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29 July 2009
Project File: 109-2

Armac Construction Ltd.
P.O. Box 218
Bowen Island, B.C.
V0N 1G0

Attention: Roger McGillivray

Dear Mr. McGillivray;

RE: BIOPHYSICAL ASSESSMENT OF THE BELTERRA PROPERTY, BOWEN ISLAND.

Whitehead Environmental Consultants Ltd. completed an environmental assessment of the above property in May and June 2009. This document provides our biophysical assessment report for development planning purposes, as requested by you and required by the Bowen Island Municipality's Planning Department. The report is based on our review of prior reports and a series of field investigations by the undersigned in May and June 2009.

The purpose of this report is to:

- supplement the prior reports and provide information on the presence/absence of sensitive plant or animal species, habitats or ecosystems;
- determine the streamside protection setback required in accordance with the provincial Riparian Areas Regulation (RAR);
- evaluate the existing pedestrian trails within the property; and
- provide recommendations for the management of site drainage.

1. PROJECT UNDERSTANDING

The subject property is described legally as "Lot B, District Lot 489, Group 1, New Westminster District, Plan 22869", and covers approximately 10.0 acres (4.047 hectares) (Figures 1 and 2). It is accessed from Carter Road immediately west of Island Pacific School (IPS) and Cates Hill Chapel. The neighbouring properties include an undeveloped portion of the Camp Bow-Isle lands to the west; Raven Hill Farm to the northwest; undeveloped municipal lands to the north; IPS, Cates Hill Chapel and covenanted lands of the Terminal Creek ravine to the east; and Grafton Road and developed estate-size residential lots on Cates Hill to the south.

Our understanding is that you intend to develop a cohousing project, known as Belterra, on the property. The proposed layout of the development is yet to be determined, as it will be created jointly by the cohousing partners. However, you have already delineated a proposed natural park area along the Terminal Creek ravine and intend to retain the connections to the existing trail network (Figure 2). As part of the development planning, you have commissioned a number of prior environmental studies and opinions and solicited comment from regulatory agencies,

particularly with regard to protection of Terminal Creek and its riparian corridor and other potentially sensitive environments on the property.

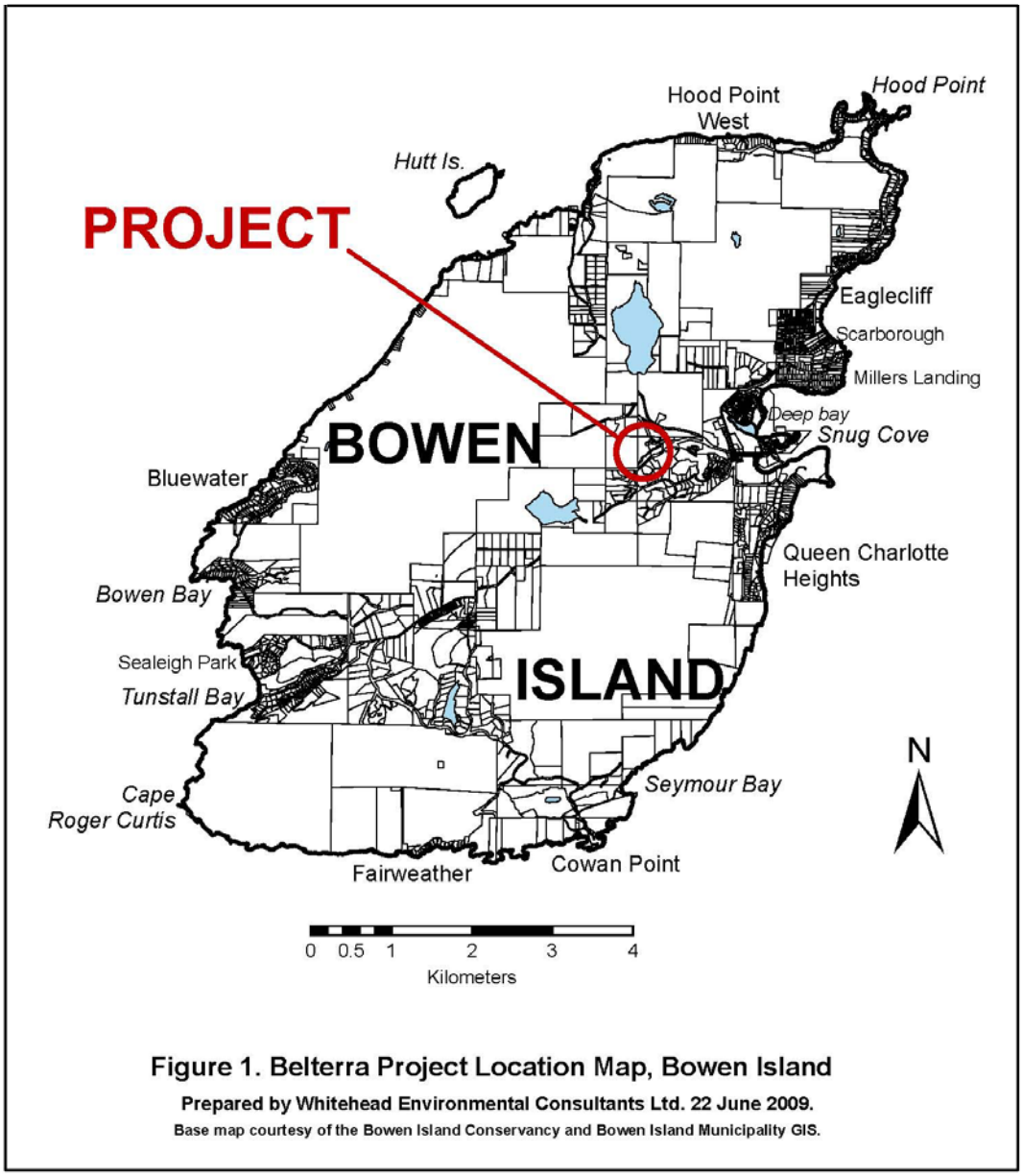

Figure 1. Belterra Project Location Map, Bowen Island

Prepared by Whitehead Environmental Consultants Ltd. 22 June 2009.

Base map courtesy of the Bowen Island Conservancy and Bowen Island Municipality GIS.

