10 kg
3	Class 2.2 Non-Flammable and Non-Toxic Gases as defined in section 2.14 (b) of the Federal Regulations	10 kg
4	Class 2.3, Toxic Gases as defined in section 2.14 (c) of the Federal Regulations	5 kg
5	Class 3, Flammable Liquids as defined in section 2.18 of the Federal Regulations	100 L
6	Class 4, Flammable Solids as defined in section 2.20 of the Federal Regulations	25 kg
7	Class 5.1, Oxidizing Substances as defined in section 2.24 (a) of the Federal Regulations	50 kg or 50 L
8	Class 5.2, Organic Peroxides as defined in section 2.24 (b) of the Federal Regulations	1 kg or 1 L
9	Class 6.1, Toxic Substances as defined in section 2.27 (a) of the Federal Regulations	5 kg or 5 L
10	Class 6.2, Infectious Substances as defined in section 2.27 (b) of the Federal Regulations	1 kg or 1 L, or less if the waste poses a danger to public safety or the environment
11	Class 7, Radioactive Materials as defined in section 2.37 of the Federal Regulations	Any quantity that could pose a danger to public safety and an emission level greater than the emission level established in section 20 of the "Packaging and Transport of Nuclear Substances Regulations"
12	Class 8, Corrosives as defined in section 2.40 of the Federal Regulations	5 kg or 5 L

[1] If the spill enters, or is likely to enter, a body of water, it is reportable regardless of the quantity
'Federal regulations' refer to the Transportation of Dangerous Goods Regulations under the *Transportation of Dangerous Goods Act 1992*
'Hazardous Waste Regulation' refers to B.C. Reg. 63/88

13	Class 9, Miscellaneous Products, Substances or Organisms as defined in section 2.43 of the Federal Regulations	25 kg or 25 L
14	Waste containing dioxin as defined in section 1 of the Hazardous Waste Regulation	1 kg or 1 L, or less if the waste poses a danger to public safety or the environment
15	Leachable toxic waste as defined in section 1 of the Hazardous Waste Regulation	25 kg or 25 L
16	Waste containing polycyclic aromatic hydrocarbons as defined in section 1 of the Hazardous Waste Regulation	5 kg or 5 L
17	Waste asbestos as defined in section 1 of the Hazardous Waste Regulation	50 kg
18	Waste oil as defined in section 1 of the Hazardous Waste Regulation	100 L
19	Waste containing a pest control product as defined in section 1 of the Hazardous Waste Regulation	5 kg or 5 L
20	PCB Wastes as defined in section 1 of the Hazardous Waste Regulation	25 kg or 25 L
21	Waste containing tetrachloroethylene as defined in section 1 of the Hazardous Waste Regulation	50 kg or 50 L
22	Biomedical waste as defined in section 1 of the Hazardous Waste Regulation	1 kg or 1 L, or less if the waste poses a danger to public safety or the environment
23	A hazardous waste as defined in section 1 of the Hazardous Waste Regulation and not covered under items 1 – 22	25 kg or 25 L
24	A substance, not covered by items 1 to 23, that can cause pollution	200 kg or 200 L
25	Natural gas	10 kg, if there is a breakage in a pipeline or fitting operated above 100 psi that results in a sudden and uncontrolled release of natural gas

BRITISH COLUMBIA
Ministry of Environment and Climate Change Strategy

Update to Minister/End-of-spill Report Form

Environmental Emergency Program
SpillReports@gov.bc.ca

This report template can be completed to satisfy the requirements of either the End-of-Spill Report or the Update to Minister Report. Please specify which report you are completing in section I of this form. If any of the fields of this form are not applicable to the spill for which this form is being completed, indicate 'N/A' in the field; reports with incomplete fields will be sent back to the responsible person.

End-of-Spill Report: Section 6 of the Spill Reporting Regulation outlines the requirements for the End-of-Spill Report. Responsible persons must submit a written End-of-Spill Report to the Ministry of Environment and Climate Change Strategy within 30 days following the emergency response completion date of a spill as outlined in section 6 (1) of the Spill Reporting Regulation. Responsible persons must submit a written report to the Ministry of Environment and Climate Change Strategy as soon as practicable if either of the following two conditions are present:

1. The spill entered, or was likely to enter, a body of water as defined in the Spill Reporting Regulation
2. The quantity of the substance spilled was, or was likely to be, equal to or greater than the listed quantity for the listed substance as outlined in the Spill Reporting Regulation

Update to Minister Report: Section 5 of the Spill Reporting Regulation outlines the requirements for the Update to Minister Report. Responsible persons must submit a written report to the Ministry of Environment and Climate Change Strategy as soon as practicable if any of the following three conditions are present:

1. On request of the Minister
2. At least once every 30 days after the date that the spill began
3. At any time that the responsible person has reason to believe that information previously reported in the Initial Report has become inaccurate or incomplete

Complete this form and submit it by email to SpillReports@gov.bc.ca. For additional information, please visit the British Columbia Environmental Emergency Program Report a Spill webpage.

Dangerous Goods Incident Report (DGIR) number:

Section I: Type of report Sections 5 and 6 of Spill Reporting Regulation	
This form is completed to satisfy the requirements of the: ☐ Update to Minster Report	☐ End-of-Spill Report

Section II: Contact information Section 6 (2) (a) of the Spill Reporting Regulation	
Details for person filling put the report	Name of company representative:
	Company name:
	Email:
	Address:
	Telephone number:

Details for responsible person Same as above ☐	Name of company representative:
	Company name:
	Email:
	Address:
	Telephone number:
Details for owner of the substance spilled Same as above ☐	Name of company representative:
	Company name:
	Email:
	Address:
	Telephone number:

Section III: Timing of the spill
Section 6 (2) (b) of the Spill Reporting Regulation

Date of spill:	Time of spill:	Duration of the spill (days):
Date reported:	Emergency response completion date[1]:	

Section IV: Site description
Section 6 (2) (c) (d) of the Spill Reporting Regulation

Provide a description of the spill site and the sites affected by the spill. The description of the spill site may include a description of the receiving environment, the proximity to a nearby city/town/roadway, the type of vegetation in the area, how densely populated the area is, accessibility to spill site, nearby waterways, and any other defining characteristics of the area.

Latitude:	Degree	Minutes:	Seconds:
Latitude:	Degree	Minutes:	Seconds:
or Site civic address or location:		Street City:	Postal Code:
Or DLS or BCNTS (if applicable):		Site ID number (if applicable):	

[1] For the definition of the *emergency response completion date*, please refer to B.C. Reg. 187/2017 Spill Reporting Regulation

Section V: Description of the source, type, and quantity of the spill **Section 6 (2) (e) (f) of the Spill Reporting Regulation**
Description of the source of the spill (pipeline, rail, truck, facility, etc.):
Type of substance spilled (common name):
United Nations (UN) number of substance spilled (if applicable):
Item number from the table in the Schedule in the Spill Reporting Regulation:
Quantity (in litres or kilograms) of the substance spilled – if the quantity is unknown, provide a reasonable estimate and explain why the quantity is unknown and cannot be determined:
Description of the source of the spill (pipeline, rail, truck, facility, etc.):

Section VI: Description of the circumstances, cause, and impacts of the spill **Section 6 (2) (g) (i) (ii) (iii) of the Spill Reporting Regulation**
Provide a description of the activity during which the spill occurred (transportation, transfer of cargo, fuelling, cleaning, maintenance, etc.):
Provide a description of the incident leading to the spill (tank rupture, overfill, collision, rollover, derailment, fire, explosion, etc.):
Provide a description of the underlying cause of the spill (human error, external conditions, organizational or management failure, etc.):

Section VII: Impacts to human health, the environment, and infrastructure **Section 6 (2) (g) (iv) (v) of the Spill Reporting Regulation**		
Describe any adverse effects of the spill on human health (please state 'N/A' if there were no adverse effects on human health):		
Number of people evacuated:		
Number of fatalities:		
Number of people injured:		
Describe any adverse impacts on infrastructure [2] (please state 'N/A' if there were no adverse impacts to infrastructure):		
Impacts to water		
Was there an impact to a body of water?	☐ Yes	☐ No
Description of impact:		
Describe the body of water (stream, aquifer, fish habitat, naturally formed body of water, ditch, lake, etc.):		
Name of body of water:		
Impacts to the environment		
Was there an impact on flora (vegetation)? ☐ Yes ☐ No	If yes, list the common and species names:	
Provide a description of the impact on flora (oiled, removed, etc.):		
Was there an impact on fauna (animals)? ☐ Yes ☐ No	If yes, list the common and species names:	
Provide a description of impact on fauna (include injured, dead, etc.):		

[2] For the definition of *infrastructure,* refer to section 91.1 of the *Environmental Management Act 2003*

Was there an impact on aquatic and/or terrestrial habitats? ☐ Yes ☐ No	If yes, list the type of habitat (riparian, breeding ground, etc.):
Provide a description of impact on aquatic and terrestrial habitats, including response actions taken to restore any of the impacts listed:	

Section VIII: Spill response actions **Section 6 (2) (h) of the Spill Reporting Regulation**		
Action taken to comply with section 91.2 of the *Environmental Management Act 2003*	Who took the action (company, person, contractor, etc.)	Date that the action was taken (click the arrow or enter the date using the format YYYY-MM-DD)

Section IX: Waste disposal (please state 'N/A' if no waste was produced) **Section 6 (2) (i) of the Spill Reporting Regulation**		
List the type of waste	Method of disposal	Location of disposal

Section X: Attached reports, maps, and photographs **Section 6 (2) (j) (k) of the Spill Reporting Regulation**	
Report of results of sampling, testing, monitoring, and/or assessing carried out during spill response actions (including reports from Qualified Professionals), if applicable	Copy attached ☐
Map of the incident site and areas surrounding the incident site (required)	Copy attached ☐
Photographs of the spill (required)	Copy attached ☐

Section XI: Agencies on scene or notified **Section 6 (2) (l) (m) of the Spill Reporting Regulation**
List the names of all agencies that were at the incident site:
List the names of other persons or agencies that were advised about the spill:

Section XII: Additional comments

Section XIII: Verification of information provided	
I confirm that the above information is true and complete.	
Name of person completing form:	Date completed (YYYY-MM-DD)
Name of responsible person (person or company):	Date completed (YYYY-MM-DD)

Section XIV: Approval - For internal use only	
Reviewed by	Date completed (YYYY-MM-DD)

Save Resent Form

ATTACHMENT B

BC Hydro Chance Find Procedure

Heritage

Before work starts, environmental issues (including heritage) are identified by planners and designers by using the relevant checklist (e.g. DDEC, TEC, PIQ, etc.). In addition, the design drawing and the Work Order should include specific instructions for field crews.

