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BURNCO AGGREGATE PROJECT

Fish Habitat Offset Plan



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1.0 INTRODUCTION

This report briefly describes the proposed BURNCO Aggregate Project (the Proposed Project), the existing environmental conditions at the Proposed Project site, and summarizes the expected residual effects on fish and fish habitat that are described in the Environmental Assessment Certificate Application/Environmental Impact Statement (EAC Application/EIS). It describes measures intended to offset the residual effects and how they will result in a net benefit for fish and fish habitat.

This report has been developed to support a Request for Authorization under subsection 35(2) of the *Fisheries Act*. Additional information regarding the existing environmental conditions and residual effects on fish and fish habitat is provided in the Fish and Fish Habitat Baseline Report (Volume 2, Part B – Section 22.0: Appendix 5.1-A) and the Fisheries and Freshwater Habitat Assessment (Volume 2, Part B - Section 5.1).

2.0 PROJECT DESCRIPTION

BURNCO Rock Products Ltd. (BURNCO) is proposing to construct and operate a sand and gravel operation on private property (the Property) near the lower portion of the McNab Creek watershed (BC Watershed Code 900-106300) on the western shore of Howe Sound's Thornbrough Channel. The land-based activities for the Proposed Project are entirely contained within land that has been privately owned since 2008. The marine loading structure is contained within privately held water lot lease. The Proposed Project is located approximately 22 km west-southwest of Squamish and 35 km northwest of Vancouver, with geographic coordinates of 49° 34' 00"N, 123° 23' 20"W.

The proposed sand and gravel pit will be situated on a relatively flat, recently clear-cut (2002 to 2004) area of the glacial fan-delta west of the mouth of McNab Creek. The Proposed Project will be situated on the glacial fan-delta between the mouths of Harlequin Creek and McNab Creek. Thirty-five watercourses (i.e., streams, ditches, and groundwater-fed watercourses) are present on the Property. The majority of the identified watercourses do not flow continuously and many of them are not connected to fish bearing watercourses (Figure 1). The main fish bearing watercourses in the area include McNab Creek, Harlequin Creek, WC 2, and several natural groundwater-fed watercourses that occur downslope (south) of the proposed pit (Figure 2).

At BURNCO's request, Golder Associates Ltd. (Golder) undertook habitat assessment and mapping of freshwater fish habitats within or adjacent to the footprint of the Proposed Project components, including the proposed mine pit, processing plant, waste rock dump, conveyer system and barge loading facility, as well as ancillary components such as buildings, roads, and transmission lines (Figure 3 and Figure 4). The methods for assessing and mapping the freshwater fish habitats are described in the Fish and Fish Habitat Baseline Report (Volume 4, Part G – Section 22.0: Appendix 5.1-A).

Sand and gravel will be extracted from the pit using an electric powered floating clamshell dredge equipped with a primary crusher linked to a floating conveyor system. The dredge will float on the surface of the pit pond. From this location, the floating clamshell will extract material according to the aggregate deposit and mine plan, gradually enlarging the pit to an approximate size of 28 ha. The extraction will result in the forming of a pit lake by intercepting groundwater and will be isolated from existing watercourses to avoid the release of sediment-laden water from the pit lake during operations.



The processing plant will be located in existing cleared areas near the land-based log sorting area south of BC Hydro's right-of way. The processing plant will be less than one hectare in size and will be preloaded above the pit elevation to enhance the water recycling process and drainage. Appropriate erosion and sediment control measures, along with a water management plan that includes rinse water recycling will be developed and implemented to avoid or manage the release of sediment-laden water to aquatic habitat (see Volume 3, Part E - Section 16.0). All components of the processing plant will be located outside of setbacks around fish bearing watercourses, riparian areas and mature forest stands as defined by the *Forest and Range Practices Act* (2002) *Forest Planning and Practices Regulation* (2002, Division 3 — Riparian Areas - Section 47 of the regulation).

The processed sand and gravel products will be conveyed to product stockpiles prior to loading. An electric conveyor will move material from each stockpile to a barge conveyor using an automated materials-handling system connected to each stockpile. All processing facilities and conveyers will be enclosed to avoid or reduce fugitive dust emissions. Sorted aggregate products will be conveyed from the plant to barges via a barge-loading facility on the marine foreshore to the south of the pit, which is located within an existing foreshore lease and log dump area at the southwest corner of the Property.

The barge loading facility and jetty will consist of an electric covered conveyor with a capacity of >1,500 tonnes of aggregate per hour. The barge will be secured to a series of steel pilings arranged perpendicularly to the foreshore. The barge will be slowly moved laterally as it is filled. The loading facility will be fed by a covered 1.6 m wide conveyor supported by steel piles and oriented in a north south alignment across the foreshore. The conveyor will be located at a height greater than five meters above High High Water. The bathymetry of the near shore marine environment in the area of the proposed marine loading facility and jetty precludes the requirement for dredging. Barges will be filled in approximately two to three hours during daylight hours.

3.0 AFFECTED HABITAT COMPONENTS

For the purposes of this Habitat Offset Plan, habitat components affected by the Proposed Project have been defined as:

- 1) Upper and lower segments of watercourse 2 (WC 2); and
- 2) Marine foreshore habitat

Watercourse 2 is a constructed groundwater-fed stream located near the center of the Proposed Project Area and has been further separated into two distinct segments according to its location. The upper segment is located above (upstream) from the hydropower line Right-of-Way (RoW) and access road culvert, while the Lower segment is the portion of WC 2 below (downstream) from the access road culvert and extending to the ocean.

The following sections describe the habitat and biological characteristics of the above affected components.



3.1 Habitat Description

3.1.1 Watercourse 2 (WC 2)

The upper segment of WC 2 consists of a straight, excavated channel flowing from north to south for approximately 520 m through the area of the proposed aggregate pit. The lower segment consists of an excavated and historically naturally occurring channel flowing from north to south for approximately 670 m to its mouth and south of the proposed aggregate pit.

WC 2 was originally excavated in three phases between 1985 and 2003, with the first two phases roughly corresponding to the lower segment of WC 2, and the third phase corresponding to the upper segment:

- Phase 1 - The first (and furthest downstream) portion of WC 2 was constructed in 1985;
- Phase 2 - The middle portion of WC 2 was constructed in 1998; and
- Phase 3 - The upper portion of WC 2 (above the BC Hydro RoW) was constructed from 2001 to 2003.

The original objective of the construction of WC 2 was to provide spawning habitat for Chum salmon and rearing habitat for Coho Salmon. The upper segment consists of a low gradient (<1%) channel with long stretches of uniform dimension that is flat bottomed in cross-section with slow moving, moderately deep water. There is a short (<150 m) length of riffle-pool habitat near its upper extent (Figure 5).

The banks within the upper segment are steep and long with slopes as high as 45° and a bank slope approximately 10 m long throughout much of the watercourse. The slopes are exposed and have little riparian vegetation, resulting in erosion and deposition of fines and sand on the channel bed. Substrate throughout the majority of the upper segment now consists mainly of fines and sand. Some exposed gravel and cobbles are found in a short segment of riffle-pool habitat near the top of WC 2. The fine substrate throughout most of WC 2 provides poor spawning habitat for salmonids. Suitable spawning habitat in the upper segment is restricted to a short segment (120 m) of riffle-pool habitat near the top of WC 2. The slow moving, deep-water conditions of WC 2 do provide favourable velocities and depth for rearing and overwintering juvenile Coho and other salmonids (Volume 2, Part B - Section 5.1 and Volume 4, Part G – Section 22.0: Appendix 5.1-A).

The lack of riparian vegetation limits shade and overhanging vegetation cover for fish in the upper segment. Boulders, logs and stumps were placed in discrete clusters along the length of WC 2 and they do provide instream cover. Beaver dam construction above the culvert at the downstream end of the upper segment of WC 2 may currently be acting as a temporary obstruction to fish passage during some seasons of the year.

Below the culvert, the lower segment of WC 2 consists primarily of slow-flowing, low-gradient run and pool habitats. The lower length of the segment turns south and drains into the historically natural portion of WC 2 where it enters the foreshore. The lower segment of WC 2 is tidally influenced with backwatering effects all the way up to the culvert, with brackish conditions extending approximately 100 m upstream from the mouth. The lower segment of WC 2 provides juvenile salmonid rearing habitat with some spawning habitat that appears to be mainly used by Pink Salmon (Volume 2, Part B - Section 5.1 and Volume 4, Part G – Section 22.0: Appendix 5.1-A).



3.1.2 Foreshore Habitat

The intertidal zone in the Proposed Project Area consists of a gradual sloping beach extending seaward over a linear distance of approximately 150 m (Picture 1, Attachment A). Substrate in the intertidal zone is composed mainly of cobble and gravel. Sand and silt are evenly distributed throughout most of the intertidal zone. In the subtidal zone, the seafloor drops off rapidly. Soft sediment is the dominant substrate type in the shallow subtidal area.

Historical log handling activities in the subtidal zone of the Proposed Project Area have resulted in extensive carpeting of the seafloor with wood and bark debris, particularly in the western portions of the water lot. The accumulation of wood debris increases with depth, extending to an unknown distance. In shallower waters, the wood debris is mixed with sand (Volume 2, Part B - Section 5.2).

3.2 Biological Description

3.2.1 WC 2

Infrequent observations of adult Chum and Coho Salmon spawners have been recorded in WC 2 during spawner enumeration surveys for the Proposed Project (Hatfield 2009). Of the few observed, most were found in the lower segment below the culvert at the Hydro RoW. Additionally, numbers of Chum spawners observed were higher in previous years than in recent surveys suggesting that use may have declined (Volume 4, Part G - Section 22.0: Appendix 5.1-A).

Juvenile Coho are present in the upper segment, as determined from electrofishing, minnow trapping, and fyke net sampling. Densities at separate sampling locations within the upper segment ranged from 0.012 to 0.582 fish/m² with higher densities observed in the riffle-pool segment near the upstream extent of WC 2 (Volume 4, Part G – Section 22.0: Appendix 5.1-A).

Juvenile Coho densities are not as high as those reported in studies of similar habitats throughout the region. Juvenile Coho densities in side channels and off-channel ponds compiled from twelve studies in the Pacific Northwest was an average of 1.01 fish/m², ranging from 0.02 to 5.4 fish/m² (Keeley et. al. 1996). Side-channel and off-channel habitats in Washington State had summer juvenile Coho densities of 2.07 (+/- 1.51) fish/m² in constructed habitats and 1.18 (+/- 0.95) fish/m² in natural side-channel and off-channel habitats (Morley et. al. 2005). Summer sampling of groundwater channels by Sheng et. al. (1990) found juvenile Coho present in densities of 7 fish/m² in a groundwater channel on the Cheakamus River near Squamish, BC, and 14 fish/m² in a groundwater channel in a lower Fraser River tributary.

Coho smolt production is not as high as reported by studies of other similar habitats in the region. Sheng et al. (1990) found Coho smolt production in constructed groundwater channels ranging from 1 to 3 smolts/m². Coho smolt production from off-channel habitat in the Cheakamus River near Squamish, B.C., was found to be an average of 0.67 smolts/m² (Foy et. al. 2001). Keeley et. al (1996) found Coho smolt production in side-channels to be an average of 0.67 smolts/m² and range from 0.013 to 2.01 smolts/m². A study of salmonid productivity of side-channel and off-channel habitats in Washington State found winter densities of Coho juveniles to be 0.77 (+/- 0.87) juvenile Coho/m² and 0.21 (+/- 0.20) juvenile Coho/m² in constructed habitats and natural off-channel habitats, respectively (Morley et. al. 2005).



Results of recent fisheries studies completed in the Proposed Project Area support the assessment of the upper segment of WC 2 as having low value Chum Salmon spawning habitat (Volume 4, Part G – Section 22.0: Appendix 5.1-A). No Chum fry were captured during fish sampling activities in the upper segment, including a spring smolt outmigration sampling program. In contrast, hundreds of Chum fry were captured during the same period in the McNab Creek mainstem (Volume 4, Part G – Section 22.0: Appendix 5.1-A).

Cutthroat Trout were found in low numbers during sampling in WC 2, with density results at separate sampling locations ranging from zero to a maximum of 0.116 fish/m² captured in the riffle-pool segment of the upper segment during electrofishing efforts in 2011. Cutthroat Trout densities in nearby streams (Watercourse #5 and Harlequin Creek) were higher, ranging from 0.172 to 1.479 fish/m². Generally, Cutthroat densities in the upper segment of WC 2 were lower than observed densities in similar habitats in the region. A study of side-channel and off-channel habitats in Washington State found average Cutthroat Trout densities of 0.07 (+/-0.13) trout/m² in constructed habitats and 0.11 (+/-0.11) trout/m² in natural side-channel and off-channel habitats during the summer. Winter densities were 0.04 (+/-0.04) trout/m² in constructed habitats and 0.60 (+/-0.94) trout/m² in natural side-channel and off-channel habitats (Morley et. al. 2005).

3.2.2 Western Portion of the Foreshore

Epiflora and epifauna communities in the intertidal and shallow subtidal portion of the Proposed Project site were influenced by substrate, which included 'hard substrate', 'soft substrate' or 'woody debris'. Highest species density/diversity occurred on hard substrate habitat, dominated by sessile organisms such as barnacles and mussels in the intertidal areas. Sea lettuce and rockweed were the most common macroalgae species associated with hard substrate. The woody debris zone present in the subtidal portion of the foreshore supported the lowest density and diversity of epibenthic species in the Proposed Project Area (Volume 2, Part B – Section 5.2). The accumulation of wood debris in the western area where the barge loading facility will be located appears to have reduced the value of the shallow subtidal habitat for salmonids.

3.3 Summary

The locations within the Proposed Project Area that are expected to be directly affected by the Project activities appear to have less functionality than was previously envisioned when the upper segment of WC 2 was designed and constructed. The upper segment of WC 2 was originally designed to provide spawning habitat for Chum Salmon, with the additional function of providing rearing habitat for Coho Salmon. Although it was constructed with the intent of providing spawning habitat, ongoing sediment inputs and a lack of riparian vegetation appears to have led to a reduction of its function over the years and overall it does not appear to be currently providing good spawning habitat. The marine foreshore, where the barge loading facility will be located, appears to have been affected by log handling activities that have reduced its habitat value.



4.0 RESIDUAL EFFECTS

The design of the Proposed Project had the first priority to avoid or reduce effects to fish and fish habitat and to incorporate creation of fish habitat. Efforts were made to keep the Proposed Project footprint out of aquatic and riparian habitats. Groundwater modeling (Volume 2, Part B - Section 5.6) was used to inform the design of the proposed aggregate pit and to adjust the elevation of the proposed pit lake that will be formed, such that groundwater losses for the majority of the watercourses, including McNab Creek and the natural groundwater-fed watercourses, would not occur. Surface water assessment (Volume 2, Part B - Section 5.5) based on the groundwater modeling results indicate that there will be slight increases in flow and wetted area for McNab Creek and all of the natural watercourses downslope of the pit area, except WC 2 which will experience reduced flows, during operation and following closure of the Proposed Project.

After considering design alternatives to avoid the Proposed Project’s effects on the aquatic environment and the application of mitigation measures to reduce the magnitude of the potential effects, the following residual effects have been identified:

- The destruction of the upper segment of WC 2, including the loss of a 20 m segment of WC 2 directly below the culvert;
- The reduction of flow and associated decrease in wetted area in the lower segment of WC 2 caused by the removal of the upper segment; and
- The permanent footprint of the steel pilings that will be used to support the conveyer and barge loading system in the intertidal and shallow subtidal habitat of the foreshore.