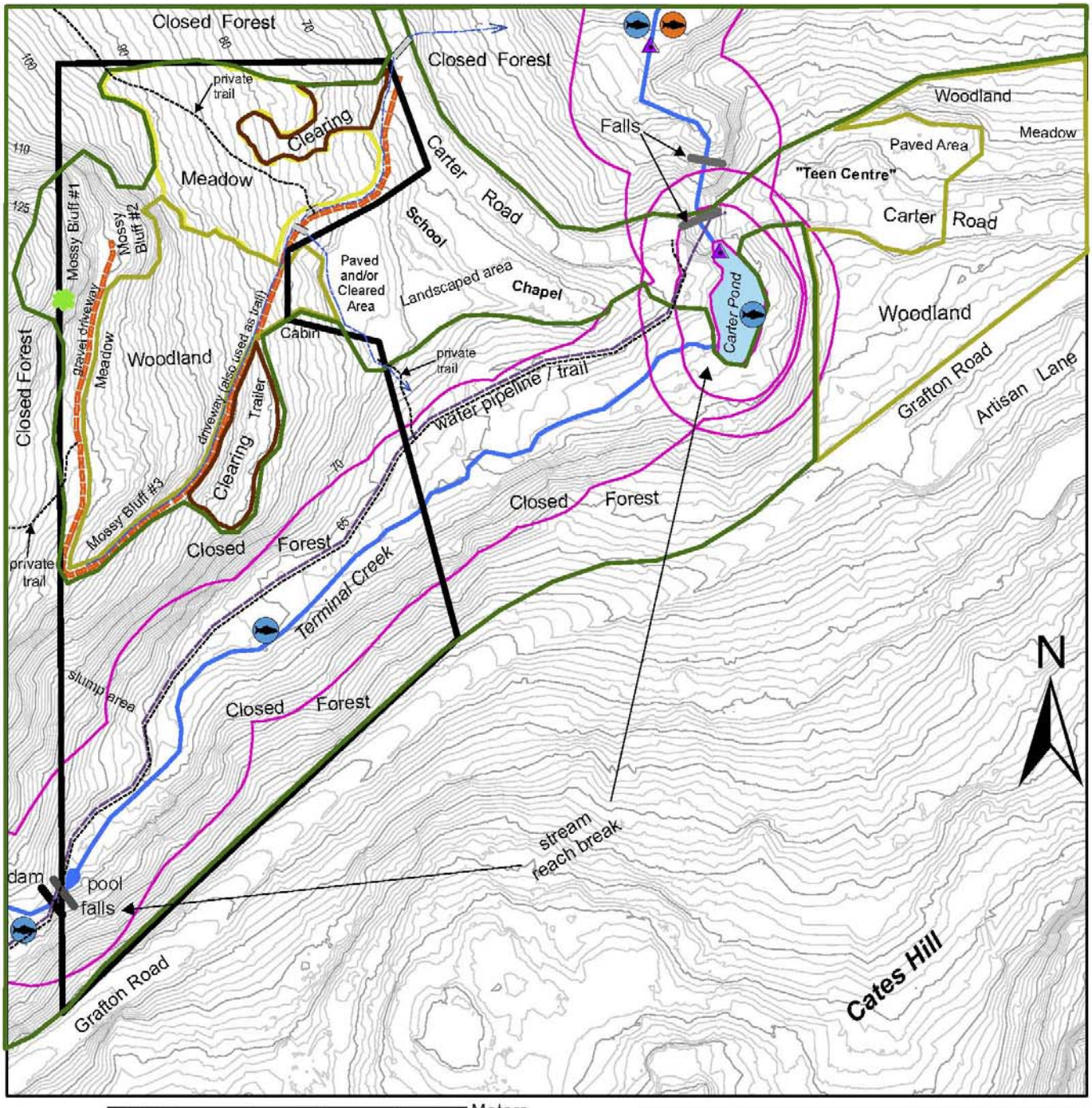

Figure 2. Belterra Property Biophysical Features

Prepared by Whitehead Environmental Consultants Ltd.
22 June 2009

Base map courtesy of the Bowen Island Conservancy and Bowen Island Municipality GIS.
Topography contour interval is 1 m. All feature locations are approximate.

2. EXISTING CONDITIONS

2.1 Built Infrastructure

The main driveway access is already in place and drivable to the top of the property; however additional surfacing is still needed (Figure 2). There is no permanent residence on the property at present; however, there is a small cabin, occupied by Bowen Island artist Bob Bates, and a storage trailer on the lower part of the property above IPS. The only other infrastructure includes the Cove Bay Water System (CBWS) pipeline and maintenance trail along the north side of Terminal Creek within a Statutory Right-of-Way (Plan LMP35692 and Plan 17871). There is also a cement dam above a bedrock waterfall on Terminal Creek adjacent to the extreme southwest corner of the property.

Existing trails, although not "built" structures, are considered part of the existing infrastructure. The property contains connections to four trails that are part of the informal, island-wide trail network which crosses private and public lands (Figure 2). Two trails cross the property from east to west: one following the CBWS pipeline and the other following the existing driveway for much of its length. The other trails are oriented north-south, the third linking to a private property to the north, and the fourth connecting the IPS parking lot to the pipeline trail to the south.

2.2 Physiography and Soils

The subject lands are located on the southeast-facing flank of a hill on the north side of Terminal Creek. Elevations above sea level range from approximately 60 m in the ravine bottom on the east side, to 125 m on the hilltop near the northwest corner (Fig. 2). Topographic details are shown in Figure 2. The topography is variable and can be characterized as moderately to steeply sloping with numerous steeper areas and occasional flatter benches; the steepest lands occur in the northwest corner (where cliffs are present) and along the Terminal Creek ravine, in the southwest.

The distribution of soil types on the project lands according to the BC Soil Survey map is shown in Figure 3. Soil description summaries are provided in Table 1 on the next page. Soils consist of gravelly sandy loam, often stony, over glacial till or bedrock, with an abundance of bedrock outcrops of varying sizes. The topographic classes range from gently to strongly sloping, with gradients ranging from 5% to greater than 60%.