Remember:
Heritage information must not be shared or redistributed without the permission of the Archaeology Branch.

The examples and procedures included in this guide are provided to help field crews understand and identify heritage resources in a field setting, before and during work. If work activities inadvertently uncover what are believed to be human remains, artifacts, or other kinds of heritage resources, ensure the Stop Work Procedures are followed.

The best practices for the field

1. Ensure all crew members (including contractors) have taken the BC Hydro Heritage Awareness Training.
2. Check design drawing and Work order for environmental/heritage instructions.
3. Follow all environmental/archaeological instructions provided in your work plans.
4. Check for any work conditions (e.g., notifications, permits, person on site requirements, etc.).
5. In the field watch for indicators/signs and artifacts or features.
6. Call your manager and your BC Hydro Environmental Representative if you come upon a chance find (suspected human remains or evidence of past human occupation) and follow Stop Work Procedures.

Stop work procedures:

If you find potential **human remains or evidence of past human occupation:**

1. Stop work immediately!
2. Call your Manager and Environmental Representative as soon as possible.
3. Avoid disturbing the site and erect barriers (pylons) or flag off the affected location to prevent further disturbance.

Additional requirements if human remains are found:

- **Your Manager should contact the police and/or coroner.**
- **If the site is a busy location, or has high visibility, assign an employee to stand watch until the police arrive.**
- **Ensure the remains are treated with full dignity and respect by all those at the scene.**

Filing an IMS report

Chance finds and near misses are internally reportable. The responsible BC Hydro manager/representative* is to complete an environmental incident report in the IMS (Incident Management System). The chance find or near miss must be entered within 24 hours.

Notifying BC Hydro Heritage Department

Notify the BC Hydro Heritage Department of all chance finds and near misses at **heritage@bchydro.com** as soon as possible.

On site safety

- Identify primary contractor who is responsible for on-site safety at all times.
- If required on site, the archaeology crew MUST be present for the tailboard.
- Ensure safe work procedures for working around electrical equipment are followed.

* Contractors must inform their BC Hydro contract representative

Local Environment Contact: _____

Heritage Resources
Field reference guide

The term heritage resources refers to places and objects associated with past human culture and history including:

Archaeological sites that contain physical evidence (artifacts or features) of past human activity.

Historical sites that contain architectural and other heritage material for which written documents are available.

It's the law! Heritage places and objects are protected under the Heritage Conservation Act.

BCH18-396 March 2018

BC Hydro
Power smart

Artifacts

An artifact is an object made or modified by humans such as works of art, tools, implements or weapons that indicate historic, ancient or prehistoric settlement or use of an area.

Bone Artifacts

Bone and antler were used to create a variety of tools and objects such as projectile points, chisels, harpoons, fishing lures, needles, spindle whorls, and objects of art and ornamentation.

5cm

Flaked Stone

Flakes or chips can be removed from stones to create stone tools such as projectile points, debitage, cores, cobble tools, microblades and retouched flake tools.

5cm

Pecked Stone Objects

Stones can be pecked or carved into a variety of items such as bowls, net weights and hand mauls.

5cm

Ground Stone Artifacts

Some stone types can be ground into a variety of items such as points, abraders, beads and clubs.

5cm

Wetsite Materials

Organic objects such as rope, cordage, basketry, mats, wooden fish weir stakes, house posts, leather, and bone can be preserved when submerged in water, clay, or any environment free of oxygen.

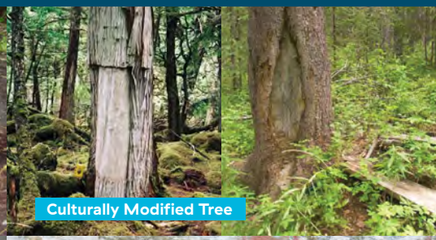
5cm

Features

Features are non-portable elements of historical or archaeological places. Some examples of these are shown below.

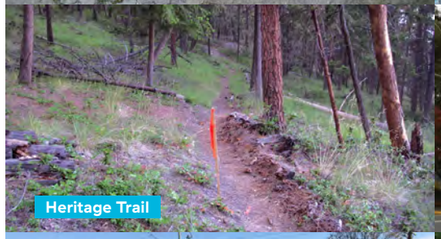
Photo Credit: Millennia Research Ltd., Cordillera Archaeology, Golder Associates, Darcy Mathews, Bert William, BC Hydro, Richard Bruce


Shell Midden


Culturally Modified Tree


Petroglyph


Pictograph


Heritage Trail


Heritage Building


Cemetery


Burial Mound/Cairn


Cultural Depressions


Cultural Stratigraphy

ATTACHMENT C

Watercraft Inspection Checklist

BOAT INSPECTION CHECKLIST

Check these common hiding spots for invasive species:

1) Prop
2) Anchor
3) Bait Bucket
4) Dock lines
5) Hull
6) Rollers
7) Trailer
8) Bunk
9) Axel
10) Live wells
11) Bilge
12) Motor
13) Ballast

1) ☐ _____
2) ☐ _____
3) ☐ _____
4) ☐ _____
5) ☐ _____
6) ☐ _____
7) ☐ _____
8) ☐ _____
9) ☐ _____
10) ☐ _____
11) ☐ _____
12) ☐ _____
13) ☐ _____

Help spread the message, not the mussel at
DON'TMOVEAMUSSEL.CA

OKANAGAN waterwise

CLEAN DRAIN DRY

ATTACHMENT D

Equipment Disinfection Procedure

Equipment Disinfection Procedures to Prevent the Accidental Spread of Aquatic Invasive Species – Version 1.1 June 2009

Contact:

Matthias Herborg, Aquatic Invasive Species Coordinator, Ministry of Environment, B.C.; email: Matthias.Herborg@gov.bc.ca; phone: 250 356 7683

Scope:

The procedures described here are intended to help reduce the risk of spread of the invasive freshwater algae Dydimo or 'rock snot' in B.C., and provide direction on how to prevent the spread of New Zealand mudsnail and zebra / quagga mussel.

Rationale:

The procedures outlined here are best management practises for fieldwork carried out by Ministry staff and its contractors. The introduction and spread of a whole range of non-native aquatic species is posing an increasing risk to fisheries and biodiversity of B.C.'s aquatic environment.

One major pathway for the spread for a range of these organisms is the accidental transport of these 'aquatic hitchhikers' on waders, boats, trailers, nets and other equipment moved between water bodies. Many of these organisms can grow from fragments hardly visible to the human eye, so proper disinfection procedures need to be followed to prevent the spread of aquatic invasive species between watersheds during fieldwork. These procedures describe methodologies which prevent the spread of Dydimo, a microscopic freshwater algae that can form large mats in rivers and streams. However, a range of the methods described here are also successful at preventing the transport of other freshwater species like New Zealand mud snail, Eurasian watermilfoil, and zebra / quagga mussels.

The approach described here is based on general watershed zones, since the distribution data for Dydimo in B.C. is too limited to target specific infested sites.

When to disinfect equipment:

- These procedures aim to prevent the spread of aquatic invaders from infested sites to un-infested sites, particularly if personnel are moving between watersheds which are not naturally connected.

- The current disinfection boundaries (see maps below) are based on ecological drainage units and delimit the minimum level of disinfection required. One exception is the additional disinfection area around the Somas River watershed and the Alberni Inlet area (Vancouver Island). Since this is the only know location of New Zealand mud snail, we request all gear to be cleaned when leaving this area. Whenever equipment is moved across a disinfection boundary, both general and field gear disinfection (Level 1 + 2) is to be conducted.

- Whenever possible a more prudent approach should be adopted, and at least the general procedures (Level 1) are to be used if you move between watersheds within 7 days.

- Additionally, field gear disinfection (Level 2) is to be conducted whenever field gear is returned to storage or a MoE office, and will be used within the next two weeks. As long as an immersion tank or other facilities are set aside for disinfection, this should require very little time.

- The Ministry strongly discourages the use of felt-soled waders, as they are a major pathway for the dispersal of aquatic hitchhikers, including Dydimo, and particularly difficult to disinfect. Newly developed rubber-soled alternatives are available on the market, and provide the same non-slip qualities, but are much easier to clean. Some regions have already moved to rubber-soled waders and are satisfied with their performance.

Procedures:

All removal of fragments or dirt should either take place when leaving the site or in a location where run-off is not going into a water body. DO NOT clean the gear with water from the site as you might just re-contaminate it, unless you use additional disinfection procedures afterwards.

