CASCADE ENVIRONMENTAL
RESOURCE GROUP LTD

MEMORANDUM

DATE: November 24, 2014

TO: Deborah McQueen, Hummingbird Lane Joint Venture
Triage and Planning Unit, Fisheries and Oceans Canada

CC: Caroline Ashekian, Environmental Coordinator, District Of Squamish
Sarah McJannet, Acting Director of Planning, District of Squamish

FROM: Mike Nelson, R.P. Bio., Cascade Environmental
Karlene Loudon, B.Sc., B.T.M., Cascade Environmental

RE: Riparian Area Regulation Assessment for 1038 Finch Drive, Squamish, BC

FILE #: 604-01-01

Hummingbird Lane Joint Venture plans to subdivide 1038 Finch Drive in Squamish, BC, a 0.848 ha (2 acre) property, into 8 single family lots centered on a large (0.077 to 0.093 ha) community garden. The proposed community will be designed with a focus on sustainability, communal living and community gardening. Single family homes are intended to be modest and make use environmentally friendly, energy efficient building practices. Four watercourses (ditches) border the rectangular property and therefore, a *Riparian Areas Regulation* (RAR) assessment is required, as per the District of Squamish Official Community Plan Bylaw No. 2100, 2009 (Part 5 – Development Permit Area (DPA) Guidelines, and more specifically, DPA 11 – Protection of Riparian Areas). Cascade Environmental Resource Group Ltd. (Cascade) was retained to conduct the RAR assessment of these watercourses. Recommendations are provided to avoid causing serious harm to fish, as required by the Fisheries Act, by adhering to Fisheries and Oceans Canada (DFO) measures to avoid harm.

Methodology

The initial field work for the RAR assessment was conducted by Cascade on June 27, 2014. Four watercourses were identified at the site; all of them constructed ditches with ephemeral flow. On June 27, 2014 all the ditches were dry. The banks of each ditch were staked and the average channel widths were determined using the detailed assessment methodology. For ditches, the channel width is measured at half of the bankfull depth. Site card field forms were filled out to assess the fisheries habitat value of all four ditches. A follow up site visit was conducted on October 23, 2014, the last day of a significant rainstorm that delivered 204.9 mm of precipitation in a nine-day period. The follow up visit allowed for an assessment of connectivity during a high-water storm event. Sixteen baited Gee-style minnow traps, four in each ditch, were set overnight, October 27-28, 2014.

Results

These four man-made ditches, referred to as north ditch, east ditch, south ditch and west ditch, are shallow and dry for the majority of the year, only offering stagnant water during storm events and the rainy season. Stagnant waters tend to become deoxygenated and provide poor fish habitat. No fish were captured during the fish sampling program and therefore, the ditches were determined to be non-fish bearing. The site potential vegetation type (SPVT) was determined to be deciduous or coniferous trees (TR).

Connectivity – North ditch is interrupted by a portion of high ground approximately halfway along the length of the ditch. Water runs away from the high point in both the east and west direction. The water that flows west joins west ditch, then travels south along the property's western boundary before being discharged into south ditch. Water that flows east from the high point in north ditch joins east ditch at the northeast corner of the property. East ditch also receives water from eastern neighbours, and then flows south into south ditch. South ditch parallels Finch Drive, and carries water west for 190 m before flowing into a creek, locally referred to Finch Creek, and subsequently Logger's Lane Creek. All four ditches are dry for the majority of the year and contain water only during storm events in the rainy season. The locations of each ditch can be seen in Map 1.

Fish Status - No fish were captured during minnow trapping. No data currently exists on the Fisheries Information Summary System (FISS) for fish presence in the subject ditches. Fish have been captured, however, in the parent stream, Finch Creek. Cascade Environmental caught threespine stickleback (*Gasterosteus aculeatus*) in Finch Creek near Robin Drive in 2012. The Squamish Watershed Society sample Finch Creek approximately every 3 months, and have found coho salmon (*Oncorhynchus kisutch*), cutthroat trout (*O. clarkii*), threespine stickleback and sculpin (*Cottids*).

