Aquatic Environmental Assessment for the North Harrison Lake Log Handling Facility Re-activation

North Harrison Log Handling Facility

Prepared For

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Submission Date
January 2019

Date: November 9, 2019

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Peter Barrs, RPF – BC Timber Sales

From: Wayne Wall, RPBio
Graham/Wall Consulting Ltd.

Re: Letter of Transmittal for the *Aquatic Environmental Assessment for the North Harrison Lake Log Handling Facility Re-activation*

Background

In the summer of 2018, Graham/Wall Consulting Ltd. (GWCL) was contracted by the Infinity Pacific Stewardship Group to conduct an aquatic environmental assessment of the proposed log handling facility located on the north east side of Harrison Lake. The assessment was conducted under the Fisheries Act of Canada (2012) and adapted for the aquatic environment using the *Approved Work Practices for Re-Activated Log Dumps in Marine Waters of British Columbia* (2011) (AWP). The final report was completed in January 2019, prior to the changes to the Fisheries Act of Canada (2019) coming into force in August 2019. The primary recommendation in the 2018 assessment was that the proposed log handling facility would have to go to project review.

The purpose of this Letter of Transmittal is to determine if the content of the 2018 report is still relevant in relation to the present Fisheries Act (2019).

Relevancy of the 2018 Report in Relation to the Fisheries Act (2019)

The relevant change between the Fisheries Act (2012) and the Fisheries Act (2019) is the removal of *serious harm to fish* and the re-instatement of *harmful alteration, disruption or destruction of fish habitat* (HADD) and the requirements for project review and project authorization.

Presently, there are no current standards and codes of practices for the development or re-activation of log handling facilities in either the marine or aquatic environments in British Columbia. The AWPs (2011) are the most relevant guidance to follow when conducting an assessment of a previously active log dump. These AWPs were developed prior to the Fisheries Act (2012) coming into force so there is some consideration given to creating a HADD when re-activating a log handling facility. Following the direction in the AWPs, log handling facilities that have been dormant longer that 10 years but have begun to show signs of recovery require a project review. The Harrison Lake log handling facility has been dormant for longer than 10 years and is showing some signs of recovery. Using these criteria, along with other findings in the assessment, the recommendation for the Harrison Lake Log Handling Facility to go to project review was made in the 2018 assessment.

When reviewing the 2018 assessment in relation to the changes made in the Fisheries Act (2019), a similar outcome was made. There is the potential of a HADD occurring during the construction and operation of the Harrison Lake log handling facility. The risk of a HADD occurring will require the log handling facility go to project review. There is sufficient information in the report for a project review and a determination of whether or not an authorization is required under the Fisheries Act (2019). The assessment is consistent with the standards of the AWP and contains the relevant information required for a project review. If the outcome of the project review determines that a HADD will occur, the Department of Fisheries and Oceans Canada will require that the project obtain an authorization under the Fisheries Act (2019). The authorization could contain direction on mitigation and/or habitat off-setting requirements for this specific project.

If you have any further questions, please feel free to contact me at (250) 287-9977 or by email at w.wall@shaw.ca.

Yours truly

Wayne Wall, RPBio
Graham/Wall Consulting Ltd.

Signatures

This report has been prepared by Graham/Wall Consulting Ltd. for the sole use and distribution of Infinity Pacific Stewardship Group. Results and observations in this report have been made in a manner consistent with the level of care and skill normally applied by environmental professionals practicing under similar conditions.

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EXECUTIVE SUMMARY

Graham/Wall Consulting Ltd. (GWCL) was retained by Infinity Pacific Stewardship Group (Infinity) to provide an aquatic environmental assessment of the near-shore and sub-surface areas for the proposed re-activation of the North Harrison Lake log handling facility. The purpose of the assessment was to determine the effects of the re-activation the North Harrison Lake Log Handling Facility on fish habitat. The results of the assessment would also determine if the re-activation of the log handling facility would meet the Approved Work Practices (AWP) for Re-Activated Log Dumps in Waters of British Columbia (DFO, 2011) and not require DFO review or if it would result in serious harm to fish under the Fisheries Act requiring review by DFO.

The freshwater aquatic environmental assessment determined that with proper facility design and in water mitigation and/or compensation recommendations (boom stick/debris curtain installation, direction of skidways and deep-water storage) deposition will be contained within the previously impacted area. Existing habitat will be protected thus not resulting in serious harm to fish and will not require review under the Fisheries Act. The proposed re-activation of the facilities falls under the Approved Work Practices (AWPs) siting criteria conditions; (3.a.) "the site remains degraded, and that the proposed re-activation construction and operational activities will not result in an increase to the existing habitat impacts associated with the original log dump, you may proceed with Notification." and (3.b.) as "the site remains degraded, but is within 100m of important fish habitat (aquatic vegetation and gravel beaches) consult your qualified professional for appropriate measures to implement in order to prevent negative impacts to theses habitats" (DFO, 2013).

By following best practices to avoid causing serious harm to fish in the current Fisheries and Oceans Act Legislation(DFO, 2013), and Fisheries and Oceans Canada "Projects Near Water" Guidelines, log handling facilities can proceed without review provided: there will be no increase in the previous footprint, there is a debris management plan in place to avoid wood accumulation on site and, the site has been used within the last 10 years. The construction and operation of the proposed Harrison Lake log handling facility site will be located inside the footprint of a historical log dump that was last operated more than 40 years ago (circa 1960). Operation at the facility is anticipated to begin in 2019 which is 10+ years since its last operation. As this is more than 10 years since the previous operation, under the new changes to the Fisheries Act review by DFO will be required.

Based on the observations along eight transects for this assessment, the site has not fully recovered from the past operation. Each of the transects showed some degree of impact with historical woody accumulation (stumps, logs and branches) and thick, fine, natural sedimentation covering most surfaces. Discarded deleterious material was observed at the approximate location of the historic skidways/barge facility (Transect #3). There are two narrow freshwater aquatic plant beds located along the shallow near shore habitats on either side of the previous skidway location. There is also a limited narrow near shore gravel zone. The site will continue to be impacted (not fully recovered) at the anticipated commencement of the operations of the facility. As Qualified Environmental Professionals (QEP) we recommend that the following facility design and in water

mitigation/compensation measures be followed in order to re-activate of this previously impacted site. Serious harm to fish or fish habitat should not result provided the operators of the facility:

a. Installs a boomstick barrier/debris curtain along each side of the skidway to contain and direct generated woody debris along historical impact zones. Containment will ensure reduction of benthic footprint and area of impact.

b. Re-aligns the skidway directly towards deep water near Transect #3. This transect displays the greatest historical deposits (deleterious materials) and the shortest distance to deep water (~9m of depth by the 20m distance mark).

c. Maintains a skidway length of at least 30m to reduce angle and speed the bundles will strike the surface of the water. This will access deeper water for the bundles prior to leaving the skidway and reduce woody debris caused by abrasion from log movement within the bundles.

d. Adequately anchors boomstick barriers for deep-water log storage at the 30+m distance location from the beach. This will avoid shallow near-shore impacts (plant beds and clean gravel) created by: shadow effect, grounding of bundles and deposition of woody debris.

e. Observes specific fish migration windows for species of concern (salmon and sea run trout) during spawning, rearing and juvenile ocean migration.

No sensitive wildlife features such as bald eagle or osprey nests were noted on site at the time of assessment.

1.0 INTRODUCTION

Log handling facilities are an integral part of forestry harvesting operations in Coastal British Columbia. Approved Work Practices (AWPs) from both Fisheries and Oceans (DFO) and the Coastal Forest Sector have been developed to assist the proponent in the siting, design, operation and deactivation phases of the log handling facilities. The Approved Work Practices are designed to mitigate or avoid negative impacts on fish habitat and rearing environments (DFO, 2011). Although these AWPs are no longer listed on the DFO website, they continue to be the best guidance documents available. An updated guidance document has also identified serious harm to fish food supply, nursery and "any other life process" as areas for review and focus (DFO, 2013). Following these guidelines will ensure that no serious harm to fish, fish habitat or life requirements will occur. Freshwater disturbances can be minimized dependant on adequate shallow flushing capacity created by wind and seasonal currents near the site, the methods of handling logs and the intensity of use of the area. There are two main impacts that result from the development of log handling facilities:

1. Physical disturbance of natural aquatic habitats
   - These result from construction and operation of the facilities.
   - Mechanical scouring of logs and their movement through the water column.
2. Ecosystem changes
   - Accumulations of wood debris such as bark, sticks, and abraded wood fibre on the aquatic bottom will alter benthic populations (McDaniel, 1975). Thick layers of wood debris may smother benthos fauna, reduce fecundity and increase eggs mortality. Toxic compounds can also be released in the ecosystem from bark leachates and degradation (DFO, 2003).
   - Increased turbidity (suspended materials) and shadowing (log bundles / floating structures) will decrease primary productivity that is dependant on sunlight and light penetration through the water.

These issues can be minimized with site-specific Best Management Practices (BMPs). The overall impact of log handling facilities on coastal aquatic environments can be minimized by utilizing pre-existing facilities, targeting sites with a lower degree of biological significance or selecting sites that have been previously approved.

As part of the process for the Re-Activation of the North Harrison Lake Log Handling Facility, Graham/Wall Consulting Ltd. (GWCL) was retained by Infinity Pacific Stewardship Group to conduct an aquatic environmental assessment of the area. The assessment was conducted following the methodology described in DFO's *Marine Assessment Protocol for Assessing Fish Habitat and Wood Debris Deposition*.

The main objectives of this assessment include;

- Determining if the site conforms to the criteria conditions for the re-activation of an existing log dump as outlined by *Approved Work Practices for Re-Activated Log Dumps in Marine Waters of British Columbia* (DFO, 2011),

- Determining the extent and magnitude of previous impacts on aquatic habitats and accumulations of wood debris,
- Describing the physical and biological characteristics of the flood zone and near-shore zones of the area,
- Documenting habitat and impacts to the aquatic environment using still and video photography,

Under Section 35 (1) of the current *Fisheries Act,* "*no person shall carry on any work, undertaking or activity that results in serious harm to fish that are part of a commercial, recreational, or Aboriginal fishery, or to fish that support such a fishery"* (DFO, 2013). In the case where serious harm is authorized by the Minister (Section 35 (2)(b)), offsetting measures to counterbalance serious harm to fish will be required. These will maintain or improve fisheries productivity after all feasible measures to avoid (or mitigate) impact have been undertaken. These measures will account for the potential habitat losses created by the re-activation or operation of the facilities. AWPs and proposed mitigation measures are intended to avoid any serious harm to fish. Proposed compensation programs are intended to enhance fish productivity in adjacent areas to offset any potential impacts from the facility.

The assessment was conducted after the 2012 revisions to the *Fisheries Act* legislation came into effect and this report has been written using the current legislation. At the time of this assessment the February 6, 2018 *Proposed Amendments to the Fisheries Act* have not been passed through the House of Commons, the Senate or received Royal Assent.

1.1 Limitation

This report has been prepared for the use and distribution by Infinity Pacific Stewardship Group. Results are based upon an inspection of the flood zone and near-shore areas mentioned in this report and on the conditions observed July 4th, 2018. Results and Observations in this report have been made in a manner consistent with the level of care and skill normally applied by environmental professionals practicing under similar conditions to those encountered at the time of the assessment. Significant environmental changes can occur in aquatic environments that have the potential to invalidate the results in this report. If such a change occurs (the probability of change increases over time) reassessment of site may be necessary.

1.2 Site Description

The North Harrison Lake License of Occupation (LOO) application is located on the northeastern shoreline of Harrison Lake, approximately 55km north of the town of Harrison Hot Springs, BC (Figure 1). The area falls within Lower Fraser Watershed and is in the Traditional Territory of the Xa'Xtsa First Nations.

Personal communications with BC Timber Sales planning staff outlined the Harrison Lake log handling facility area being used for log handling between 1940 and 1960. During these active phases at the

Harrison Lake log handling facility an unknown volume of wood, comprised mostly of western hemlock and Douglas fir was watered. During the next active phase of operations an estimated 82,994 m3 of wood will be watered over a four-year period. The estimated volume by species is 56,552m3 Douglas fir (68%), 11,153m3 western hemlock (14%) and 2,458m3 western red cedar (3%).

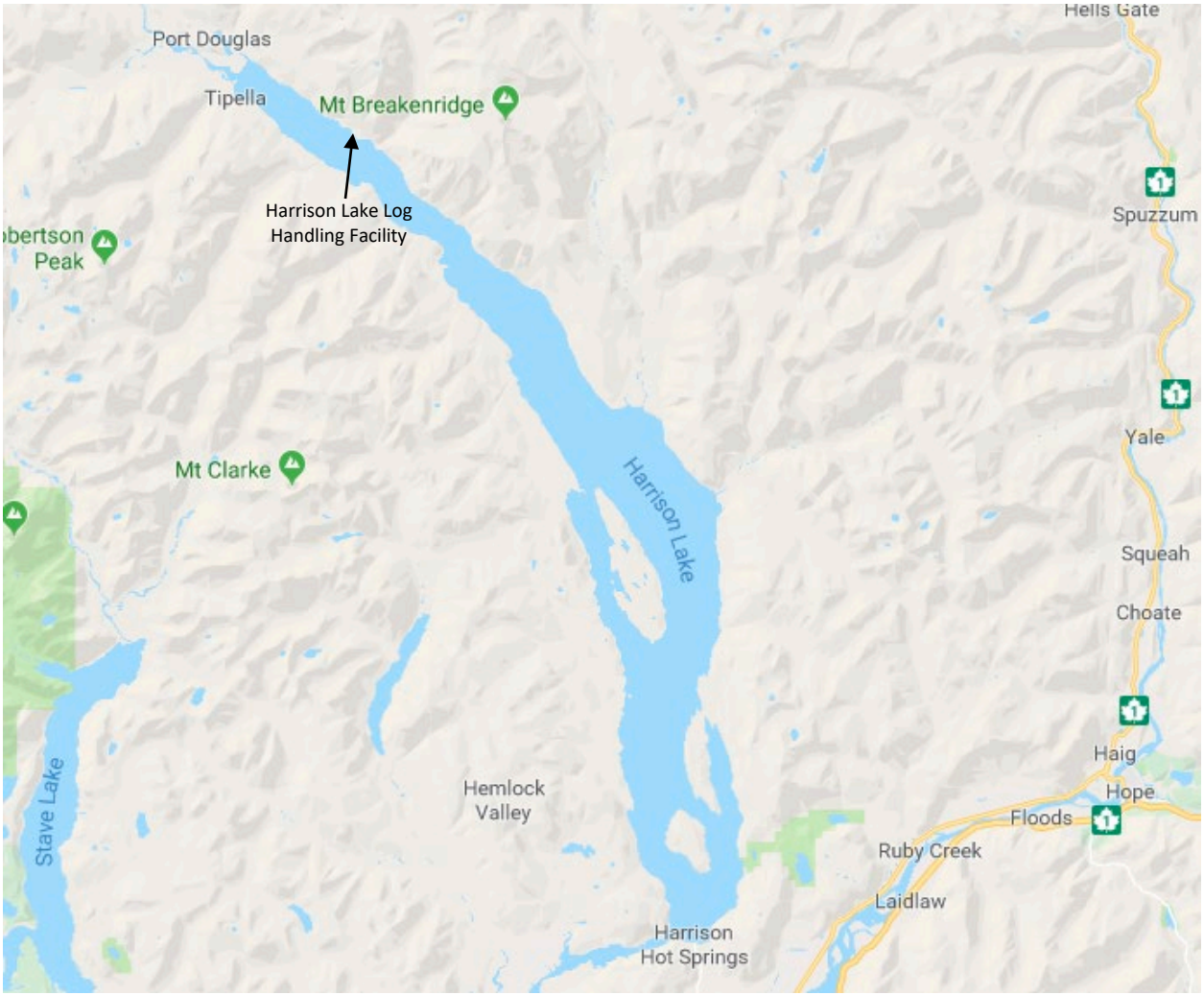

Figure 1. Overview map of the location of the North Harrison Lake Log Handling Facility, 55km northwest of the town of Harrison Hot Springs, BC.