Level 1: General disinfection procedures followed whenever possible as you move to a new site:

- When leaving a waterbody, remove any visible plants and animals from your gear and boat.
- Remove any mud and dirt since they might contain Dydimo or New Zealand mud snails
- Eliminate water from any conceivable item before you leave the visiting area

Level 2: Field gear disinfection procedures:
To disinfect your waders, nets, sieves, buckets, floats, gloves, etc., use **ONE** of the following procedures (see Table 1 for effectiveness). Make sure that all parts of the equipment get fully submerged for the whole time period required:

- Submerge all gear in hot water (45ºC - uncomfortable to touch) for at least 10 minutes, or until soaked through. Felt-soled waders or other absorbent materials need to soak for 40 minutes

OR

- Freeze all gear until solid (> 4hrs)

OR

- Soak in a 2% solution of household bleach for 1 minute

OR

- Soak in a 5% household bleach solution and soak for 15 minutes

Table 1: Effectiveness of different equipment disinfection procedures	Dydimo [1]	New Zealand mud snail[2]	Zebra / Quagga mussel[3]	Fish path ogen [4]	Amphibian pathogen[5]
Immersion in 45ºC water for 10mins (or 40mins for felt-soled waders or absorbent material)	Yes	Yes	Yes	?	?
Freeze until solid (4hrs or more)	Yes	Yes	Yes	?	?
Soak in a 2% solution of household bleach for 1min	Yes	?	Yes (larvae only)	?	?
Soak in a 5% household bleach solution and soak for 15mins	Yes	?	Yes (larvae only)	Yes	Yes

? Indicates that there is currently a lack of information on the effectiveness of this treatment for this species or pathogen

See for source information and more detail:
[1] http://www.biosecurity.govt.nz/didymo
[2]New Zealand mudsnail prevention guide:
http://seagrant.oregonstate.edu/sgpubs/onlinepubs/g06006.html
[3]Stop Aquatic Hitchhikers: http://www.protectyourwaters.net/hitchhikers/
[4]Standard operating procedures for research, evaluation, and development
[5]Hygene protocols for amphibian field staff and researchers, Ministry of Environment, B.C.

Figure 1: Disinfection boundaries for Vancouver Island. Note the additional zone around the Somass watershed to prevent the spread of New Zealand mud snail (green dot).

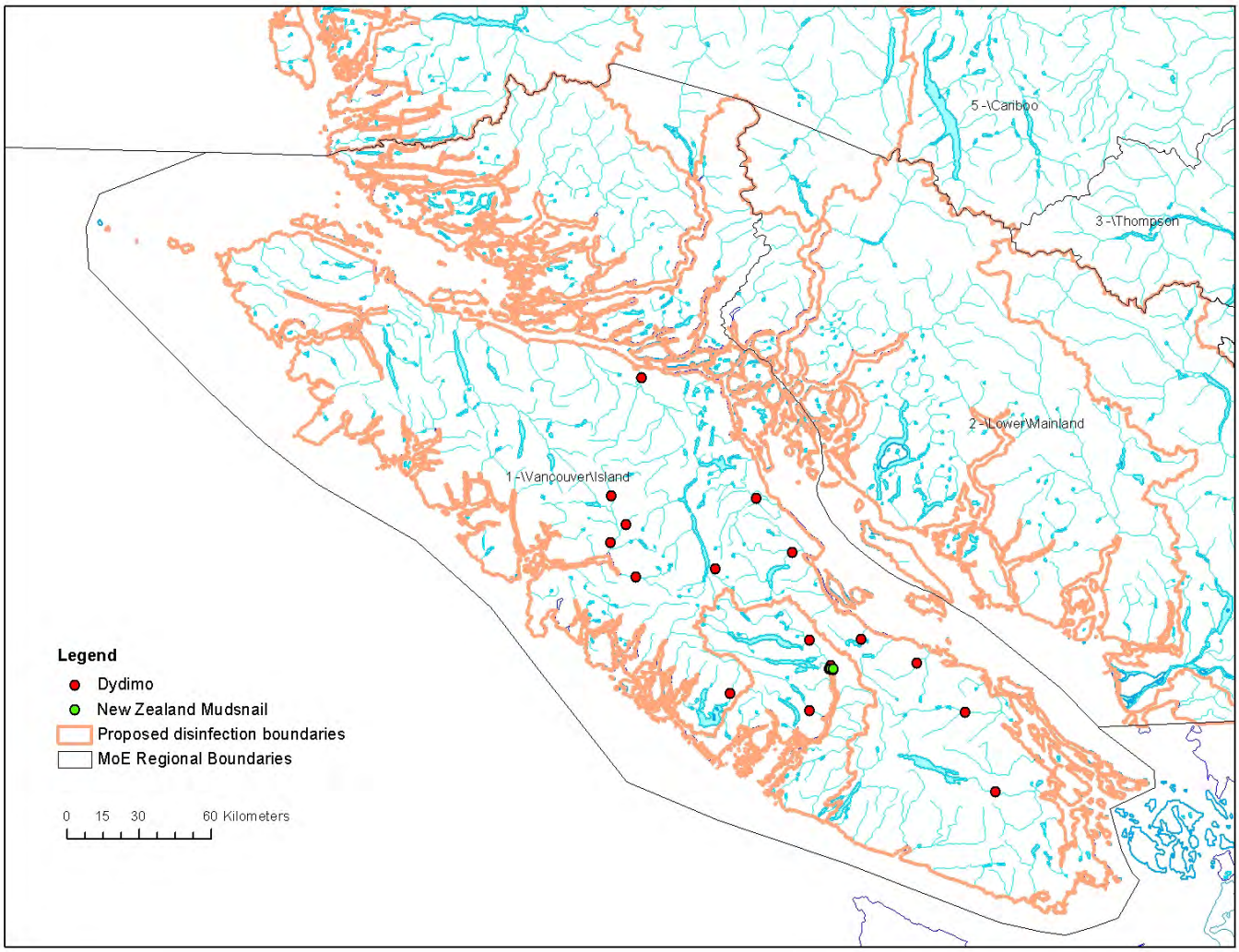


Figure 2: Disinfection boundaries for the Thompson, Lower Mainland, and Okanagan Regions.

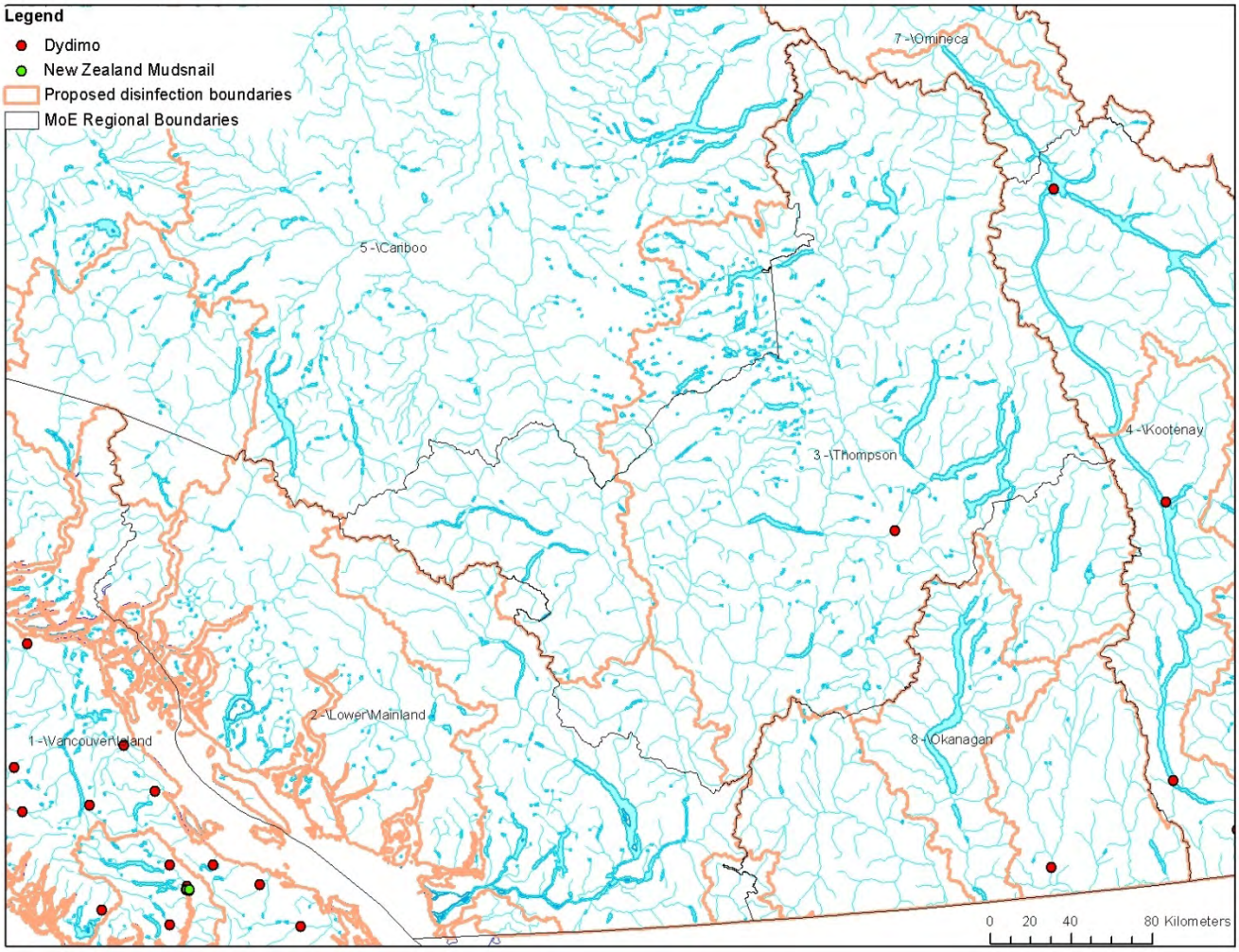


Figure 3: Disinfection boundaries for Kootenay Region.