The direct and indirect habitat destruction or permanent alterations associated with the Proposed Project are summarized in Table 1.

Table 1: Summary of Habitat Area Affected by the Proposed Project

| Habitat Component | Instream Habitat Loss (m ²) | Riparian Habitat Loss (m ²) |
|--|---|---|
| Upper segment of WC 2(physical footprint) | 3,307* | 1,560 |
| Lower segment of WC 2 (20 m segment) below the culvert) (physical footprint) | 112 | NA |
| Lower segment of WC 2 (surface area loss due to reduced flows) | 116 | NA |
| Marine Foreshore Intertidal 8 Steel pilings (42cm diameter) | 1.1 | NA |
| Marine Foreshore Subtidal 10 Steel pilings (42cm diameter) | 1.4 | NA |
| Total Area Affected | 3,538 | 1,560 |

Note:

* Habitat area by habitat type is shown in Figure 5.



5.0 HABITAT OFFSET PLAN

To offset the identified residual effects associated with WC 2, BURNCO is proposing to construct a 770 m extension off the lower segment of WC 2. The extension will be located in the clear-cut area to the west of the lower segment of WC 2 and south of the BC Hydro RoW (Figure 6).

To address the residual effects in the marine foreshore area, BURNCO is proposing to construct approximately 10 m² of hard substrate intertidal habitat attached to the pilings supporting the conveyer system across the foreshore.

A description of the proposed Habitat Offset Plan, including rationale, physical and biological characterization of the site, recommended mitigation during construction and schedule is provided in the following sections.

5.1 Extension

Currently, the proposed site for the extension is within immature second growth forest that has established following logging of the site approximately 13 years ago (Picture 2, Attachment A). This area does not contain any surface water watercourses or ponds and thus, the area does not currently provide any aquatic habitat.

The proposed construction of a 770 m extension will connect to WC 2 just below the existing culvert and will meander to the west over relatively uniform terrain to where it will eventually connect to the outlet of the future pit lake (Figure 7, Figure 8, and Figure 9). The extension stays 15 m from WC 5 and has been designed to avoid adverse changes to the hydrology of WC 5. During the first year of the Proposed Project, approximately 720 m of the extension will be constructed. Once pit operations are finished (year 16), the remaining 50 m of the extension will be constructed and the connection to the pit lake outlet structure will be completed. BURNCO has committed to including a flow control mechanism into the design of the outlet (Figure 10), such that maintenance flows (i.e., for sediment flushing) can be provided from the pit lake. Physical monitoring of sedimentation rates will be conducted to determine whether periodic maintenance flows will benefit the function of the habitat by providing a mechanism for bedload movement within the extension. Sediment particle analysis of WC 2 has been done to identify the flow that will be required to promote bedload movement in the extension and this information has been incorporated into the design of the outlet for the pit lake.

The extension will have an average wetted width of five meters and an average depth of approximately 30 cm. The extension will use the configuration and physical characteristics of the existing lower segment of WC 2 for the basis of its design (Picture 3, Attachment A). The extension will incorporate a minimum of 20 root-wad or tree-top woody debris structures that will be located within excavated pools distributed along the length of the extension to provide additional instream cover for fish. The extension will also incorporate three engineered off-channel pond structures that will provide additional rearing and overwintering habitat. Each of the pond structures will be a minimum of 10 m in diameter and 1.5 m in depth. Details regarding the design and features of the extension are provided in Figure 11 and Figure 12 along with design notes.

The riparian area adjacent the proposed extension is within an existing planted clearcut, currently in the young forest stage (conifers). Access for and construction of the extension will occur along the proposed channel alignment to reduce clearing requirements and existing vegetation disturbance during construction. The area does not currently contain a watercourse so the creation of the extension in this area of existing vegetation will create



additional riparian habitat. It is expected that that little or no additional planting will be required in this area, but it will be monitored to confirm that it remains functional.

To address the loss of approximately 1,200 m² of wetland habitat that may be providing breeding habitat for amphibians (Volume 2, Part B - Section 5.1), this Habitat Offset Plan includes creation of four shallow ponds located near but not directly connected to the proposed extension (Figure 7, Figure 8, and Figure 11). The ponds have been designed to provide approximately 1,250 m² of suitable aquatic habitat for amphibian breeding. The maximum depth of the ponds and slope of the pond banks will be constructed to provide suitable conditions for amphibian breeding. These ponds will be separated from the extension to avoid fish feeding on the amphibian eggs and tadpoles. The wetted area of these ponds is not included in the fisheries habitat balance, as the ponds will not be providing habitat for fish.

A groundwater monitoring well has been installed at the approximate mid-point of the extension and it will be used to inform the detailed design. The excavation of the well location in early May found the groundwater in the area was less than two meters below the surface. The shallow depth of the groundwater in the area below the BC Hydro RoW suggest the stream banks will be much lower than the stream banks currently present in the upper segment of WC 2.

5.2 Marine Foreshore Habitat

To address the residual effects in the marine foreshore area, BURSCO is proposing to construct approximately 10 m² of hard substrate intertidal habitat attached to the pilings supporting the conveyer system across the foreshore. The hard substrate surfaces will consist of precast rough aggregate rock and concrete plates attached to the pilings to increase the surface area and diversity of rocky surfaces in the shallow sub-tidal, lower, and mid intertidal zones. The rough surface of the aggregate plates will provide vertical and horizontal substrate and crevasses for the attachment of sessile epifauna and marine algae. The aggregate plates will be positioned and sized to limit shading effects on intertidal habitat around the base of the pilings. The 10 m² surface area of the aggregate plates has not been included in the habitat offset balance calculation as the use of aggregate surfaces for habitat creation is relatively new and habitat value provided by the plates will be determined through monitoring.

5.3 Rationale for the Proposed Habitat Offset

The Habitat Offset Plan has been designed to produce a net gain in fish habitat at the Proposed Project site. A summary fish habitat gains that will result from the Habitat Offset Plan is presented in Table 2.

Table 2: Summary of Fish Habitat Gain

| Habitat Type | Habitat Offset Area (m ²) |
|---|---------------------------------------|
| Wetted area of instream juvenile Coho and Cutthroat Trout rearing habitat | 4,213* |
| Riparian Habitat | 19,196** |
| Total Area | 23,382 |

Notes:

* This area includes the total length of the extension and the wetted area of the proposed off-channel ponds that will be connected to the extension. The initial wetted area will be 3,562 m² and 560 m² will be added after operation of the pit is finished.

** The initial riparian offset area will be 15,864 m² and an additional 3,332 m² of riparian offset will be added following operation of the pit.



FISH HABITAT OFFSET PLAN

The Habitat Offset Plan provides more new and notably improved fish habitat (23,382 m²) than will be lost or disrupted by the Proposed Project (5,098 m²). The fish habitat created by the extension of the lower segment of WC 2 is expected to fully offset the habitat losses associated with the Proposed Project impacts. The upper segment of WC 2 currently provides a similar function (i.e., salmonid rearing and overwintering habitat) to what will be provided by the extension of the lower segment of WC 2, although the proposed extension will provide higher value habitat as a result of the presence of a functional and improved riparian area and the incorporation of instream cover structures.

The proposed offset habitat provided by the extension will provide additional and improved juvenile Coho rearing and overwintering habitat and rearing habitat for all age classes of Cutthroat Trout. The abundance of juvenile Coho is often limited by the availability of suitable rearing habitat (Larkin 1977). Juvenile Coho are known to be nomadic and individuals that are unable to occupy a territory within suitable habitat in their natal stream tend to be displaced downstream. Displaced individuals will migrate along an estuary shoreline and enter other available watercourses (Otto and McInerney 1970). This activity appears to be occurring in WC 2 as no recent Coho spawning activity was observed, while juvenile Coho were regularly observed in the upper and lower segments.

The provision of suitable rearing and overwintering habitat for juvenile Coho will also provide suitable habitat for Cutthroat Trout. Adult and juvenile Coastal Cutthroat Trout cohabit with juvenile Coho in off-channel and groundwater-fed watercourses (Hartman and Brown 1987).

In addition to the proposed rearing and overwintering habitat creation, sections of the channel bed, approximately 10% of the channel length, will incorporate placement of substrate suitable for spawning by coho and chum salmon. However, this will be completed on a "field fit" basis and is only intended to encourage opportunistic spawning use. Hydraulic conditions may not be suitable to support spawning use and its success is uncertain, so has not been incorporated into the intent of the offset plan.

The extension in the location proposed is expected to require less excavation than was necessary for the upper segment of WC 2, as the water table in the area is closer to the surface. It is expected that the entire length of the extension will experience some level of tidal backwatering effect. Reduced excavation depth will avoid the creation of steep unconsolidated banks and the potential for excessive sedimentation. The reduced size and height of the stream banks will support the efficient re-vegetation of the disturbed soils. The re-vegetated stream banks are expected to be stable and provide overhanging vegetation similar to what is present along the existing lower segment of WC 2.

The potential for success of the compensation habitat is expected to be good as the creation of similar groundwater-fed watercourse habitat in the lower segment of WC 2 has been successful at the site already. The proposed offset habitat is planned to be permanent, but it is expected that the instream and riparian habitat will take some time to adjust and fully develop. The current plan is to construct the extension in advance of shutting off the upper segment of WC 2. This will allow time for adjustments in the extension to be implemented prior to it being connected with WC 2. This will reduce the risk of releasing sediment-laden water into WC 2 while adjustments are made to the extension. The location of the pit lake outlet and the upper end of the extension has been moved away from the original culvert location in order to simplify construction and provide more space for the extension.



The proposed extension is located on property that is owned by BURNCO and under their long-term control. This control of the site along with the potential to connect the extension to the outlet of the pit lake following operation of the mine allows for a level of flow control and adaptation that is viewed as highly beneficial to the success and productivity of the offset habitat that will be created.

5.4 Alternative Offset Options

During the development of the Proposed Project design, a number of different habitat offset options were considered. A number of different habitat offsetting options were shared with Fisheries and Oceans Canada (DFO) who provided the following advice regarding the various options (DFO 2011)”

- Proposed side-channel development on McNab Creek - considered high risk and susceptible to lateral movement of the creek.
- A new extension off Harlequin Creek - had potential but there was concern that it would experience regular perturbations associated with variable flow and bedload.
- Predator shelters and reef balls placed in the marine environment - considered experimental and their success was viewed as uncertain.
- Riparian planting associated with McNab Creek - appeared to be unnecessary or unlikely to be effective.

A summary of Golder’s review of the various proposed options is presented in Table 3 and Golder agrees with DFO’s evaluation of the various alternative options.

Table 3: Summary of Habitat Offset Alternatives Assessed

| Option | Constructability ¹ | Durability ² | Function ³ | Uncertainty ⁴ |
|---------------------------------------|-------------------------------|-------------------------|-----------------------|--------------------------|
| McNab Side-channel Creation | High | Low | Similar | High |
| Harlequin Creek Side-channel Creation | High | Moderate | Similar | Moderate |
| Reef Balls / Predator shelters | High | High | Not Similar | High |
| Riparian Planting | High | High | Not Similar | Low |
| Marsh Benches | Moderate | Moderate | Not Similar | Low |

Notes:

- 1) High = Standard construction methods and standard design; Moderate = Standard design with non-standard construction methods; Low = Non-standard design and non-standard construction methods.
- 2) High = Expectation of lasting > 10 years; Moderate = Expectation of lasting 5 to 10 years; Low = Expectation of lasting < 5 years.
- 3) Similar = Same species and life history stage affected; Not Similar = A different species or life history stage affected.
- 4) High = Limited evidence of successful implementation or function at other sites; Moderate = Successful implementation but limited evidence of function; Low = Successful implementation and demonstration of function at other sites.





5.5 Mitigation Measures

The specific construction methodology will be developed by the contractor selected for the job, as it will depend on, among other factors, available equipment. However, the construction methods will need to take into account the geotechnical characteristics and materials present in the area. The construction sequence is expected to approximate the following:

- Will follow the mitigation measures outlined in the Fisheries Habitat Protection and Mitigation Plan and the Sediment, Erosion and Drainage Control Plan (Volume 4, Part E - Section 16.2).
- Work on the majority of the extension will begin prior to the closure of the upper segment of WC 2.
- Clearing of the vegetation in the clear-cut will be kept to a minimum along the extension to facilitate the establishment of riparian habitat.
- Heavy equipment will be used to excavate the extension.
- The majority of the construction work for the extension will be done in isolation from WC 2.
- The connection between the extension and WC 2 will be done in a controlled manner once turbidity levels in the extension have dropped to appropriate levels and the bed and banks have stabilized.
- In-water work associated with the connection will be conducted during the work window of reduced risk for the area. Proposed Project works outside of the wetted margin or in full isolation may take place, with appropriate precautions, outside of that work window.
- The work will follow applicable portions of the best management practices outlined in the Land Development Guidelines for The Protection of Aquatic Habitat (DFO 1993).
- The work will follow specific requirements stipulated in an Authorization issued by Fisheries and Oceans Canada (DFO).
- Specific work instructions will be included in the Contractor's Environmental Protection Plan to identify deleterious substances/substances capable of causing pollution and how the contractor will control such substances at their source (will include mitigation outlined in the Fisheries Habitat Protection and Mitigation Plan).
- An environmental monitor will be on site when in-water work occurs and will initially use visual observation to look for evidence of sediment released beyond the work site. If a sediment release is observed, turbidity monitoring will be used to verify that water quality performance criteria are met.
- Samples yielding turbidity values above ambient water quality guidelines for the protection of Aquatic life (fresh, marine, estuarine; provided in Volume 4, Part G – Section 16.2: Table 16-1) at sampling locations outside the worksite will trigger additional mitigation measures including the slowing down or suspension of work until turbidity levels meet the performance criteria.
- The sediment control system will be inspected regularly and repaired as necessary. Once the work has been completed, the system will be removed in a manner that prevents the escape or re-suspension of sediments.



FISH HABITAT OFFSET PLAN

- Prior to the commencement of the construction activities, the contractor will develop an activity specific Spill Prevention and Emergency Response Plan, including providing names and telephone numbers of persons and organizations that may be contacted in the event of a potential environmental incident. The Spill Prevention and Emergency Response Plan will be posted in conspicuous locations on site for ready access in the event of an environmental incident. All on-site personnel will be made aware of the location of the Spill Prevention and Emergency Response Plan. An outline of what is to be included in a Spill Prevention and Emergency Response Plan is provided in Volume 4, Part G - Section 16.3.
- The construction contractors will have an appropriate supply of spill response equipment on site, including but not necessarily limited to, a spill containment boom and sorbent pads.
- The contractors' equipment will be in good repair and cleaned of external oils and grease prior to mobilizing onsite. The contractor will have maintenance and inspection records for each self-propelled machine (e.g., tracked excavator).
- In the event of an environmental emergency, the contractor will notify the Environmental Monitor immediately. If the environmental emergency is a spill of a hazardous product in quantities equal to or greater than those listed in the *Spill Reporting Regulations* under the *Environmental Management Act*, the contractor will immediately notify the British Columbia Provincial Emergency Response Program (PEP) at 1-800-663-3456. Spills of any hazardous material, chemical, or any other material, which could be deleterious to fish, will be immediately reported to Environment Canada at (604) 666-6100.
- Emergency response equipment necessary to contain hazardous material spills will be onsite at all times and available for immediate use.
- The Contractor will be required to deploy absorbent pads within the area contained by the silt curtain in the event of a spill or leak of hydraulic fluids, fuel, or other deleterious material, or other method as specified in the contractors' Spill Prevention and Emergency Response Plan.
- The environmental monitor will be on-site during all construction activities conducted below High Water.
- The environmental monitor will carry out measurements, make visual observations and provide information regarding compliance to the contractor, in regards to construction activities in and around the aquatic environment and the application of identified mitigation measures.
- The implementation of measures and control of activities will remain the responsibility of the contractor as they are in direct control of the site and activities on the site.
- The environmental monitor will prepare and submit regular (based on an agreed to schedule) environmental monitoring reports. The regular reports will document construction activities, effectiveness of mitigation measures, incidents, non-compliant events, corrective action taken and photograph documentation.
- In accordance with the recent revisions to the fisheries protection provisions of the *Fisheries Act*, in the event of a non-compliant incident the monitor will contact DFO's Observe, Record and Report (ORR) line (1-800-465-4336) and report the incident.