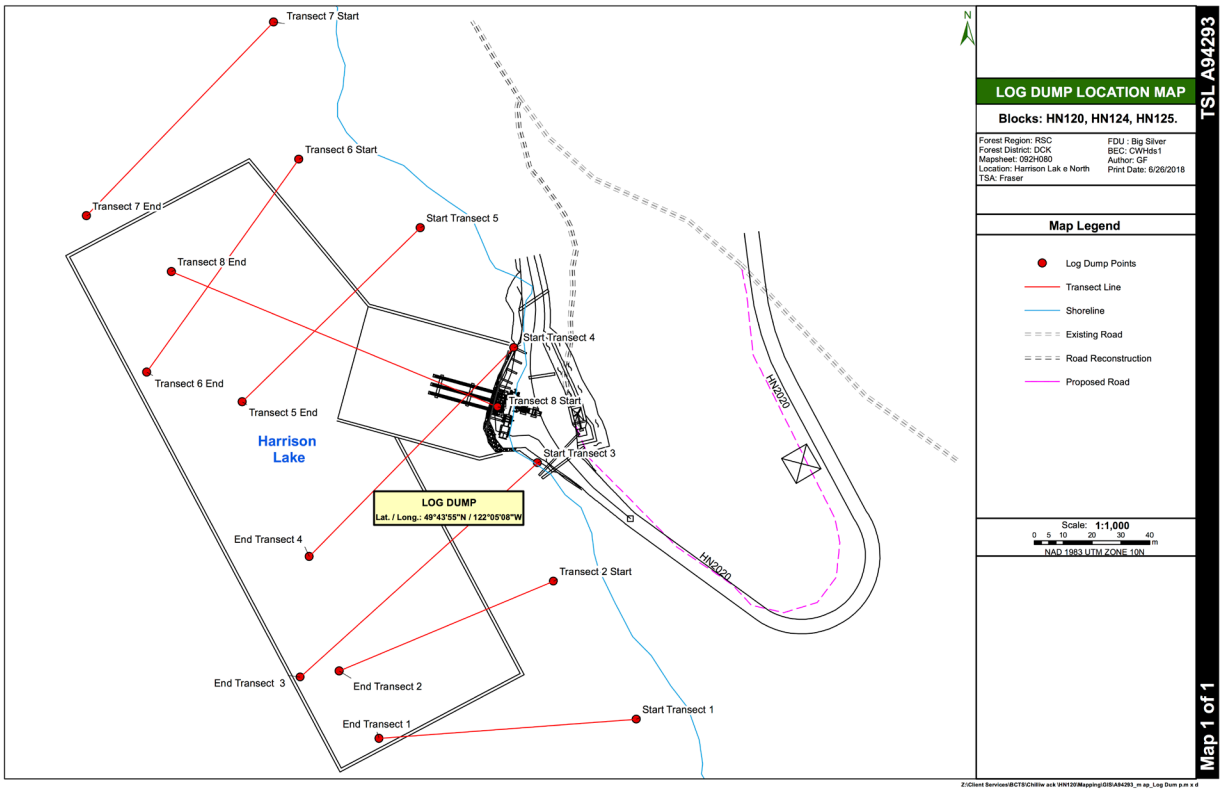

Figure 2. Location of the North Harrison Lake Log Handling facility LOO on the northeast shoreline of Harrison Lake.

2.0 METHODS

The methodologies of the assessment of the foreshore, near-shore flood zone and sub-aquatic zones followed the Marine Assessment Protocol for Assessing Fish Habitat and Wood Debris Deposition for Re-Activated Log Dumps (DFO 2011). Although, these methods are no longer listed on the DFO website, they are the most current guidelines to utilize to determine the potential for causing serious harm to fish if the facility licence is renewed. These methods will be utilized until further guidance is given from DFO relating to log handling facilities.

On July 4th, 2018, a biological team of WCB qualified divers, including Steven Lacasse, RPBio, Trudy Lacasse (BCL Biotechnologies Ltd.) and Wayne Wall, RPBio (GWCL) conducted the environmental assessment. There were three main components to this survey describing wood debris impacts and habitat types:

1. Foreshore Survey
2. Sub-Aquatic Transect Survey
3. Near-shore Flood Zone Cross Transect Survey

The description of the habitat was done following the categories described in Tables 1, 2, 3 and 4.

Table 1. Impact Assessment Categories

Wood Debris	Criteria
No-Low (0%-33% wood debris coverage)	-No to little wood debris present -No habitat scouring -Flora remains rooted in/on substrate - Infauna organisms abundant (substrate dependent) -Native species assemblages, diversities and abundances present
Moderate (34%-66% wood debris coverage) Wood debris >2.5cm depth	-Wood debris present but less than 2.5 cm thick -Occasional flora present
High-Severe (67-90% wood debris coverage) Wood Debris >2.5cm depth	-Large areas with high coverage of debris -No rooted flora present -Infauna absent (substrate dependent).

Table 2. Description of the fauna and flora

Single	Rare	Few	Abundant
1 individual	<5 individuals/transect	5-10 individuals/transect	>10 individuals/transect

Table 3. Debris Categories

Fine Wood Waste	Coarse Wood Waste	Large Wood Waste	Other
-small wood pieces -woody silt	-small branches -defined strips -sticks and bark	-large branches -log/log bundles -stumps	-cable -steel pipe -refuse

Table 4. Substrate Categories

Substrate	Definition
Silt/Clay/Mud	Loose sedimentary deposit; **<0.06mm**
Sand	Loose granular material; **0.06mm-2mm**
Gravel	Loose rounded fragments of rock; **2-64mm**
Cobbles (shot-rock)	Loose stone larger than gravel, smaller than a boulder; **64-256mm**
Boulders	A detached mass of rock; **>256mm**
Bedrock	Solid rock underlying unconsolidated surface material
Shell Hash	Shell fragments of various organisms

2.1 Foreshore Survey

While determining the transect line attachment locations, digital photographs of the shore were taken, and general observations of the aquatic riparian and above-water flood zone areas were made. Any special habitat concerns were noted.

2.2 Sub-aquatic Transect Survey

Seven transects were established perpendicular to the lake shoreline. Their locations were selected to encompass the proposed Licence of Occupation area and review the different habitat types and degree of impact from woody debris within the LOO. The transects were numbered sequentially from the south to the north side of the site. Beach attachment points were estimated utilizing geo-referenced maps and scaled measurements. Outer end anchor points of each transect were geo-referenced using an iPad mini (GPS accuracy +/- 5m). An eighth transect was conducted along a proposed (and recently developed) skidway location and planned bundle pathway. This transect had both ends geo-referenced using an iPad mini. All references are outlined on the site plan (Table 5). Transect lines were made out of sinking line with coded tape labels every 5-meters. Transect lines were attached at the highest high water (HHW) mark to solid objects on the beach with the 0+000m label estimated from the geo-referenced anchor locations. Each transect was run perpendicular to the shoreline. Video recordings began at the surface immediately in front of the beach and continued along each transect with additional observations recorded at every 5m station. Depth information from a Suunto diving computer was recorded every 10m. Substrate type, aquatic flora, sessile and motile fauna as well as their relative abundance were recorded along each transect. The SCUBA and video surveys were limited to shallow aquatic areas of less than 30.5m (100 feet) deep. Each video segment, documenting the transect swims is included entirely in the detailed video log (Appendix 2).

The distances along each transect were corrected (using Pythagorean theorem) to adjust for the slope of the lake floor to produce more accurate bathymetric profiles. Stations mentioned in the report are slope distances. The raw video compilation, which contains surveyed distances, depths (in feet), DVD times, and specific remarks regarding observed biological features are included in Appendix 2.

The description of the fauna and flora was done using the categories described in Table 2. A detailed list of the observed biota and all scientific names for species mentioned in this report can be found in Appendix 3. The following reference material was used to confirm the species identification from the video review: Nedeau, E.J. et al, 2009, Pojar and Mackinnon, 1994.

2.3 Near-shore Flood Zone Cross-Transect Survey

The near-shore section between the transect lines was observed and recorded on video. At the end of each sub-aquatic transect survey, the biological diving team swam from the surface (0m depth) to a maximum of 6m (20 feet) in depth and then back to the surface as they proceeded towards the next sub-aquatic transect line. This procedure results in a zig-zag pattern of review between two transect lines. Each video segment, documenting the shallow near-shore sections of the surveyed site, is included entirely in the detailed video log (Appendix 2).

3.0 RESULTS

The weather at the time of the survey was clear, sunny and warm. Surface water visibility was fair (2 – 4 m visibility) with suspended fine sediments observed. The assessments were done during a mid-flood event (water ~ 6 feet (1.8m) above 0 ft stage height, late summer, water level). This depth was taken at the Killer Cove Marina located near the southern end of Harrison Lake. The depth information obtained for each surveyed transect (Table 5) was calculated and converted into cross-sectional bathymetric profiles and displayed in Appendix 1.

The description of the fauna and flora was done using the categories (i.e. single, rare, few, abundant) described in Table 2. The raw video compilation which contains surveyed distances, depths (in feet), DVD times, and specific remarks regarding observed biological features are included in Appendix 2. A detailed list of the observed biota and all scientific names for species mentioned in this report can be found in Appendix 3.

Site plan maps with the transect locations and summary of bathymetric and habitat findings are included in Appendix 4. The starting time of the dive surveys, the lake height and the corrected depth to the Chart Stage height for all 10m intervals along the transect line have been included in Table 5.

3.1 Bio-Physical Description

At the time of the assessment, no evidence of terrestrial or aquatic wildlife features, such as wildlife trees, raptor/aquatic bird nests, heron colonies or nests were found on site.

All eight transects were located along the shore of Harrison Lake (Appendix 4). The backshore consisted of a mixture of old forest comprised mainly of coastal Douglas fir (*Pseudotsuga menziesii*), western hemlock (*Tsuga heterophylla*), western red cedar (*Thuja plicata*) and with young red alder (*Alnus rubra*) growing along the roadways and historic dump area. The transects were numbered sequentially from south to north. Transect 1 was located outside the proposed southern boundary of the License of Occupation (LOO). Transect 2 was approximately 50m to the north and just inside the southern boundary of the LOO. Transect 3 was 100m north of the southern boundary of the LOO and along the south side of the historic dump and barge ramp. Transect 4 was off the north end of the recently installed log cribbing for the proposed skidway location. Transect 5 was 50m north of the proposed new skidway location. Transect 6 was inside the north boundary of the LOO and approximately 100m north of the new skidway location. Transect #7 was outside of the north boundary for the LOO. Transect 8 was attached directly to the new log crib at the proposed location for the new skidway. This transect was added to provide a detailed habitat review along the proposed log travel corridor for the new dump.

Shoreline feature displayed an increasing slope bottom with distance from the beach. At all transects, once the 70-foot depth measurement was obtained, the dive team returned towards the beach for the next section of the survey. Soft fine sediment deposition over steep slopes did not require deeper inspection for fish habitat. Transect 1, at the southern extent of the area, was the only transect of the

Table 5. Position of transects with corresponding depths/corrected distances along transect lines.

	Location		Start time	Water Height above Chart Stage height		Distance along Transect (m)										
	Origin (calculated)	Anchor (geo-referenced)				0	10	20	30	40	50	60	70	80	90	100
Transect 1	49˚43.865' N 122˚05.100' W	49˚43.859' N 122˚05.177' W	11:08	1.8m	Observed depth (m)	0.0	-1.8	-5.5	-10.4	-13.4	-14.9	-14.6	-12.5	-14.9	-18.3	-21.6
					Depth relative to Stage height (m)	1.8	0.0	-3.7	-8.5	-11.6	-13.1	-12.8	-10.7	-13.1	-16.5	-19.8
					Corrected distance (m)	0	9.8	19.1	27.9	37.4	47.3	57.3	67.0	76.7	86.2	95.6
Transect 2	49˚43.890' N 122˚05.122' W	49˚43.872' N 122˚05.191' W	11:30	1.8m	Observed depth (m)	0.0	-0.9	-2.7	-8.2	-10.7	-13.7	-14.6	-16.2	-17.1	-22.3	
					Depth relative to Stage height (m)	1.8	0.9	-0.9	-6.4	-8.8	-11.9	-12.8	-14.3	-15.2	-20.4	
					Corrected distance (m)	0 .0	10.0	19.8	28.2	37.8	47.4	57.3	67.2	77.2	85.7	
Transect 3	49˚43.912' N 122˚05.128' W	49˚43.879' N 122˚05.202' W	11:50	1.8m	Observed depth (m)	0.0	-3.0	-8.2	-10.4	-14.6	-16.2	-17.1	-18.0	-21.9	-21.9	
					Depth relative to Stage height (m)	1.8	-1.2	-6.4	-8.5	-12.8	-14.3	-15.2	-16.2	-20.1	-20.1	
					Corrected distance (m)	0.0	9.5	18.1	27.8	36.9	46.8	56.7	66.7	75.9	85.9	
Transect 4	49˚43.933' N 122˚05.135' W	49˚43.891' N 122˚05.191' W	13:17	1.8m	Observed depth (m)	0.0	-1.8	-2.4	-3.7	-7.3	-12.8	-14.6	-18.3	-20.7		
					Depth relative to Stage height (m)	1.8	0.0	-0.6	-1.8	-5.5	-11.0	-12.8	-16.5	-18.9		
					Corrected distance (m)	0	9.8	19.8	29.7	39.0	47.4	57.2	66.5	76.2		

Table 5. Position of transects with corresponding depths/corrected distances along transect lines (continued).

	Location		Start time	Water Height above Chart Stage height		Distance along Transect (m)										
	Origin	Anchor				0	10	20	30	40	50	60	70	80	90	100
Transect 5	49˚43.957' N 122˚05.162' W	49˚43.920' N 122˚05.213' W	13:35	1.8m	Observed depth (m)	0.0	-1.2	-2.7	-6.7	-12.5	-16.5	-20.1	-22.6			
					Depth relative to Stage height (m)	1.8	0.6	-0.9	-4.9	-10.7	-14.6	-18.3	-20.7			
					Corrected distance (m)	0.0	9.9	19.8	29.0	37.1	46.3	55.6	65.3			
Transect 6	49˚43.970' N 122˚05.197' W	49˚43.921' N 122˚05.237' W	13:49	1.8m	Observed depth (m)	0.0	-1.2	-2.4	-4.3	-11.3	-16.5	-21.0				
					Depth relative to Stage height (m)	1.8	0.6	-0.6	-2.4	-9.4	-14.6	-19.2				
					Corrected distance (m)	0.0	9.9	19.9	29.7	36.8	45.4	54.3				
Transect 7	49˚43.995' N 122˚05.207' W	49˚43.955' N 122˚05.257' W	14:16	1.8m	Observed depth (m)	0.0	-0.9	-2.1	-3.4	-8.2	-12.2	-16.5	-20.7			
					Depth relative to Stage height (m)	1.8	0.9	-0.3	-1.5	-6.4	-10.4	-14.6	-18.9			
					Corrected distance (m)	0	10.0	19.9	29.8	38.5	47.7	56.8	65.8			
Transect 8	49˚43.923' N 122˚05.140' W	49˚43.946' N 122˚05.221' W	14:55	1.8m	Observed depth (m)	-1.5	-2.7	-5.5	-11.6	-15.2	-18.0	-20.1	-22.6			
					Depth relative to Stage height (m)	0.3	-0.9	-3.7	-9.8	-13.4	-16.2	-18.3	-20.7			
					Corrected distance (m)	0	9.9	19.5	27.5	36.8	46.4	56.2	65.9			

seven transects to display a shallower fractured bedrock outcrop (reef) at 0+070 distance. All other transects display continued variable slopes to depth from the beach to 70+ feet.

3.2 Transect 1 - South Boundary – Outside Proposed Log Storage Area

Transect 1 was located at the southern boundary of the LOO (Figure 3). The survey commenced at 1.8m above stage height. From the point of commencement (POC) to Δ 0+010m (the flood zone), the beach area consisted predominantly of gently sloping angular fractured boulders, gravel and driftwood. Between Δ 0+010m and Δ 0+025m the substrate transitions to fine sediment (various thickness) over gravel and coarse wood debris. This section also displayed various species and densities of aquatic grasses. Aquatic grasses ended at Δ 0+025m and the fine sediment substrate continues to Δ 0+060m where large angular boulders and fractured bedrock become visible. At Δ 0+080m the benthos becomes steep to vertical fractured bedrock with fine sediments on rock ledges. There was no-low wood debris impact noted along the transect. The aquatic vegetation observed along Transect 1 included; pondweed, quillwort and green mat algae. Aquatic invertebrates noted along the transect included; freshwater mussels (Anadonta spp.) and small opaque shrimps (Mysis spp). One unidentified fish was observed along the transect. The transect ended at a depth of -19.8m below stage height at station 0+090m.

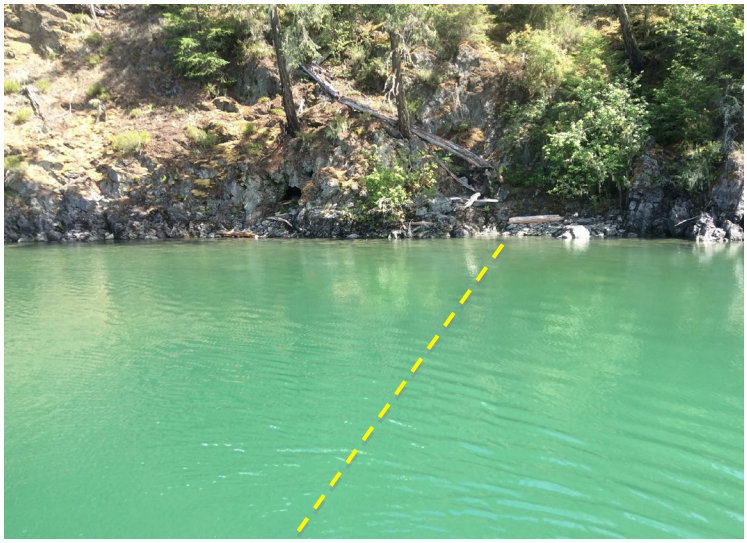

Figure 3. Transect 1, South Boundary – Outside Proposed Log Storage Area

3.3 Transect 2 –South Boundary – Inside Proposed Log Storage Area

Figure 4. Transect 2, South Boundary – Inside Propose Log Storage Area

Transect 2 was located approximately 50m north of Transect 1 and is inside the proposed south boundary of the LOO. The survey started at 1.8m above stage height. The beach consisted steeply sloping fractured bedrock and angular boulders and driftwood debris (Figure 4). The upland substrate transitioned to gently sloping gravel / boulder with a dusting or fine sediments and sparse woody debris at Δ 0+005m. Aquatic plants first appeared at Δ 0+015m and continued until Δ 0+025m. The substrate became thick fine sediments until Δ 0+085m where a fractured bedrock wall continued to depth. Occasional sticks and a few pieces of large wood debris were scattered throughout the thick fine sediment area. The wood debris impact along Transect 2 was found to be in the no-low range. The aquatic vegetation observed along Transect 2 included; quillwort, waterweed and green filamentous algae near the deep margin at Δ 0+025m. Aquatic invertebrates noted along the transect included; freshwater mussels and a single snail (shell only). No fish were observed along the transect. The depth at Δ 0+90m was -20.4m below stage height.