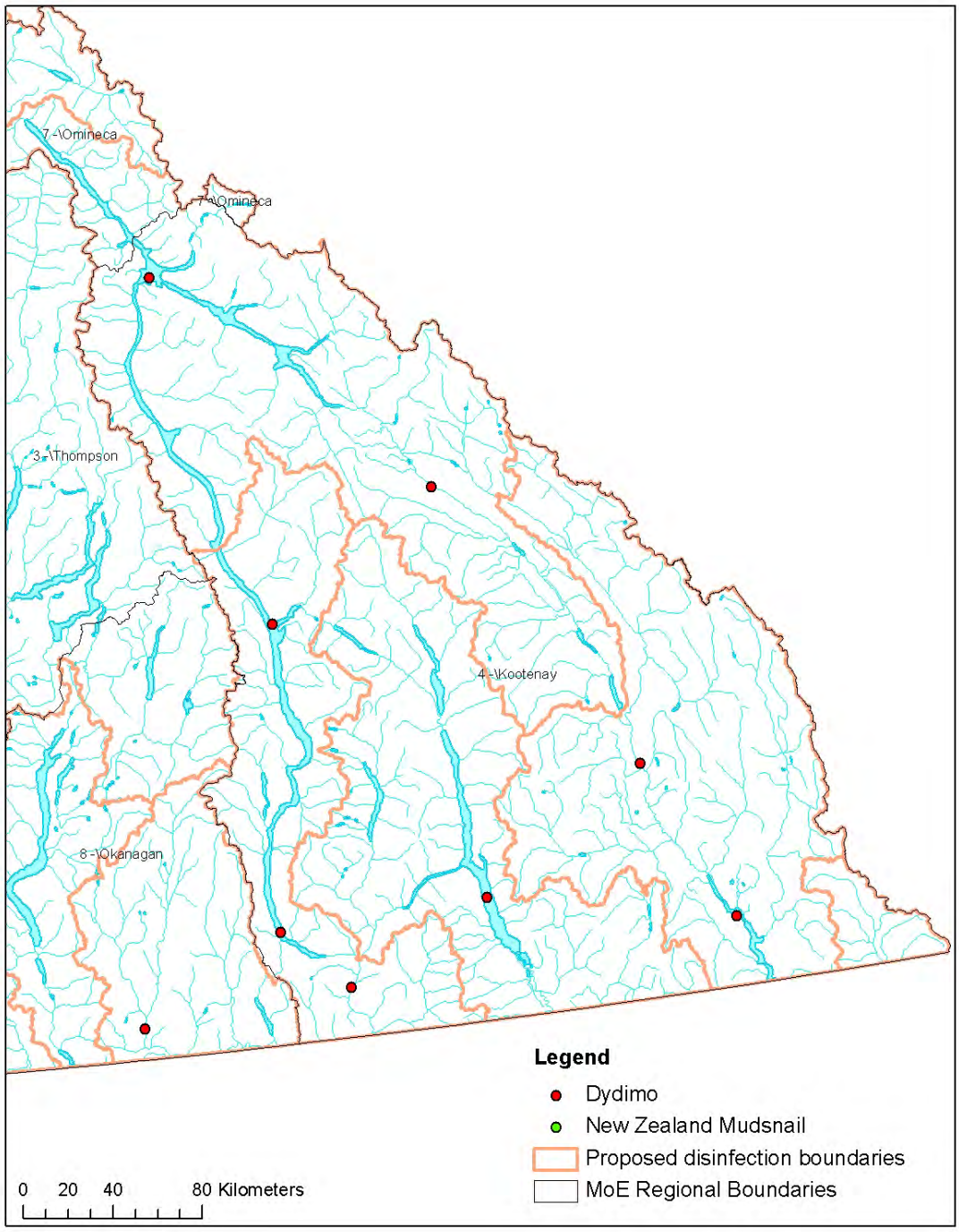


Figure 4: Disinfection boundaries for the Cariboo Region.

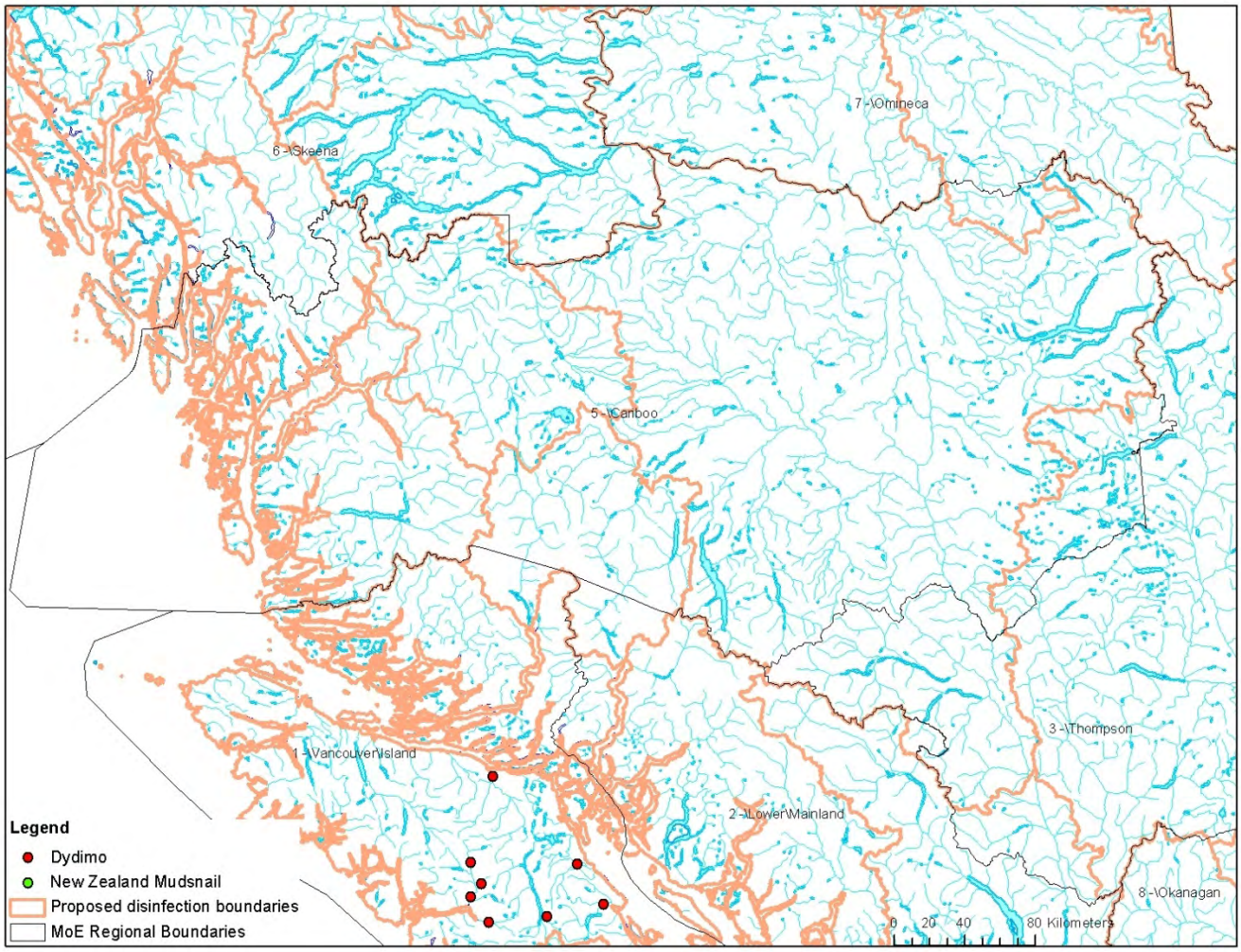


Figure 5: Disinfection boundaries for the Skeena Region.