Fish and fish habitat monitoring plans will be developed to monitor the construction of the offsetting habitat as well as the functionality and use of the habitat offset. These plans will be developed and submitted to DFO as part of the application package for an authorization under Section 35 of the *Fisheries Act*. The monitoring plan(s) will be provided to DFO and Ministry of Forest Lands and Natural Resource Operations (FLNRO) for review and approval prior to the start of construction.

5.5.1 Environmental Monitoring

- Construction monitoring will be conducted by a Qualified Environmental Professional (QEP) to minimize impacts to fish and fish habitat during construction activities.
- The environmental monitor will be on-site during all Proposed Project activities conducted below High Water.
- The environmental monitor will carry out measurements, make visual observations and provide information regarding compliance to the contractor, in regards to construction activities in and around the marine environment and the application of identified mitigation measures.
- The monitor will also assess the effectiveness of the mitigation measures and confirm the Proposed Project footprint is as expected.
- The environmental monitor will prepare and submit to DFO and FLNRO regular (based on an agreed to schedule) environmental monitoring reports. The regular reports will document construction activities, effectiveness of mitigation measures, incidents, non-compliant events, corrective action taken and photograph documentation.
- In accordance with the recent revisions to the fisheries protection provisions of the *Fisheries Act*, in the event of a non-compliant incident the monitor will contact DFO's Observe, Record and Report (ORR) line (1-800-465-4336) and report the incident.

5.5.2 Habitat Offset Monitoring

- Habitat monitoring will be conducted to confirm that habitat offset measures outlined in the authorization are followed and to assess the functionality of the offset habitat over the long term.
- Prior to construction, a fish and fish habitat monitoring plan will be developed for review and approval by DFO and FLNRO. The monitoring plan will focus on the physical stability, functionality and fish use of habitat features included in the offset habitat.
- The monitoring program will also assess qualitative and quantitative habitat metrics such as stem density for riparian planting and percent cover for instream habitat features.
- The monitoring will also include fish density and distribution within the extension and compared with suitable reference habitat sites.
- The habitat will be monitored upon completion of construction and an initial monitoring report with as-built drawings will be provided to DFO and FLNRO.



- The initial monitoring report will confirm whether the construction of the habitat meets the design performance criteria outlined in the *Fisheries Act* authorization.
- The offset habitat will then be monitored during the growing season of years 1, 2, 3 and 5 (if necessary) and monitoring reports will be provided to DFO and FLNRO.
- If the long-term performance objectives of the habitat authorization are determined to not be met, DFO and FLNRO will be consulted to identify appropriate measures.
- The habitat offset monitoring will be conducted by a QEP with experience monitoring habitat compensation projects. An outline of what will be included in the monitoring plan is provided in Volume 4, Part G - Section 17.0.

5.5.3 Schedule

During the first year of the Proposed Project, and prior to operations and in advance of the upper segment of WC 2 being impacted by development of the aggregate pit, approximately 720 m of the WC2 extension will be constructed. The four amphibian pools will also be constructed at this time (according to specifications in Drawings 1 to 5) to provide suitable breeding habitat on site before Project operations begin. Once pit operations are finished (year 16), the remaining 50 m of the WC2 extension will be constructed and the connection to the pit lake outlet structure will be completed (Figure 6 to Figure 8).



6.0 CLOSURE

We trust this information is sufficient for your needs at this time. Should you have any questions or concerns, please do not hesitate to contact the undersigned at 604-296-4200.

GOLDER ASSOCIATES LTD.

Dave Carter, M.Sc., B.Sc.
Senior Environmental Scientist

Shawn Redden M.Sc. R.P.Bio.
Associate, Senior Fisheries Biologist

DC/SR/asd

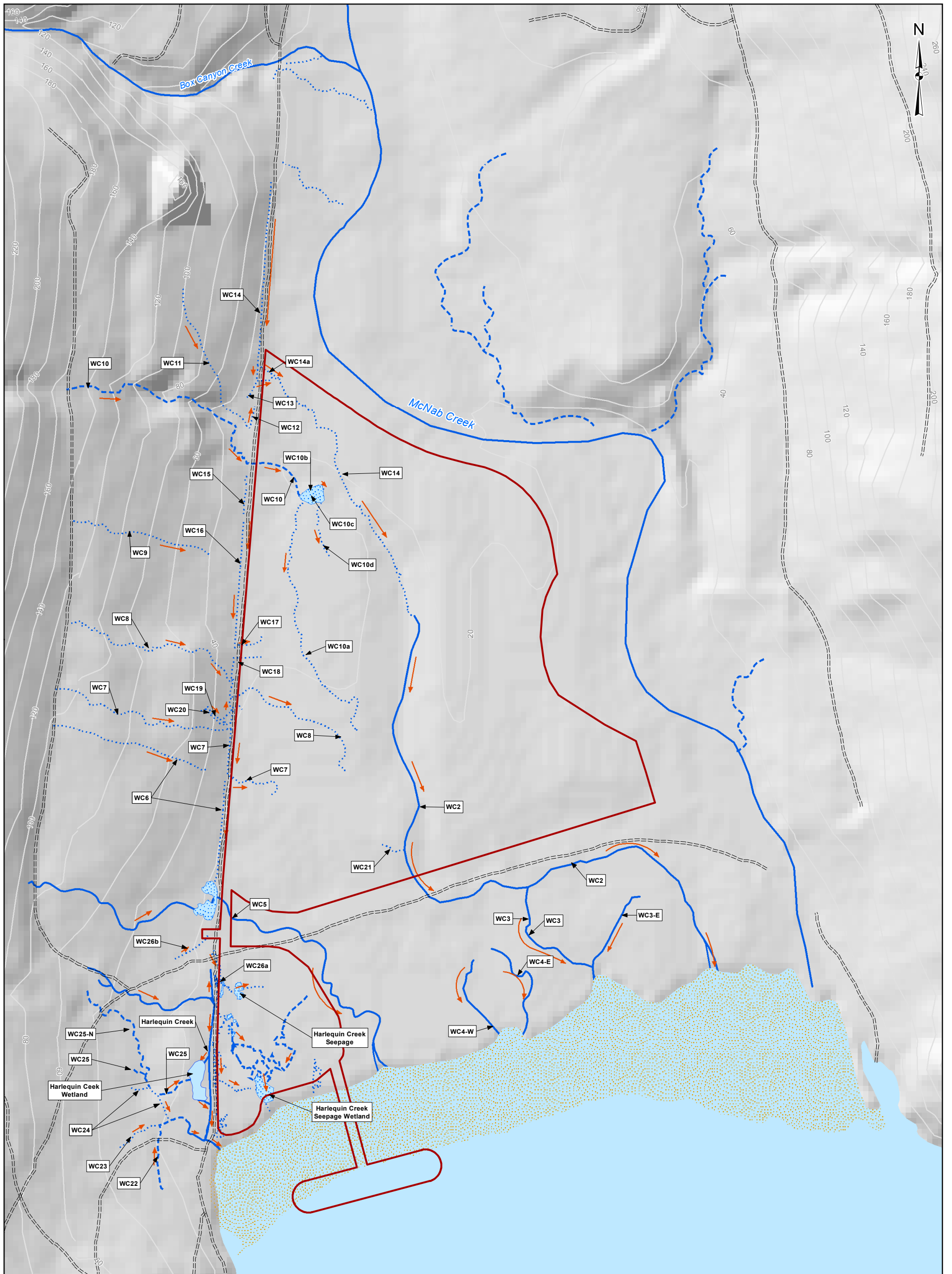
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o:\final\2011\1422\11-1422-0046\1114220046-576-r-rev0\1114220046-576-r-rev0-burnco fish habitat offset plan 23mar_16.docx



7.0 REFERENCES

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- DFO. 2011 Letter from Susan Farlinger, Regional Director General, Pacific Region to Kim Titus, Vice President, Aggregate Division BURNCO Rock Products Ltd.
- Foy, M, H. Beardmore, S. Gidora. 2001 CHEAKAMUS RIVER Coho Salmon Production From Constructed Off-Channel Habitat, Resource Restoration Group, Habitat and Enhancement Branch Lower Fraser Area, DFO.
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- Keeley, E.R., P.A. Slaney, and D. Zaldokas. 1996. Estimates of production benefits for salmonid fishes from stream restoration initiatives. Province of British Columbia, Ministry of Environment, Lands, and Parks, and Ministry of Forests. Watershed Restoration Management Report No. 4: 22p.
- Larkin, P. A. 1977. Pacific salmon. Pages 156-186 in J. A. Gulland, editor. *Fish population dynamics*. J. Wiley and Sons, New York, New York.
- Morley, S.A., P.S. Garcia, T.R. Bennett and P. Roni. 2005. Juvenile salmonid (*Oncorhynchus ssp.*) use of constructed and natural side channels in Pacific Northwest rivers. *Can. J. Fish. Aquat. Sci.* 62:2811-2821
- Otto, R. G., and J. E. McInerney. 1970. The development of salinity preference in pre-smolt coho salmon, *Oncorhynchus kisutch*. *Journal of the Fisheries Research Board of Canada* 27:793-800.
- Sheng, M.D., M. Foy, and A.Y. Feorenka. 1990. Coho salmon enhancement in British Columbia using improved groundwater-fed side channels. *Can. Manuscr. Rep. Fish. Aquat. Sci.* No. 2071.



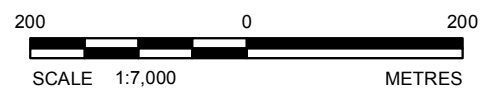
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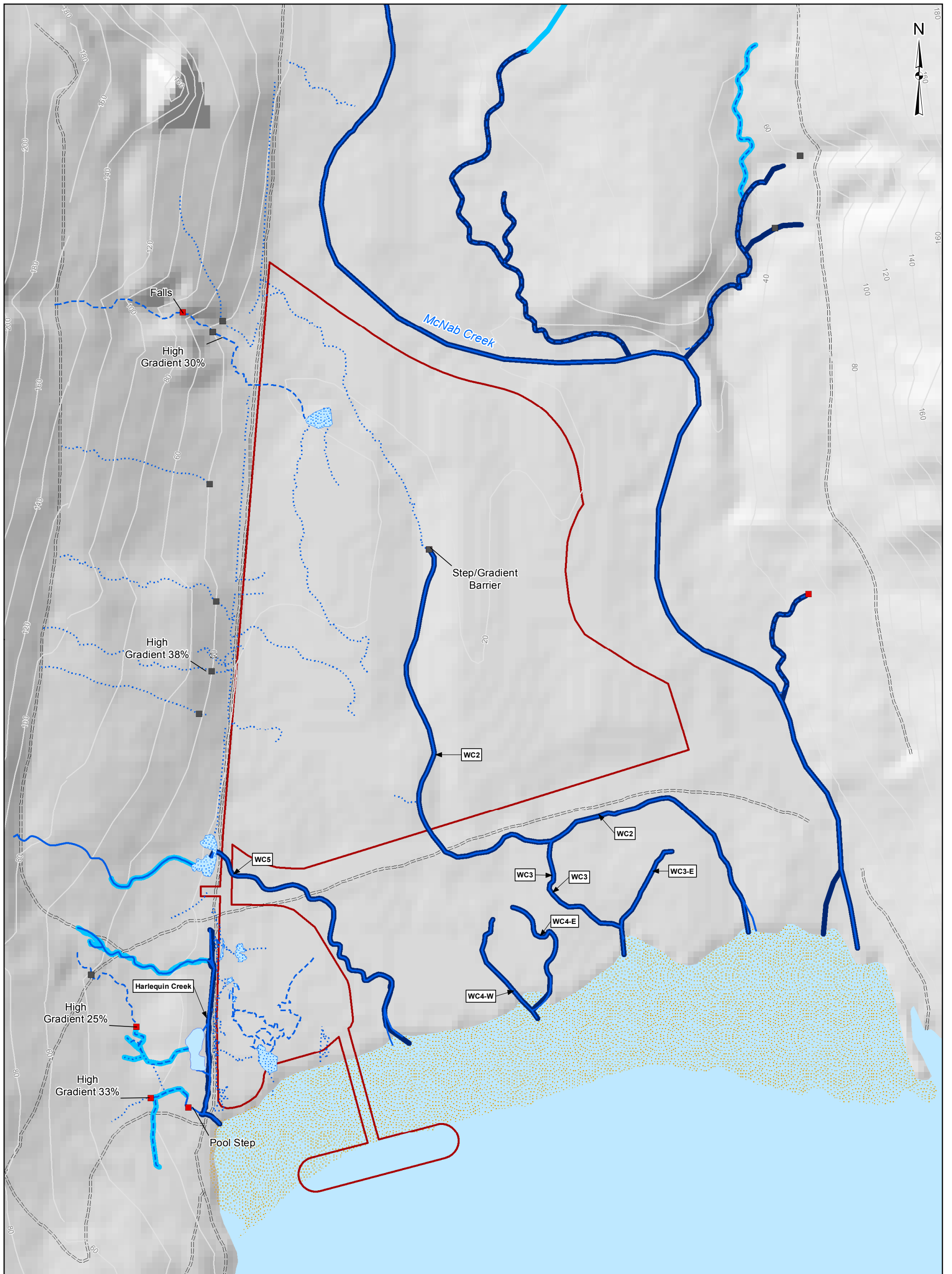
- Project Area
- Low Lying Wetted Area
- Beaver Impounded Wetted Area
- Waterbody
- Intertidal Zone
- Road (Existing)
- Contour (20m)
- Permanent / Perennial Watercourse
- Intermittent Watercourse
- Ephemeral Watercourse
- Direction of Flow

REFERENCE

Watercourses from the Province of British Columbia and Field data. DEM from Geobase. Base data from the Province of British Columbia. Contours from TRIM positional data. Projection: UTM Zone 10 Datum: NAD 83



| | | | | | |
|---------|--------------------------|---|-------------|-----------------|--------|
| PROJECT | | BURNCO ROCK PRODUCTS LTD. BURNCO AGGREGATE PROJECT, HOWE SOUND, B.C. | | | |
| TITLE | | WATERCOURSES | | | |
| | PROJECT NO. 11-1422-0046 | | PHASE No. | | |
| | DESIGN | DC | 01 May 2015 | SCALE AS SHOWN | REV. 0 |
| | GIS | DL | 10 Mar 2016 | | |
| | CHECK | DC | 10 Mar 2016 | FIGURE 1 | |
| REVIEW | SR | 10 Mar 2016 | | | |



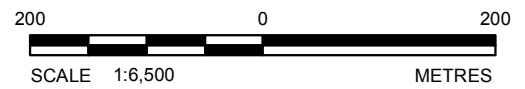
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LEGEND