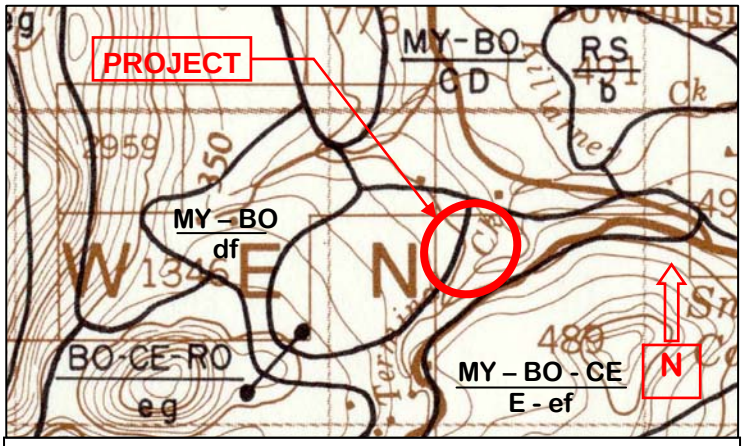

Figure 3. Provincial soils mapping for the project area, Bowen Is.

The BC Soils Atlas contains comments regarding land use opportunities and limitations, which are based on a very broad mapping scale. These comments, summarized in Table 1 are, therefore, very general in nature and subject to site-specific confirmation.

Table 1. Description of the major soil types reported to occur in the Belterra Property. (after Luttmerding 1980, 1981)

Soil Name [a] (map symbol)	**Material**	**Drainage and water retention**	**Land Use Comments** [b]
Bose (BO)	130 to 160 cm of gravelly lag or glaciofluvial deposits over moderately coarse-textured glacial till and some moderately fine-textured glaciomarine deposits.	Well to moderately-well drained; low water-holding capacity; rapidly pervious in the upper layers, slowly pervious in the compacted underlay; lateral seepage along top of compacted subsoil is common after prolonged, heavy rain.	Low subsoil permeability and often strongly sloping topography limit septic tank effluent disposal.
Cannell (CE)	10 to 100 cm of moderately coarse-textured glacial till or colluvium over bedrock	Well to rapidly drained; low to moderate water holding capacity; rapidly pervious; lateral seepage along the surface of underlying bedrock.	Low subsoil permeability and often strongly sloping topography limit septic tank effluent disposal.
Rock Outcrop (RO)	Areas of bedrock exposed or with less than 10 cm of organic or mineral soils on the surface.	Rapidly drained; no moisture holding capacity; impervious; fast surface runoff.	Difficult to build roads through (blasting required).
Murrayville (MY)	20 – 100 cm of moderately coarse to medium-textured littoral deposits over fine-textured marine deposits.	Mostly imperfectly drained, with perched water table during winter; may include moderately well drained areas; moderate water holding capacity and slow surface runoff	Development limitations possible due to variable bearing strengths and high shrink-well potential; septic tank effluent disposal is limited due to low subsoil permeability.

[a] Soil types are presented in approximate order of abundance.
[b] The land use comments included in the BC Soils Atlas are very general in nature. It should be understood that site-level capability for land use planning will need to be based on detailed evaluation of local characteristics.

2.3 Vegetation

The property has been selectively logged on a number of occasions over the decades, beginning in the late 1800s or early 1900s, and most recently in the mid to late 1980s or early 1990s. Existing vegetation is represented by three native plant communities and three variations brought about by past human activity (Figure 2). The three native vegetation communities are mature second-growth coniferous forest (closed forest) which covers the largest area, terrestrial herbaceous (also known for present purposes as mossy bluff), and wetlands. The man-made areas include woodland, meadow and recently cleared areas. Each is described in greater detail below. Representative views of the vegetation are provided in the attached photos.

Closed coniferous forest. Tree species in these areas include Douglas-fir, western redcedar and western hemlock (Photos 1 and 2). Deciduous tree species, which occur in amounts of less than 25%, include red alder and bigleaf maple, and are typically present along the edges of the woodlands, meadow and clearing or in the ravine bottom (Photos 3 and 4). The tallest conifers, mostly western redcedar and Douglas-fir, reach heights in excess of 40 m and diameters of ~1 m, mostly within the Terminal Creek ravine, where soils tend to be deepest.

The understory in most of the coniferous forest consists of sword fern, salal and a variety of mosses, with red and evergreen huckleberry scattered throughout. The density of ground cover varies greatly and can be almost non-existent in areas that are densely shaded by the forest

canopy. In the more open forest areas, salal or Oregon Grape can form very dense cover, and the shrub ocean spray is common beside the rock bluffs. Other woody shrubs include holly and red elderberry on more open areas, and salmonberry, stink currant, ninebark and devil's club beside Terminal Creek.

Mossy bluff. The bedrock outcrops are typically covered by several species of mosses, lichens and grasses, as well as a variety of other herbaceous species, including stonewort, saxifrage, foxglove and small amounts of parsley fern and spleenwort (Photos 5, 6, 7 and 8). Salal and sword fern are also present along the edges where soils are slightly deeper. Parsley fern is relatively uncommon on Bowen Island as it is limited to very dry bluff habitats, usually near the shoreline.

Wetland. The wetlands occur only in the Terminal Creek floodplain, are typically less than 10 m^2 and situated mostly in small depressional areas that are separate from the main stream channel (Photo 9). One wetland area was noted beside a pool of the main channel at the upstream end of the study area (Photo 10). Vegetation in the off-channel wetlands included mainly skunk cabbage and water parsley surrounded by salmonberry; while the streamside wetland was dominated by small fruited bulrush, angelica, horsetail and other water-loving species.

Woodland. This term is used in this report to describe the areas that were selectively logged within the past 25 years and in which the individual trees tend to be more widely spaced and there is a greater proportion of deciduous trees. At least one large pile of woody debris, remaining from the last logging, was also observed. The predominant conifers are western hemlock and western redcedar (with Douglas fir limited to the drier sites), while the red alder and bigleaf maple are the deciduous trees. The woodland understorey is typically much more dense than in the closed forest due to the lack of excessive shade. Common understorey species include salal, Oregon grape, bracken fern, and grasses (Photos 11, 12, 13).

Meadow. This area is characterized by an expanse of grasses and almost complete absence of tree cover, and occasional piles of stones or boulders. The trees would appear to have been removed at least 20 years ago and the soil mechanically leveled or graded after logging, which has led to the establishment of the complete grass cover. Other common species include bracken fern, thistle, dandelion, hawks bill, asters, pearly everlasting and soft rush, the latter being most common in areas where the soil is often saturated; seedlings of red alder and Douglas-fir (the latter heavily browsed by deer) were common on the north edge. (Photos 14, 15, 16).