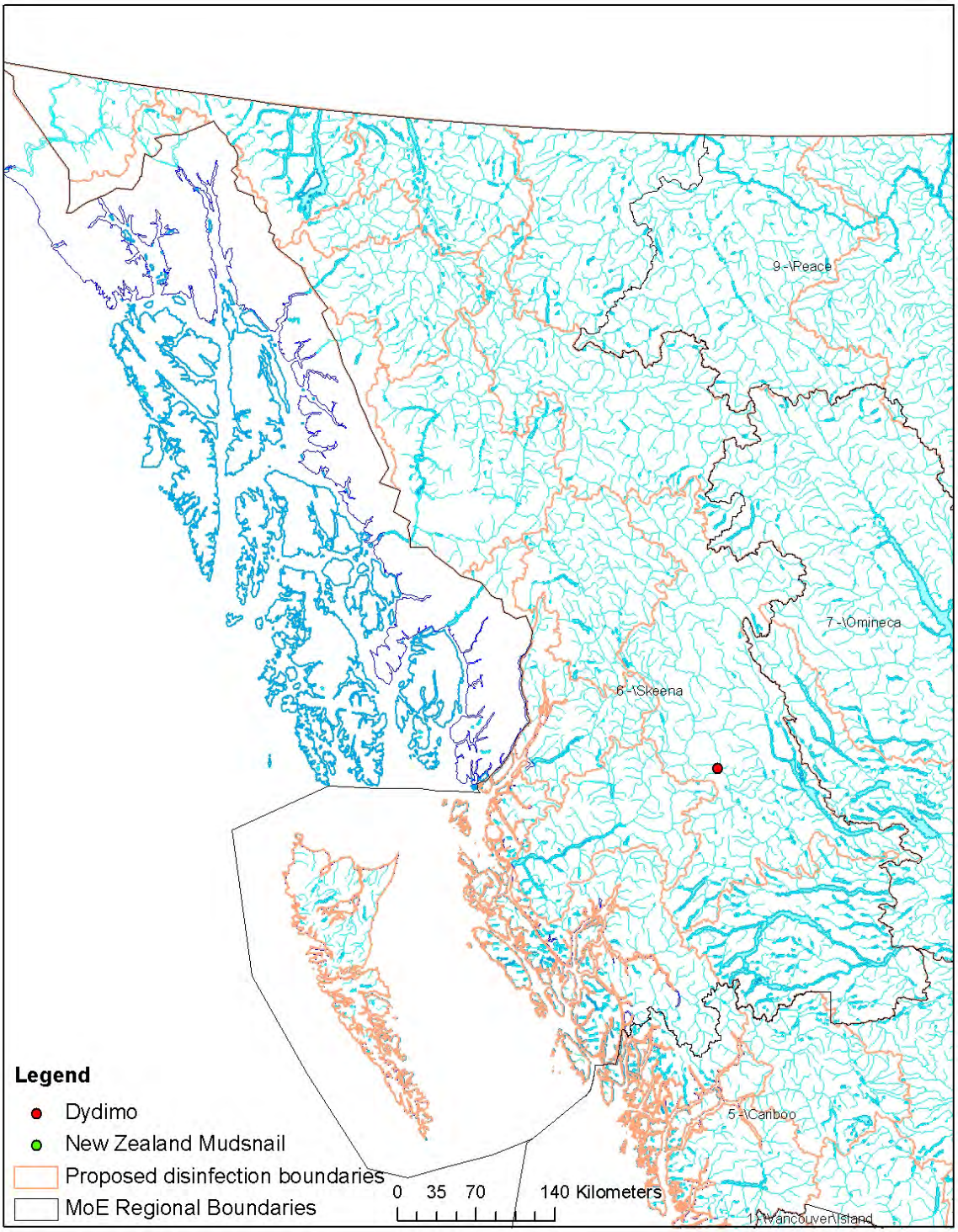
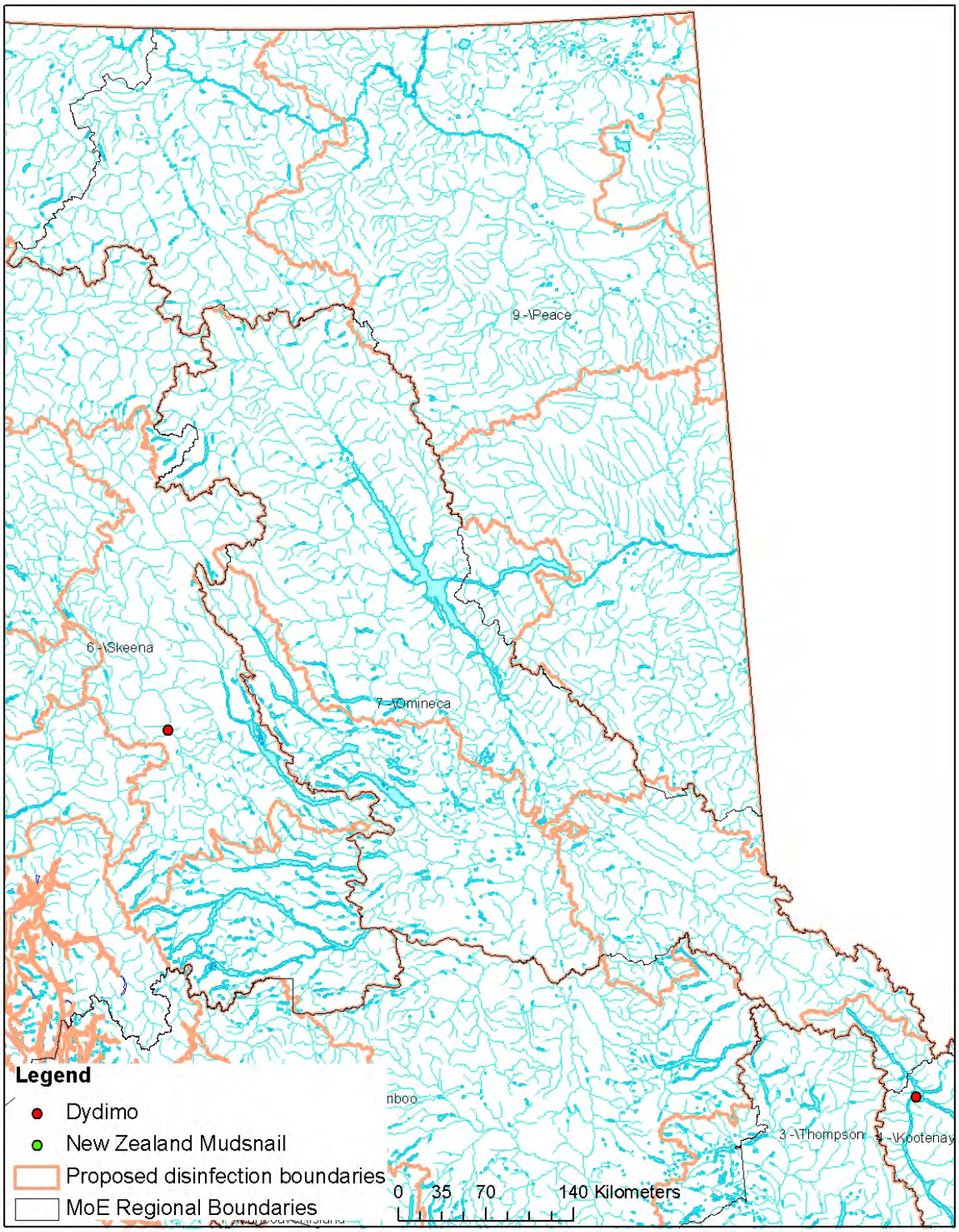


Figure 6: Disinfection boundaries for the Omineca and Peace Region.



golder.com

APPENDIX F

Public Safety Plan

REPORT

Public Safety Plan

BC Hydro CLBWORKS-27 Lower Columbia White Sturgeon Habitat Restoration

Submitted to:

BC Hydro

6911 Southpoint Drive
Burnaby, BC
V3N 4X8

Submitted by:

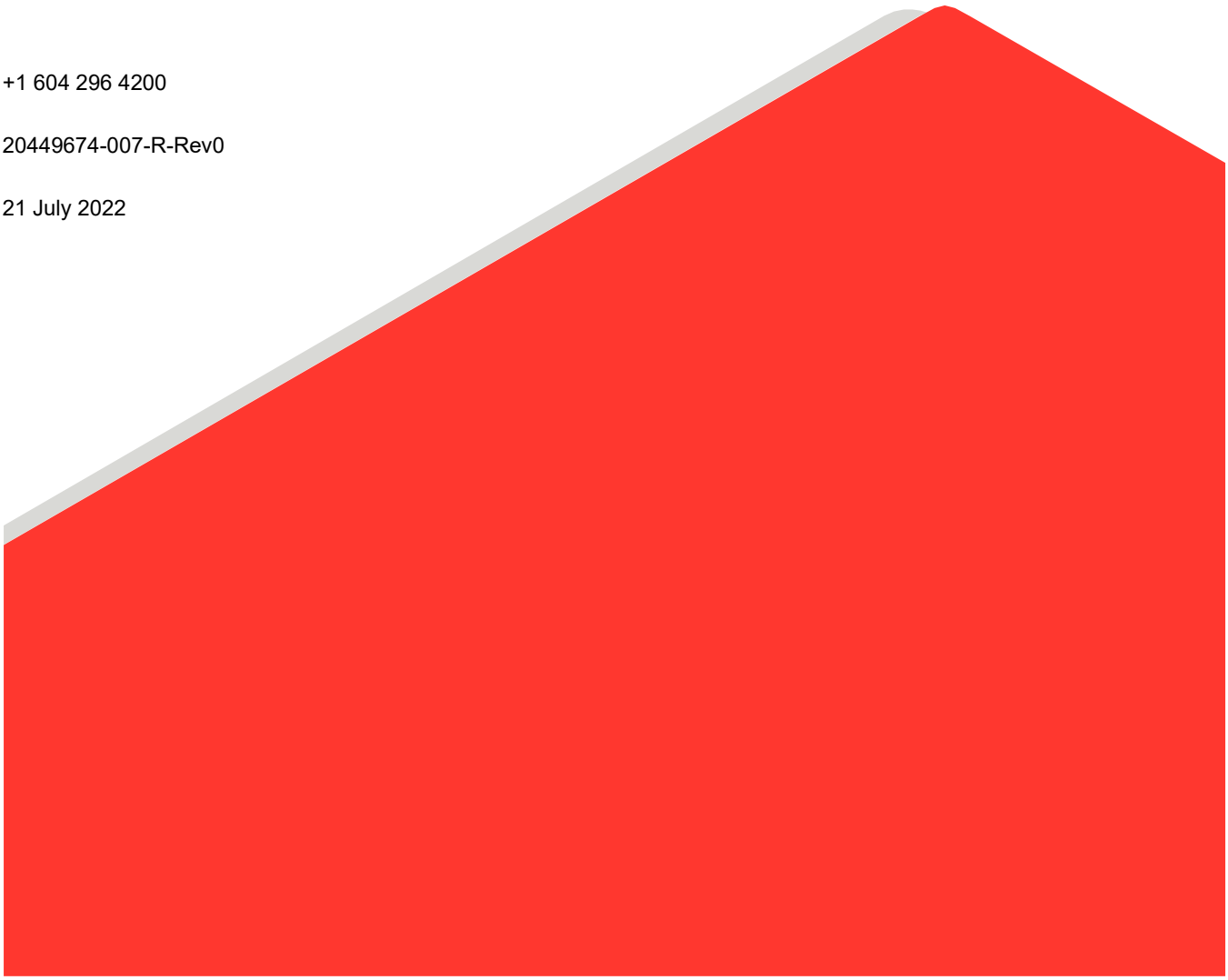
Golder Associates Ltd.