- Field Observed
- Gradient greater than 25% *
- Project Area
- Low Lying Wetted Area
- Beaver Impounded Wetted Area
- Waterbody
- Intertidal Zone
- Road (Existing)
- Contour (20m)
- Permanent / Perennial Watercourse
- Intermittent Watercourse
- Ephemeral Watercourse
- Anadromous/Resident Fish Presence
- Resident Fish Presence

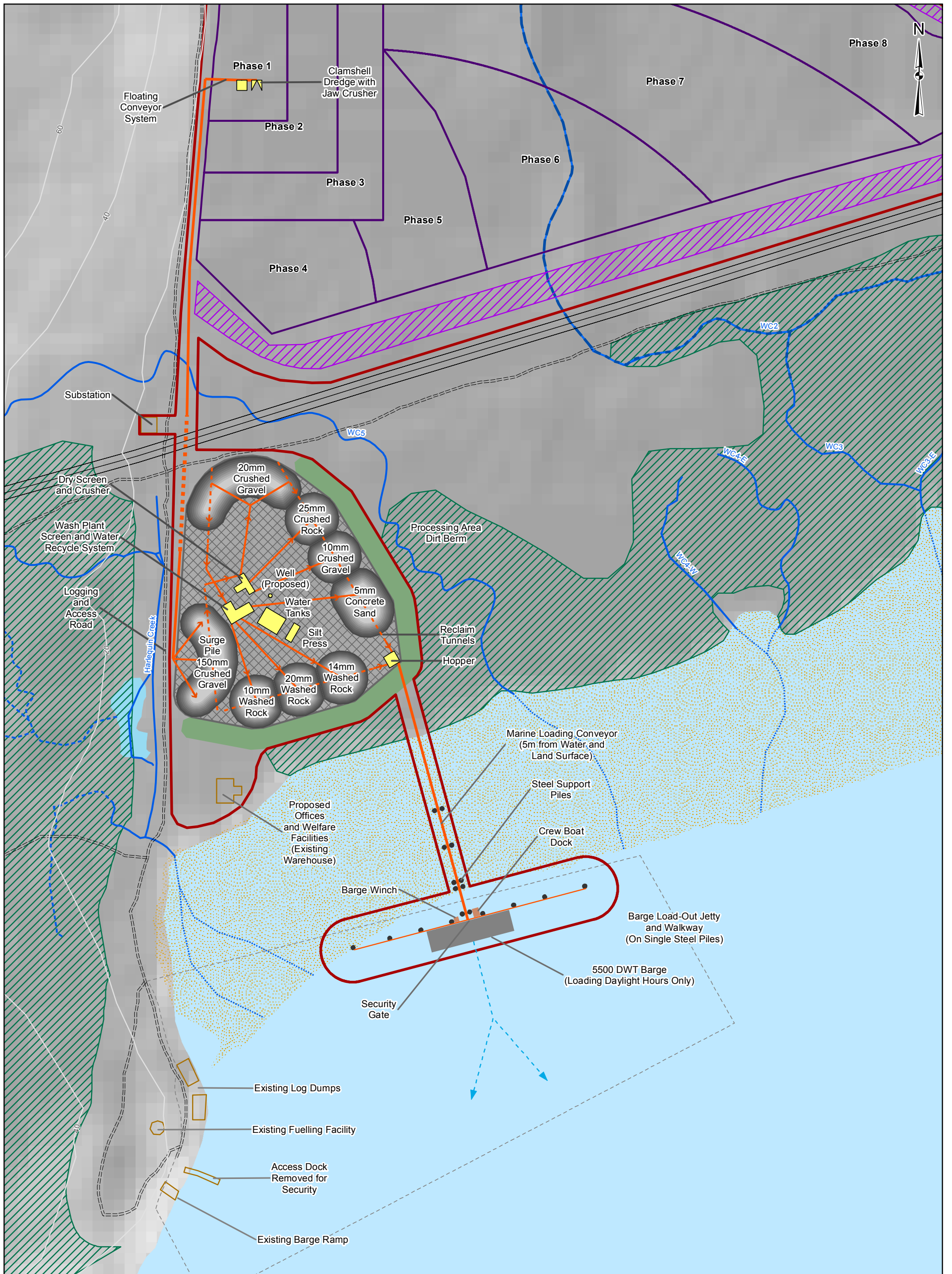
REFERENCE

* Gradient greater than 25% determined based on TRIM Positional data and Geobase DEM. DEM from Geobase. Watercourses from the Province of British Columbia and field data. Base data from the Province of British Columbia. Contours from TRIM positional data. Projection: UTM Zone 10 Datum: NAD 83



| | | | |
|--------------------------|----|---|-----------------|
| PROJECT | | BURNCO ROCK PRODUCTS LTD. BURNCO AGGREGATE PROJECT, HOWE SOUND, B.C. | |
| TITLE | | FISH DISTRIBUTION AND BARRIERS | |
| PROJECT NO. 11-1422-0046 | | PHASE No. | |
| DESIGN | DC | 01 May 2015 | SCALE AS SHOWN |
| GIS | DL | 10 Mar 2016 | REV. 0 |
| CHECK | DC | 10 Mar 2016 | FIGURE 2 |
| REVIEW | SR | 10 Mar 2016 | |





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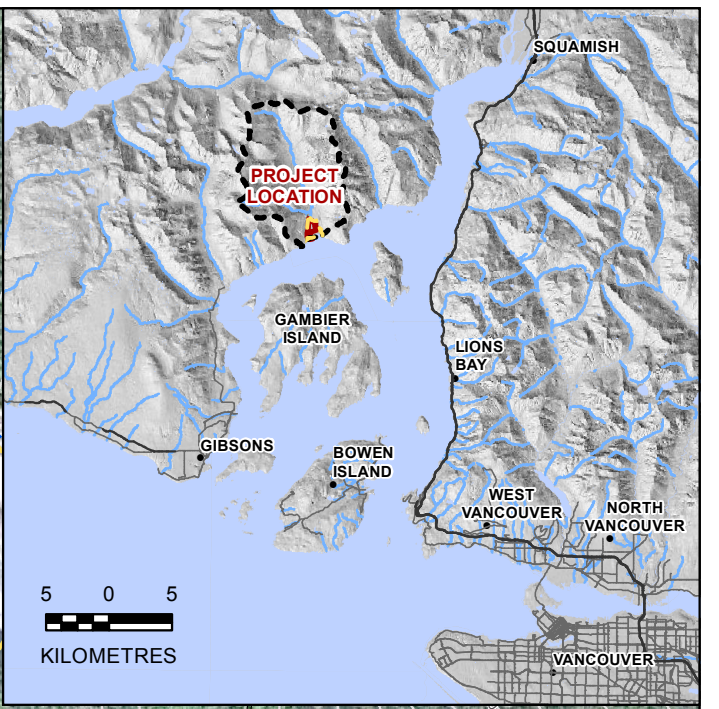
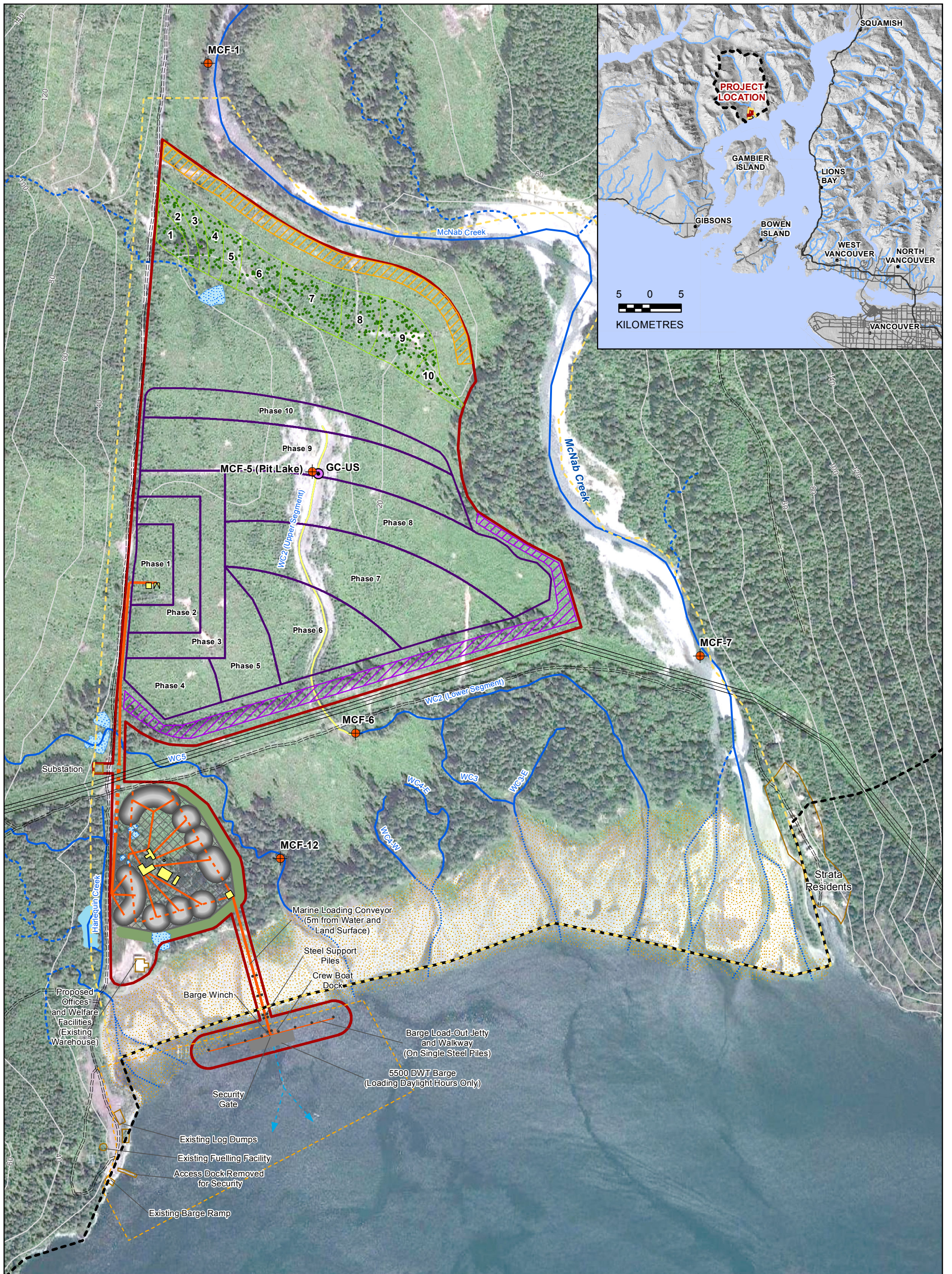
| LEGEND | | | |
|--------|---|--|-----------------------------------|
| | Project Area | | Mature 2nd Growth Forest |
| | Proposed Aggregate Pit Area | | Waterbody |
| | Processing Area | | Intertidal Zone |
| | Existing Feature | | Elevated Conveyor |
| | Existing Log Tenure Area | | Underground Conveyor |
| | Possible Processing Plant Configuration | | Barge Load-out |
| | Product Stockpiles | | Transmission Line |
| | Pit Lake Containment Berm | | Road (Existing) |
| | Processing Area Berm | | Permanent / Perennial Watercourse |
| | | | Intermittent Watercourse |
| | | | Intertidal Watercourse |
| | | | Constructed Watercourse |
| | | | Phase 1 (1985) |
| | | | Phase 2 (1998) |
| | | | Phase 3 (2001 - 2003) |
| | | | Barge Route |
| | | | Contour (20m) |
| | | | Pile |

REFERENCE
 DEM from Geobase. Base data from the Province of British Columbia. Contours from TRIM positional data. Additional detailed site features provided by McElhanney. Watercourses from LRDW and Field data. Projection: UTM Zone 10 Datum: NAD 83



| | | | |
|--------------------------|----|---|-----------------|
| PROJECT | | BURNCO ROCK PRODUCTS LTD. BURNCO AGGREGATE PROJECT, HOWE SOUND, B.C. | |
| TITLE | | CONCEPTUAL OPERATIONAL SITE LAYOUT | |
| PROJECT NO. 11-1422-0046 | | PHASE No. | |
| DESIGN | DC | 14 May 2015 | SCALE AS SHOWN |
| GIS | DL | 10 Mar 2016 | REV. 0 |
| CHECK | DC | 10 Mar 2016 | FIGURE 3 |
| REVIEW | SR | 10 Mar 2016 | |





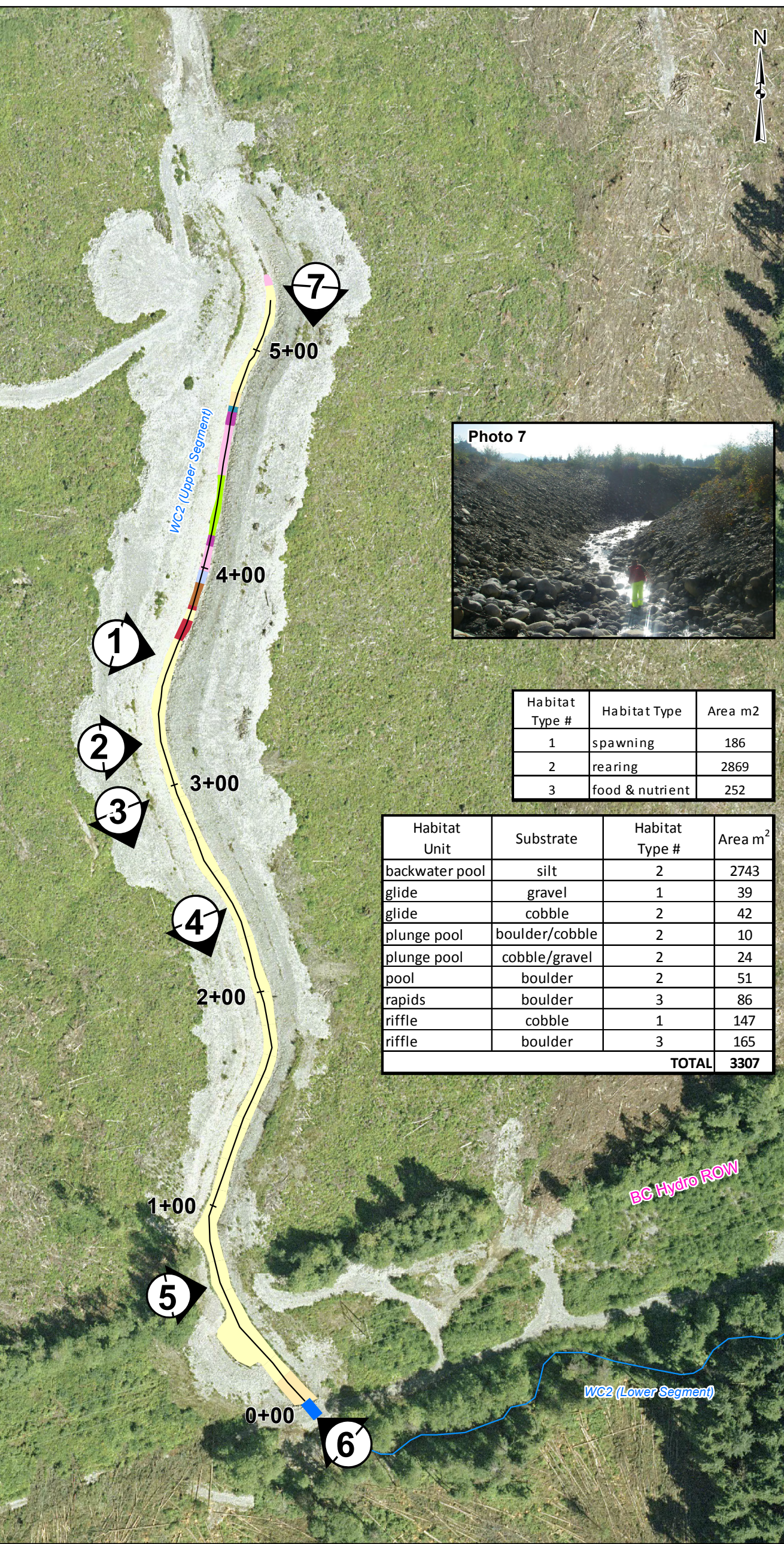
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- LEGEND**
- Predicted Water Quality Location
 - Station Locations (ID)
 - Project Area
 - Local Study Area
 - Regional Study Area
 - Proposed Aggregate Pit Phase
 - Processing Area
 - Existing Feature
 - Existing Log Tenure Area
 - Product Stockpiles
 - Possible Processing Plant Configuration
 - Fines Storage Area
 - McNab Creek Flood Protection Dyke
 - Pit Lake Containment Berm
 - Processing Area Berm
 - Low Lying Wetted Area
 - Intertidal Zone
 - Elevated Conveyor
 - Underground Conveyor
 - Barge Load-out
 - Transmission Line
 - Road (Existing)
 - Upper Segment of WC2 - Proposed Area of Impact
 - Permanent / Perennial Watercourse
 - Intermittent Watercourse
 - Intertidal Watercourse
 - Barge Route
 - Contour (20m)
 - Pile