3.4 Transect 3 –South of Proposed Log Dump (Historic Dump / Barge Ramp Location)

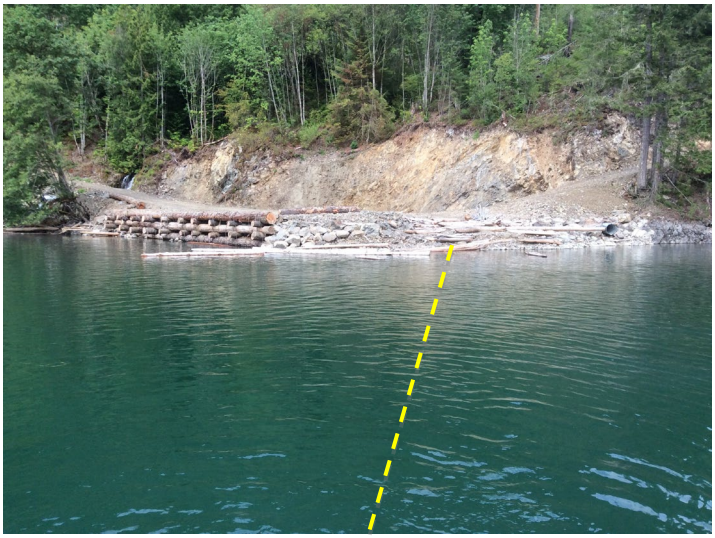

Figure 5. Transect 3, South of Proposed Log Dump – Historical Dump / Barge Ramp Location

Transect 3 was located along the south side of the historical log dump and barge loading location (Figure 5). The upper flood zone beach area consisted of steep sloping cobble, blast rock and boulder fill. The transect began at 1.8m above stage height. The fractured angular boulder substrate transition to gravel at Δ 0+005m. This quickly transitioned to thick fine sediments. Fine wood debris and occasional discarded metal (cable, tire rims) were observed near the beach. Sparse grasses were observed only at Δ 0+07.5m. Beyond Δ 0+085m the

substrate became steep / vertical fractured bedrock with a covering of thick fine sediments. Impact from wood debris was in the no-low to moderate impact range with fine wood debris near the beach and larger woody debris (mostly buried) at depth. Aquatic vegetation observed along Transect 3 was sparse quillwort (at Δ 0+07.5monly) and thin green mat algae to Δ 0+020m. No invertebrates or fish were observed along this transect. The depth at Δ 0+090m was -20.1m below stage height.

3.5 Transect 4 – Mid Station of Proposed Storage Area – Across Proposed Skidway

Transect 4 was attached to the northeast end of the recently constructed log cribbing and proposed skidway anchor location. The survey started at 1.8m above stage height. The beach consisted of vertical constructed intersecting logs with small rip-rap and boulder fill (Figure 6). The base of cribbing is constructed on steep angular boulder fill. The fill zone transitioned to clean gravel and thick fine sediments at Δ 0+010m. This is also the commencement of pondweed. Gentle sloping thick fine sediments, fine wood debris and dense tall pondweed continue across the face of the recently constructed crib area until Δ 0+035m. The thick fine sediment slopes more steeply from Δ 0+040m to Δ 0+080m. Fractured bedrock outcrops with a few buried sticks are observed at the deeper sections beyond Δ 0+070m. Transect 4 wood debris was in the no-low to moderate impact range with fine/coarse wood debris impact being concentrated along the constructed cribbing Δ 0+030m to Δ 0+045m. Sparse large wood debris and a few buried sticks were present along the fine sediments slope. Aquatic vegetation included pondweed/waterweed. Aquatic invertebrates observed included; freshwater mussels and opaque shrimps. No fish were noted on Transect 4. The depth at Δ 0+80m was -18.9m below stage height.

Figure 6. Transect 4, Mid Station of Proposed Storage Area – Across Proposed Skidway.

3.6 Transect 5 – North of Proposed Log Dump Area

Transect 5 was located approximately 50m north of the proposed log dump skidway and recently constructed log cribbing / fill area. It started at 1.8m above stage height. The beach consisted of clean gravel and dense floating driftwood, logs and large woody debris. (Figure 7).

Gravel with varying thickness of fine woody debris continued from Δ 0+005m to Δ 0+020m where a narrow band of sparse grass continued to Δ 0+025m. Thick fine sediments continued to depth with large wood debris being observed between Δ 0+025m to Δ 0+045m. Beyond Δ 0+045m the substrate is thick fine sediments to the end of the transect at Δ 0+065m. The wood debris impact along Transect 5 was moderate to high/severe with areas of 100% coverage (near-shore) stacked / semi buried from Δ 0+035m to Δ 0+045m. Aquatic vegetation covered a narrow band and included quillwort, waterweed and fine filamentous algae. Dense numbers of small opaque shrimp were the only aquatic invertebrates. There was a small unidentified fish (sculpin) observed among some buried sticks near the end of Transect 5. The depth at Δ 0+070m was -20.7m below stage height.

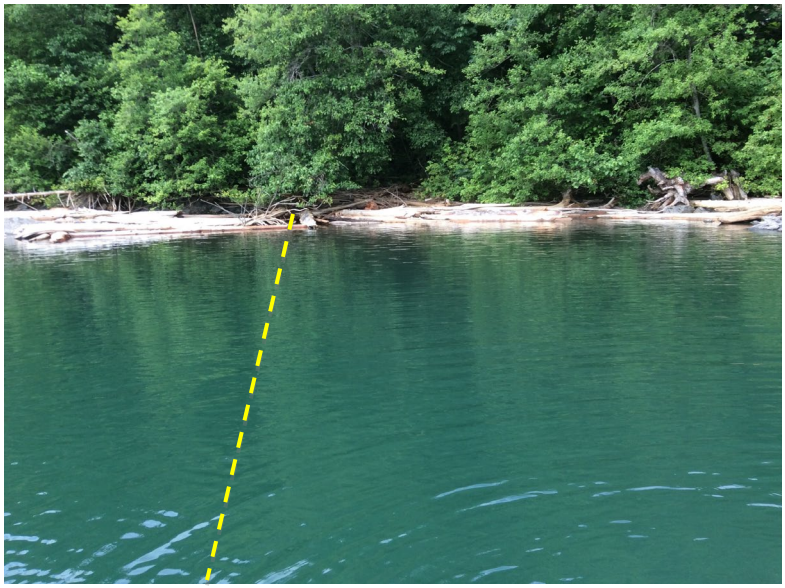

Figure 7. Transect 5. North of Proposed Log Dump Area

3.7 Transect 6 –North Boundary – Inside Proposed Log Storage Area

Transect 6 was located at the northern boundary of the proposed storage area of the LOO and started at 1.8m above stage height. The beach consisted of gently sloping fractured bedrock and boulders with dense logs and driftwood. (Figure 8). Clean gravel with a few angular boulders continued from Δ 0+005m to Δ 0+020m. Several species of aquatic vegetation were also observed in this region from Δ 0+010m to Δ 0+020m. From this distance to Δ 0+065m (end of survey) the bottom was steeply sloping thick fine sediments with patchy semi-buried woody debris. The wood debris impact along Transect 6 was in the no-low range. Aquatic vegetation included pondweed and quillwort. Aquatic invertebrates observed included;

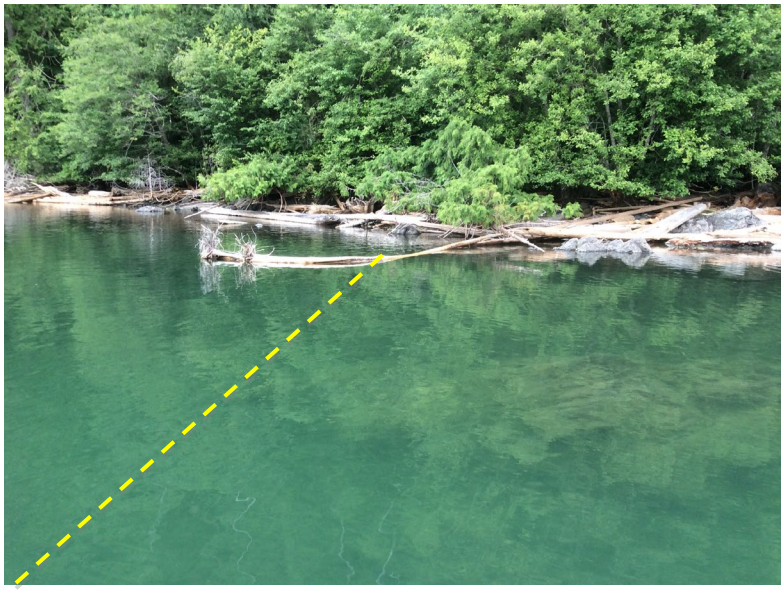

Figure 8. Transect 6, North Boundary – Inside Proposed Log Dump Storage Area

freshwater mussels and opaque shrimps. No fish were observed on Transect 6. The depth at Δ 0+50m was -19.2m below stage height.

3.8 Transect 7 –North Boundary – Outside Proposed Log Storage Area

Transect 7 was located at the northern end of the survey, just outside the proposed boundary of the LOO log storage area. The survey started at 1.8m above stage height. The beach was gently sloping gravel and boulders with thick driftwood above water level. (Figure 9). Gravel/angular boulder substrate with a dusting of fine sediments and woody debris continued to Δ 0+020m. From Δ 0+020m, the sloping gravel bank had thick leaf deposits along with coarse and large woody debris. Aquatic grasses began at Δ 0+022m and ended at Δ 0+035m. From Δ 0+040m to the end of the transect at Δ 0+070m the dominant substrate was thick fine sediments with large wood debris and a few buried sticks. The wood debris impact along Transect 7 was in the moderate to severe range with the majority being buried in fine sediment or having a complete dusting when suspended. Aquatic vegetation included; waterweed, filamentous green algae, and tall pondweed. Aquatic invertebrates observed were; freshwater mussels and opaque shrimp. One juvenile trout/salmonid was noted near the buried large wood debris on this Transect. The depth at Δ 0+070m was -18.9m below stage height.

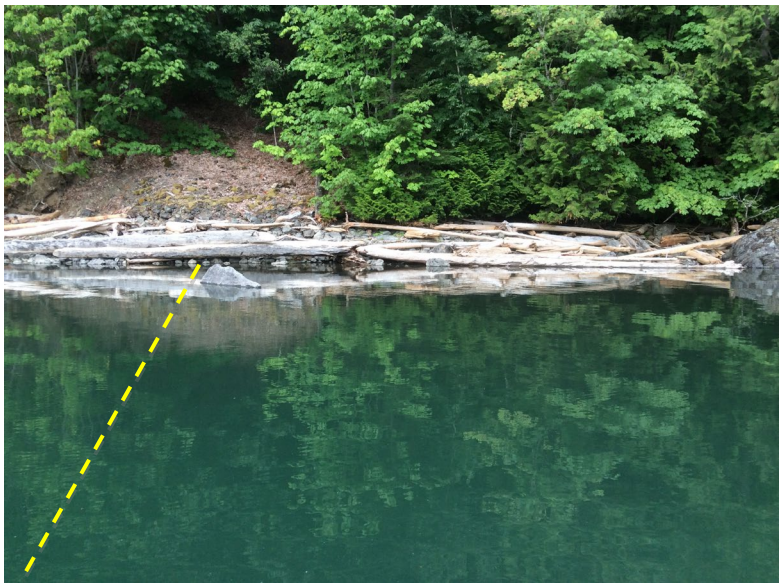

Figure 9. Transect 7, North Boundary – Outside Proposed Log Dump Storage Area

3.9 Transect 8 – Mid-Station of Proposed Log Dump – Skidway Location

Transect 8 was located at the proposed skidway location along the recently constructed beach cribbing. This location was observed in order to document the proposed pathway/corridor for the movement of processed and bundled logs. The survey started at 1.8m above stage height along the face of the log cribbing. The beach consisted of a log cribbing (vertical constructed intersecting logs) with small rip-rap and boulder fill (Figure 10). The base of cribbing is constructed on steep angular boulder and gravel fill. The gravel fill zone transitioned thick fine sediments with coarse wood debris and dense tall pondweed/waterweed from Δ 0+005m to Δ 0+025m. From Δ 0+025m, gently sloping thick fine sediments, with varied amount of large wood debris, continued until the intersection of Transect 5 at Δ 0+070m. The wood debris impact along Transect 8 was in the moderate to severe range with the majority being buried in fine sediment or having a complete dusting when suspended. Aquatic vegetation included; tall pondweed and waterweed. Freshwater sponge (encrusting and finger-type) were the only aquatic invertebrates observed. No fish species were observed on this transect. The depth at Δ 0+070m was -20.7m below stage height.

Figure 10. Transect 8, North Boundary – Outside Proposed Log Dump Storage Area

3.10 Shallow Survey along Beach - Cross-Transect Swims

The area located between Transect 1, Δ 0+020m and Transect 2, Δ 0+022m was surveyed. This area was predominantly moderate to gently sloped angular boulders and gravel. A single length of discarded cable was observed near Transect 1. Many areas had thin cover or a dusting of fine sediments. A few wood chunks and sparse large wood debris were noted during the swim. Aquatic vegetation (waterweed, pondweed, quillwort, and filamentous algae) displayed varying densities throughout the shallow section. Plants were observed from depths of 2.5m to 5.5m. No aquatic invertebrates or fish were noted.

The substrate between Transect 2 Δ 0+025m and Transect 3 Δ 0+005m was gently sloped gravel, small angular boulders and sparse wood debris. Areas with fine sediment cover displayed various densities of aquatic grasses in this shallow region (2m to 6m depth). Substrate becomes larger angular boulders/fill with discarded metal and tires near Transect 3. The grass bed also terminated at Transect 3. Impact from wood debris was no-low with sparse scattered large and coarse wood debris noted. One small unidentified fish was observed within the grasses.

Transect 3, Δ 0+020m displays an increasing sloped gravel bank with a dusting of fine sediments. Freshwater mussels, sparse aquatic grasses are noted along the shallower sections towards Transect 4. Pondweed, waterweed, fine filamentous algae and coarse woody debris increase in density as Transect 4 (0+010m distance) is approached. Noted invertebrates were; acorn barnacles and sunflower star. No fish were noted.

The substrate between Transect 4, Δ 0+035m and Transect 5, Δ 0+025m was predominantly thick fine sediments, buried large and coarse woody debris and dense aquatic grasses at the near-shore depths. The beach area displays more bedrock and deposited driftwood than previous transect sections. This area displays moderate to severe impact from deposited woody debris. Marine vegetation observed included; various densities of pondweed, waterweed, quillwort and fine filamentous algae. Freshwater mussels were noted within the grass areas. No fish were observed.

The substrate between Transect 5, Δ 0+025m and Transect 6, Δ 0+015m was predominantly gently sloping thick, fine sediments. Large woody debris, wood chunks, areas with thick leaves and angular boulders are scattered throughout the area. Aquatic vegetation is dense quillwort and pondweed with sparse waterweed and fine filamentous algae. No fish or invertebrates were observed along this shallow swim section.

The shallow area between Transect 6, Δ 0+020m to Transect 7, Δ 0+025m displays more zones with steep fractured bedrock. Large woody debris, bedrock ledges and angular boulders all have sediment covering with dense colonization of aquatic vegetation (quillwort, pondweed and filamentous algae). No fish or invertebrates were observed within this shallow section. There was evidence of historical industrial activity (sunken logs with cut ends and corroded discarded cable).

4.0 DISCUSSION

4.1 Pre-Existing Impact on Aquatic Habitat and Extent of Impact

The site conditions observed during the July 4th, 2018 assessment demonstrated the extent of the near-shore impact and recovery to the benthic habitat at this site since last operations ceased. The site in this area remains moderately impacted with the high/severe impact zone being more concentrated in the areas north of the proposed skidway location. The southern section of the near-shore and LOO area is in the no-low impact range. Recent construction of a cribbing and dump facility appears to have deposited clean fill (angular boulders and shot rock) up to the historically impacted sub-aquatic area. Appendix 4 – Historical Woody Debris area map outlines the observed locations for various categories of observed debris.

The North Harrison Lake Log Handling Facility proposal has a low flushing capacity. Wood waste would not be expected to disperse rapidly and sedimentation from near-by glacial streams (Lillooet River) will cover deposited debris over time. Outside of wind generated surface movement, there would be little natural removal of woody debris from this site.

4.2 Sensitive Species and Habitats

The log handling facility proposed for re-activation has some important fish rearing habitat as the site has established aquatic plant beds present, limited shallow clean gravel beds, and important (although relatively sparse) freshwater fish and invertebrate species. The area is an established historical log dump site that has been previously disturbed by industrial activity. The proposed site is not located within 100m of anadromous fish-bearing streams. However, there is "important habitat" within Licence of Occupation. There are two aquatic grass beds, one on either side of the historical and established log dump/barge loading facility. The grass beds are noted to have colonized on and around previously deposited woody debris (fine, coarse and large woody debris). This observation indicates that some recovery from impact has occurred over time. Maps included in Appendix 4 detail observed aquatic plant areas and overlays of the woody debris impact zones. Mitigation efforts should be taken to minimize future wood impact/disturbance to established grass beds. The existing design has proposed skidways directing log bundles parallel to the general beach and travelling along shallow substrates with largest aquatic grass beds.