Suite 200 - 2920 Virtual Way, Vancouver, British Columbia, V5M 0C4, Canada

+1 604 296 4200

20449674-007-R-Rev0

21 July 2022



Distribution List

BC Hydro (electronic copy)

Table of Contents

1.0 INTRODUCTION 1

2.0 PROJECT DETAILS 1

2.1 Project Location 1

2.2 General Description 3

3.0 PUBLIC SAFETY HAZARDS 3

4.0 SITE ESTABLISHMENT 4

4.1 Planned Hours of Work 4

4.2 Security and Access 4

4.3 Project Signs 5

5.0 SAFETY DURING CONSTRUCTION 5

5.1 On-Water Work 5

5.2 Coordination with HLK / ALH Operations 5

5.3 Contractor's Site-Specific Health and Safety Plan 5

5.4 Incident Response 6

6.0 CONCLUSION 6

TABLES

Table 1: Hours of Work 4

FIGURES

Figure 1: Site Plan 2

1.0 INTRODUCTION

This Public Safety Plan has been prepared for BC Hydro's Phase 2 CLBWORKS-27 Lower Columbia White Sturgeon Physical Works Project (the Project). The Project objective is to enhance White Sturgeon spawning substrate at the Keenleyside spawning area in the Lower Columbia River, which is located immediately downstream of the Hugh L. Keenleyside Dam (HLK) and the adjacent Arrow Lake Generating station (ALH).

The Project will generally involve the placement of spawning substrate at the selected substrate placement area, including delivery of the substrate material to a laydown area by truck, loading the substrate material onto a barge, using a tugboat to transport the barge to the substrate placement area and securely anchoring the barge, and placing the substrate material using a long reach excavator or crane with clamshell bucket.

This Public Safety Plan provides an overview of the Project approach for promoting public safety and managing public access to the site during construction.

2.0 PROJECT DETAILS

2.1 Project Location

The Project is located northwest of the City of Castlegar, and the substrate placement area for the Project is located on the Lower Columbia River, immediately downstream of the HLK and ALH, and adjacent to the north bank of the river. In addition to the on-water work zone, the Prime Contractor for construction will require access to a laydown area for equipment storage and for stockpiling substrate material prior to loading to the barge for placement. The preferred laydown area has been identified as the south bank of the river, immediately downstream of HLK. Potential secondary locations for the laydown area were identified on the south bank of the river, immediately upstream of the dam or on the north bank of the river, adjacent to the substrate placement area; however, this plan has been developed assuming that the preferred laydown area would be used.

A site plan showing the locations of the substrate placement area and the preferred laydown area is provided in Figure 1 below.

SETOUT POINTS

POINT No.	EASTING (m)	NORTHING (m)
1	444281.73	5465766.21
2	444350.82	5465733.86
3	444423.03	5465656.42
4	444415.72	5465645.81
5	444334.35	5465689.86
6	444265.86	5465740.11

LEGEND:

- EXISTING RIVER BED SURFACE
- SUBSTRATE PLACEMENT AREA
- TOPOGRAPHIC EXTENTS

NOTES:

1. ALL UNITS ARE IN METRES UNLESS OTHERWISE NOTED.
2. COORDINATE SYSTEM IS UTM NAD 83, ZONE 11.
3. EXISTING GROUND CONTOURS ARE SHOWN AT 1 m INTERVAL RELATIVE TO CGVD 2013.
4. CONSTRUCTION ACCESS SHALL BE VIA ARROW LAKES DR AND THE EXISTING ACCESS ROAD TO THE PROPOSED LAYDOWN AREA.
5. SUBSTRATE MATERIAL SHALL BE STOCKPILED IN THE LAYDOWN AREA AS-NEEDED.

REFERENCE:

1. IMAGE ©2021 GOOGLE, OBTAINED FROM GOOGLE EARTH PRO, USED UNDER LICENSE. GOOGLE EARTH IMAGE IS NOT TO SCALE.
2. BATHYMETRY SURVEY CONDUCTED BY GRANT LAND SURVEYING INC, ON JULY 01, 2019.

SCALE: 1:2500 — 0 — 100m

BC Hydro Contract No ....

ISSUED FOR INFORMATION ONLY

By .... Date ....
Hydro's Representative

NOT FOR CONSTRUCTION

GOLDER
MEMBER OF WSP

BC Hydro

HUGH KEENLEYSIDE (ARROW DAM)

DOWNSTREAM SUBSTRATE PLACEMENT
WHITE STURGEON PHYSICAL WORKS (PHASE 2)
SITE PLAN

NO	REMARKS
0	ISSUED FOR INFORMATION ONLY

REFERENCE DRAWINGS

REVISIONS

DESIGN NUMBER	
WORK ORDER NUMBER	
CSA S250 ACCURACY NAD 83 - 11UTM	
BASE ACCURACY LEVEL:	
ASB ACCURACY LEVEL:	

DSGN	R.CUNNINGHAM
INDEP CHK	G.TANG
DFTG	A.DONG
DFTG CHK	S.REDDY
INSP	-
REV	C.COLES
ACPT	C.COLES

DATE	DIST	DRAWING NUMBER	REPORT NUMBER	FIGURE NUMBER	SIZE	REV
2021-09-02		209-C13-00071		2	D	0

2.2 General Description

The proposed construction methodology for the substrate placement includes the following construction activities:

- Complete general construction setup activities, including preparing the laydown area, preparing the barge, and completing pre-construction bathymetric survey.
- Set anchors. A typical four-point anchor system has been assumed, with two anchors in the river and two on the shore. River anchors are assumed to be installed by a dive crew.
- Deliver washed substrate material to the proposed laydown area by truck, and stockpile prior to barge loading.
- Load substrate material from the stockpile to the barge at the proposed loading location.
- Use tugboat to transport the barge from the loading area on the south river bank to the gravel placement area.
- Place gravel using a long reach excavator (or alternatively, a crane with a clamshell bucket) located on the barge. The barge is to be anchored in place during placement activities.
- Complete construction takedown and cleanup activities, including removing anchors, post-construction bathymetric survey, and cleaning up the laydown area and the barge.

Since the detailed construction methodology is ultimately the responsibility of the Prime Contractor, the actual construction methodology may vary from the above methodology proposed by Golder. However, Golder has assumed that the actual construction methodology will be generally similar to the above for the purpose of developing this Public Safety Plan.

3.0 PUBLIC SAFETY HAZARDS

At this stage of Project planning and staging, the following key areas for public interaction and potential public safety hazards have been identified:

Land-based access on either side of Columbia River:

- Access road (south bank) from Arrow Lakes Drive to the laydown area
- Keenleyside Road over the Dam Crest
- Public parking and access road (north bank) off Broadwater Road
- Fishing spot, river bank and public walking access below parking lot (north bank), in and around ALH

Water-based access:

- ALH Outflow / Spillway Discharge
- Marine users in and around the substrate placement area
- Marine users in and around near the laydown/barge loading area (south bank, immediately downstream of HLK)

Public access and safety, including fencing and signs, should be planned, managed, and installed by the Prime Contractor for the duration of the physical works, in and around the identified public access points. Signs should be posted at least two weeks prior to work commencing.

4.0 SITE ESTABLISHMENT

4.1 Planned Hours of Work

The planned hours of work for the Project are as follows.

Table 1: Hours of Work

	Day Shift	Night Shift
Monday – Friday	7 am – 7 pm	No work
Saturday	7 am – 7 pm	No work
Sunday	No work	
Holidays	No work	

The Contractor shall submit a request in writing for permission to complete work outside the above times. No night shift work is expected to be required for this project.

4.2 Security and Access

Site access and security considerations are as follows:

- The north bank of the river, adjacent to the substrate placement area, can be accessed from Broadwater Rd and the public parking area.
- The laydown area, if the preferred location is used, can be accessed from Arrow Lakes Drive.
  - Crew access and parking will be at this location.
- The Contractor should place signage at the public parking area off Broadwater Rd and at the stairs that are used to access the river, to limit public access to the shoreline during construction.
- The Contractor should install temporary construction fencing at the laydown area to limit public access.

Marine-based security:

- In and around the substrate placement area: appropriate Transport Canada recommended navigational hazard markers, including floating buoys and lights and markers, shall be maintained by the Prime Contractor around their marine work site
- In and around the laydown and barge loading area: appropriate Transport Canada recommended navigational hazard markers, including floating buoys and lights and markers, shall be maintained by the Prime Contractor around their marine work site

4.3 Project Signs

As detailed in the Project's Communications Plan, the Contractor shall post project signs at both the public parking area off Broadwater Rd, and at the access to the laydown area. The project signs should include the project name, construction dates, hours of work, and Contractor name and contact info.

5.0 SAFETY DURING CONSTRUCTION

5.1 On-Water Work

The Prime Contractor will be responsible for implementing the following protocols for on-water work during construction:

- Transport Canada guidelines for on-water work zones should be adhered to.
- Transport Canada protocols for navigation signage should be followed.
- The Contractor shall moor the barge set-up out of the navigational channel overnight.
- Appropriate overnight lighting and navigational markings signage.

5.2 Coordination with HLK / ALH Operations

The Prime Contractor will manage operational communication and coordination with HLK dam and ALH generating station (operated and maintained under FortisBC, owned by Columbia Power) operations, to establish mutually agreed work times and no-work times, in consideration of dam and spillway outflow / overflow operations.

5.3 Contractor's Site-Specific Health and Safety Plan

The Contractor shall prepare a site-specific Health and Safety Plan that shall be submitted for review a minimum of two weeks prior to the start of construction. The Health and Safety Plan should include the following:

- General project description.
- Project team and responsibilities.
- Site rules.
- Site-specific hazards and mitigations/controls.
- Detailed description of the proposed barge anchor system.
- Safety and communication plan for diving operations (if using).