Clearing. This term is used in this report to describe two sites which, although cleared, have not become a meadow and still contain areas of exposed soil. One is located immediately below the driveway on the south side (Photo 17) and the other in the lower east side (Photo 18) (Figure 2). The predominant vegetation in the clearings includes bracken, thistle, grasses, salal, trailing blackberry, swordfern, and seedlings of hemlock and red alder.

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2.4 Fish

Terminal Creek, which is Bowen Island's most important fish stream, crosses the southern portion of the property from west to east. Fish species present within the property include resident coastal cutthroat trout, some of which can reach up to 30 cm in length. Chum and Coho salmon, as well as sea-run cutthroat trout also occur in this creek; however, their upstream limit is at the foot of the impassable falls below Carter Pond (Fig. 2). This stream originates in Grafton Lake approximately 1.3 km upstream and is used as a reservoir for the CBWS; the terms of the Water Licence require a minimum flow of 8.5 litres per second (0.3 cfs) to be released at all times into Terminal Creek at the lake outlet to sustain aquatic habitat.

2.5 Wildlife

Wildlife in the general project area includes deer, small mammals such as mice, voles, shrews, Douglas squirrel in the more forested areas, and a diversity of resident and migratory songbirds, woodpeckers and raptors. Deer sign, including droppings, tracks and browsed vegetation were very common throughout the property, most notable on the mossy bluffs above the driveway and along the fringes of the meadow.

Garter snakes and, possibly, northwestern alligator lizard are likely present in the more open areas such as the meadow and mossy bluffs; however none were observed during our study or noted in the previous reports. Amphibians in the area may include frogs, newts and salamanders; a Red-legged frog, which is a Blue-listed species, was observed in the Terminal Creek ravine.

It is likely that a number of the live trees and standing dead trees in the ravine and other closed forest areas provide nesting and feeding habitat for a number of bird species including owls, woodpeckers, squirrels and others. Great Blue Heron, which are Blue-listed, have been observed along the stream. Blue Grouse, a species that is becoming less common on Bowen Island, used to be heard calling in the Cates Hill area to the south. The lack of recent records in the area suggests that this species is sensitive to development. No Blue Grouse were heard during the present assessment.

Among the invertebrates, the most conspicuous species include slugs and snails in the moist forest areas, spiders and ticks, and butterflies, moths, beetles, small flies and other insects throughout.

2.6 Wells, Water Licences and Pipelines

There are no wells on the property, to our knowledge.

There are numerous water licences on Terminal Creek. The closest ones that are relevant to any development proposal for the Belterra lands are located at Carter Pond and at the foot of the falls downstream. Both licences are held by the Department of Fisheries and Oceans (DFO) for the purpose of water supply to the fish hatchery located farther downstream in Crippen Regional Park.

The CBWS main water supply pipeline, which is buried along most of its length, follows the north side of Terminal Creek across the property and is paralleled by a maintenance trail that is also used recreationally (Figure 2).

2.7 Site Drainage

The lower half of the property below the driveway drains directly to the Terminal Creek ravine within the Belterra lands. Runoff occurs as dispersed or sheet flow over the surface and soon becomes shallow groundwater in uppermost layer of the forest soils; as a result, there are no defined water courses in this area. Some of the shallow groundwater emerges as surface water seeps at the toe of the ravine beside the pipeline corridor, and again soaks into the ground on its route to the aquifer below Terminal Creek. An area of unstable slope was observed on the steep ravine bank in the southwest portion of the property. At slump this site appears to have occurred as a result of saturation of the surface soils by shallow groundwater (Fig. 2; Photo 19)

Drainage from the upper half of the property is intercepted by a ditch (Photo 20) along the ascending leg of the driveway and directed to two point discharges, one to Terminal Creek ravine above Carter Pond, and the other below Carter Road (Fig. 2). The upper drainage is conveyed under the driveway opposite the IPS parking area (Photo 21) and then follows a shallow ditch along the west side of the parking lot (Photo 22) and ultimately discharges to the ravine (Photo 23); the remains of two abandoned silt fences were observed at the discharge point (Photo 24).

The lower drainage follows a shallow ditch beside the driveway (Photo 25), is culverted under Carter Road (Photos 26 and 27) and discharged to the top of the slope above the Municipal Works Yard. An overgrown swale at the foot of this slope (Photo 28) conveys seasonal runoff eastward toward Terminal Creek below the lower falls. Judging by the indistinct channel that has formed on the ravine banks below both discharges, it is evident that the volumes of runoff are typically very low. However, sediment has accumulated in the flatter portions of the ditches (reducing their capacity), and rills have been scoured into the surface soils on the steep banks, exposing vegetation roots (Photos 29 and 30).

The above observations indicate that (a) there is a risk of flooding the roadbed during heavy rainfall due to sediment build-up in the ditches and/or blockage of the culvert, and (b) significant erosion can occur during periods of peak runoff such as very heavy rainstorms and rain-on-snow events. Over time, the loss of vegetation cover coupled with continued seasonal peak flows can lead to the formation of unstable gullies and, potentially, sedimentation of aquatic habitat within Terminal Creek.

2.8 Sensitive Ecosystems

Sensitive ecosystems on Bowen Island have been mapped under the auspices of the federal-provincial Sensitive Ecosystem Inventory (SEI) (McPhee *et al.* 2000) and the Island Trust Ecosystem Mapping (ITEM) project (Islands Trust 2000). The accuracy of these inventories at the level of individual properties is limited because the mapping, under both systems, was based primarily on aerial photo interpretation followed by only partial ground-truthing. A review of these databases shows that the Belterra property contains the riparian corridor of Terminal Creek (SEI) and second growth forest (ITEM). Of these only the riparian corridor is considered truly sensitive.

Based on the site-specific information collected during the present and previous studies in and around the subject lands, three species at risk were identified: red-legged frog, Great Blue Heron and Band-tailed Pigeon, all of which are Blue-listed provincially by the Conservation Data Centre (CDC) (Ministry of Environment 2007). The frog resides in the Terminal Creek ravine, feeding and likely also breeding there or in the upstream or downstream vicinity. The heron is an occasional visitor to the pools in the creek, where it feeds on fish. The pigeon may feed seasonally in the upper parts of the property (on holly, Saskatoon, trailing blackberry and other berries); however, no nests were observed; its use of the lands is, therefore, considered transient.