It should be noted that although most of the near-shore sections of the LOO area does not meet the 20m minimum depth for log storage set out under Siting Criteria 4 of the Approved Work Practices (AWP) for Re-Activated Log Dumps in Marine Waters of British Columbia the area has been previously impacted and still shows continued impact and thus is consistent and acceptable within the published Assessment Protocol.

There were no sensitive wildlife features such as wildlife trees, active raptor/aquatic bird nests, or heron colonies/nests found on site. A review of the relevant literature found that, although Harrison Lake is not within known Sockeye salmon or White Sturgeon spawning grounds, cool summer water flows from the Lillooet icefields combined with lake depth provide important temperature regulation of downstream areas. (Sta'ailes Fisheries, 2013). The area does not fall within designated critical summer and fall habitat for resident salmonid species, however, Harrison Lake has been identified as habitat for late season Sockeye salmon migration. (Grant et al., 2018). Native trout and char are documented within Harrison Lake and productive rearing habitat need to be maintained. White sturgeon is a SARA listed species with habitat in the Harrison River, below Harrison Lake, with no documented information relating to lake residence or habitat requirements. (DFO, 2014) As a listed species, it is an organism of concern for this area.

Water quality and quantity are critical to habitat productivity and environmental sustainability. Adequate planning, proper mitigation and on-site due diligence are all critical to protecting the environment. Work procedures are approved, operating procedures are generated in order to achieve "best" results to reduce habitat alteration, damage or destruction. Industrial activity and land base development, combined with global climate events, influence the aquatic environment. Each unit taken separately may not significantly harm to the environment, however, combined impacts may be creating damaging and unmonitored conditions. Future recommendations can only be considered with adequate data and information to provide professional guidance on environmental issues.

5.0 CONCULUSION & RECOMMENDATIONS

Although the aquatic environmental assessment confirmed that the proposed re-activation of the North Harrison Lake Log Handling Facility falls under the *Approved Work Practices* (AWPs) siting criteria conditions this area has been inactive for more than 10 years. Therefore, in order to meet all aspects of the guidelines, a project review will be required.

General recommendations have been outlined in the Debris Management Plan (Appendix 5) and the Environmental Impact Mitigation Plan (Appendix 6). Provided these plans are followed this reactivation proposal will not result in "serious harm to fish that are part of a commercial, recreational or Aboriginal fishery", as determined through the assessment by Qualified Environmental Professionals (QEPs). Based on the findings of this assessment, the site displays limited impacted with woody debris and has not fully recovered from the past operation. It will continue to be impacted (not fully recovered) at the anticipated approval date.

The assessed area of the North Harrison Lake Log Handling Facility proposal meets the siting criteria for log storage areas. Although the minimum 20m depth for log storage is not met each transect was noted to have some historic wood debris. These accumulations appear to be remaining from past operations and the area remains degraded from historical activity. Some evidence of historical forest industry activity and evidence indicates that the impact footprint extends beyond the surveyed area.

Debris curtains and focused bundle movement are recommended for protection of the aquatic grass beds to the north and south of the recommended skidway location. Recent observation indicate that the grass beds are surviving with limited wood debris accumulation. Due to limited water currents (generated by season specific wind direction) within the freshwater environment, curtains will allow woody debris to settle and remain within the log transport corridor and protect grass beds from deposition. Appropriate skidway placement and debris curtains will also confine and direct woody debris towards the deeper, non-vegetated areas and exclude debris from the established, productive near-shore environments.

Recommendation #1: An anchored boomstick barrier, with attached debris curtain should be installed along either side of the skidway (minimal corridor width not to interfere with log movement).

Recommendation #2: Skidways should be adjusted (angled) more perpendicular to the general beach. Steep sloping near-shore for the shortest distance of log bundles to access deep water should be the focus of design. This would be achieved by anchoring the skids just north of Transect #3 at the historic dump and barge ramp.

Recommendation #3: Skidway length should be adequate to ensure bundles do not ground at any point during water movement or activities. Metal skids should be at least 30m in length to ensure logs will float off of the skids prior to reaching lake bottom. Transect #3 has a 8.5m depth at 30m (slope distance) from the beach.

It should be noted that although much of the proposed LOO area does not meet the 20m minimum depth for log storage set out under Siting Criteria 4 of the Approved Work Practices (AWP) for Re-activated Log Dumps in Marine Waters of British Columbia the area has been previously impacted and shows continued degradation and thus is consistent and acceptable with the aquatic Assessment Protocol.

Recommendation #4: Shoreward boundaries of the storage area should be adequately anchored to maintain a 30m distance from the beach (low water level). This will ensure eliminate shadow effect from stored bundles and reduce woody debris settlement into shallow productive habitat. Anchors can be attached with cable/rope out to depth, stiff-legged out from the beach, or combinations of both.

Recommendation #5: Fish spawning/migration windows (late fall and early spring) should be observed with log dumping activities scheduled to coincide with low probability of fish interference. A plan should be developed (in consultation with local stakeholders) to address production alternatives should fish disturbance become an issue.

In summation, the impact assessment found wood debris impact to be no-low impact for much of the southeast LOO area with high/severe impact noted near-shore from Transect 4 through Transect 7, northwest of the historic skidway location. Lack of water movement, combined with continued fine sediment input, allows deposited woody debris to be buried and colonized with freshwater plants, invertebrates and fish. There is no land use plan for the Harrison Lake area (Mosher, 2017) however, historical operations and recent management direction in Living with the Harrison Salmon Stronghold – A Strategic Plan (2013) acknowledge that log booming and handling has occurred and is considered appropriate for the area. With implemented recommendations and adequate environmental awareness, there is no biological reason why the re-activation of the facility should not be approved for the proposed volume of projected use.

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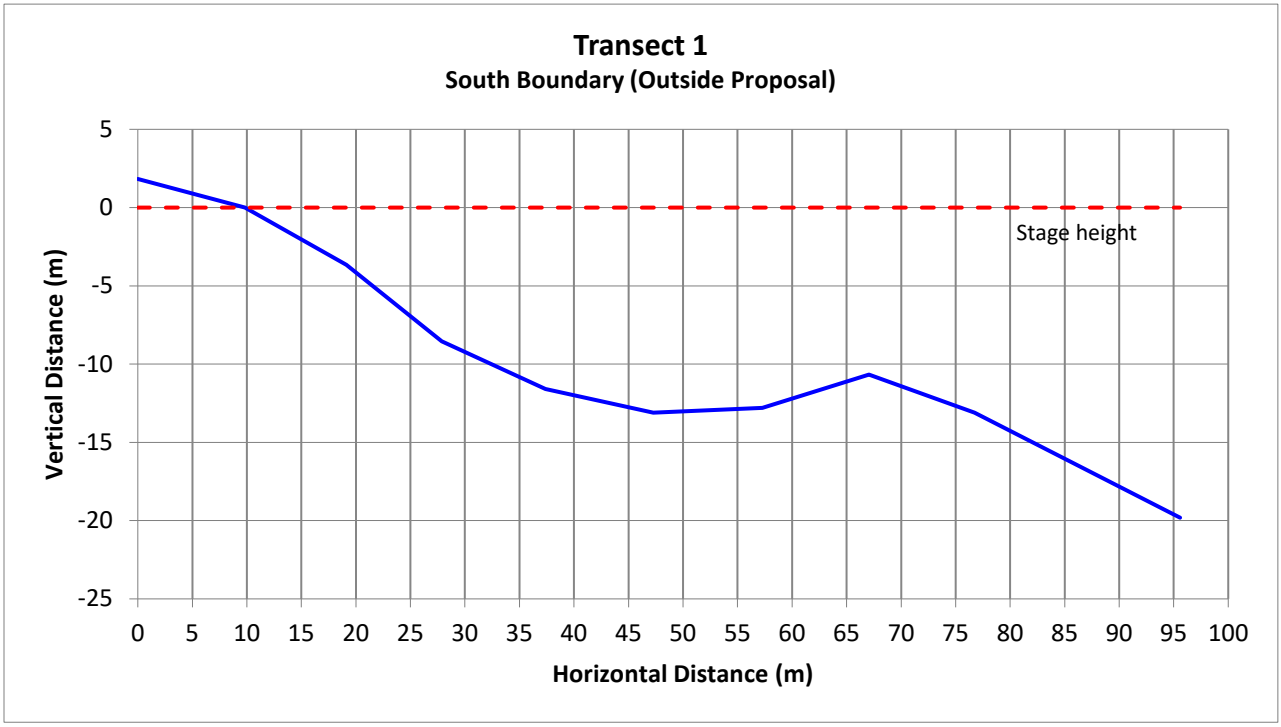
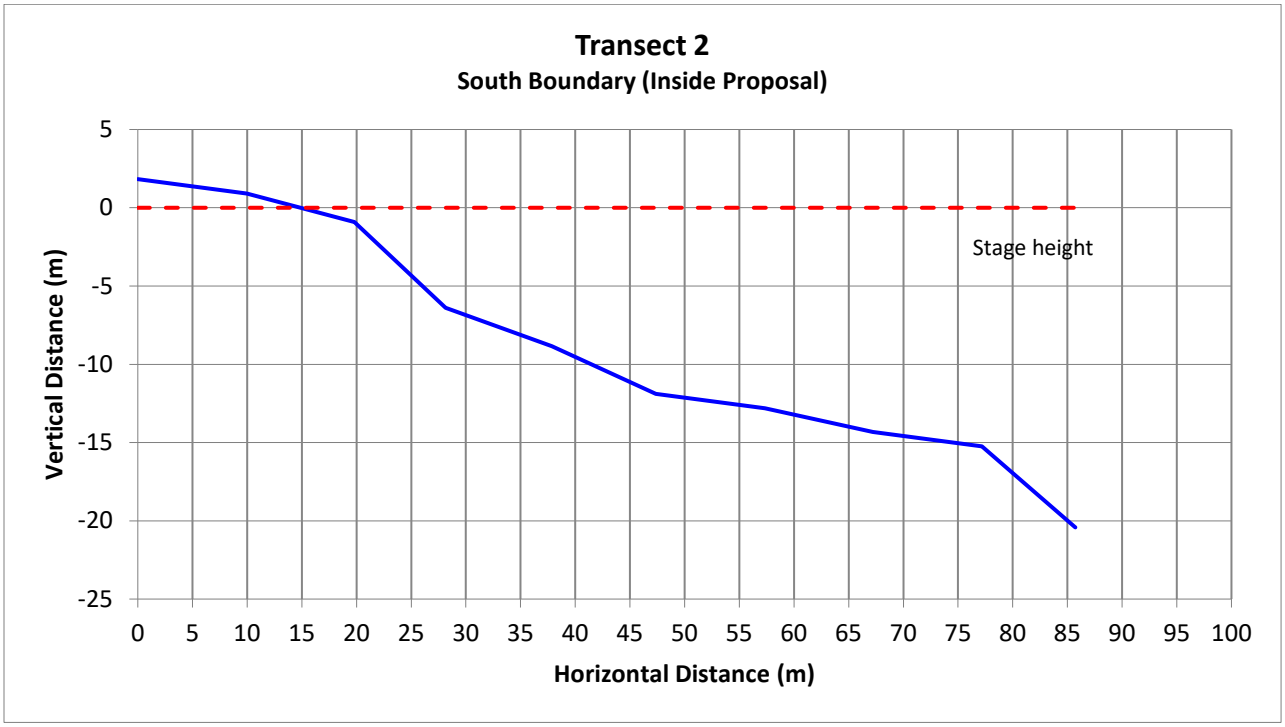
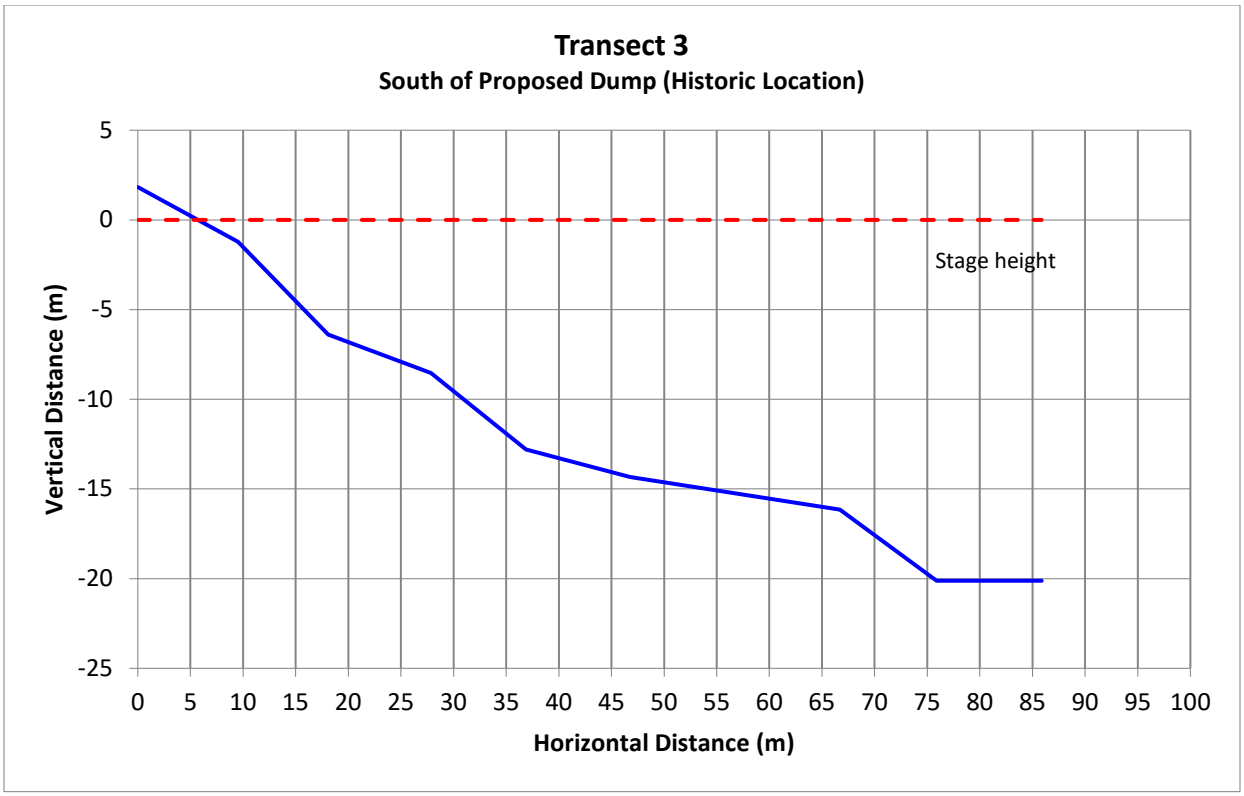
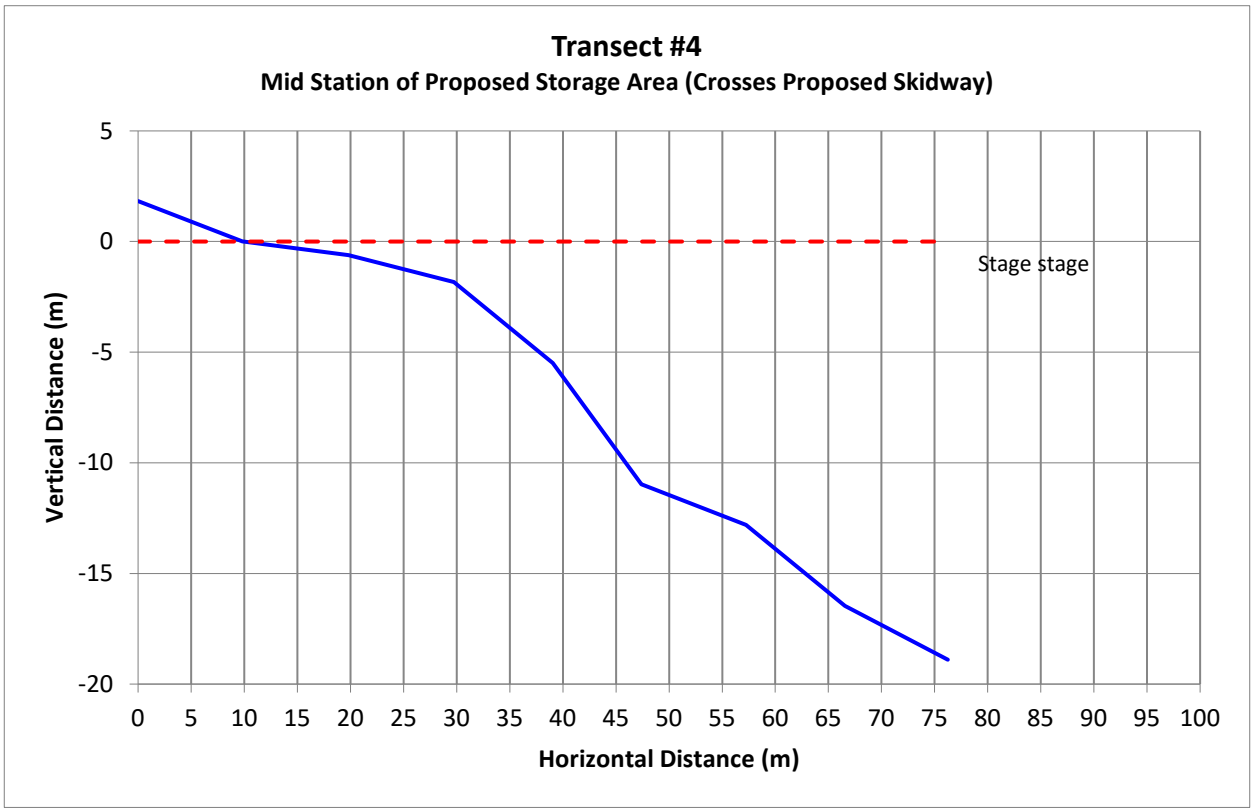
Appendix 1