5.4 Incident Response

The Contractor shall prepare an Emergency Response Plan (ERP) to provide details on their proposed response in the event of an incident or emergency. The ERP should include the following:

- List of emergency contacts.
- Site location and directions to the nearest hospital.
- A list of potential emergency situations.
- Procedure to follow in the event of an emergency.
- Required notifications and communications in the event of an emergency.

The Contractor will be responsible for ensuring the ERP is communicated to all workers and visitors to the Project site.

6.0 CONCLUSION

This Public Safety Plan provides an overview of general procedures for managing public access and promoting public safety for the duration of the Project. The Contractor will have responsibility for overall coordination of safety at the Project site during construction.

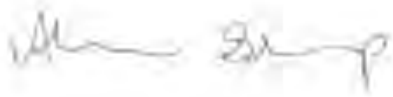
7.0 CLOSURE

We trust that the information provided above is sufficiently detailed to meet your present needs.

Please contact the undersigned if any additional information is required or if there are any questions concerning the information presented

Golder Associates Ltd.

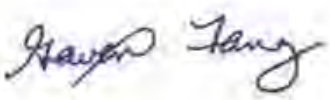
Prepared by:



Aleicia Sharp, PEng
Estimator

John Smith
Operations Manager - Marine Construction

Reviewed by:



Gaven Tang, MASc, PEng
River Engineer

Chris Coles, MASc, PEng
Associate, Senior Hydrotechnical Engineer

AS/JS/GT/CC/lih

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APPENDIX G

Communications Plan

REPORT

Communications Plan

BC Hydro CLBWORKS-27 Lower Columbia White Sturgeon Habitat Restoration

Submitted to:

BC Hydro

6911 Southpoint Drive
Burnaby, BC
V3N 4X8

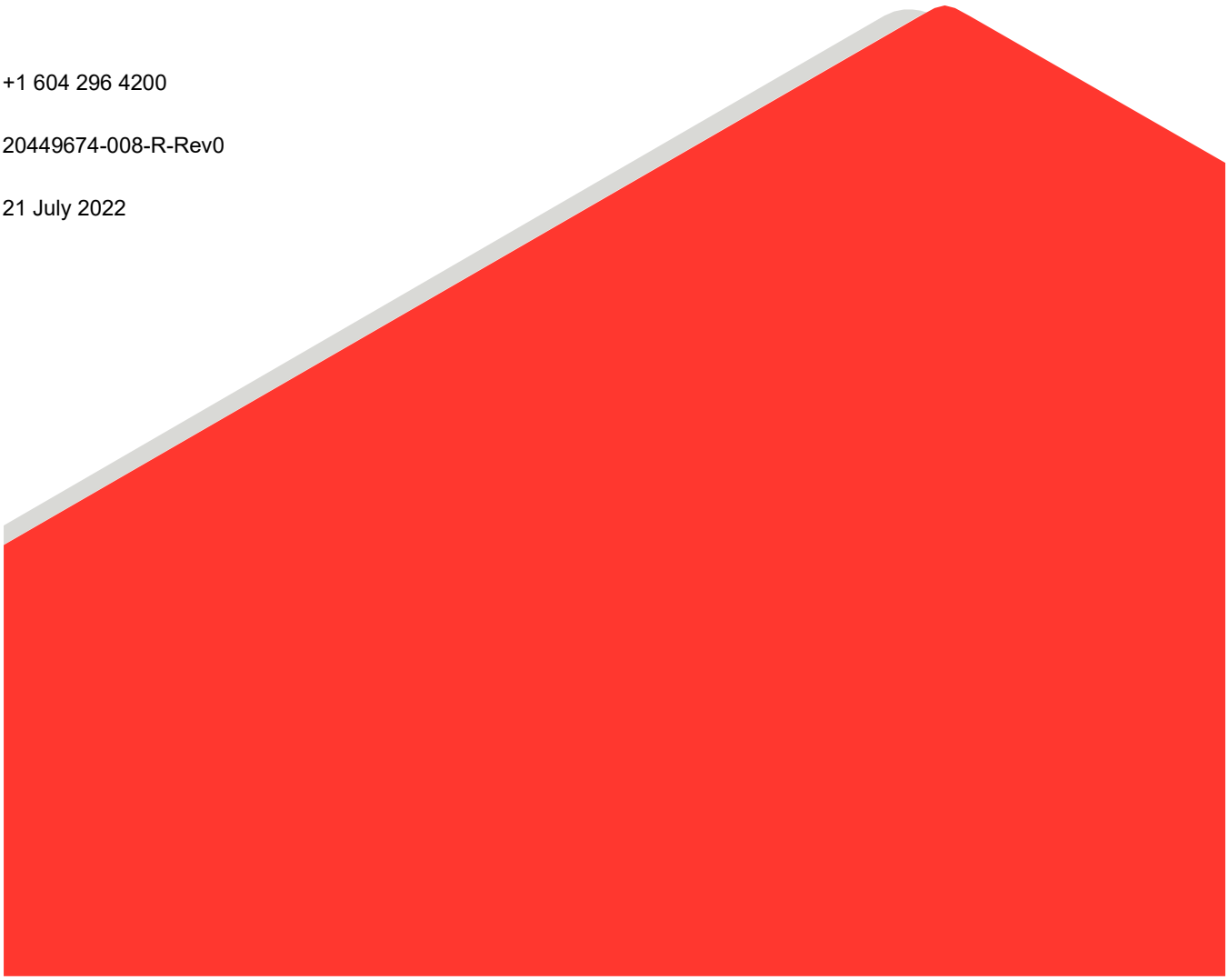
Submitted by:

Golder Associates Ltd.
Suite 200 - 2920 Virtual Way, Vancouver, British Columbia, V5M 0C4, Canada

+1 604 296 4200

20449674-008-R-Rev0

21 July 2022



Distribution List

BC Hydro (electronic copy)

Table of Contents

1.0 INTRODUCTION 1

2.0 PROJECT PARTIES AND STAKEHOLDERS 1

3.0 NOTIFICATIONS AND PROJECT SIGNS 4

3.1 Regulatory Notifications and Approvals 4

3.2 Other Stakeholder Notifications 4

3.3 Project Signs 5

4.0 COMMUNICATIONS DURING CONSTRUCTION 5

4.1 Construction Plans 5

4.2 Contractor Site Operational and Navigational Communication 5

4.3 Project Team Communication 6

4.4 Incident Response and Communications Protocol 6

5.0 CONCLUSION 6

6.0 CLOSURE 7

FIGURES

Figure 1: Project Organizational Chart 3

1.0 INTRODUCTION

This Communications Plan has been prepared for BC Hydro's Phase 2 CLBWORKS-27 Lower Columbia White Sturgeon Physical Works Project (the Project). The Project objective is to enhance White Sturgeon spawning substrate at the Keenleyside spawning area in the Lower Columbia River, which is located immediately downstream of the Hugh L. Keenleyside Dam (HLK) and the adjacent Arrow Lake Generating station (ALH).

The Project will generally involve the placement of spawning substrate at the selected location, including delivery of the substrate material to a laydown area by truck, loading the substrate material onto a barge, using a tugboat to transport the barge to the substrate placement area and securely anchoring the barge, and placing the substrate material using a long reach excavator or crane with clamshell bucket.

The Project Works is expected to be undertaken by a single Prime Contractor engaged by BC Hydro: an experienced marine construction contractor operating equipment to complete the physical works described. The Prime Contractor may also engage sub-contractors.

This Communications Plan outlines the various Project parties and external and internal stakeholders, including regulatory agencies and required permits for the Project. The Plan includes lines and levels of communications between the various parties and includes preliminary communication processes and procedures to be refined during detailed Project planning and operations.

2.0 PROJECT PARTIES AND STAKEHOLDERS

The Parties involved with the project can be categorized into 3 groups:

- Project Owner
- Prime Contractor (including sub-contractors)
- 3rd party / external Stakeholders

The Organizational Chart in Figure 1 outlines the relevant project parties and anticipated contractual relationship and lines of communications.

The Owner's Project team will include the following:

- BC Hydro key Project Team to lead the Project
- Prime Consultant for Phase 3 (Implementation) of the Project, who may act as Agent / Owner's Representative for BC Hydro.
- Operations Team for HLK and ALH, including Columbia Power and FortisBC as required to coordinate the Physical Works including Site access and security, and Dam / Powerstation Spillway Operations.