Two sensitive ecosystem types (or environmentally sensitive areas – ESAs) have been also identified:

- the riparian corridor of Terminal Creek; and
- the mossy bluffs on the west side of the property.

Recommendations regarding protection of these ESAs and species at risk are provided in Section 5.

The following factors contribute to the sensitivity of Terminal Creek and its riparian corridor: (a) the stream is high quality habitat for important fish populations; (b) the riparian vegetation provides nutrients to the stream ecosystem, (c) the forest root system plays an important role in stabilizing the steep ravine banks, and (d) the undisturbed valley-bottom area serves as a natural corridor for wildlife movement.

The mossy bluff areas are considered sensitive due to the presence of plant and animal species that are specially adapted to the seasonally very dry and hot conditions and which, therefore, have a relatively limited distribution on Bowen Island and in the Georgia Basin region. Three mossy bluff areas were identified (Figure 2). Of these, mossy bluff #1 is the least disturbed and contains unique plant species, and is, therefore, considered more ecologically sensitive than the other two. Areas #2 and #3 appear to have developed into their current condition as a result of the tree cover removal, which allowed greater sunshine penetration to the ground and, in turn, caused increased dryness and heat; these areas were not found to contain unique plant species and are, therefore, considered relatively less sensitive.

Our original work plan included an effort to ascertain whether or not the subject lands contained plant communities that are listed as being “at risk” by the CDC. Once in the field, in view of the partially disturbed nature of most of the property (with the exception of the Terminal Creek ravine), we determined that it was not possible to accurately identify any such areas and concluded, therefore, that such an approach was not justified in this case.

3. RIPARIAN AREA ASSESSMENT

The riparian setback was conducted following Schedule A of the provincial Riparian Areas Regulation (RAR). The RAR method allows for two alternatives: a simple assessment, which is based on fish presence or absence and existing or potential streamside vegetation conditions, and a detailed assessment, which takes into account detailed site-specific observations on a number of ecological factors. The simple assessment leads to three possible outcomes for the width of the streamside protection area: 30 m, 15 m or 5 m. The detailed assessment method can lead to a variety of values for the width of the streamside protection area, and was used in this case.

The detailed RAR assessment method entails the identification of stream reach boundaries[1], followed by measurement of channel bank-full widths at 10 m intervals at 11 points around the centre of the reach, measurement of the channel's average gradient, determination of the channel type (based on the relationship between width and gradient), potential vegetation type, and a zone of ecological sensitivity based on: bank stability and presence of large organic debris (LOD), shade and availability of fish food insects. The combination of the above information leads to the determination of the width of a Streamside Protection and Enhancement Area (SPEA), which is the term used in the RAR for the riparian setback.

The results are summarized as follows. During the initial reconnaissance of Terminal Creek, it was determined that the project area encompassed one stream reach only, which was approximately 380 m long (Fig. 2). The width and gradient measurements yielded an average channel width of 6.48 m and an average gradient of 4% which, according to the graphic relationship stipulated in the RAR, is a "cascade-pool" channel type. Based on "trees" being identified as the potential riparian vegetation type, the widths of the zones of sensitivity for LOD and stability, shade and insects were determined to be 13 m, 15 m and 19.5 m, respectively. These results yield a SPEA width of 19.5 m, measured horizontally from the high water level.

The SPEA boundary was then manually mapped onto the survey plan using the stream high water level identified by the professional land surveyor. The location of the SPEA in relation to the proposed park boundary is shown in Figure 4.

It is clearly evident from these results that the proposed park boundary along the Terminal Creek ravine provides a significantly greater width of protection than the SPEA.

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1 A "reach" is defined as a length of a watercourse having similar channel shape, channel dimension and slope. Reach breaks are typically associated with abrupt changes in gradient, such as falls, cascades, pools, etc., or marked changes in channel shape.