-Transect Cross-sectional Profiles-






Transect 3
South of Proposed Dump (Historic Location)
Vertical Distance (m)
5
0
-5
-10
-15
-20
-25
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
Horizontal Distance (m)
Stage height


Transect #4
Mid Station of Proposed Storage Area (Crosses Proposed Skidway)
Vertical Distance (m)
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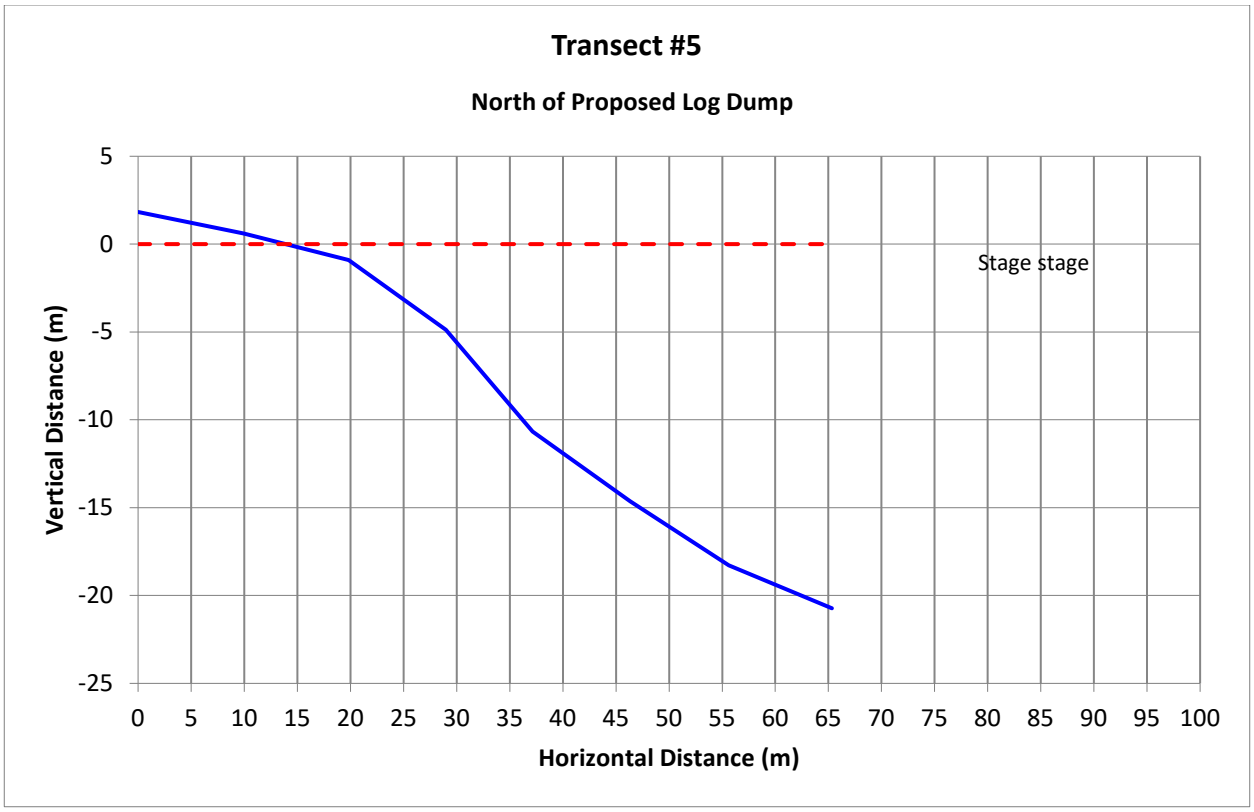
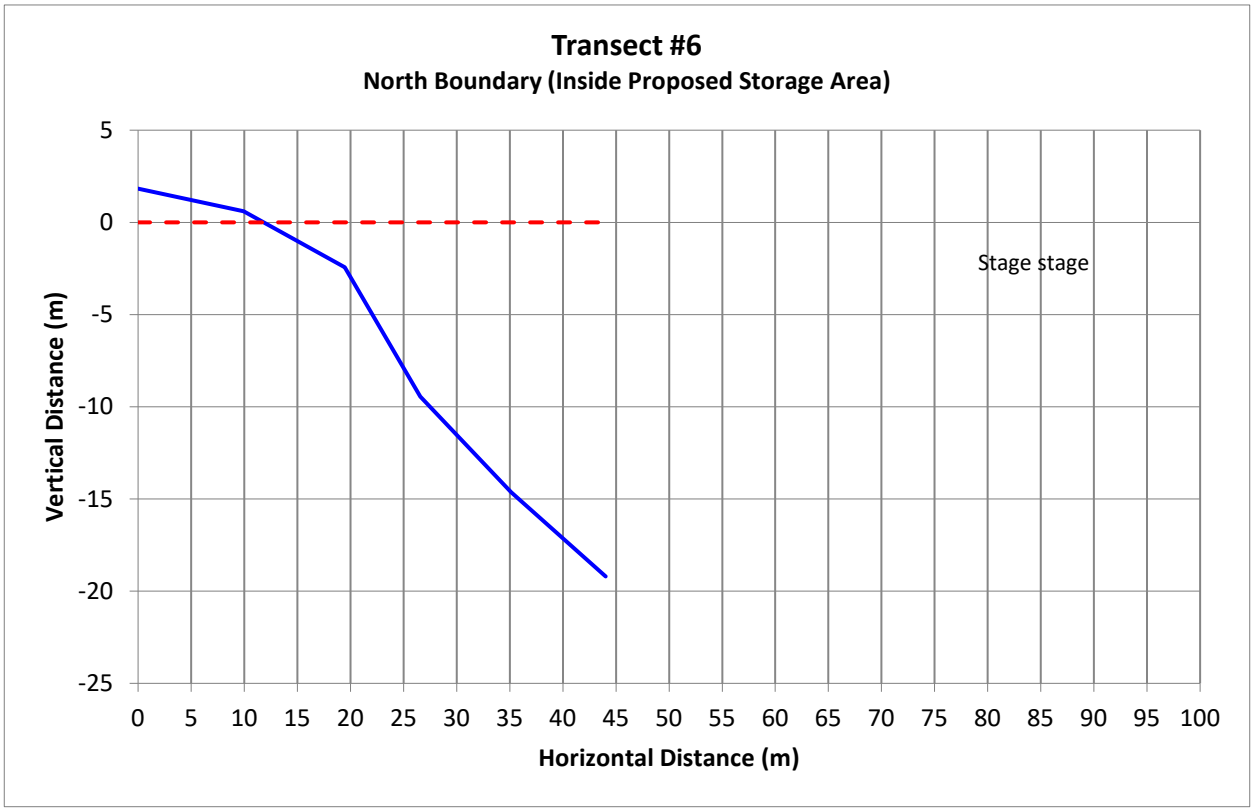
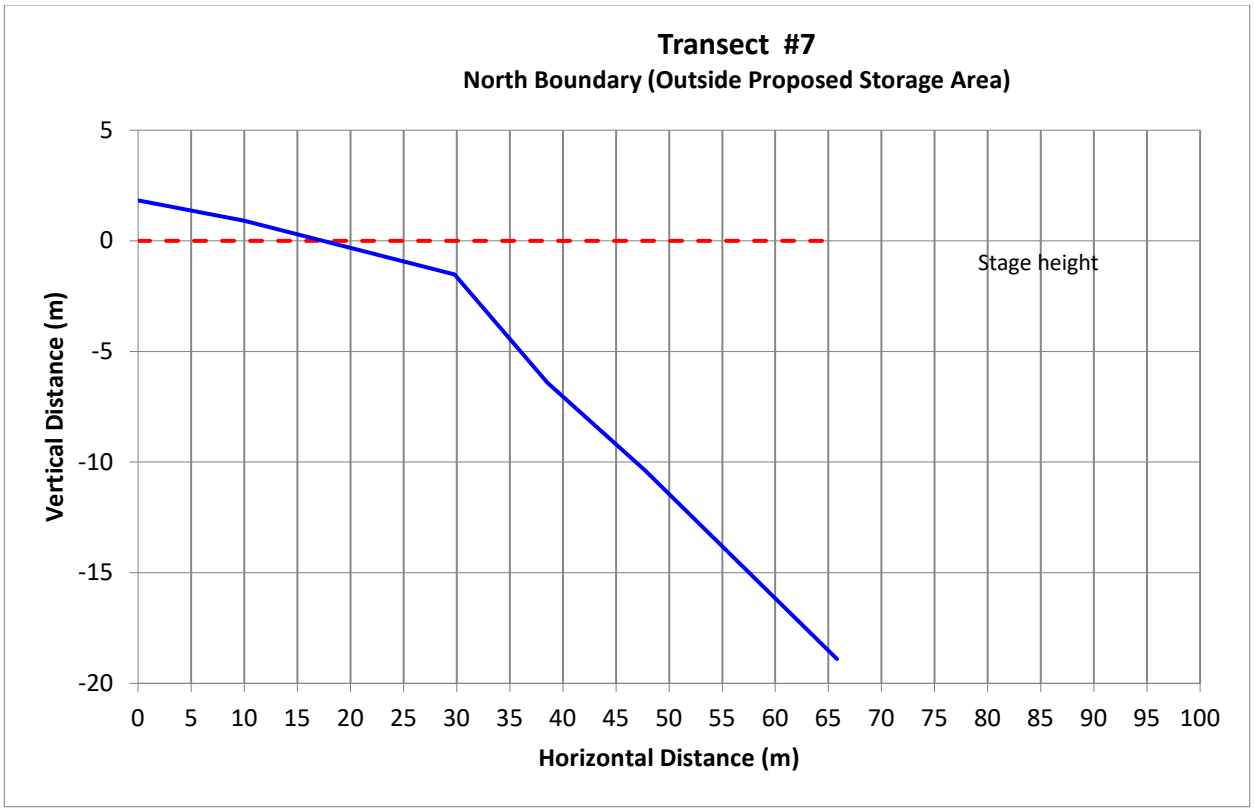
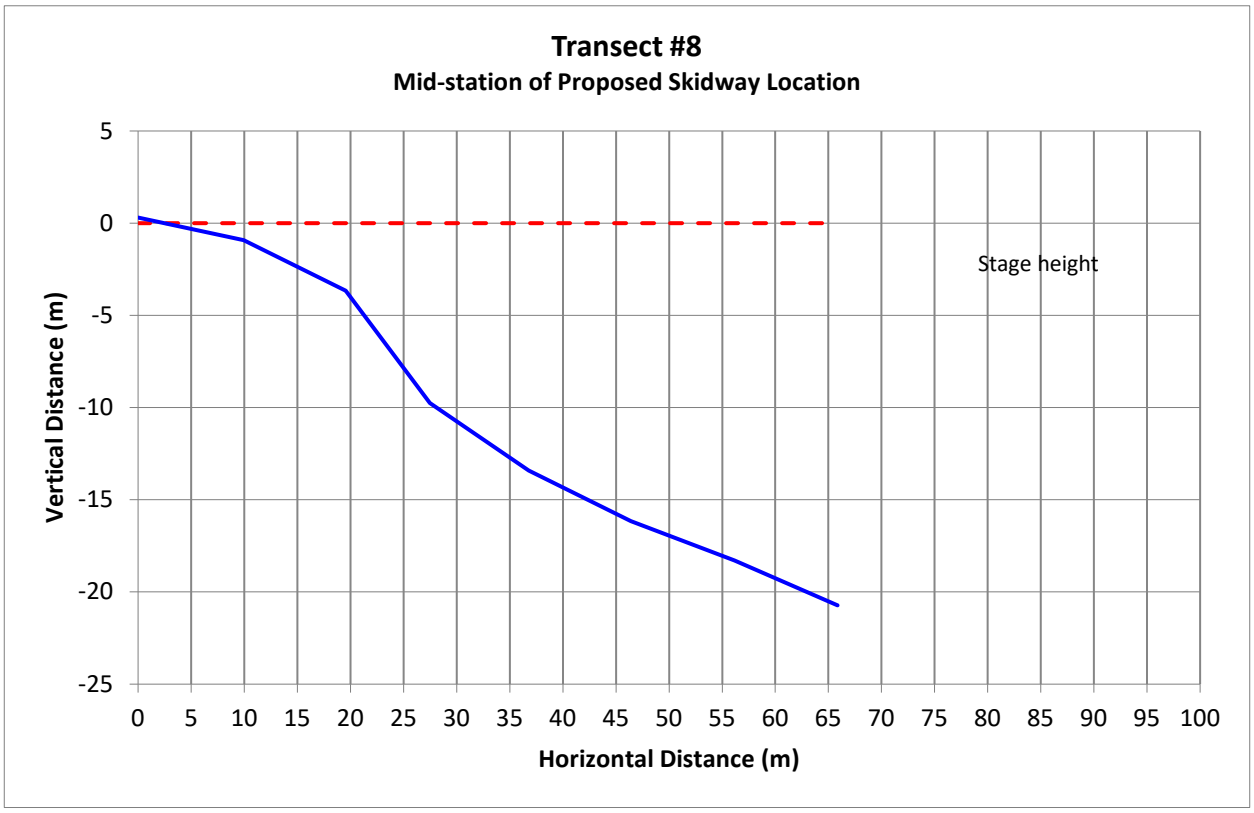
0
-5
-10
-15
-20
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
Horizontal Distance (m)
Stage stage


Transect #5
North of Proposed Log Dump
Vertical Distance (m)
5
0
-5
-10
-15
-20
-25
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
Horizontal Distance (m)
Stage stage


Transect #6
North Boundary (Inside Proposed Storage Area)
Vertical Distance (m)
5
0
-5
-10
-15
-20
-25
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
Horizontal Distance (m)
Stage stage


Transect #7
North Boundary (Outside Proposed Storage Area)
Vertical Distance (m)
5
0
-5
-10
-15
-20
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
Horizontal Distance (m)
Stage height


Transect #8
Mid-station of Proposed Skidway Location
Vertical Distance (m)
5
0
-5
-10
-15
-20
-25
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
Horizontal Distance (m)
Stage height

Appendix 2

-Detailed Video Log –Transects to Depth

Video Time (h:mm:ss)	Depth (ft)	Remarks
DVD Track #1 - Introduction – Harrison Lake Log Dump - Historical Review for Re-Activation		
0:00:00		Survey Title Page - Harrison Lake - Pre-Operation Log Dump Survey - Transects to Depth
0:00:27		Survey For: - Infinity Pacific Stewardship Group
0:00:41		Survey Team: BCL Biotechnologies Ltd., Graham / Wall Consulting Ltd..
0:01:10		Survey Date: July 4, 2018
DVD Track #2 - Area Overview		
0:01:14		Area Overview - South Coast British Columbia / Fraser Valley
0:01:26		Area Overview - Fraser Valley - Harrison Lake
0:01:38		Area Overview - Harrison Lake - Historical / Proposed Log Dump Location
0:01:50		Area Overview - Transect Line Location Relative to Proposal
DVD Track #3 - Transect #1 - South Boundary - Outside Proposed Log Storage Area (July 4, 2018 11:08 a.m.)		
0:01:58		Detailed Chart - Transect Location, Dive Direction / GPS Coordinates
0:02:11		Surface, beach overview, steep fractured bedrock, angular boulders, few chunks / driftwood, begin descend
0:02:15	0	0m - Beach attachment to large angular fractured boulder, dusting fine sediments, sparse fine woody debris
0:03:02		5m - Gentle sloping angular gravel, fine wood debris, large angular boulders, large wood debris (stump), dusting fine sediments
0:03:27		Large angular boulder crest (steeper to depth), thin layer fine sediments
0:03:34	6	10m - Begin thick fine sediments, sparse quillwort (quillwort), fish under transect marker (stickleback??)
0:04:08		Thick fine sediments, gravel (angular rocks), waterweed, dense quillwort (quillwort), few buried sticks, freshwater mussels
0:04:35	7	Thick fine sediments, dense quillwort (quillwort), begin sparse tall pondweed
0:04:49		15m - Thick fine sediments, dense quillwort (quillwort), sparse tall pondweed
0:05:17	18	20m - Thick fine sediments, buried coarse wood debris, sparse aquatic grasses (deep boundary)
0:06:01		25m - Large wood debris (dusting fine sediments) on thick fine sediment substrate
0:06:12		Thick fine sediments, few freshwater mussels, thin mat green algae
0:06:38	34	30m - Thick fine sediments
0:07:06		Thick fine sediments, sharp edged depressions with whitish fine deposits
0:07:15		35m - Steep fine sediments, depressions observed (various sizes)
0:07:52	44	40m - Steep fine sediments, few depressions, small opaque shrimp
0:08:18		Large wood debris (mostly buried), dusting fine sediments, thick fine sediment bank
0:08:52	49	50m - Thick fine sediments, large wood debris (stump) with dusting fine sediment
0:09:27		55m - Thick fine sediments, few buried sticks
0:09:42	48	60m - Large wood debris (stump), dusting fine sediments, thick fine sediment
0:10:12	42	65m - Thick fine sediment bank (ridge), few angular boulders
0:10:36	41	70m - Thick fine sediments, few angular boulders with dusting fine sediments
0:11:02		75m - Bedrock crest of ridge, thick fine sediments
0:11:23	49	80m - Steep thick fine sediments
0:11:41		Fractured bedrock, dusting fine sediments, vertical wall to depth
0:12:11	60	85m - Vertical fractured bedrock, thick fine sediments on ledges
0:13:01	71	90m - Vertical fractured bedrock, thick fine sediments on ledges