FISS records exist for Logger's Lane Creek, reporting the presence of threespine stickleback, coho salmon, cutthroat trout, rainbow trout (*O. mykiss*), and lamprey (general) (MOE, 2014). Electrofishing and minnow trapping conducted by Cascade Environmental from September 9 to 15, 2014 in Logger's Lane confirmed the presence of threespine stickleback, coho, cutthroat, lamprey and sculpin.

South Ditch – The south ditch is the largest of the ditches and runs just outside of the southern boundary of the property, along Finch Drive (Map 1; Photo 1). The average channel width is 1.51 m. The ditch was dry during the RAR assessment (June 27, 2014), but contained water during the follow up visits (October 23, 27 & 28, 2014), with a maximum water depth of approximately 40 cm. Water and sediment are orange in color and heavily oxidized. On October 28, 2014, the water temperature was 9.9 °C, turbidity was 7.34 NTU, pH was 4.75 and dissolved oxygen was 3.8 mg/L (34%). Bed materials are dominantly silty fines, leaf litter and organic debris. Both banks are moderately sloped. There is no large woody debris in the ditch as it is a maintained roadside ditch; however, overgrown shrubs and young coniferous trees offer cover. The southern property line and south ditch are defined by a row, approximately 1 to 6 m wide, of young western redcedar (*Thuja plicata*), Sitka spruce (*Picea sitchensis*), blue spruce (*P. Pungens*), red alder (*Alnus rubra*), salmonberry (*Rubus spectabillis*) and a large infestation of Japanese knotweed (*Fallopia japonica*; Photo 3). No fish were found during minnow trapping; however, one northern red-legged frog (*Rana aurora*) was caught (Photo 2). The northern red-legged frog is Blue listed in BC and listed as a species of Special Concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC).

Photo 1: Looking east along Finch Drive at south ditch. October 23, 2014.

Photo 2: Northern red-legged frog found in a minnow trap in south ditch. October 28, 2014.

Photo 3: Japanese knotweed along south and east ditch, to be removed as part of the compensation project. October 23, 2014.

West Ditch – The west ditch straddles the western property line. It receives drainage water from neighbouring properties, as well as the western portion of north ditch (Photo 4) and an unnamed ditch that flows from the north. West ditch flows south and, during high water storm events, is connected to south ditch (Photo 5). At all but the highest water events, west ditch is interrupted by an elevated portion of ground at its midway point, creating stagnant water conditions. It has an average channel width of 1.38 m (Photo 6). West ditch was dry during the RAR assessment (June 27, 2014), but contained water during the follow up visit (October 23, 2014) with a maximum water depth of approximately 30 cm. On October 28, 2014, the water temperature was 9.8 °C, turbidity was 4.53 NTU, pH was 4.5 and dissolved oxygen was 3.2 mg/L (28%). There is no large woody debris and minimal cover for fish. Both banks are shallow. Bed materials consist of fines with a thick layer of leaf litter. Grass is well established in the bed of the ditch. West ditch is lined by a row, approximately 0 to 2 m wide, of red alder, western redcedar, small-flowered bulrush (*Scirpus microcarpus*) and grasses.

Photo 4: Looking north at the connection between west ditch and north ditch. October 23, 2014.

Photo 5: Looking southwest at the southwest corner of the subject property, where west ditch flows into south ditch. October 23, 2014.