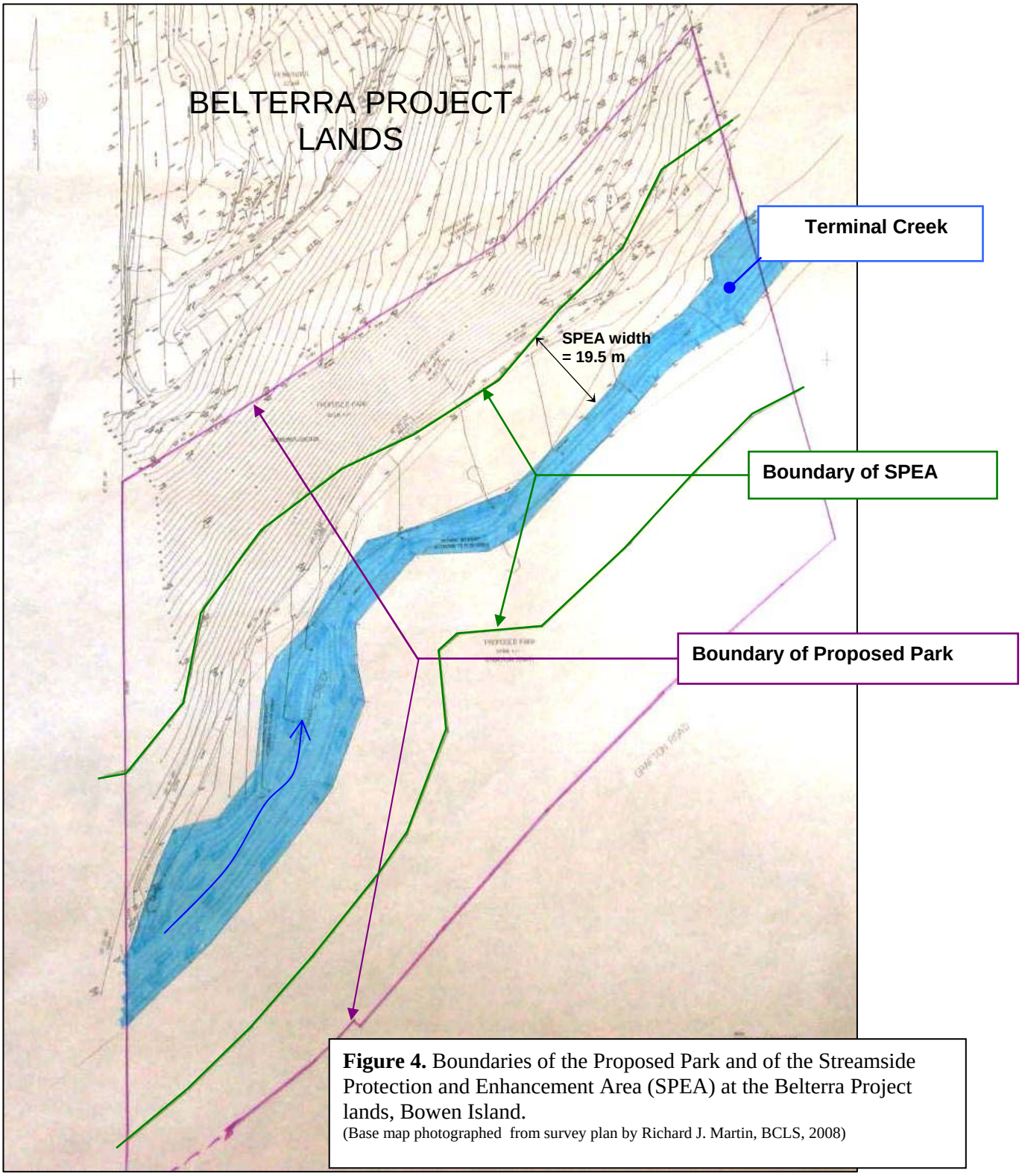

Figure 4. Boundaries of the Proposed Park and of the Streamside Protection and Enhancement Area (SPEA) at the Belterra Project lands, Bowen Island.
(Base map photographed from survey plan by Richard J. Martin, BCLS, 2008)

4. SUMMARY OF KEY ENVIRONMENTAL ISSUES

4.1 Sensitive Species and Ecosystems

The main sensitive species on the project area is the red-legged frog, which is present in the Terminal Creek ravine. This species is Blue-listed by the CDC, which means that it is considered vulnerable due to habitat loss. The prime habitat for this species lies entirely within the proposed nature park and is, therefore, not considered at risk due to the Belterra project.

Two sensitive ecosystems or ESAs were found on the lands: the riparian corridor of Terminal Creek and the mossy bluff areas on the upper west side of the property, particularly near the northwest corner. The Terminal Creek riparian area is considered the key ESA on the property. This ESA lies entirely within the proposed park and is, therefore, considered adequately protected. The continued use of the existing trail beside the pipeline does not raise environmental concerns if the intensity of trail use continues to be the same as at present and no trail improvement is contemplated.

The mossy bluff areas are considered sensitive due to the presence of plant and animal species that have a relatively limited distribution. Based on our understanding of the preliminary development concept, the mossy bluff #1 in the northwest corner of the Belterra lands north of the driveway will remain undisturbed, while most of the adjacent mossy bluff (#2) down slope on the east side of the driveway would be developed, and all or most of the lower mossy bluff (#3) would remain undisturbed. The proposed larger-than-required protection of the Terminal Creek ravine – which, as indicated previously, is the key ESA on the property – is considered by the undersigned to compensate for the likely losses in area #2 and potential minor losses in area #3, as these are judged to be less sensitive than area #1.

4.2 Riparian Area Protection

The results of this assessment confirm that the width of the proposed park area in relation to Terminal Creek is significantly greater than the width of the streamside protection and enhancement area required under the provincial Riparian Areas Regulation and the municipal Land Use Bylaw. As a result, the extent of the riparian and ravine habitat to be protected under the present conceptual park dedication far exceeds the requirements under the municipal and provincial regulations. Consequently, Terminal Creek and its riparian ecosystem are considered to be more than adequately protected by the proposed park.

4.3 Trails

The Belterra lands contain pedestrian trails that connect to neighbouring properties and are used for private and/or public purposes. The continued use of these trails, as contemplated in the project concept, does not raise any environmental concerns. Minor improvements along the Terminal Creek pipeline trail can be made without increasing the risk of adverse effects on the stream and its riparian ecosystem.

4.4 Stormwater Management

The portion of the Belterra lands where future development is proposed drains to two ultimate discharge points off the property above Terminal Creek, one immediately southeast of the project and the other farther east below Carter Road. Although the amount of flow carried in the associated ditches appears to be low at present, the ravine banks below both discharges points do show early signs of erosion. Once the property is further developed –especially with an increase in impervious surfaces such as pavement and roofs– the frequency and intensity of stormwater discharges can be expected to increase. The rate of erosion on the receiving banks will, therefore, also likely increase, potentially destabilizing the steep slopes and, ultimately, possibly leading to harmful alteration of fish habitat in Terminal Creek. The erosion and its potential impacts can be readily prevented or minimized (mitigated) by incorporating best practices into the design of the project's stormwater management system.

5. RECOMMENDATIONS

The potential impacts described above can be mitigated through careful planning and design of the development(s), and by employing standardized best management practices (BMPs) during construction and subsequent operation.

You have indicated your intention to retain the rural, forested aesthetics and other natural features of the land as much as possible. The following recommendations are offered to help you avoid or minimize environmental impacts and risks:

1. Design the project layout to use the existing driveway and former road beds as much as possible, rather than constructing new routes through undisturbed areas.

2. Schedule any clearing within the woodland areas, or blasting, to take place between August 16 and February 1 to avoid the bird nesting season. Also,

    a. the trees to be removed should be marked beforehand and then inspected by a qualified environmental professional before felling, to confirm that they do not contain any nests of owls, hawks, eagles or herons, or active nests of any other bird species;
    b. trees should be felled in a manner that avoids damage to adjacent trees and habitat; and
    c. where excavation is necessary, every effort should be made to avoid tearing the larger roots (>5 cm diameter) of adjacent trees to be retained; exposed root ends should be cut with a saw to aid in healing.

3. Design the storm water drainage system in a manner that tends to:
    a. provide sufficient capacity for the anticipated peak flows under extreme rainstorm events;
    b. detain runoff in areas of permeable soils to facilitate groundwater recharge;
    c. disperse runoff to the down-slope side of the new buildings rather than intercepting and channeling these flows to the existing ditch;
    d. provide sediment traps at the inlets of the culverts under the driveway and Carter

Road;

e. provide rock armour below the culvert outlets for energy dissipation, and other means of preventing erosion on the steep banks below these discharges; and
f. incorporate yearly inspection and maintenance of all ditches, sediment traps and culverts into the project operations .