Video Time (h:mm:ss)	Depth (ft)	Remarks
DVD Track #4 - Transect #2 - South Boundary - Inside Propose Log Storage Area (July 4, 2018 11:30 a.m.)		
0:13:20		Detailed Chart - Transect Location, Dive Direction / GPS Coordinates
0:13:32	0	Beach overview, steep fractured bedrock, few large angular boulders, large wood debris, driftwood, begin descend
0:13:48		Discarded corroded cable, fractured bedrock, few small boulders, dusting fine sediments
0:14:03		5m - Gentle sloping gravel, patchy fine wood debris (recent), few small angular boulders, dusting fine sediments
0:14:35	3	10m - Gravel, angular boulders, dusting fine sediments, few sticks
0:15:05	6	15m - Gravel, few small angular boulders, fine wood debris, dusting fine sediments, snail shell, sparse quillwort (quillwort) - shallow boundary
0:15:37	9	20m - Gravel, few angular boulders, thick fine sediments, dense quillwort (quillwort), sparse waterweed
0:16:04		Thick fine sediments, dense quillwort (quillwort) / waterweed / green filamentous algae, few large wood debris - dusting fines
0:16:24	19	25m - Thick fine sediments, few angular boulders, dense green filamentous algae - deep boundary
0:16:43		Thick fine sediments, freshwater mussels
0:17:14	27	30m - Thick fine sediments, few large angular boulders
0:17:38		35m - Thick fine sediments, few small depressions, buried sticks
0:17:59	35	40m - Thick fine sediments
0:18:34		45m - Thick fine sediments
0:18:56	45	50m - Thick fine sediments
0:19:32		55m - Thick fine sediments, large wood debris - dusting fine sediments
0:19:56	48	60m - Thick fine sediments
0:20:37		65m - Thick fine sediments
0:20:58	53	70m - Thick fine sediments, few sticks
0:21:24		75m - Thick fine sediments
0:21:46	56	80m - Thick fine sediments
0:22:55		85m - Thick fine sediments, begin steep bank to depth
0:23:03	73	90m - Fractured bedrock, ledges with thick fine sediments
DVD Track #5 - Transect #3 - South of Proposed Log Dump - Historic Dump Location (July 4, 2018 11:50 a.m.)		
0:23:30		Detailed Chart - Transect Location, Dive Direction / GPS Coordinates
0:23:42	0	Surface, beach overview, blast rock / cobble fill area (historic dump), large wood debris (driftwood), begin descend
0:24:01		5m - Steep cobble / blast rock fill area, few large angular boulders, dusting fine sediments
0:24:13		Gravel / thick fine sediments, sparse quillwort (quillwort), discarded cable
0:24:27	10	10m - Thick fine sediments, steep fine / coarse wood debris
0:25:00		15m - Thick fine woody debris / fine sediments, suspended fine wood debris in water column
0:25:31		Thick fine sediments, thin green algae mat, fine woody debris
0:25:42	27	20m - Thick fine sediments, thin green algae mat, sparse coarse wood debris - buried
0:26:13		25m - Thick fine sediments / fine woody debris, buried coarse wood debris, few freshwater mussels
0:26:39	34	30m - Thick fine sediments, sparse coarse wood debris (mostly buried)
0:27:05		35m - Thick fine sediments
0:27:23	48	40m - Thick fine sediments, buried coarse wood debris
0:27:52		45m - Thick fine sediments
0:28:08	53	50m - Thick fine sediments, few small sticks (buried)

Video Time (h:mm:ss)	Depth (ft)	Remarks
DVD Track #5 - Transect #3 - South of Proposed Log Dump - Historic Dump Location (July 4, 2018 11:50 a.m.) continued		
0:28:34		55m - Thick fine sediments, large log (1/2 buried - dusting fine sediment)
0:28:56	56	60m - Thick fine sediments, few small deep depressions
0:29:17		65m - Thick fine sediments
0:29:41	59	70m - Thick fine sediment crest, steeper to depth
0:30:07		75m - Thick fine sediments
0:30:28	72	80m - Thick fine sediments
0:31:02		85m - Fractured bedrock ridge, thick fine sediments
0:31:29	72	90m - Fractured bedrock ridge, thin fine sediments, vertical to depth
DVD Track #6 - Transect #4 - Mid Station of Proposed Storage Area - Across Proposed Skidway (July 4, 2018 13:17 p.m.)		
0:31:38		Detailed Chart - Transect Location, Dive Direction / GPS Coordinates
0:31:50	0	Surface, eastern end of recent log crib construction / fill area, large angular boulders, begin descent
0:32:17		Base of large angular boulder bank, gravel, dusting fine sediments, sparse coarse wood debris
0:32:31	4	5m - Steep angular boulder fill / clean gravel junction, sparse coarse wood debris
0:33:01	6	10m - Gravel / thick fine sediment junction, sparse tall pondweed
0:33:21		Thick fine sediment, few pieces coarse wood debris, dense tall pondweed
0:33:38		15m - Thick fine sediment, large wood debris, dense tall pondweed
0:34:13	8	20m - Thick fine sediment, dense tall pondweed
0:35:21	12	30m - Thick fine sediment, dense tall pondweed
0:35:50	15	Thick fine sediment / fine wood debris, few freshwater mussels, sparse tall pondweed / waterweed
0:36:11	17	35m - Thick fine sediment, sparse fine wood debris, few small depressions, sparse large wood debris, sparse waterweed
0:36:39	24	40m - Thick fine sediment sparse fine wood debris
0:37:02		45m - Large angular boulder crest, begin steeper fine sediment slope
0:37:18		Steep fractured bedrock bank, thick fine sediments on ledges
0:37:33	42	50m - Steep thick fine sediments, large wood debris
0:37:58		55m - Thick fine sediments, small opaque shrimp near small depressions
0:38:18	48	60m - Small opaque shrimp swimming over thick fine sediments
0:39:11		65m - Thick fine sediments
0:39:28	60	70m - Fractured bedrock outcrops, thick fine sediments, few buried sticks, freshwater mussels
0:39:49		75m - Thick fine sediments
0:40:07	68	80m - Thick fine sediments, small opaque shrimp on sediment
DVD Track #7 - Transect #5 - North of Proposed Log Dump Area (July 4, 2018 13:35 p.m.)		
0:40:17		Detailed Chart - Transect Location, Dive Direction / GPS Coordinates
0:40:30	0	Surface, overgrown beach, dense floating driftwood, logs / large wood debris, begin descending
0:40:49		Clean gravel beach, dense floating driftwood / branches
0:41:02		5m - Gravel, fine wood debris (50% cover), coarse wood debris
0:41:09		Gravel, thick fine wood debris (90% cover)
0:41:27	4	10m - Gravel, few large angular boulders, dusting fine sediments, thin fine / coarse wood debris / leaves (up to 50% cover)
0:41:45		15m - Gravel, thin fine sediments, sparse fine wood debris
0:42:03	9	20m - Thick leaves, dusting fine sediments, begin sparse quillwort (quillwort) / waterweed / fine filamentous algae

Video Time (h:mm:ss)	Depth (ft)	Remarks
DVD Track #7 - Transect #5 - North of Proposed Log Dump Area (July 4, 2018 13:35 p.m.) continued		
0:42:45		25m - Large wood debris (stump), dusting fine sediments, sparse waterweed (deep boundary)
0:43:08	22	30m - Thick fine sediments, few coarse wood debris
0:43:33		35m - Large wood debris, stacked over thick fine sediments
0:44:00	41	40m - Large wood debris (semi-buried), thick fine sediments
0:44:21		45m - Thick fine sediments with mostly buried large woody debris
0:44:41	54	50m - Thick fine sediments, large wood debris
0:45:05		55m - Thick fine sediments
0:45:10		Thick fine sediments, few buried sticks, bottom fish (sculpin??)
0:45:24	66	60m - Thick fine sediments, small opaque shrimp
0:45:57	70	65m - Thick fine sediments, dense small opaque shrimp
DVD Track #8 - Transect #6 - North Boundary - Inside Propose Log Storage Area (July 04, 2018 13:49 p.m.)		
0:46:06		Detailed Chart - Transect Location, Dive Direction / GPS Coordinates
0:46:18	0	Surface, gentle sloping fractured bedrock / boulder beach, dense logs / driftwood, begin descent
0:46:59		5m - Clean gravel, few angular boulders
0:27:20	4	10m - Gravel, large angular boulders, dusting fine sediments, dark shelled snail (attached)
0:47:46		Gravel, angular boulders, coarse wood debris, sparse quillwort (quillwort) - shallow boundary
0:47:57	8	15m - Gravel, thick fine sediments, sparse coarse wood debris dense quillwort (quillwort), dense freshwater mussels
0:48:12		Gravel, thick fine sediments, dense quillwort (quillwort), begin sparse tall pondweed, few wood chunks
0:48:32	14	20m - Thick fine sediments, sparse coarse wood, dense quillwort (quillwort) - deep boundary, sparse tall pondweed, waterweed
0:49:14		25m - Thick fine sediments, few wood chunks
0:49:42	37	30m - Thick fine sediments, sparse fine wood debris
0:50:27		35m - Thick fine sediments, large wood debris (mostly buried)
0:51:00	54	40m - Thick fine sediments
0:51:34		45m - Thick fine sediments
0:51:58	69	50m - Thick fine sediments, few opaque shrimps, buried sticks

Video Time (h:mm:ss)	Depth (ft)	Remarks
DVD Track #9 - Transect #7 - North Boundary - Outside Proposed Log Storage Area (July 04, 2018 14:16 p.m.)		
0:52:19		Detailed Chart - Transect Location, Dive Direction / GPS Coordinates
0:52:32	0	Surface, gentle sloping gravel / boulder beach, thick driftwood, begin descent
0:52:49	1	Gravel, dusting fine wood debris
0:53:08		5m - Gravel, recent fine / coarse woody debris, few historical wood chunks
0:53:46	3	10m - Gravel, small angular boulders, dusting fine sediments, few leaves
0:54:26		15m - Gravel, small angular boulders, dusting fine sediments, few sticks / wood chunks
0:54:47	7	20m - Gravel, small angular boulders, thick leaves / coarse wood debris (90% cover)
0:55:10	9	Gravel, small angular boulders, leaves, sparse coarse wood debris, sparse filamentous green algae / waterweed
0:55:34		25m - Gravel, thick leaves, sparse tall pondweed / waterweed, large wood debris
0:56:10	11	30m - Dense large wood debris over thick fine sediments, sparse tall pondweed / waterweed
0:57:15		35m - Thick piles large wood debris over thick fine sediments, sparse tall pondweed / waterweed
0:57:42	27	40m - Thick fine sediments, dense large wood debris (deep boundary), few freshwater mussels
0:58:22		45m - Thick fine sediments, buried large wood debris, juvenile salmonid / trout
0:58:54	40	50m - Thick fine sediments
0:59:23		55m - Thick fine sediments, large wood debris dusting fine sediment
0:59:55	54	60m - Thick fine sediments, buried large wood debris, few small opaque shrimps
1:00:26		65m - Thick fine sediments
1:00:51	68	70m - Thick fine sediments, few buried sticks
DVD Track #10 - Transect #8 - Mid-Station of Proposed Log Dump - Skidway Location (July 04, 2018 14:55 p.m.)		
1:01:15		Detailed Chart - Transect Location, Dive Direction / GPS Coordinates
1:01:28	0	Surface, recently constructed log cribbing / fill area, few corroded cables, begin descent
1:02:09	5	Base of angular boulder fill area, begin gravel with dusting fine sediments
1:02:25	7	Discarded corroded cable (historic), thick fine / coarse wood debris, few boulders, begin sparse tall pondweed
1:03:08	9	10m - Thick fine sediments, dense tall pondweed, sparse waterweed
1:03:40		12m - Intersect Transect #4 (25m), thick fine sediments, dense tall pondweed
1:04:04	12	15m - Thick fine sediments / fine woody debris, dense tall pondweed, sparse waterweed
1:04:53	18	20m - Large woody debris, sparse tall pondweed / waterweed
1:05:26		Historic branch with freshwater sponge - encrusting and finger types
1:05:41	29	25m - Thick leaves, dusting fine sediments, waterweed
1:06:21	38	30m - Thick fine sediments / leaves, dusting fine sediment
1:06:49		35m - Thick fine sediments, buried large wood debris
1:07:10	50	40m - Thick fine sediments, large wood debris, dusting fines
1:07:33		45m - Thick fine sediments, buried large wood debris
1:07:53	59	50m - Thick fine sediments, large wood debris / branch, dusting fines
1:08:18		55m - Thick fine sediments, semi-buried large wood debris
1:08:39	66	60m - Thick fine sediments, few buried sticks
1:09:04		65m - Thick fine sediments
1:09:24	74	70m - Intersect Transect #5 (70m), thick fine sediments, large wood debris, dusting fines

Video Time (h:mm:ss)	Depth (ft)	Remarks
DVD Track #11 - Credits		
1:10:04		Closing Title Page & Survey Credits
1:10:48		End of Survey - Transects to Depth

Detailed Video Log - Cross-transect Swims

Video Time (h:mm:ss)	Depth (ft)	Remarks
DVD Track #1 - Introduction		
0:00:00		Survey Title Page - Harrison Lake - Pre-Operation Log Dump Survey - Shallow Shoreline Swim
0:00:27		Survey For: – Infinity Pacific Stewardship Group
0:00:41		Survey Team: BCL Biotechnologies Ltd., Graham / Wall Consulting Ltd.
0:01:10		Survey Date: July 4, 2018
DVD Track #2 - Area Overview		
0:01:14		Area Overview - South Coast British Columbia / Fraser Valley
0:01:26		Area Overview - Fraser Valley - Harrison Lake
0:01:39		Area Overview - Harrison Lake - Historical / Proposed Log Dump Location
0:01:50		Area Overview - Transect Line Location Relative to Proposal
DVD Track #3 - Transect #1 to #2 Shallow Shoreline - Southeast of Proposed Log Dump (July 4, 2018 11:23 a.m.)		
0:01:58		Detailed Chart - Transect Location, Dive Direction / GPS Coordinates
0:02:11	16	20m - Transect #1 - sparse suspended fine woody debris
0:02:25		Thin fine sediments, few sticks, dense quillwort (quillwort), sparse pondweed
0:02:49	8	Gravel, dusting fine sediments, dense quillwort (quillwort)
0:03:03		Angular shaped boulders, few wood chunks, dusting fine sediments, dense quillwort (quillwort), shallow boundary
0:03:13		Discarded cable, gravel, thin layer fine sediments (~5mm thickness), sparse quillwort (quillwort) / waterweed
0:03:31	11	Gravel, thin layer fine sediments, sparse coarse wood debris, quillwort (quillwort), waterweed, filamentous algae
0:04:03		Large wood debris, dusting fine sediments, dense quillwort (quillwort) / filamentous algae, sparse waterweed, pondweed
0:04:42	10	Sunken historic boomstick, dusting fine sediments, dense waterweed / pondweed
0:05:10		Thick fine sediments over boulders / large woody debris, sparse quillwort (quillwort) / filamentous algae / pondweed
0:05:27	18	Thick fine sediments, sparse pondweed, deep edge of aquatic plant zone
0:05:52		Large wood debris, dusting fine sediments, dense quillwort (quillwort), sparse waterweed / pondweed
0:06:14	8	Gravel, dusting fine organic sediments, shallow edge aquatic plant zone
0:06:44		Gravel, small angular shaped boulders, dusting fine sediments, sparse pondweed / waterweed
0:07:03	11	Thick fine sediments, dense quillwort (quillwort) / filamentous algae / waterweed, sparse large wood debris
0:07:32	16	Dense large wood debris over thick fine sediments, dense filamentous algae, sparse waterweed (deep aquatic boundary)
0:07:54		22m - Transect #2, dense quillwort (quillwort), sparse waterweed
0:08:01	11	20m - Gravel / small angular boulders, dusting fine sediments, dense quillwort (quillwort)
DVD Track #4 - Transect #2 to #3 - Shoreline Southeast of Dump to Historical Log Dump Area (July 04, 2018 11:44 a.m.)		
0:08:04		Detailed Chart - Transect Location, Dive Direction / GPS Coordinates
0:08:17	19	25m - Transect #2, steep thick fine sediments over gravel, deep edge aquatic plant zone
0:08:45		Thick fine sediments, dense filamentous algae (deep boundary), large woody debris / small boulders, dusting fine sediments
0:09:22	10	Gravel crest, dense quillwort (quillwort), sparse water milfoil, patches of thick fine sediments
0:09:33		Historic corroded steel truck rim, thick fine sediments, dense quillwort (quillwort), gravel crest
0:09:41		Large / coarse wood debris, dusting fine sediments, dense quillwort (quillwort) / filamentous algae, sparse waterweed