REFERENCE
 Watercourses from the Province of British Columbia and field data. Contours from TRIM positional data. Additional detailed site features provided by McElhanney. Base data from the Province of British Columbia. Base Imagery from Google Maps 20100807. Projection: UTM Zone 10 Datum: NAD 83



| | | | | | |
|---------|--|--|--|---------------------------------------|--|
| PROJECT | | BURNCO ROCK PRODUCTS LTD. BURNCO AGGREGATE PROJECT, HOWE SOUND, B.C. | | | |
| TITLE | | FISH AND FISH HABITAT SITE PLAN | | | |
| | | PROJECT NO. 11-1422-0046 DESIGN DC 01 May 2015 GIS DL 10 Mar 2016 CHECK DC 10 Mar 2016 REVIEW SR 10 Mar 2016 | | PHASE No. SCALE AS SHOWN REV. 0 | |
| | | FIGURE 4 | | | |



| Habitat Type # | Habitat Type | Area m2 |
|----------------|-----------------|---------|
| 1 | spawning | 186 |
| 2 | rearing | 2869 |
| 3 | food & nutrient | 252 |

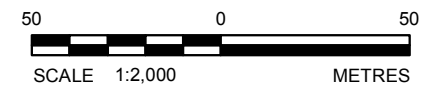
| Habitat Unit | Substrate | Habitat Type # | Area m ² |
|----------------|----------------|----------------|---------------------|
| backwater pool | silt | 2 | 2743 |
| glide | gravel | 1 | 39 |
| glide | cobble | 2 | 42 |
| plunge pool | boulder/cobble | 2 | 10 |
| plunge pool | cobble/gravel | 2 | 24 |
| pool | boulder | 2 | 51 |
| rapids | boulder | 3 | 86 |
| riffle | cobble | 1 | 147 |
| riffle | boulder | 3 | 165 |
| TOTAL | | | 3307 |

LEGEND

- backwater pool; silt
- glide; cobble
- glide; gravel
- plunge pool; boulder/cobble
- plunge pool; cobble/gravel
- pool; boulder
- rapids; boulder
- riffle; boulder
- riffle; cobble
- Lower Segment of WC2
- 100m Increments Along Watercourse
- Culvert
- # Photopoint

REFERENCE

Watercourse from the Province of British Columbia and field data. Base Image from Google Maps 20150807.
 Projection: UTM Zone 10 Datum: NAD 83



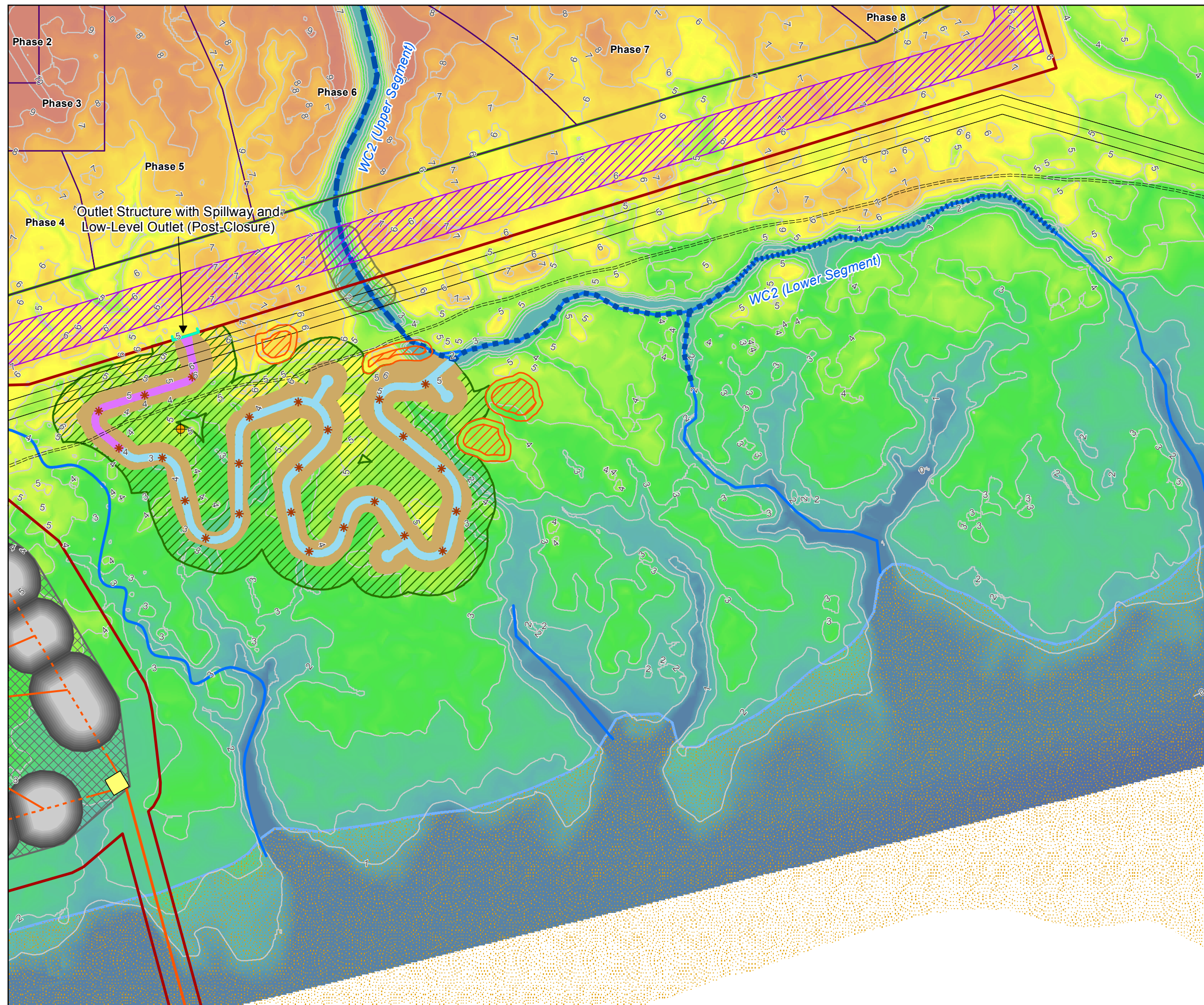
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| PROJECT | | BURNCO ROCK PRODUCTS LTD. BURNCO AGGREGATE PROJECT, HOWE SOUND, B.C. | |
| TITLE | | UPPER SEGMENT OF WC2 HABITAT UNITS | |
| PROJECT NO. 11-1422-0046 | | PHASE No. | |
| DESIGN | RH | 08 Oct 2009 | SCALE AS SHOWN |
| GIS | DL | 10 Mar 2016 | REV. 0 |
| CHECK | DC | 10 Mar 2016 | |
| REVIEW | SR | 10 Mar 2016 | |



FIGURE 5

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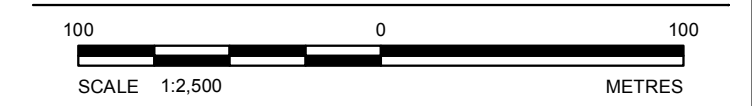
| | |
|---|---|
| Project Area | Processing Area |
| Proposed WC2 Extension (~770 m) | Product Stockpiles |
| Proposed Channel Extension: Year 1 Channel Construction | Final Pit Lake Outline |
| Proposed Channel Extension: Project Closure Channel Construction | Proposed Aggregate Pit Phase |
| Top of Bank | Pit Lake Containment Berm |
| Riparian | Possible Processing Plant Configuration |
| Channel Infill, Riprap and Filter Zone | Intertidal Zone |
| Proposed Amphibian Pond (Combined Area ~1250 m ²) | Above-Ground Conveyor |
| Outlet Structure with Spillway and Low-Level Outlet | Below Pile Conveyor |
| Constructed Watercourse | Transmission Line |
| Phase 1 (1985) | Road (Existing) |
| Phase 2 (1998) | |
| Phase 3 (2001 - 2003) | |
| Wood Debris | |
| Installed Well - Coordinates: 10U 0471586 E 5490127 N +/- 3m Depth to bottom of well from top of casing: 5.33 mbtoc Stick-up above ground surface: 0.85 m Depth to water from top of casing: 2.945 mbtoc (~2.1 mbgs) | |

Generalized Features

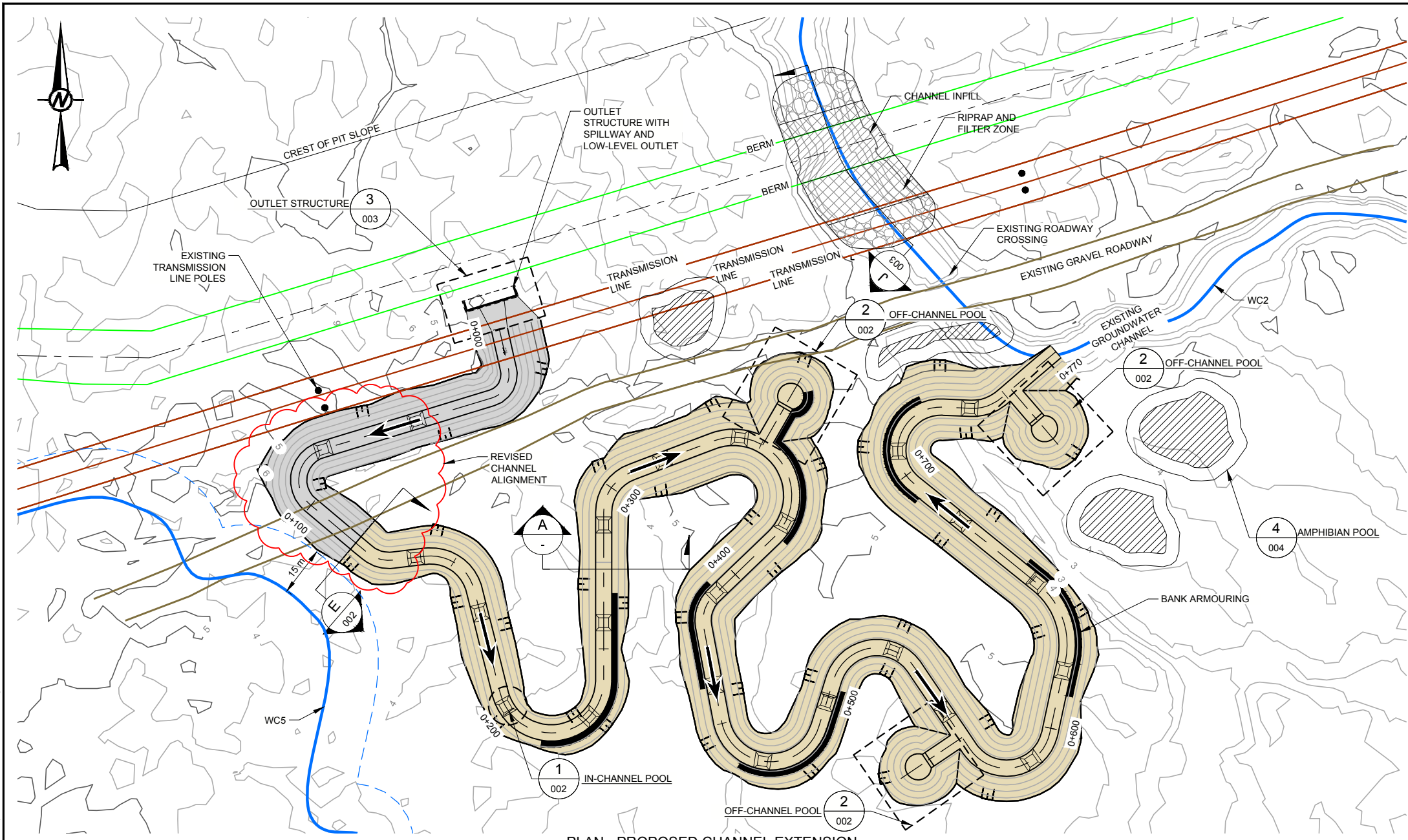
TREE COVER DETAIL
NOT TO SCALE

WOOD DEBRIS (ROOT WAD)
COVER DETAIL
NOT TO SCALE

REFERENCE
 Installed well, wood debris, WC2 Extension and outlet structure from Golder Associates Ltd. Base data from the Province of British Columbia. Contours from TRIM positional data. Watercourses from the Province of British Columbia and field data. Additional detailed site features provided by McElhanney.
 Projection: UTM Zone 10 Datum: NAD 83



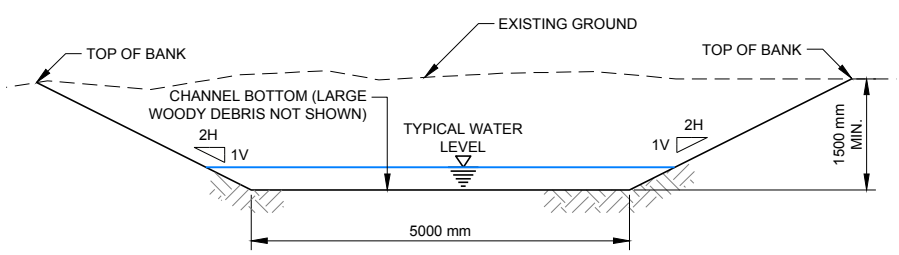
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| PROJECT | | | |
| BURNCO ROCK PRODUCTS LTD. BURNCO AGGREGATE PROJECT, HOWE SOUND, B.C. | | | |
| TITLE | | | |
| PROPOSED EXTENSION | | | |
| | PROJECT NO. 11-1422-0046 | | PHASE No. |
| | DESIGN | DC | 09 Jan 2015 |
| | GIS | DL | 10 Mar 2016 |
| | CHECK | DC | 10 Mar 2016 |
| | REVIEW | SR | 10 Mar 2016 |
| | | SCALE AS SHOWN | REV. 0 |
| FIGURE 6 | | | |