Additional information can be obtained from the Ministry of Environment's *Stormwater Planning Guidebook* (see References).

4. Plan any development such that excavation or heavy truck traffic can be avoided during periods of heavy rainfall.

5. Construct additional sediment traps where necessary to collect any silt-laden runoff during the rainy season, and design these to facilitate future maintenance if they are to be retained after construction. Ensure that the sediment traps are maintained (i.e., accumulated sediment removed) frequently during the road and driveway construction period and at least annually thereafter.

6. Revegetate all areas of exposed soil as soon as possible after construction, and irrigate as necessary to promote early germination and root development. Preferably use native species for revegetation in areas that are not to become maintained gardens (see Appendix 1).

7. We also encourage you to consider creating rainwater harvesting systems including a large cistern for use in garden irrigation and fire suppression into each of the new buildings. The summertime use of rainwater harvested from rooftops during the rainy season can significantly reduce the demand on the local groundwater and surface water resources, thus contributing to the stewardship of the island's limited potable water supply.

8. Similarly, we encourage the use of road surfacing methods that retain the permeability of the travelled surface, especially in driveways and parking areas.

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We trust that this report meets your needs at this time. Should you have any questions or require any additional information, please contact the undersigned at your convenience at 604-947-0144 or by e-mail at alanjw@telus.net .

Yours truly,

WHITEHEAD ENVIRONMENTAL CONSULTANTS LTD.

Alan J. Whitehead, M.Sc., R.P.Bio.
Principal

Attachments: References
Photographs
Appendix 1 – Revegetation Guidelines

c.c. Planning Department, Bowen Island Municipality

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Ministry of Environment. 2007. BC Conservation Data Centre/ Data Access. http://www.env.gov.bc.ca/cdc/ (accessed June 24th 2009)

Photo 1. Mature second-growth coniferous forest in the Terminal Creek ravine near the east end of the Belterra property. Dog is walking on water pipeline maintenance trail. 19-Jun-09.

Photo 2. Mature second-growth coniferous forest on the south side of the Terminal Creek ravine near the west end of the Belterra property. 19-Jun-09.

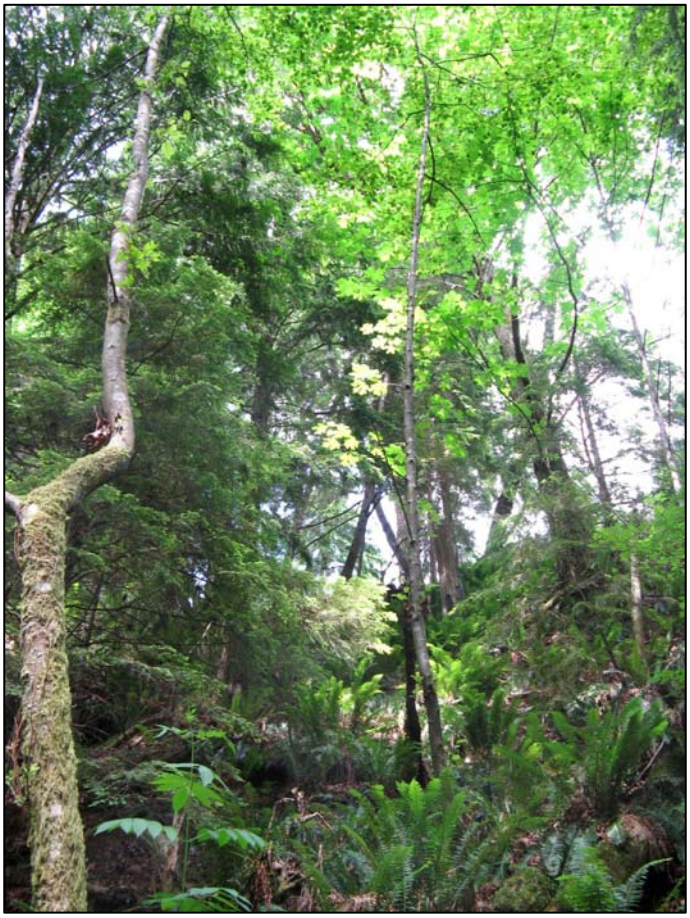

Photo 3. Red alder and bigleaf maple within mature second growth coniferous forest on north side of Terminal Reek ravine. 19-Jun-09.

Photo 4. Young red alder along bottom of the Terminal Creek ravine within the Belterra Project lands. 19-Jun-09.

Photo 5. Mossy bluff (terrestrial herbaceous) vegetation community at northwest corner of the Belterra property, viewed to west from below end of driveway. 19-Jun-09

Photo 8. Mossy bluff (terrestrial herbaceous) vegetation community at mid-elevation west side of the Belterra property, viewed to west. 19-Jun-09

Photo 7. Parsley fern growing on mossy bluff at northwest corner of Belterra property. 19-Jun-09.

Photo 8. Spleenwort growing on mossy bluff at northwest corner of Belterra property. 19-Jun-09.

Photo 9. Floodplain wetland beside Terminal Creek within Belterra property. 19-Jun-09.

Photo 10. Riparian wetland beside Terminal Creek near west boundary of Belterra property. 19-Jun-09.

Photo 11. Woodland vegetation within Belterra property to northwest of meadow. 19-Jun-09.

Photo 12. Woodland vegetation within Belterra property to northwest of meadow. 19-Jun-09.

Photo 13. Woodland vegetation within Belterra property. 19-Jun-09.

Photo 14. Meadow vegetation within Belterra property to northwest of meadow. An existing private trail crosses this meadow from lower right to upper left. 19-Jun-09.

Photo 15. Meadow vegetation within Belterra property beside upper end of driveway. 19-Jun-09.

Photo 16. Soft rush in an area of seasonally saturated soil within the main meadow on the Belterra property. 19-Jun-09.

Photo 17. Clearing vegetation type within Belterra property to below driveway. 19-Jun-09.

Photo 18. Clearing vegetation on lower east side of Belterra property below meadow. 19-Jun-09.