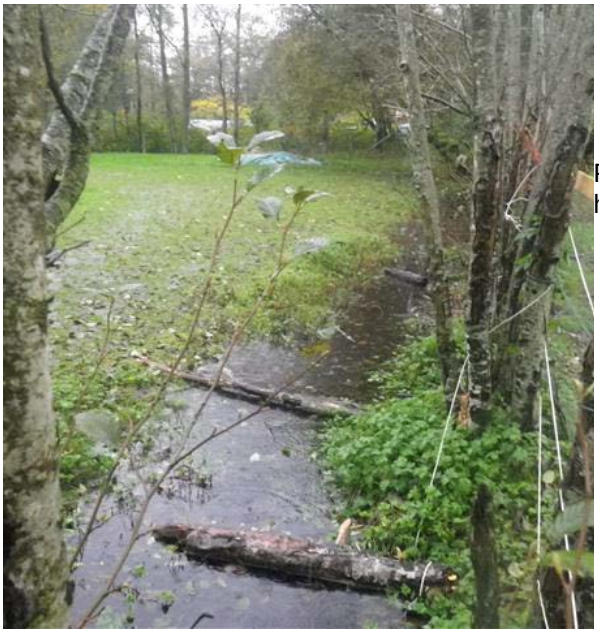

Photo 6: Looking north along west ditch at high water. October 23, 2014.

North Ditch – North ditch straddles the northern property line, with an east-west orientation (Photo 7). It receives drainage water from the neighboring properties. It is interrupted by a high point of land approximately half way along the ditch. Water flows away from the high point. North ditch is connected to west ditch and east during storm events. Detailed assessment calculations reveal the average width to be 1.89 m. The ditch was dry during the RAR assessment on June 27, 2014, but held a maximum water depth of approximately 25 cm on October 23, 2014. Water quality was tested on October 28, 2014. Water temperature was 9.8 °C, turbidity was 4.22 NTU, pH was 4.5 and dissolved oxygen was 3.3 mg/L (29%). There is no large woody debris in the ditch and minimal vegetation cover. The south bank of north ditch is shallow, while the north bank has a moderate slope. The substrate consists of organic fines with established grasses and a thick layer of leaf littler. North ditch is delineated by a strip, approximately 0 to 1 m wide, of red alder, salmonberry, hardhack (*Spiraea douglasii*), bracken fern (*Pteridium aquilinum*), red-osier dogwood (*Cornus sericea*) and willow (*Salix* spp.).

Photo 7:
Looking east along north ditch, with the high portion of land (dis-connectivity) located at the base of the alder trees at the top/centre of the photo. October 23, 2014.

East Ditch – East ditch straddles the eastern property boundary (Photo 8). It receives drainage water from the neighbouring properties as well as a small ditch that flows in from the east at the northeast corner of the subject lot. When water is present in the ditch (e.g. October 23, 2014), it reaches a maximum depth of 20 cm, and flows to the south along the property line before discharging into south ditch. Through a detailed assessment, the average channel width was calculated as 1.84 m. Water quality on October 28, 2014 revealed a water temperature of 9.5 °C, turbidity of 11.4 NTU, pH of 4.75 and dissolved oxygen of 5.7 mg/L (50%). Both banks are shallow. The substrate consists of organic fines with a thick layer of leaf litter. There is no large woody debris in the ditch, but the riparian vegetation does offer a significant amount of cover. East ditch is delineated by a strip, approximately 1 to 8 m wide, of young red alder, western redcedar, willow and salmonberry.

Photo 8:
Looking east at east ditch during the high water event. October 23, 2014.

Wildlife Danger Tree Assessment

A tree assessment was conducted within the riparian area of all four ditches on November 3, 2014 by Karlene Loudon of Cascade Environmental. The assessor walked the perimeter of the property assessing trees for dangerous characteristics and wildlife value. Suspect trees were flagged and given an assessment number, and a field data card was completed. The potential development is classified as a Type 3 Level of Disturbance as it will include construction activity with heavy machinery, tree falling and the installation of permanent buildings. In summary, 19 trees offered suspect characteristics; two of which were deemed safe through a detailed assessment. Of the remaining 17 trees deemed dangerous, 5 should be modified and 12 should be fallen. Twelve of the dangerous trees are located along west ditch; two of which should be modified and 10 of which should be fallen. These trees will be removed in the creation of the proposed rain-garden (as described later in this document), along with the other trees along the west ditch. Two dangerous trees are located along north ditch, both of which should be fallen, and three dangerous trees are location along east ditch, all of which should be modified. The trees along south ditch are generally healthy; however two alder trees had some stem rot, although not to the extent that they were an imminent hazard. As the rot will likely continue and the trees will have to be removed in the future, the proponents may elect to remove the trees at this time, providing appropriate compensation is offered.