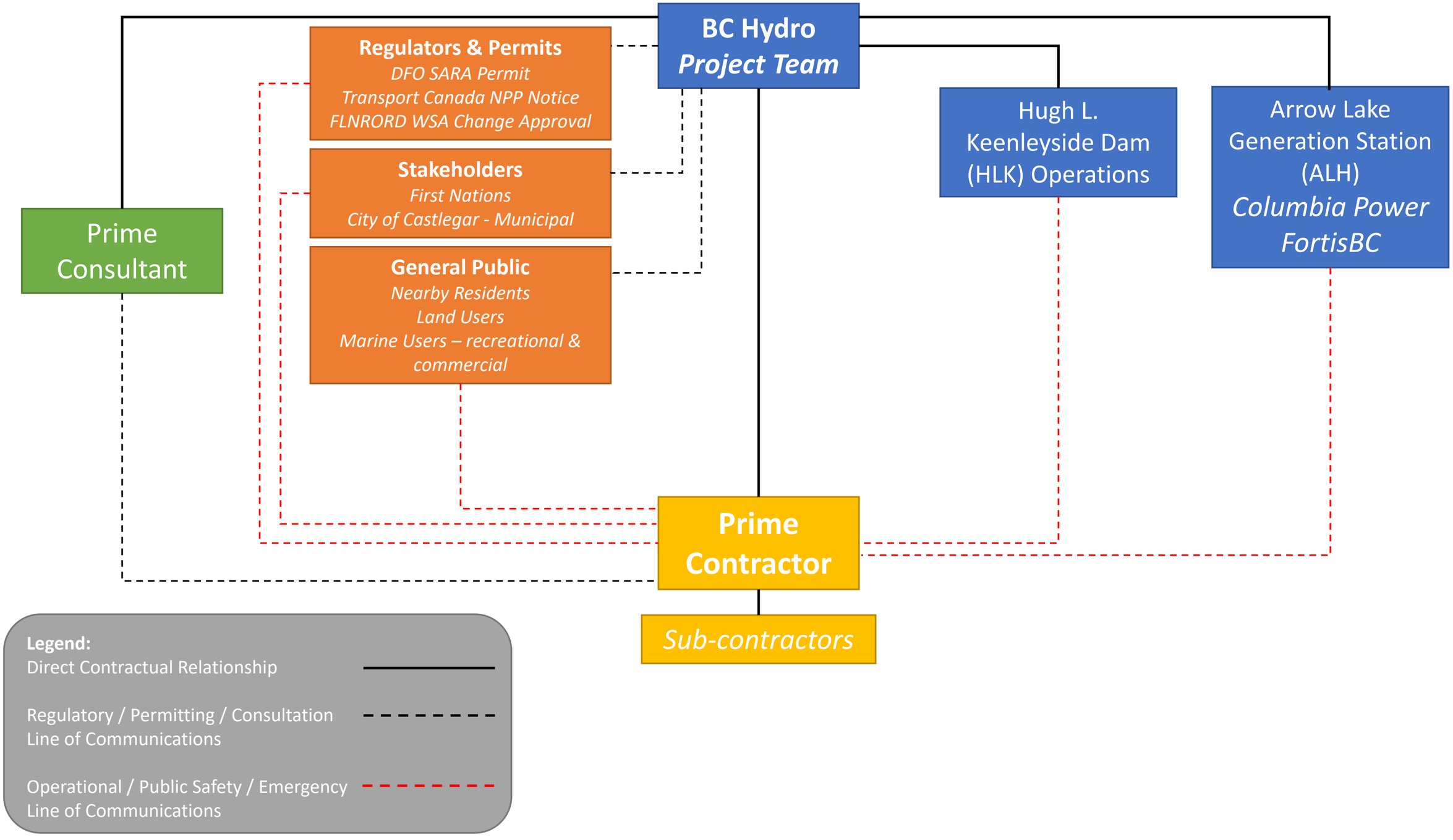
The Physical Works will be undertaken by the Prime Contractor team, under contract to BC Hydro, who will be responsible for managing the Site.

- Prime Contractor
  - Subcontractors to the Prime Contractor

Third-party stakeholders to the Project may include regulatory stakeholders and other local stakeholders. These could include, but are not limited to, the following:

- Transport Canada, who will be required to review the Project under the Navigation Protection Program (NPP), as per the *Canadian Navigable Waters Act,* to determine if the Project would be considered an interference to navigation and whether approval is required.
- Department of Fisheries and Oceans (DFO).
- Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRORD).
- Local First Nations groups.
- The City of Castlegar.
- Marine users, including commercial and recreational.
- Other residents and general public in the vicinity of the Project, including walkers and hikers.

Additional stakeholders and individual contacts at the above-named companies/organizations may be identified during Phase 3 of the Project. As project stakeholders are identified, a single master contact list including organizations and individual names and roles should be kept. This will assist to avoid errors and duplication at various stages of stakeholder communication throughout the Project.


BC Hydro
Project Team
Regulators & Permits
DFO SARA Permit
Transport Canada NPP Notice
FLNRORD WSA Change Approval
Stakeholders
First Nations
City of Castlegar - Municipal
General Public
Nearby Residents
Land Users
Marine Users – recreational & commercial
Prime Consultant
Hugh L. Keenleyside Dam (HLK) Operations
Arrow Lake Generation Station (ALH)
Columbia Power
FortisBC
Prime Contractor
Sub-contractors
Legend:
Direct Contractual Relationship
Regulatory / Permitting / Consultation Line of Communications
Operational / Public Safety / Emergency Line of Communications

3.0 NOTIFICATIONS AND PROJECT SIGNS

3.1 Regulatory Notifications and Approvals

Any identified regulatory stakeholders should be notified early in Phase 3 (Implementation) of the Project, to ensure that all required permits and approvals are in place. The following permits and approvals have been identified as being required for the Project:

- *Species at Risk Act* (SARA) permit: White Sturgeon are considered Endangered under SARA, and the Project location is considered Critical Habitat, therefore BC Hydro must apply to DFO for a SARA permit.
- *Water Sustainability Act* Section 11 Change Approval: BC Hydro will need to apply to the Ministry of FLNRORD for approval for changes in and about a stream.
- Navigation Protection Program (NPP) review: the Project location on the Columbia River is considered a Scheduled Navigable Water under the *Canadian Navigable Waters Act* (CNWA) and as such may require approval under the NPP. A review will be required to determine if approval is required, as the Project does not readily qualify under any of the Minor Works categories, which are allowed to proceed with a notification only.

The above permits and approvals may be provided with additional terms and conditions; any terms and conditions that require communications or consultations with third-party stakeholders (such as First Nations, marine users, or other community groups) shall be adhered to as part of this Plan. If approval is required under the NPP, BC Hydro would be required to publish a notice with a 30-day comment period for interested parties, then await Transport Canada approval (allow 30 days). Therefore, BC Hydro should allow 60 days in their project schedule for receiving NPP approval.

3.2 Other Stakeholder Notifications

Notification and coordination with FortisBC and Columbia Power should begin as soon as practical, to accommodate detailed scheduling around planned shutdowns and regular maintenance work periods for ALH during construction.

Local residents and other stakeholders within a 5 km radius of the Project may be notified of the Project by letter, at a minimum two weeks in advance of the expected construction start date. The letter should detail the expected construction dates, proposed working days and hours, description of the Project, general description of the expected construction equipment and activities, and impacts to stakeholders (if any). The letter should also include phone and email contact information, should recipients have any questions or require additional information prior to or during construction.

3.3 Project Signs

Project signs shall be clearly and frequently posted by the Prime Contractor to meet their Prime Contractor site security requirements, and as appropriate for managing public safety. At this stage of the project planning, it is expected that public project signs will be required at a minimum of two locations:

- At the public parking area on the north bank of the Columbia River, adjacent to the work area.
- At the access road to the proposed laydown area on the south bank of the Columbia River, accessed from Arrow Lakes Dr.

The project signs should include, at a minimum, the project name, expected construction dates and hours of work, Prime Contractor name, and Prime Contractor contact info. Signs should be posted a minimum of two weeks prior to the start of construction.

4.0 COMMUNICATIONS DURING CONSTRUCTION

4.1 Construction Plans

The following construction plans are to be prepared by the Prime Contractor prior to construction:

- Quality Management Plan (QMP), which is to include the Contractor's processes and procedures for monitoring and inspecting the work to ensure conformance with the Project specifications.
- Site-specific Health and Safety Plan, which is to include the Contractor's management approach for site health and safety.
- Emergency Response Plan (ERP), which is to include the Contractor's procedures for responding to incidents and emergencies and shall be communicated to all persons working at the Project site.

The above plans should be submitted to the Consultant for review a minimum of two weeks in advance of construction. The construction plans shall consider Project communications such as site communications and Project team communications, where appropriate.

4.2 Contractor Site Operational and Navigational Communication

The Prime Contractor is expected to follow Transport Canada protocols and best practices for marine communications and signage of their marine equipment, including navigational hazard lighting and buoy markings, and radio communications. The Prime Contractor's navigational communication and signage procedures should be a key part of their site-specific Health and Safety Plan. The Contractor's communication procedures should include the following, at a minimum:

- Identification of the TC Marine Communications and Traffic Services (MCTS) centre and relevant local radio channel for the Columbia River site, or similar equivalent.

- Marine traffic / navigational radio communications as per Transport Canada protocols.
  - Advise of daily set-up location and any positioning changes during the work shift.
- Marine traffic radio used for coordination if the barge set-up is required to temporarily move out of the navigational channel for other vessel passage.

4.3 Project Team Communication

The Prime Contractor should report progress to the Prime Consultant/BC Hydro on a weekly basis, at a minimum. The weekly progress reports should include progress on the volume of spawning substrate placed daily and shall be used for progress tracking and record keeping.

4.4 Incident Response and Communications Protocol

Detailed procedures for responding to an incident shall be provided in the Contractor's ERP. An incident could include an emergency (such as medical emergencies, marine emergencies, fire, earthquake, severe weather, or general site evacuation), an environmental release (spill), or any other event that threatens health and safety, the environment, or property and requires an immediate response.

The Contractor shall include in their ERP a list of emergency contacts and phone numbers, as well as procedures to follow in the event of an incident. The Contractor shall notify the Prime Consultant/BC Hydro of the incident as soon as any emergency is safely contained.

5.0 CONCLUSION

This information presented in this Communications Plan is preliminary and expected to be further developed as the Project progresses and the Prime Contractor and Prime Consultant have been selected, with a goal of ensuring timely and appropriate Project notifications for stakeholders. Any additional stakeholders identified during Phase 3 (Implementation) of the Project should be added to those identified in this plan, and the Contractor should provide detailed input into communications during construction as part of their construction planning.

6.0 CLOSURE

We trust that the information provided above is sufficiently detailed to meet your present needs.

Please contact the undersigned if any additional information is required or if there are any questions concerning the information presented.

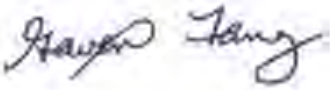
Golder Associates Ltd.

Prepared by:

Aleicia Sharp, PEng
Estimator

John Smith
Operations Manager - Marine Construction

Reviewed by:



Gaven Tang, MASc, PEng
River Engineer

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AS/JS/GT/CC/lih

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