Photo 19. Unstable slope on south side of Terminal Creek ravine near west boundary of Belterra property. 19-Jun-09

Photo 20. Drainage "ditch" along north side of driveway into Belterra property, viewed upstream from upper culvert (arrow). This driveway is also used as a trail to the Camp Bow-Isle lands. 19-Jun-09

Photo 21. Outlet of upper culvert on Belterra driveway. Discharge from this culvert ultimately discharges to Terminal Creek ravine near east boundary of the property. 19-Jun-09

Photo 22. Stormwater "ditch" along west side of IPS parking area, viewed to south. This ditch receives runoff from most of the upper Belterra property and ultimately discharges to Terminal Creek ravine near east boundary of the property. 19-Jun-09

Photo 23. Discharge point of upper stormwater ditch to Terminal Creek ravine immediately south of IPS parking lot. This location is start of trail to bottom of ravine. 19-Jun-09

Photo 24. Abandoned silt fencing (arrows) along stormwater discharge route within Terminal Creek ravine. Dashed arrow denotes stormwater route when flow is present. This site is within the IPS property immediately east of Belterra lands. 19-Jun-09

Photo 25. Stormwater ditch along lower driveway in Belterra lands, viewed from entrance to IPS parking lot. 19-Jun-09

Photo 26. Culvert (arrow) under carter Road at bottom of Belterra driveway, viewed to north. Note accumulated vegetation and leafy debris at culvert inlet. 19-Jun-09

Photo 27. Outlet of culvert under Carter Road, viewed toward Belterra driveway. This culvert carries all drainage from the lower and eastern half of the Belterra lands. 19-Jun-09

Photo 28. Shallow drainage channel at foot of slope below the culvert shown in previous photo. This channel ultimately discharges to Terminal Creek beside the Municipal Works Yard. Note accumulation of woody debris and leaves which suggest absence of significant flows.

Photo 29. Minor erosion of ravine bank below Carter Road culvert outlet. Note exposed roots. 19-Jun-09

Photo 30. Minor erosion of Terminal Creek ravine bank below IPS parking lot stormwater discharge. Note exposed roots. 19-Jun-09

APPENDIX 1

GUIDELINES FOR REVEGETATION
WITH NATIVE SPECIES OF TREES AND SHRUBS

BRITISH COLUMBIA

INFORMATION

July 1998

PLANTING CRITERIA AND RECOMMENDED NATIVE TREE AND SHRUB SPECIES FOR RESTORATION AND ENHANCEMENT OF FISH AND WILDLIFE HABITAT

Deciduous Trees

	Botanical Name	Common Name	Mature Height (m)	Best Growth Conditions[1]
	Acer circinatum	vine maple	to 7	m-w
	Acer glabrum var. douglasii	Douglas maple	to 10	d-m
	Acer macrophyllum	broadleaf maple	to 35	d-m
	Alnus rubra	red alder	to 25	m
	Betula papyrifera var. commutata	western white birch	to 30	m-w
♦	*Crataegus douglasii*	black hawthorn	to 10	m
♦	*Malus fusca*	Pacific crabapple	2-12	m-w
	Populus balsamifera or P. trichocarpa	black cottonwood	to 50	m-w
♦	*Prunus emarginata*	bitter cherry	2-15	m
	Rhamnus purshiana	cascara	to 10	d-w
	Salix lucida ssp. lasiandra	Pacific willow	to 12	w
♦	*Sorbus aucuparia*[2]	European mountain ash		

Coniferous Trees

Botanical Name	Common Name	Mature Height (m)	Best Growth Conditions[1]
Picea sitchensis	Sitka spruce	up to 70	m
Pinus monticola	western white pine	to 40	m-d
Pseudotsuga menziesii	Douglas-fir	to 70	d
Thuja plicata	western red cedar	to 60	m-w
Tsuga heterophylla	western hemlock	to 60	d-w

1. d = dry, m = moist, w = wet
2. European mountain ash is not native but is naturalized

♦ denotes fruit-bearing species

Ministry of Environment, Lands and Parks

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Lower Mainland Region

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Shrubs

	Botanical Name	Common Name	Mature Height (m)	Best Growth Conditions[1]
	Alnus crispa ssp. Sinuata	Sitka alder	1-5	m
♦	*Amelanchier alnifolia*	saskatoon	1-5	d-m
♦	*Cornus sericea or C. stolonifera*	red-osier dogwood	1-6	m
♦	*Corylus cornuta var. californica*	beaked hazelnut	1-4	m
	Holodiscus discolor	oceanspray	to 4	d-m
	Physocarpus capitatus	Pacific ninebark	to 4	w
♦	*Prunus virginiana*	choke cherry	1-4	d
♦	*Rosa nutkana*	Nootka rose	to 3	d-m
♦	*Rosa gymnocarpa*	baldhip or dwarf rose	to 1.5	d-m
♦	*Rubus parviflorus*	thimbleberry	0.5-3	m
♦	*Rubus spectabilis*	salmonberry	to 4	m-w
	Salix hookeriana	Hooker's willow	to 6	w
	Salix lucida spp. Lasiandra	Pacific willow	to 12	w
	Salix scouleriana	Scouler's willow	2-12	m
	Salix sitchensis	Sitka willow	1-8	m-w
♦	*Sambucus caerulea or S. glauca*	blue elderberry	-	d-m
♦	*Sambucus racemosa var. arborescens*	red elderberry	to 6	m
♦	*Sorbus sitchensis*	Sitka mountain ash	1-4	m
♦	*Symphoricarpos albus*	snowberry	0.5-2	d-m
♦	*Vaccinium parvifolium*	red huckleberry	to 4	m

1. d = dry, m = moist, w = wet
♦ denotes fruit-bearing species

Planting Criteria

- All riparian plantings should be based on 1 tree or shrub per 1 square metre density.
- Coniferous trees should comprise not less than 10% nor more than 25% of the tree stock planted.
- All tree/shrub species should be of guaranteed nursery stock.
- The botanical name should be used when ordering stock to ensure that the desired native species is being purchased. Each specimen should be tagged with the botanical name and the tag should be left attached after planting.
- Tree stock should be a minimum of 1.2 metres (4 feet) in height when purchased and planted 1.5 to 2 metres apart.
- Stock planted during the fall (Sept - Oct) and spring (Mar - Apr) has the greatest likelihood of surviving. Regular watering may be required until the plants are established. Additional advice on proper planting procedures should be obtained from the nursery supplying the stock.
- Planting on a given area being enhanced must be successful to an 80% take. If more than 20% die over one year, replanting is required.
- A minimum of 50% of trees and shrubs planted should be fruit-bearing species.

For further information, please contact the following:
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