LEGEND

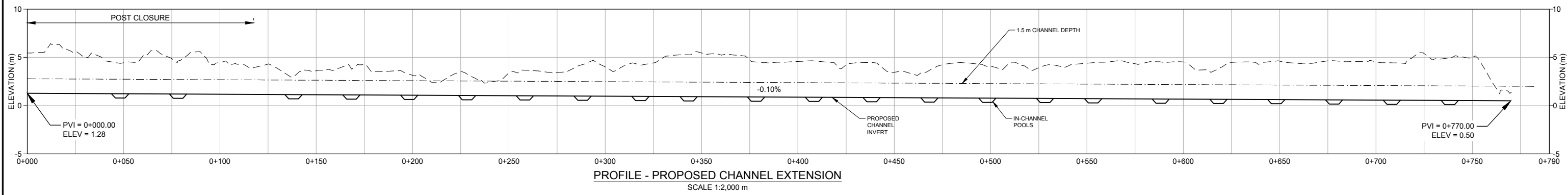
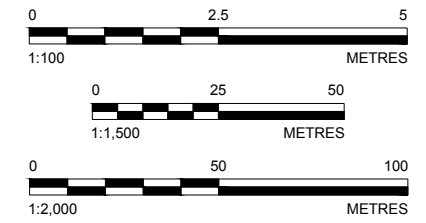
- EXISTING GROUND CONTOURS
- PROPOSED CHANNEL EXCAVATION CREST
- PROPOSED CHANNEL EXCAVATION TOE
- PROPOSED BERM
- PRE YEAR-1 CHANNEL CONSTRUCTION
- POST CLOSURE CHANNEL CONSTRUCTION
- BANK ARMOURING
- AMPHIBIAN POOLS
- EXISTING WATERCOURSE (APPROXIMATE LOCATIONS)

- REFERENCES**
- WATERCOURSES FROM LRDW AND FIELD DATA.
 - CONTOURS FROM TRIM DATA. ADDITIONAL DETAILED SITE FEATURES PROVIDED BY MCELHANNY. BASE DATA FROM THE PROVINCE OF BRITISH COLUMBIA.
 - PROJECTION: UTM ZONE 10 DATUM: NAD 83



SCALE 1:100 m **A** TYPICAL SECTION - CHANNEL

NOT FOR CONSTRUCTION
ISSUED FOR PERMITTING

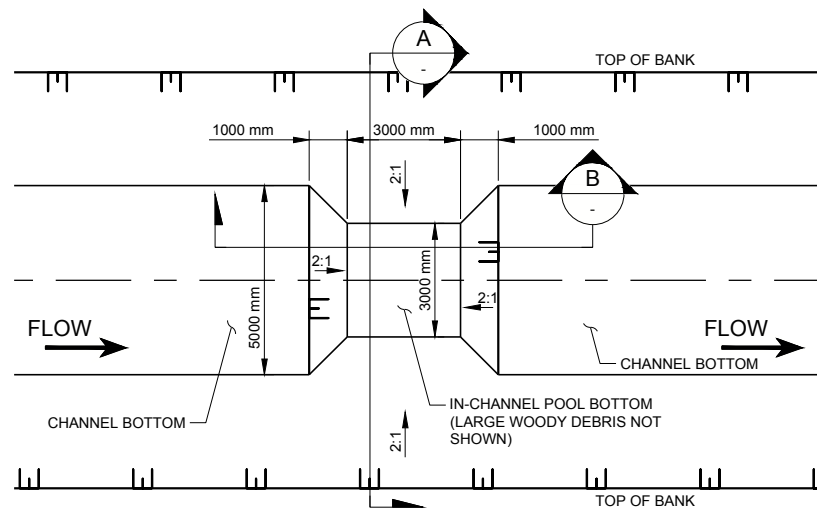


| | | | | | | | |
|---------------------|--|------------------------------|--|-------------|--|---|--|
| CLIENT | | BURNCO ROCK PRODUCTS LTD. | | PROJECT | | BURNCO AGGREGATE PROJECT | |
| CONSULTANT | | Golder Associates | | TITLE | | PROPOSED EXTENSION - CONCEPTUAL DESIGN OVERVIEW | |
| VANCOUVER | | SUITE 200 - 2920 VIRTUAL WAY | | PROJECT NO. | | 11-1422-0046 | |
| VANCOUVER, B.C. | | CANADA | | PHASE | | 4410 | |
| [+1] (604) 296 4200 | | www.golder.com | | REV. | | 0 | |
| DRAWING | | 001 | | REV. of | | 0 of 001 | |

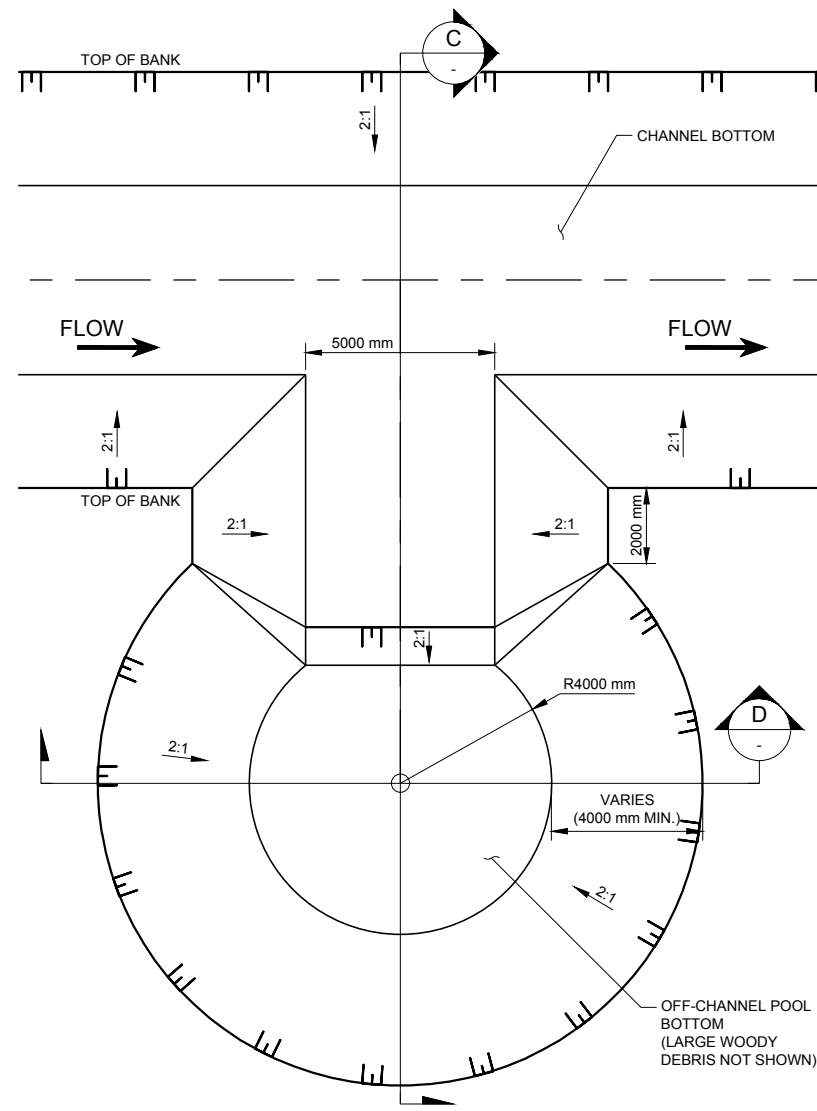
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|------|------------|-----------------------|----------|----------|----------|----------|
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| C | 2016-02-12 | ISSUED FOR REVIEW | SH | JK | JO | |
| B | 2015-10-13 | ISSUED FOR REVIEW | JO | JY | - | |
| A | 2015-08-17 | ISSUED FOR REVIEW | SH | RP | JO | |

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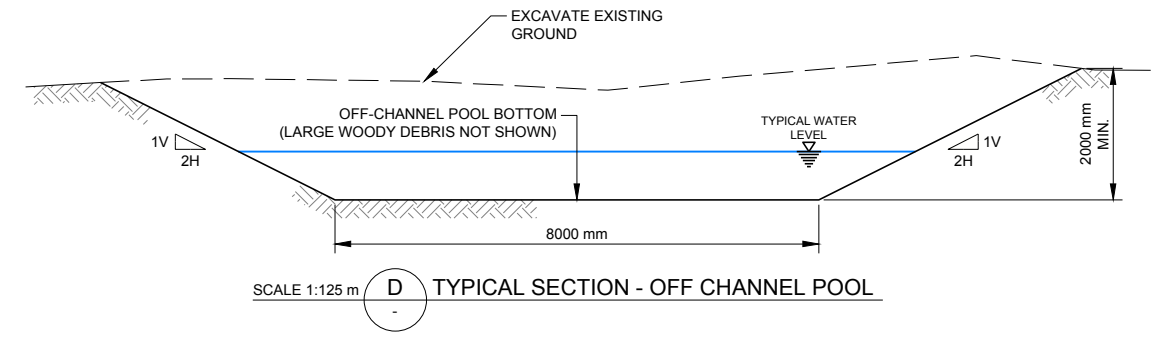
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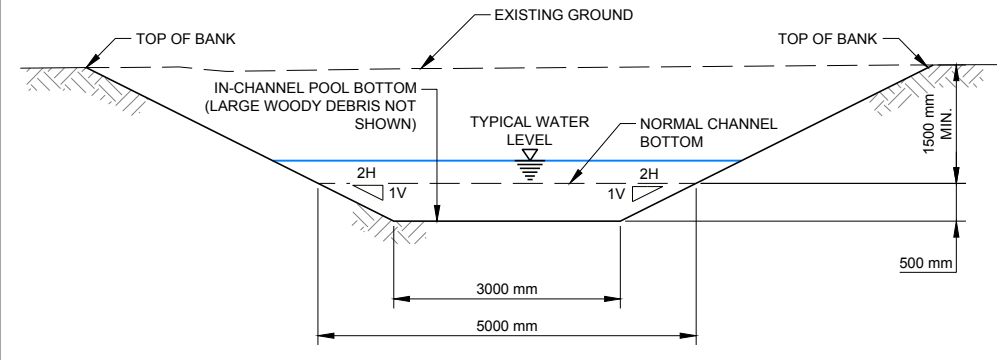
SCALE 1:200 m **1** DETAIL - IN-CHANNEL POOL



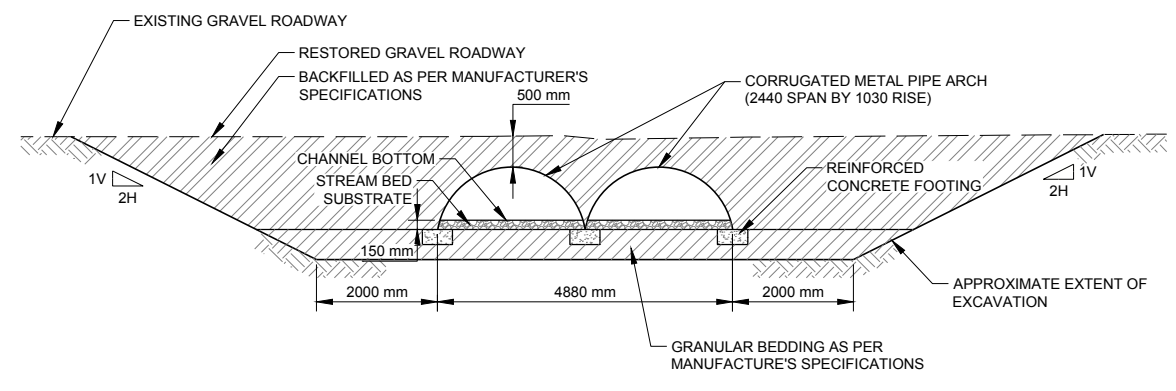
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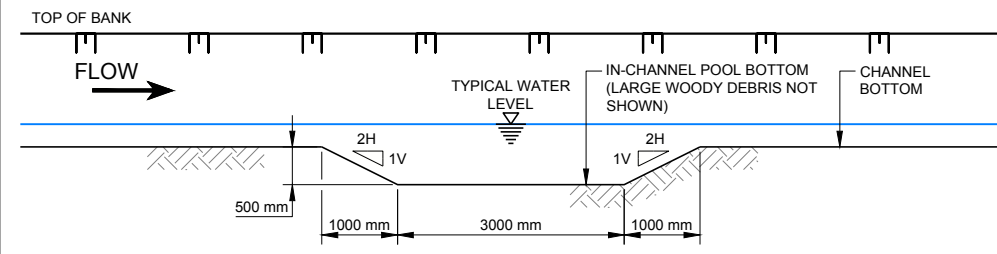
SCALE 1:125 m **D** TYPICAL SECTION - OFF CHANNEL POOL



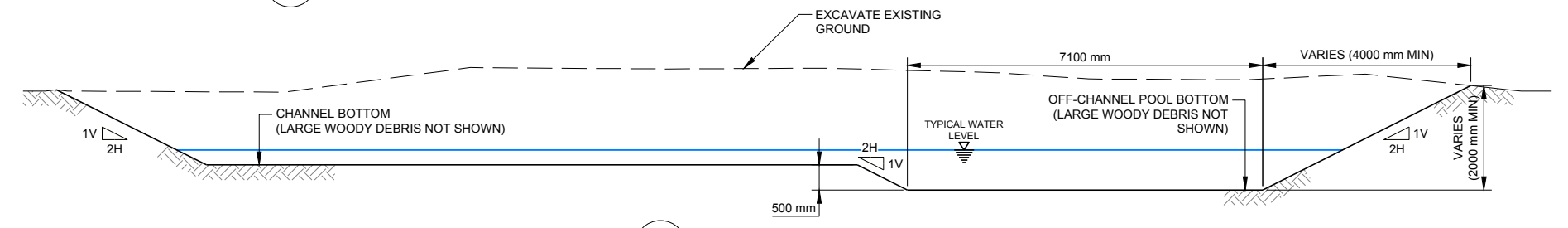
SCALE 1:100 m **A** TYPICAL SECTION - IN CHANNEL POOL



SCALE 1:125 m **E** TYPICAL SECTION - ROAD CROSSING (POST CLOSURE CONSTRUCTION)