Video Time (h:mm:ss)	Depth (ft)	Remarks
DVD Track #4 - Trans #2 to #3 - Shoreline Southeast of Dump to Historical Log Dump Area (July 04, 2018 11:44 a.m.) Cont'd		
0:09:54		Dense coarse wood debris, dusting fine sediments, dense quillwort (quillwort) / filamentous algae / waterweed
0:10:17	18	Thick fine sediments, gravel / small angular boulders, large wood debris, sparse quillwort (quillwort) / filamentous algae
0:10:47		Large wood debris over thick fine sediments, dusting fines, sparse waterweed
0:11:10		Gravel / angular boulders, dusting fine sediments, dense quillwort (quillwort), sparse waterweed, small fish (sculpin??)
0:11:27	7	Gravel / angular boulders, dusting fine sediments, thick fine wood debris in depressions, sparse quillwort (quillwort) / pondweed
0:11:50	13	Discarded rubber tire, gravel / angular boulders crest, dusting fine sediments, no aquatic plants visible - end of plant bed
0:12:16		Steep gravel bank, thick dusting fine sediments, sparse waterweed / sparse coarse wood debris
0:12:26	8	Discarded cable, gravel / angular boulders, dusting fine sediments, coarse wood debris, sparse quillwort (quillwort) / pondweed
0:12:52	1	Surface, blast rock / angular boulders - fill area, filamentous algae, thin dusting fine sediments
0:13:11	5	5m - Transect #3, steep angular boulders / blast rock fill area, thin dusting fine sediments
DVD Track #5 - Transect #3 to #4 - Historic Log Dump Through Proposed Skidway (July 04, 2018 12:01 p.m.)		
0:13:17		Detailed Chart - Transect Location, Dive Direction / GPS Coordinates
0:13:30		Thick fine sediments, large wood debris
0:13:47		20m - Transect #3, thick fine / coarse wood debris on steep bank, thin layer fine organic sediments covering
0:14:23	18	15m - Transect #3, thick fine wood debris, few chunks, dusting fine sediments, freshwater mussel shell
0:15:04		Thick fine sediments over small angular rocks, buried coarse wood debris, few small mussels, sparse waterweed
0:15:16	12	Begin sparse vegetation, quillwort (quillwort) / pondweed / thick fine sediments over gravel / angular boulders
0:15:44	11	Thick fine sediments, sparse coarse wood debris, dense quillwort (quillwort) / pondweed
0:16:05	12	Sparse coarse wood debris, dusting fine sediments, dense pondweed / quillwort (quillwort) / waterweed
0:16:27	8	Thick coarse wood debris, dusting fine sediments, gravel / boulder bank, tall pondweed
0:16:56		Thick fine sediments, few freshwater mussels, buried coarse wood debris, dense pondweed
0:17:25		Thick fine sediments, fine wood debris, buried coarse wood debris, dense pondweed, sparse quillwort (quillwort) / waterweed
0:17:50	13	Thick fine sediments, buried coarse wood debris, sparse waterweed
0:18:14		Thick fine sediments, buried coarse wood debris, dense waterweed, sparse pondweed
0:18:41		Thick fine sediments, coarse wood debris, few small angular boulders, thick dusting fine sediments, dense pondweed
0:19:04	5	10m - Transect #4, gentle sloping cobble / angular rocks, thin dusting fine sediments
DVD Track #6 - Transect #4 to #5 - Proposed Dump Area to Northeast Shoreline (July 04, 2018 13:28 p.m.)		
0:19:10		Detailed Chart - Transect Location, Dive Direction / GPS Coordinates
0:19:23	17	35m - Transect #4, deep edge sparse pondweed / waterweed, begin steep thick fine sediments
0:19:52		Steep thick fine sediments, large wood debris (dusting fines), few freshwater mussels, sparse pondweed / waterweed

Video Time (h:mm:ss)	Depth (ft)	Remarks
DVD Track #6 - Transect #4 to #5 - Proposed Dump Area to Northeast Shoreline (July 04, 2018 13:28 p.m.) continued		
0:20:06	14	Thick fine sediments, fine / large wood debris (dusting fines), tall pondweed, dense waterweed, freshwater mussels
0:20:28		Thick fine wood debris, dense waterweed, freshwater mussels
0:20:48	13	Thick fine sediments, dense waterweed, sparse coarse wood debris
0:21:09		Thick fine sediments, buried large wood debris, sparse waterweed
0:21:33	10	Thick fine sediments, buried large / coarse wood debris, sparse waterweed / pondweed
0:21:57		Thick large wood debris, thick layer fine sediments, sparse tall pondweed / waterweed
0:22:25	0	Surface, steep to vertical fractured bedrock beach, driftwood covering beach
0:22:40		Thick fine sediments, large wood debris (dusting fines), buried leaves, sparse waterweed, dense pondweed
0:22:54	8	Thick fine sediments, dense large wood debris, sparse pondweed / waterweed / fine filamentous algae
0:23:16	8	Thick leaves, small sticks, dusting fine sediments, few boulders, sparse waterweed
0:23:40		Thick fine sediments, dense quillwort (quillwort), sparse waterweed, fine filamentous algae, coarse woody debris
0:24:06	13	Thick fine sediments, coarse wood debris (dusting fines), dense quillwort (quillwort), sparse pondweed / fine filamentous algae
0:24:31	13	25m - Transect #5, large wood debris (stumps), dusting fine sediments, dense waterweed
DVD Track #7 - Transect #5 to #6 - Northeast Shoreline (July 4, 2018 13:43 p.m.)		
0:24:55		Detailed Chart - Transect Location, Dive Direction / GPS Coordinates
0:25:07	13	25m - Transect #5, large woody debris (stumps), dusting fine sediments, steep thick fine sediment, sparse filamentous algae
0:25:44		Dense large / coarse woody debris, thick fine sediments, sparse waterweed / fine filamentous algae
0:26:00	14	Thick fine sediments, buried coarse wood debris, sparse quillwort (quillwort) / waterweed
0:26:20	12	Thick fine sediments, dense quillwort (quillwort), sparse waterweed / pondweed, coarse wood debris
0:26:47		Thick fine sediments, thick leaves, dense waterweed / pondweed, sparse coarse wood debris
0:27:03	11	Thick fine sediments, dense tall pondweed, sparse coarse wood debris, few buried logs
0:27:38	13	Thick fine sediments, few wood chunks, dense quillwort (quillwort) / waterweed, sparse tall pondweed
0:28:09	14	Thick fine sediments, large wood debris (dusting fines), dense quillwort (quillwort) / fine filamentous algae, sparse pondweed
0:28:47	7	Thick fine sediments, few clean angular boulders (dusting fines), dense quillwort (quillwort) - shallow boundary
0:19:36		Boulders, large wood debris, fine sediments, dense quillwort (quillwort)
0:29:50	8	15m - Transect #6, thick fine sediments over gravel / small angular boulders, dense quillwort (quillwort)

Video Time (h:mm:ss)	Depth (ft)	Remarks
DVD Track #8 - Transect #6 to #7 - Northeast Shoreline (Near North Boundary Storage Area (July 4, 2018 14:08 p.m.)		
0:30:00		Detailed Chart - Transect Location, Dive Direction / GPS Coordinates
0:30:12	15	20m - Transect #6, thick fine sediments, sparse quillwort (quillwort) / pondweed - deep boundary
0:31:11		Large wood debris, dusting fine sediments, dense filamentous algae, sparse quillwort (quillwort) / pondweed
0:31:27		Steep fractured bedrock, thick fine sediments / quillwort (quillwort) on ledges
0:31:48	11	Steep fractured bedrock, thick fine sediments / dense quillwort (quillwort) on ledges
0:32:26	6	Steep fractured bedrock, light dusting fine sediments
0:32:41		Steep gravel / angular boulders, large wood debris, dusting fine sediments
0:32:52		Begin thick fine sediments, boulders, sparse coarse wood debris, dense quillwort (quillwort), sparse pondweed
0:33:21		Thick fine sediments, few coarse wood debris, dusting fine sediments, dense quillwort (quillwort) / waterweed
0:33:53	15	Thick fine sediments, few large wood debris, dusting fine sediments, dense quillwort (quillwort) / pondweed / filamentous algae
0:34:22		Thick fine sediments, coarse wood debris / thick large wood debris (historic logging) dense filamentous algae / waterweed
0:34:41		Dense coarse wood debris, corroded discarded cable, waterweed / quillwort (quillwort)
0:34:51		Large wood debris, thick leaves, dusting fine sediments, sparse waterweed
0:35:10	7	Gravel, small angular boulders, large wood debris, dusting fine sediments
0:35:36		Boulders, angular rocks, thick leaves, dusting fine sediments, sparse coarse wood debris
0:35:52	7	Boulders, leaves, sparse wood debris, begin dense tall pondweed
0:36:19	24	Transect #7, dense tall pondweed, thick leaves, large wood debris
0:36:29	20	25m - Transect #7, thick leaves, dense tall pondweed
DVD Track #9 – Credits		
0:36:39		Closing Title Page & Survey Credits
0:37:22		End of Survey - Shallow Swim Along Beach

Appendix 3

-Detailed Description of the Observed Biota-

Observed Species (2018)		**Abundance Rating**														
Common Name	**Scientific Classification**	Total area	Transect #1	Transect #2	Transect #3	Transect #4	Transect #5	Transect #6	Transect #7	Transect #8	Transect #1 to #2	Transect #2 to #3	Transect #3 to #4	Transect #4 to #5	Transect #5 to #6	Transect #6 to #7
	Plants															
Richardson's Pondweed	*Potamogeton richardsonii.*	a	f			a		a	a	a	a	f	a	a	a	a
Water Milfoil	*Myriophyllum spp.*	r										r				
Waterweed	*Elodia spp.*	a	r	r		f	f	f	a	a	a	a	a	a	a	a
Bristle-like Quillwort	*Isoetes echinospora*	a	a	a	r		r	a			a	a	a	f	a	a
	Algae															
Green Mat Algae	*Not identified*	r	f		r											
Filamentous Algae	*Chlorophyta spp.*	f		a			r		r		a	a		f	a	a
	Porifera															
Freshwater Sponge	*Not Identified*	r								r						
	Mollusks															
Freshwater Mussel	*Anadonta spp.*	f	f	f	f	f		a	f				a	a		
Freshwater Snail	*Not Identified*	s		s				s								
	Crustaceans															
Mycid Shrimp	*Mysis spp.*	f	f			a	a	f	f							
	Echinoderms															
Sculpin	*Not Identified*	S					s					s				
Stickleback	*Not Identified*	S	s													
Salmonid / Trout	*Not Identified*	S							s							

Abundance Rating (AR)

s = single (1 individual / transect)

r = rare (< 5 individuals / transect)

f = few (5 - 10 individuals / transect)

a = abundant (> 10 individuals / transect)

Appendix 4

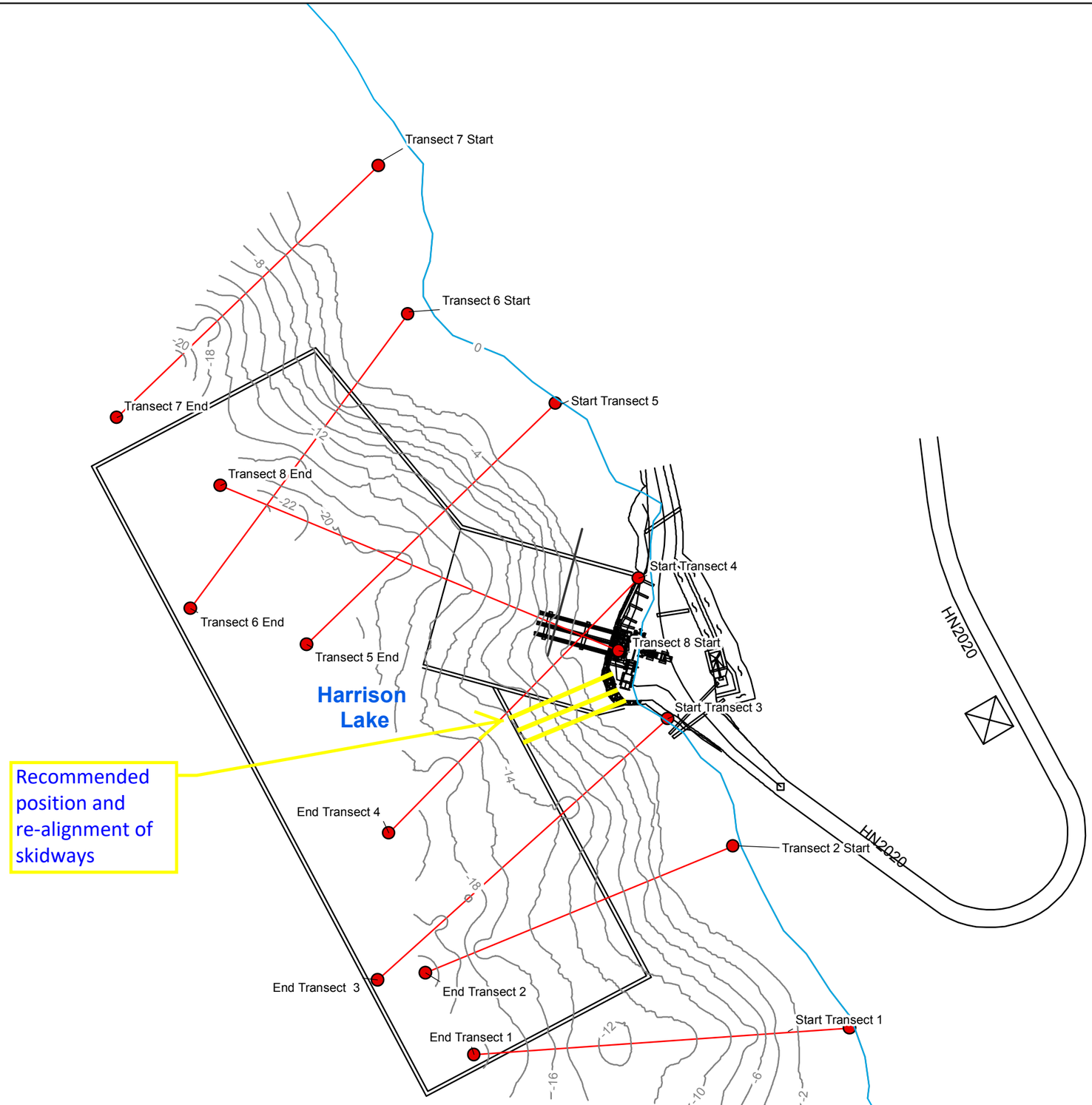
Harrison Lake Log Handling Facility LOO Area Maps

Transect Location Map

Bathymetric Map

Submergent Vegetation Map

Historical Woody Debris Area Map



N

TRANSECT LOCATION MAP

Blocks: HN120, HN124, HN125.