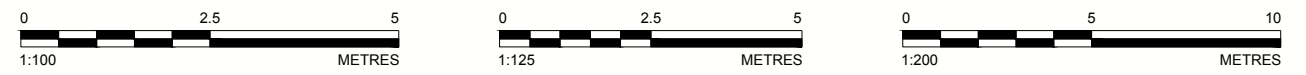


SCALE 1:100 m **B** TYPICAL SECTION - IN CHANNEL POOL



SCALE 1:125 m **C** TYPICAL SECTION - OFF CHANNEL POOL

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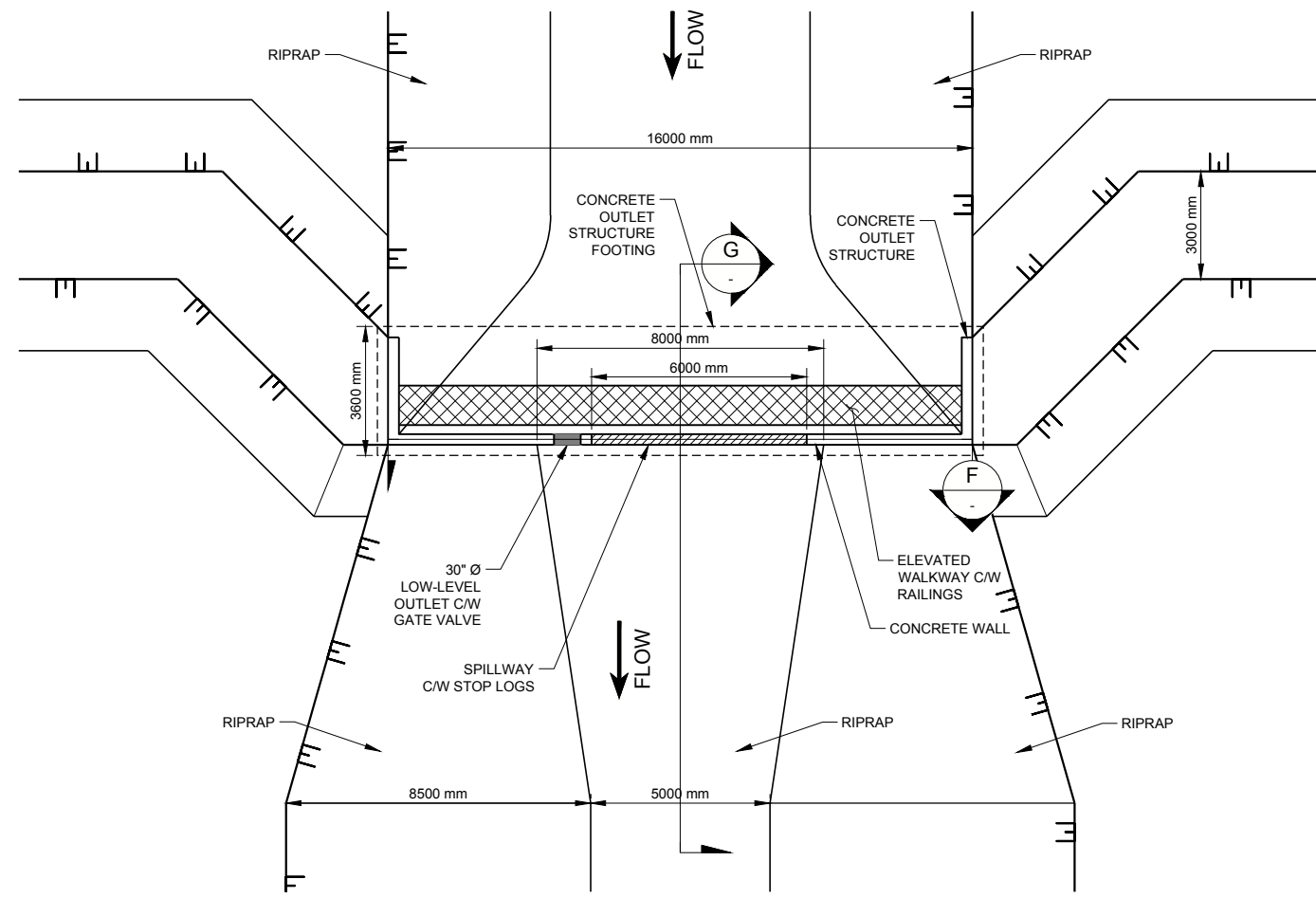


| REV. | YYYY-MM-DD | DESCRIPTION | DESIGNED | PREPARED | REVIEWED | APPROVED |
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| 0 | 2016-03-01 | ISSUED FOR PERMITTING | SH | MR | JO | SR |
| B | 2016-02-12 | ISSUED FOR REVIEW | SH | JK | JO | |
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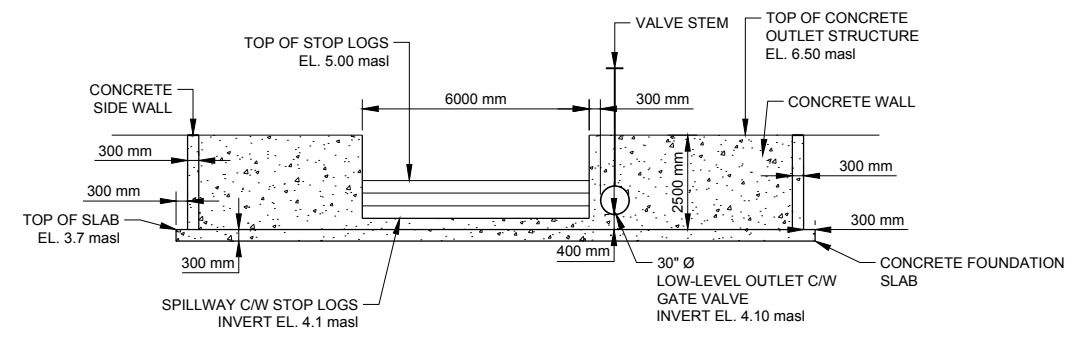
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| CLIENT BURNCO ROCK PRODUCTS LTD. | PROJECT BURNCO AGGREGATE PROJECT |
| CONSULTANT Golder Associates | TITLE TYPICAL SECTIONS AND DETAILS - POOLS AND ROAD CROSSING |
| VANCOUVER SUITE 200 - 2920 VIRTUAL WAY VANCOUVER, B.C. CANADA [+1] (604) 296 4200 www.golder.com | PROJECT NO. 11-1422-0046 |
| | PHASE 4410 |
| | REV. of DRAWING 0 of 002 |

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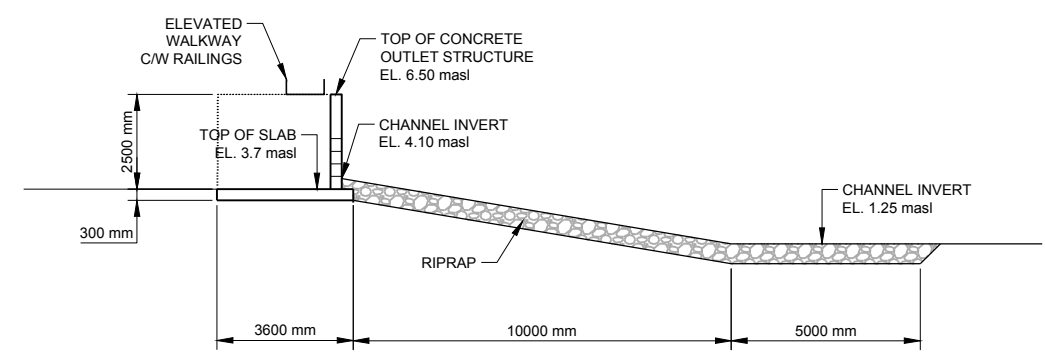
25 mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B



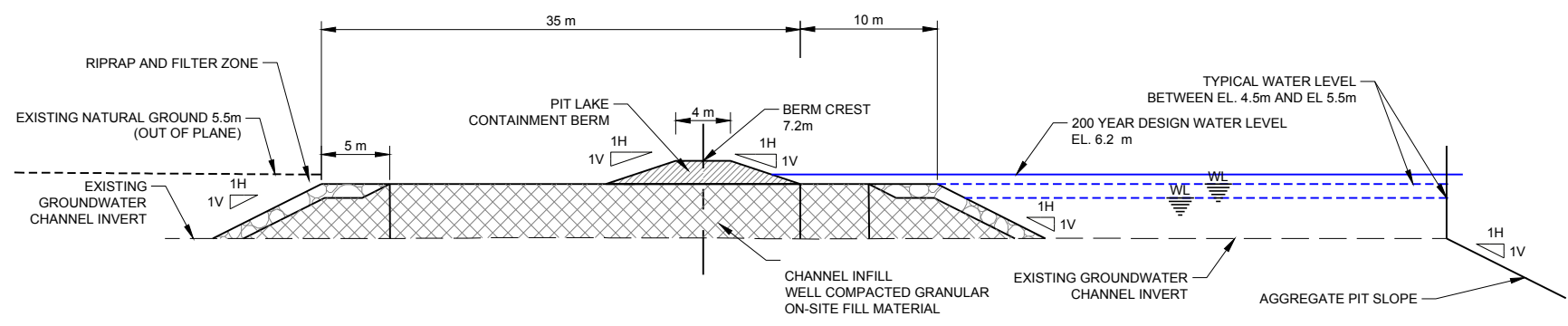
SCALE 1:200 m **3** DETAIL - OUTLET STRUCTURE
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SCALE 1:200 m **F** SECTION - OUTLET STRUCTURE

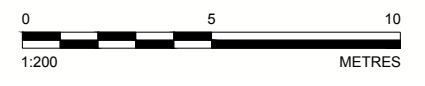


SCALE 1:200 m **G** SECTION - OUTLET STRUCTURE



SCALE 1:500 m **J** DRAINAGE CHANNEL INFILL ZONE
001

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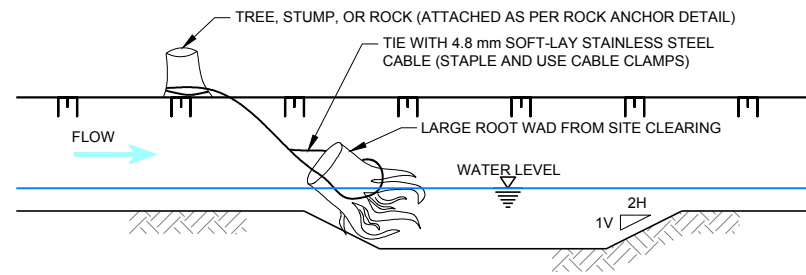


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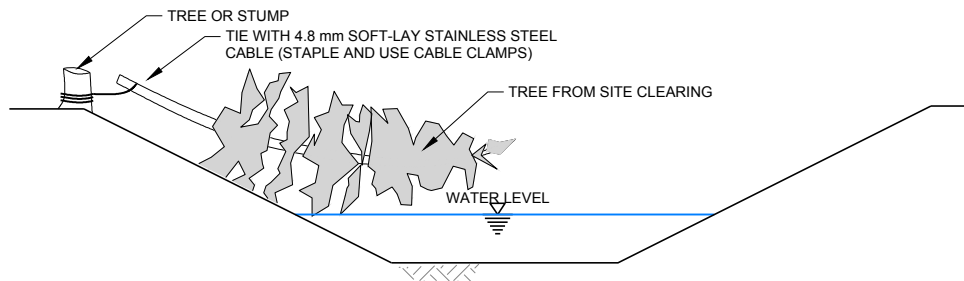
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| CLIENT BURNCO ROCK PRODUCTS LTD. | PROJECT BURNCO AGGREGATE PROJECT |
| CONSULTANT Golder Associates | TITLE OUTLET STRUCTURE DETAILS |
| VANCOUVER SUITE 200 - 2920 VIRTUAL WAY VANCOUVER, B.C. CANADA [+1] (604) 296 4200 www.golder.com | PROJECT NO. 11-1422-0046 PHASE 4410 REV. 0 of 003 |

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSIB 25 mm

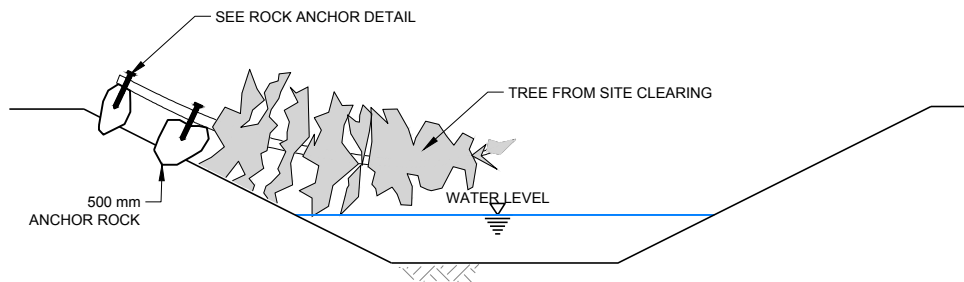


ANCHOR ROOT WAD TO TWO (2) TREES OR STUMPS, ONE UPSTREAM AND ONE DOWNSTREAM, CABLES 90° APART. WHERE NO SUITABLE TREE, STUMP, OR ROCK EXISTS, ANCHOR TO 20M REBAR, 1200 mm LONG WITH 200 mm HOOK, DRIVEN COMPLETELY INTO THE GROUND.

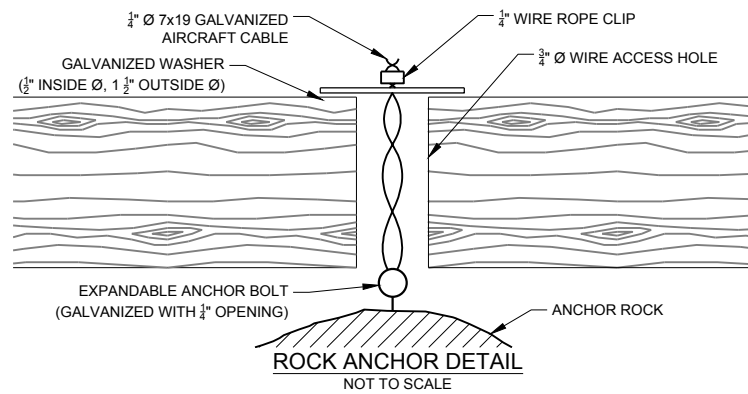
LARGE WOODY DEBRIS (ROOT WAD) COVER DETAIL
NOT TO SCALE



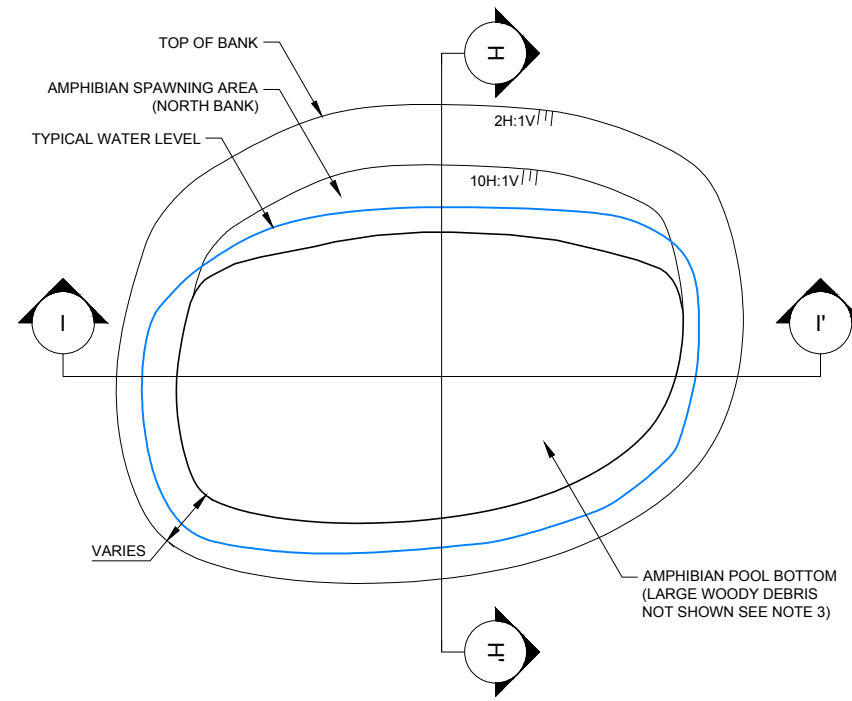
DETAIL FOR TREE COVER ANCHORED TO TREE OR STUMP
NOT TO SCALE



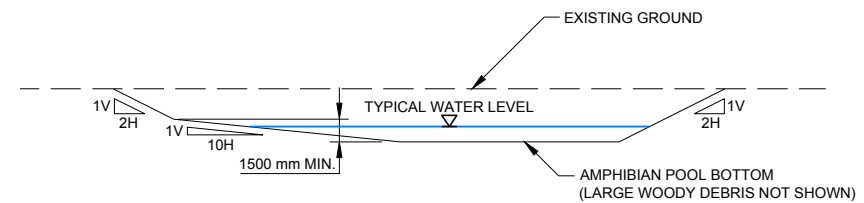
DETAIL FOR TREE COVER ANCHORED TO ROCK
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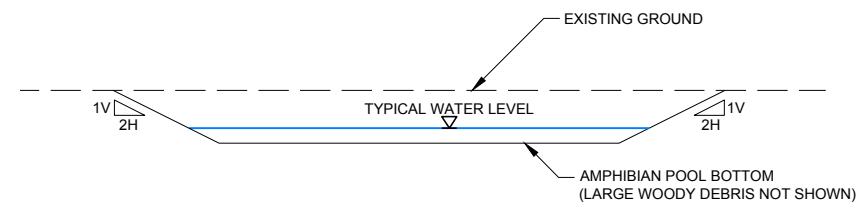
ROCK ANCHOR DETAIL
NOT TO SCALE



SCALE NTS 4 **TYPICAL DETAIL - AMPHIBIAN POOL**



SCALE NTS H **TYPICAL SECTION (NORTH-SOUTH) - AMPHIBIAN POOL**



SCALE NTS I **TYPICAL SECTION (WEST-EAST) - AMPHIBIAN POOL**

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| A | 2015-08-17 | ISSUED FOR REVIEW | SH | MSH | JO | |
| REV. | YYYY-MM-DD | DESCRIPTION | DESIGNED | PREPARED | REVIEWED | APPROVED |

CLIENT
BURNCO ROCK PRODUCTS LTD.

PROJECT
BURNCO AGGREGATE PROJECT

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TITLE
LWD AND AMPHIBIAN POOL DETAILS

PROJECT NO. 11-1422-0046 PHASE 4410 REV. 0 of DRAWING 004

1.0 GENERAL

1. QUALIFIED ENVIRONMENTAL PROFESSIONALS SHALL PROVIDE FIELD GUIDANCE ON ARRANGEMENT AND LOCATION OF IN-CHANNEL POOLS, OFF-CHANNEL POOLS, LARGE WOODY DEBRIS (LWD), TREE COVER STRUCTURES, AND RIPARIAN PLANTING DURING CONSTRUCTION.
2. ALL IMPORTED GRANULAR MATERIALS SHALL BE FROM AN APPROVED SOURCE AND SHALL BE WELL GRADED, HARD AND DURABLE, AND FREE OF ANY FOREIGN SOIL OR DEBRIS.
3. ALL IMPORTED GRANULAR MATERIALS SHALL BE MAINTAINED FREE OF CONTAMINATION FROM OTHER MATERIALS.
4. CRUSHED ROCK MATERIAL SHALL SATISFY APPROPRIATE ACID ROCK DRAINAGE AND METAL LEACHING CRITERIA.
5. GRANULAR MATERIALS USED FOR BACKFILL SHALL MEET THE APPLICABLE BC CONTAMINATED SITES REGULATION SCHEDULE 4, 5, AND 10 SOIL QUALITY STANDARDS AND SCHEDULE 9 SENSITIVE SITE SEDIMENT QUALITY CRITERIA.
6. ESTIMATED TOTAL EXCAVATION VOLUME IS 35,000 CUBIC METRES.

2.0 CHANNEL

1. THE PREFERRED METHOD OF CONSTRUCTION IS TO EXCAVATE THE CHANNEL FROM WITHIN THE CHANNEL CORRIDOR SO THAT DISTURBANCE TO EXISTING VEGETATION IS REDUCED.
2. EXCAVATE THE CHANNEL TO BED ELEVATION AS DIRECTED BY THE ENGINEER. THE CHANNEL BED IS INTENDED TO BE BELOW THE TOP OF THE GROUNDWATER TABLE BY AT LEAST 300 mm ALONG THE ENTIRE CHANNEL, AS PRACTICABLE.
3. IF UNSUITABLE MATERIAL IS ENCOUNTERED DURING CHANNEL EXCAVATION, OVER-EXCAVATE TO A DEPTH OF 300 mm AND REPLACE WITH STREAMBED SUBSTRATE (GRADATION TABLE PROVIDED BELOW) OR MATERIAL APPROVED BY THE ENGINEER.
4. STREAMBED SUBSTRATE SHALL CONFORM TO THE FOLLOWING GRADATION THAT IS TO PRODUCE A SMOOTH CURVE WITHOUT SHARP BREAKS WHEN PLOTTED WITHIN THE DEFINED LIMITS.
5. SUBSTRATE SHALL BE COMPACTED BY TAMPING (2 TAMPS) WITH THE BACKSIDE OF THE CLEANOUT BUCKET OF A TRACKED EXCAVATOR.

| STREAMBED SUBSTRATE | |
|---------------------|-----------------|
| SIEVE | PERCENT PASSING |
| 3/4" (19 mm) | 100 |
| 3/8" (9.5 mm) | 90 |
| #4 (4.75 mm) | 67 |
| #10 (2 mm) | 40 |
| #60 (0.25 mm) | 6 |
| #200 (0.075 mm) | 1 |

6. INSTALL BANK ARMOURING IN THE LOCATIONS SHOWN ON THE DRAWINGS. BANK ARMOURING SHALL CONSIST OF ANGULAR 300 mm-MINUS RIPRAP INSTALLED AT A THICKNESS OF 300 mm.
7. THE MINIMUM DISTANCE BETWEEN THE CHANNEL AND WC5 IS 15m, MEASURED BETWEEN THE CLOSEST BANK CRESTS. THE ALIGNMENT OF WC5 IS TO BE CONFIRMED AT THE TIME OF CONSTRUCTION.

3.0 IN-CHANNEL POOLS

1. IN-CHANNEL POOLS SHALL BE CONSTRUCTED TO MEET THE SAME REQUIREMENTS AS THE CHANNEL.
2. IN-CHANNEL POOLS SHALL BE CONSTRUCTED AT REGULAR INTERVALS ALONG THE CHANNEL IN LOCATIONS AS SHOWN ON THE DRAWINGS. APPROXIMATELY 20 IN-CHANNEL POOLS SHALL BE CONSTRUCTED ALONG THE CHANNEL.

4.0 OFF-CHANNEL POOLS

1. OFF-CHANNEL POOLS SHALL BE CONSTRUCTED TO MEET THE SAME REQUIREMENTS AS THE CHANNEL.
2. THREE OFF-CHANNEL POOLS SHALL BE CONSTRUCTED ALONG THE CHANNEL IN LOCATIONS AS SHOWN ON THE DRAWINGS.

5.0 LARGE WOODY DEBRIS (LWD) AND TREE COVER

1. LWD SHALL BE PLACED IN EACH OF THE IN-CHANNEL AND OFF-CHANNEL POOLS AND CONSIST OF MINIMUM 2-METRE-LONG LOGS WITH MINIMUM 1-METRE-IN-DIAMETER ATTACHED ROOT WADS.
2. LWD SHALL BE ANCHORED TO NEARBY STUMPS, LIVING TREES OR BALLASTED WITH TWO 500 mm BOULDERS BY USING WIRE ROPE, AS SHOWN ON THE DRAWINGS.
3. TREE COVER SHALL BE SPACED EQUALLY BETWEEN IN-CHANNEL POOLS ALONG THE CHANNEL, AND ANCHORED TO STUMPS, LIVING TREES, OR BALLASTED WITH TWO 500 mm BOULDERS BY USING WIRE ROPE, AS SHOWN ON THE DRAWING.

6.0 AMPHIBIAN POOLS

1. POOL SHAPE SHOWN IS TYPICAL. CONSTRUCT POND TO FIT EXISTING CLEARED AREA. APPROXIMATE WETTED SURFACE AREA IS 1250 m².
2. EXCAVATED SURFACES TO BE LEFT ROUGH TOOTHED WITH AN EXCAVATOR BUCKET.
3. LARGE WOODY DEBRIS AND TREE COVER (INSTALLED AS PER DETAILS) TO COVER MINIMUM 10% OF WETTED SURFACE AREA.
4. VEGETATION SHOULD COVER MINIMUM 50% OF WETTED SURFACE AREA.
5. VEGETATION TO INCLUDE SEDGES (I.E. INFLATED SEDGE), RUSHES (I.E. COMMON SPIKE-RUSH) AND POND-LILY (I.E. ROCKY MOUNTAIN POND LILY), PLANTED ON THE SHALLOW MARGINS OF THE POOLS.

7.0 OUTLET STRUCTURE

1. OUTLET STRUCTURE TO BE COMMISSIONED POST CLOSURE

8.0 ROAD CROSSING

1. CHANNEL SHALL CROSS BENEATH EXISTING GRAVEL ROAD THROUGH TWO CORRUGATED METAL PIPE ARCHES AS SHOWN ON THE DRAWINGS. THE APPROXIMATE LENGTH OF EACH PIPE ARCH IS 8 METRES.
2. PIPE ARCH INSTALLATION AND BACKFILL SHALL BE COMPLETED IN ACCORDANCE WITH MANUFACTURE'S SPECIFICATIONS.
3. EXISTING GRAVEL ROADWAY DISTURBED BY PIPE ARCH INSTALLATION SHALL BE RESTORED TO ITS PRE-CONSTRUCTION CONDITION.
4. CHANNEL SUBSTRATE BENEATH EACH PIPE ARCH SHALL MEET THE SAME REQUIREMENTS AS THE REST OF THE CHANNEL.

9.0 RIPARIAN REPLANTING

1. RIPARIAN ZONES DISTURBED BY THE WORK SHALL BE REPLANTED WITH ENDEMIC SPECIES OF VEGETATION CONSISTENT WITH THE ORIGINAL RIPARIAN VEGETATION AT THE SITE. VEGETATION SPECIES AND PLANTING LOCATIONS SHALL BE SELECTED WITH GUIDANCE FROM QUALIFIED PROFESSIONALS TO MAXIMIZE THE BENEFITS TO AQUATIC HABITAT AND THE SURVIVABILITY OF THE VEGETATION.
2. VEGETATION TRIMMINGS SHOULD BE SIDE CAST ADJACENT TO THE DISTURBED AREA FOR LATER REUSE. AT THE COMPLETION OF WORK IN THE RIPARIAN AREAS, SIDE CAST VEGETATION TRIMMINGS SHALL BE SPREAD OVER THE DISTURBED AREA TO ENCOURAGE NATURAL RE-VEGETATION.
3. REPLANTING OF DISTURBED RIPARIAN AREAS SHALL TAKE PLACE AS SOON AS POSSIBLE FOLLOWING COMPLETION OF THE WORK IN THE RIPARIAN AREAS. HOWEVER, SEEDING AND PLANTING SHOULD TAKE PLACE IN THE FALL (SEPTEMBER TO OCTOBER).
4. THE CONSULTANT SHALL ASSESS REGROWTH OF VEGETATION IN THE DISTURBED RIPARIAN AREAS WITHIN A YEAR OF THE COMPLETION OF THE WORK TO DETERMINE IF ADDITIONAL PLANTING OR SEEDING IS REQUIRED.
5. RIPARIAN ZONES DISTURBED BY THE WORK SHALL BE REPLANTED WITH ENDEMIC SPECIES OF VEGETATION CONSISTENT WITH THE ORIGINAL RIPARIAN VEGETATION AT THE SITE INCLUDING:

DECIDUOUS TREE SPECIES:

- VINE MAPLE *ACER CIRCINATUM*
- HAWTHORN *CRATAEGUS DOUGLASII**
- PIN CHERRY *PRUNUS PENNSYLVANICA**
- CHOKE CHERRY *PRUNUS VIRGINIANA**
- MOUNTAIN ASH *SORBUS AUCUPARIA**
- PACIFIC WILLOW *SALIX LASLANDRA*
- PACIFIC CRABAPPLE *MALUS DIVERSIFOLIA**

CONIFEROUS TREE SPECIES:

- DOUGLAS FIR *PSEUDOTSUGA MENZIESLI*
- WESTERN RED CEDAR *THUJA PICATA*
- WESTERN HEMLOCK *TSUGA HETEROPHYLLA*

SHRUB SPECIES:

- RED OSIER DOGWOOD *CORNUS SARICAA**
- THIMBLEBERRY *RUBUS PARVIFLORUS**
- SALMONBERRY *RUBUS SPECTABILIS**
- ELDERBERRY *SAMBUCUS RACEMOSA**
- SNOWBERRY *SYMPHOROCARPUS ALBUS**
- RED HUCKLEBERRY *VACCINIUM PARVIFLORUM**
- NOOTKA ROSE *ROSA NUTKANA**
- SHRUB ROSE *ROSA RUGOSA**
- PUSSY WILLOW *SALIX DISCOLOR*

* DENOTES FRUIT-BEARING SPECIES

6. ALL TREE AND SHRUB SPECIES SHALL BE GUARANTEED NURSERY STOCK FOR SUCCESSFUL TRANSPLANTING.
7. THE CORRECT BOTANICAL NAME SHALL BE USED TO ORDER PLANTING STOCK AND TAGS SHALL BE LEFT ATTACHED FOR FIELD IDENTIFICATION.
8. SHRUBS SHALL BE PLANTED ON AN APPROXIMATE 1-METRE GRID IN DISTURBED RIPARIAN AREAS.
9. TREE STOCK SHALL BE A MINIMUM OF 1.5 METRES IN HEIGHT WHEN PURCHASED, AND PLANTED AT THE WIDTH SUITABLE FOR THE MATURE STOCK BUT NO GREATER THAN 2.0 METRES APART.
10. THE QUANTITY OF STOCK PLANTED SHALL ENSURE AT LEAST 80% TAKE, OR REPLANTING WILL BE REQUIRED.
11. FRUITING TREES AND SHRUBS SHALL BE PLANTED TO PROMOTE RE-COLONIZATION BY SEED AND PROVIDE WILDLIFE FOOD SOURCES.
12. GROUND SEEDING SHALL BE CONDUCTED IN AREAS WITH HIGH SOIL EROSION POTENTIAL (E.G., STREAM BANKS ABOVE THE FLOOD LEVEL) AND SHALL CONSIST OF A COMBINATION OF 2 TO 5 SPECIES OF SOD-FORMING GRASSES, BUNCH GRASSES AND NITROGEN-FIXING LEGUMES. A GENERAL PURPOSE SEEDING MIX WOULD INCLUDE:
 - 25% RED FESCUE
 - 20% PERENIAL RYE GRASS
 - 15% HARD FESCUE
 - 15% ORCHARD GRASS
 - 10% WHITE CLOVE
 - 10% ALSIKE CLOVER
 - 5% REDTOP
13. DRY SEEDING SHALL BE DONE AT A MINIMUM RATE OF 80 KILOGRAMS PER HECTARE (8 GRAMS PER SQUARE METRE) AND FERTILIZED WITH A 19-20-12 MIXTURE AT A MINIMUM RATE OF 400 KILOGRAMS PER HECTARE (40 GRAMS PER SQUARE METRE).

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TITLE
NOTES

PROJECT NO. 11-1422-0046 PHASE 4410 REV. 0 of DRAWING 005

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Attachment A

Site Photographs



ATTACHMENT A

Site Photographs



Photograph 1: Intertidal habitat that will be crossed by the conveyer system



ATTACHMENT A

Site Photographs



Photograph 2: The clear-cut area where the planned extension will be located



ATTACHMENT A

Site Photographs



Photograph 3: The existing lower segment of WC 2 below the BC Hydro ROW

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