Forest Region: RSC
Forest District: DCK
Mapsheet: 092H080
Location: Harrison Lak e North
TSA: Fraser

FDU : Big Silver
BEC: CWHds1
Author: GF
Print Date: 02/01/2019

Map Legend

Shoreline

Bathymetry 2m

Bathymetry 2m

Log Dump Points

Transect Line

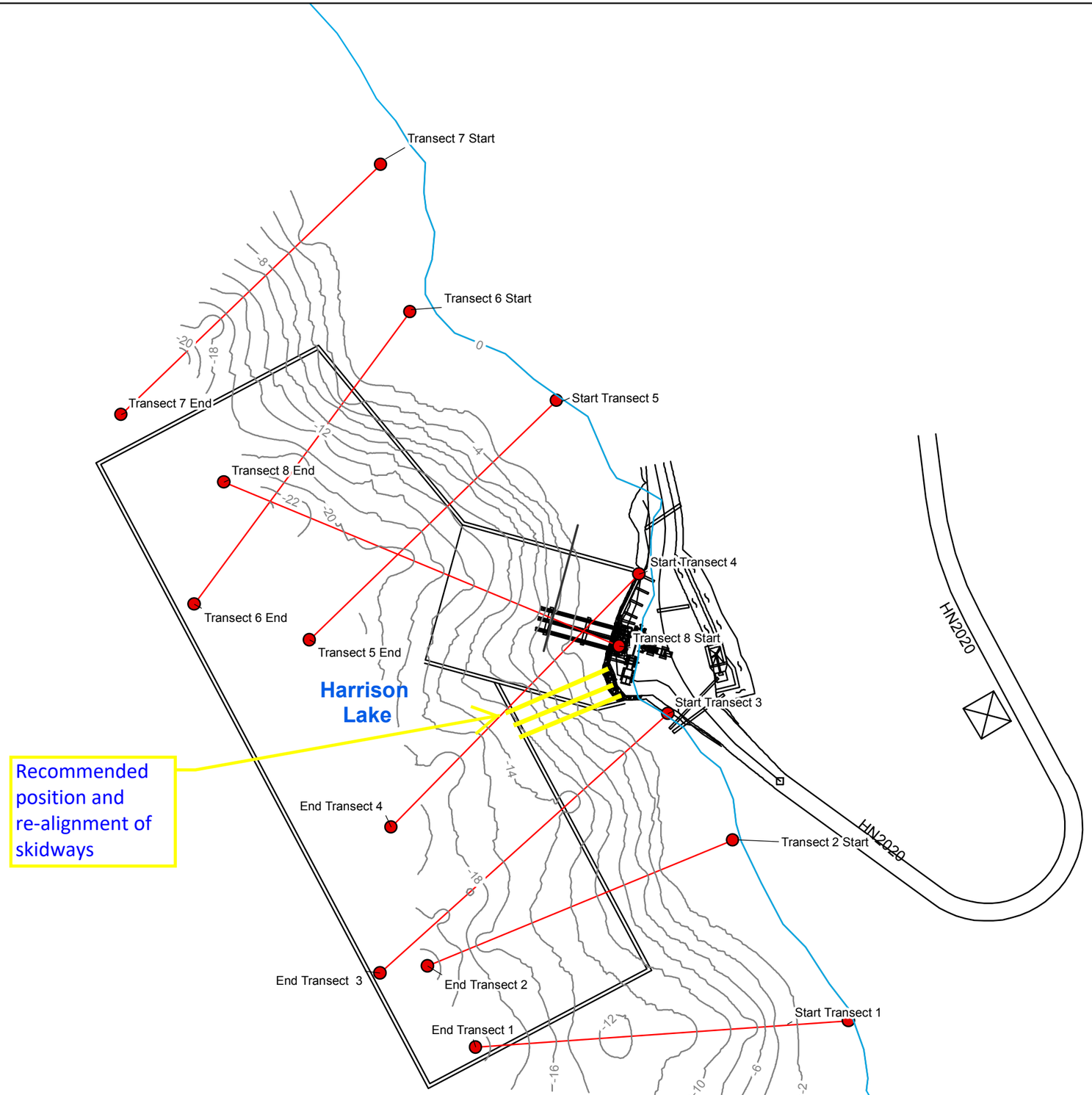
LOG DUMP
Lat. / Long.: 49°43'55"N / 122°05'08"W

Transect	Lat	Long
Start 8	49° 43.923'	122° 05.140'
End 8	49° 43.946'	122° 05.221'
Start 7	49° 43.995'	122° 05.207'
End 7	49° 43.955'	122° 05.257'
Start 6	49° 43.970'	122° 05.197'
End 6	49° 43.921'	122° 05.237'
Start 5	49° 43.957'	122° 05.162'
End 5	49° 43.920'	122° 05.213'
Start 4	49° 43.933'	122° 05.135'
End 4	49° 43.891'	122° 05.191'
Start 3	49° 43.912'	122° 05.128'
End 3	49° 43.879'	122° 05.202'
Start 2	49° 43.890'	122° 05.123'
End 2	49° 43.872'	122° 05.191'
Start 1	49° 43.865'	122° 05.100'
End 1	49° 43.859'	122° 05.177'

Scale:1:1,250
0 5 10 20 30 40 m
NAD 1983 UTM ZONE 10N

TSL A94293

Map 1 of 1



N

TSL A94293

Bathymetric MAP

Blocks: HN120, HN124, HN125.

Forest Region: RSC
Forest District: DCK
Mapsheet: 092H080
Location: Harrison Lak e North
TSA: Fraser

FDU : Big Silver
BEC: CWHds1
Author: GF
Print Date: 6/26/2018

Map Legend

Shoreline

Bathymetry 2m

Bathymetry 2m

Log Dump Points

Transect Line

Scale:1:1,250

0 5 10 20 30 40 m

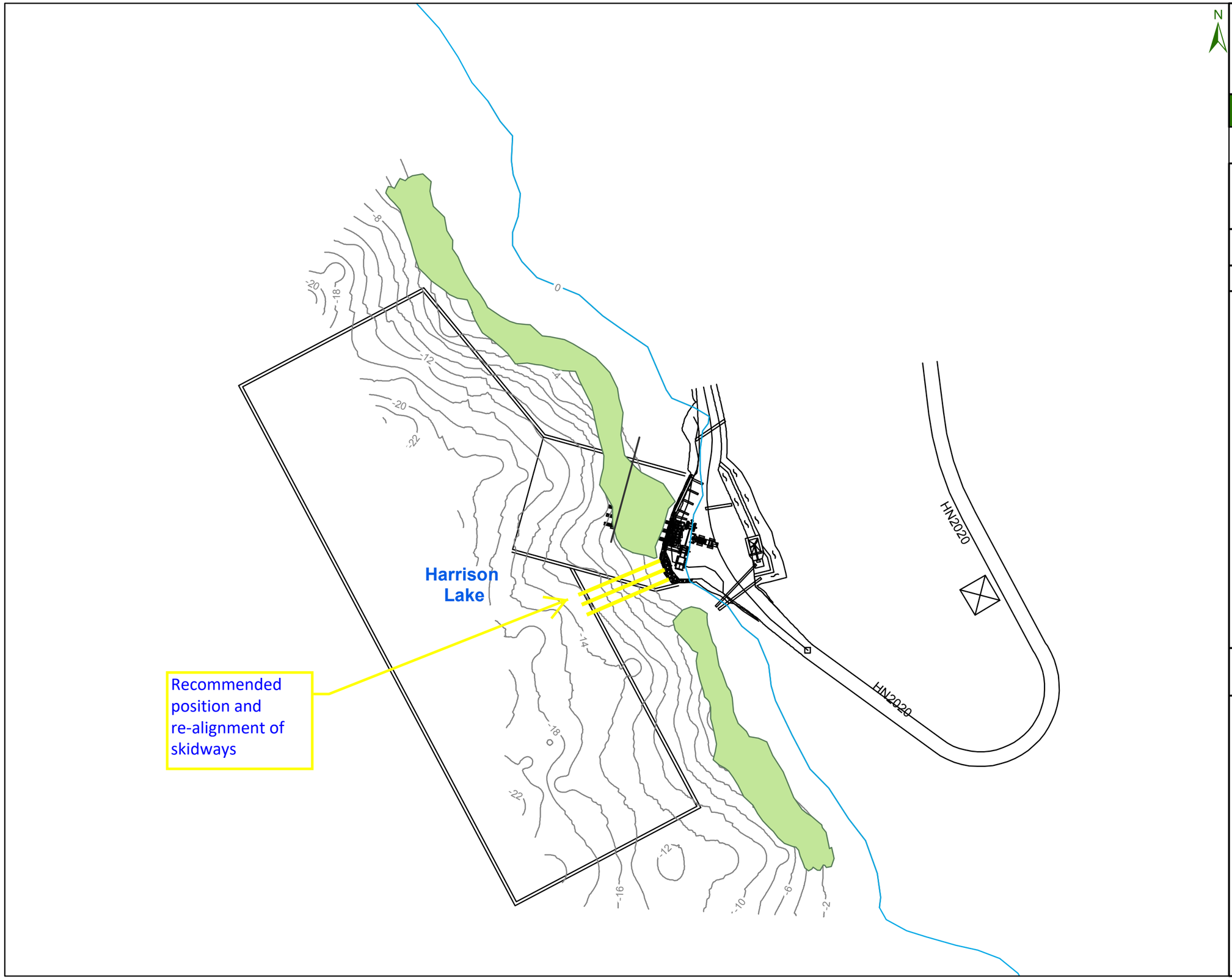
NAD 1983 UTM ZONE 10N

LOG DUMP

Lat. / Long.: 49°43'55"N / 122°05'08"W

Map 1 of 1

Z:\Client Services\BCTS\Chilliw ack \HN120\Mapping\GIS\A94293_m ap_Log Dum p.m x d



Submergent Vegetation Map

Blocks: HN120, HN124, HN125.

Forest Region: RSC
Forest District: DCK
Mapsheet: 092H080
Location: Harrison Lak e North
TSA: Fraser

FDU : Big Silver
BEC: CWHds1
Author: GF
Print Date: 6/26/2018

Map Legend

Submergent Vegetation

Shoreline

Bathymetry 2m

Bathymetry 2m

Scale: 1:1,250

0 5 10 20 30 40 m

NAD 1983 UTM ZONE 10N

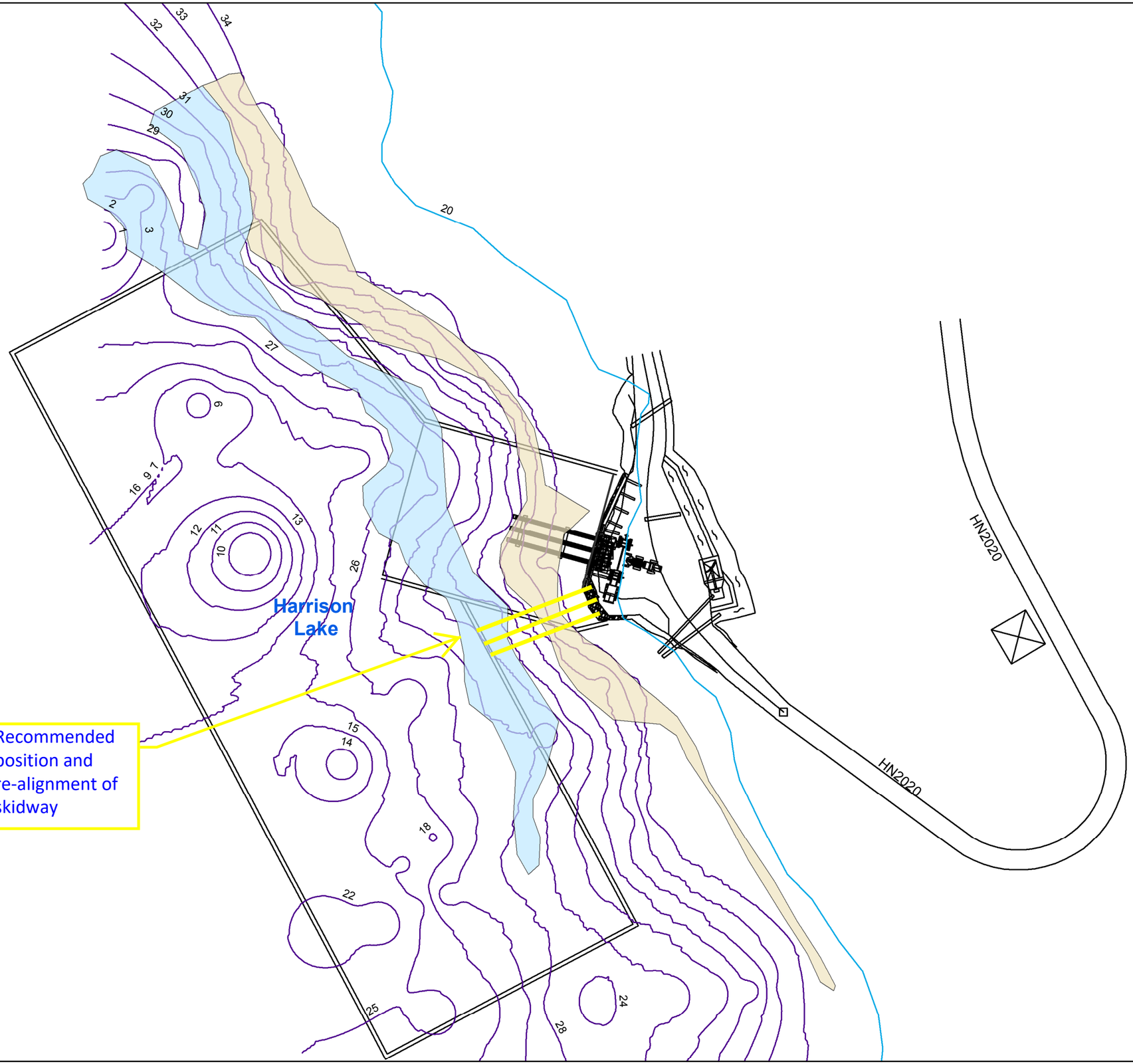
LOG DUMP

Lat. / Long.: 49°43'55"N / 122°05'08"W

TSL A94293

Map 1 of 1

Z:\Client Services\BCTS\Chilliw ack \HN120\Mapping\GIS\A94293_m ap_Log Dum p.m x d



Recommended position and re-alignment of skidway

TSL A94293

HISTORIC WOOD DEBRIS

Blocks: HN120, HN124, HN125.

Forest Region: RSC
Forest District: DCK
Mapsheet: 092H080
Location: Harrison Lak e North
TSA: Fraser

FDU : Big Silver
BEC: CWHds1
Author: GF
Print Date: 6/26/2018

Map Legend

Type

- Fine/ Coarse
- Large
- Shoreline
- Bathymetry_2m

Scale:1:1,000

0 5 10 20 30 40 m

NAD 1983 UTM ZONE 10N

LOG DUMP

Lat. / Long.: 49°43'55"N / 122°05'08"W

Map 1 of 1

Z:\Client Services\BCTS\Chilliw ack \HN120\Mapping\GIS\A94293_m ap_Log Dum p.m x d

Appendix 5
-Debris Management Plan-

These debris mitigation measures from DFO's Approved Work Practices for the re-activation of log handling facilities are recommended for the proposed Infinity North Harrison Log Handling Facility on Harrison Lake.

General

- All staff working on the log dump re-activation site must be briefed on the Debris Management Plan prior to initiating work on the site.

Minimize Debris Generation

- The DLS surface is -ballasted with a coarse shot rock. This will allow heavy machine traffic with minimal sediment generation. Ensure regular maintenance of operating surface to minimize the generation of fine sediments.
- All logs will be limbed and processed at the roadside in the woods to minimize the debris that reaches the DLS
- If logs will be spread and sorted on racks on land at the DLS, then all debris that is generated will be scraped and removed to the designated Debris Management sites.
- Coarser woody material such as chunks slabs and non-merch wood will be hauled to a debris burn site where burning will be conducted on a semi-annual basis. This site is to be situated well away from the aquatic environment.
- Finer bark and mud will be scraped up and hauled away as necessary to the designated debris burial site which is also well away from any water sources.
- Ensure log bundles are tightly secured to prevent escape, breakage or excessive shifting during handling on the skidway and during watering activities.
- Log dump skids should be kept at a minimal angle to minimize the loss of bark and debris as well as reduce bundle breakage and the resultant dewatering and re-bundling.
- Minimize the duration of in-water log storage to reduce abrasion of bundles and deposition of bark and wood debris in the aquatic environment and to facilitate the ability to sell the logs as soon as possible. Any End Use Sorts that are not moving quickly will be consolidated into a mixed boom and be towed where they will be pure boomed for market with the bundles from other operations.

Debris Containment and Collection

- Woody debris generated from placing the logs into the weigh bunks will be cleaned on a regular basis. Maintenance of the weigh bunks is required in order for the weigh bunks to properly function. This debris is removed every couple of days and hauled periodically to the debris burial site.

- The DLS perimeter is shaped to tilt back toward the back wall of the sort area and is periodically pulled back with an excavator.
- All surface water from the DLS surface is channeled toward the backwall and run through sediment ponds and oil/water separators before entering the aquatic environment
- Solid waste (business waste) is returned to town for recycling. Shop waste that cannot be recycled is disposed of in the approved Shop Waste site as per the Waste management permit. Hazardous waste such as oil products is all packaged properly and returned to the proper facilities in town as required by regulation.
- A berm (e.g. brow logs, blasted rock, concrete lock blocks) must be established around the water's edge of the dumping platform to facilitate wood debris clean-up and prevent loss of wood debris onto the aquatic environment. As a part of the berm construction the front face of the facility should be re-armoured if possible.

Appendix 6

-Environmental Impact Mitigation Plan-

These environmental protection measures from DFO's Approved Work Practices are recommended for the re-activation of log handling facilities and apply to the Harrison Lake log dump site

General Operation Mitigation Measures

- Enclose all log dump sites with a ring of boom sticks to prevent escapement of log bundles and wood debris.
- Keep boom sticks offshore with stiff legs and/or anchors. If anchors are required, anchor lines, chains or cables should be employed such that excess line does not collect on the bed of the water body or form loops that may entangle aquatic life. If concrete anchors are used, they are to be pre-cast and cured away from water before use to prevent seepage of potentially toxic substances.
- If blasted armour rock is required to re-construct the skidway or dumping platform crib wall, minimize installation of new rock. Use clean, uncontaminated rock and keep within the original log dump footprint. If rocks at the dump site contain aquatic life, they should be carefully removed during construction and relocated to another area on the beach at the same water elevation or keyed back into the re-constructed fill slope to assist with habitat re-colonization. Consult the freshwater biological professional or Environmental Monitor onsite for further advice.
- Where practicable, grade and slope the dumping platform surface so that water drains to the rear of the site where it can be filtered to remove leachate and fine wood debris before entering freshwater streams, wetlands or lake environments.
- If is determined that a float camp is needed at the site, and further assessments determine where the camp can be moored, mitigation measures will need to be developed and implemented to reduce the shading that would occur.
- Equip float camps with appropriate sewage containment and treatment facilities.
- Use fueled barges, fuelling platforms and oil/water separators which follow appropriate fuel handling and storage procedures to prevent discharge of deleterious substances to fish-bearing waters.
- Keep emergency spill kits and spill response plans on-site at all times.
- Site de-activation and remediation should follow the BMP's listed in the Guidebook.
- Environmentally Sustainable Log Handling Facilities in British Columbia (DFO, 2008).

Fish

- If fish spawning or migration activities are observed during construction or operational phase of the re-activation of the dump, operations must be temporary suspended until a qualified fisheries monitor is consulted and mitigation measures would have to be developed to avoid harming adults, redds or alevin
- Species of specific interest are Sockeye salmon, Steelhead and Rainbow trout, White Sturgeon.