Of the trees to be fallen, one offers high wildlife value and the others are ranked as low wildlife value. All trees that were deemed to be dangerous were red alders. The wire and wood fences along the west and north ditches have scared many of these trees, leaving them susceptible to fungal infections and rot. Trees assessed as safe must be reassessed if, prior to the work activity commencing, an intervening winter or major disturbance event has occurred, or if the level of disturbance is increased, or if the trees are subject to winds above 65 km/hr.

Photo 9: Tree #15, along north ditch, was assessed as dangerous due to stem damage and internal rot. Evidence of wildlife feeding is present, making this the only tree ranked with a high wildlife value. This tree is leaning towards the development and is slated for removal.

Recommendations

As all four ditches are non-fish bearing, the Streamside Protection and Enhancement Areas (SPEAs) determined through the *Riparian Areas Regulation* detailed assessment is 2.0 m. Bylaws set forth by the District of Squamish for DPA 11 require a minimum setback of 5.0 m for non-fish bearing artificial watercourse. Due to agricultural uses of the subject property, the current riparian vegetation has been reduced to thin strips, as narrow as 1 m in width, along the ditch banks. The property is long (120 m) and narrow (70 m), enabling the creation of more riparian habitat at southern and northern boundaries than on eastern and western boundaries. The establishment of 5.0 m setbacks along east and west ditch would accentuate the narrow nature of the property and impact the proposed subdivision.

The creation of a 2.0 m wide rain-garden is proposed for west ditch, which, given the current lack of vegetation, will offer increased greening, encourage movement of storm water and decrease stagnant water onsite. The rain-garden would be planted with native, moisture absorbing riparian plant species. A 5.0 m SPEA is proposed for east ditch and north ditch, which meet RAR and DPA 11 requirements. A 5.0 m setback is proposed for south ditch, with an additional 5.0 m strip of community garden adjacent, which meets DPA 11 requirements. The 10.0 m setback preserves 330 m^2 of land adjacent to south ditch, which is being offered, in conjunction with extensive riparian planting (as noted below) as compensation for the reduced SPEA along west ditch and the removal of the two to three alders in the northeast corner of the property.

Native riparian planting is recommended for all newly created riparian areas along south, north and east ditch, as well as throughout the rain-garden. As the current vegetation is largely limited to thin strips along each ditch, compensation planting will be used to improve riparian habitat onsite. The additional 5 m community garden adjacent to the 5 m SPEA along the south ditch will also provide additional non-built green space. The additional riparian planting in these areas will benefit the northern red-legged frog found in this location. Invasive species, including numerous copses of Japanese knotweed, need to be removed.

The intention of the rain-garden is to mimic and improve the infiltration function of the former west ditch. The feature will be 2 m wide and be planted with native species. The channel itself will be over-excavated and a perforated drain-pipe will run the length of the rain-garden, allowing excess water to flow into south ditch at the southwestern property boundary. A geotextile will be placed on top of the pipe, followed by a layer of drainage tile and 30-50 cm of silty loam. The rain-garden would then be planted with facultative wetland sedge, reed species and shrub. The total area of the rain-garden riparian feature is 240 m^2.

Photo 10: Photo of an example rain-garden. Photo taken from www.indy.gov on November 13, 2014.

Compensation planting will take place within the following areas:

- 5.0 m SPEA along south ditch (70 m in length)
- 2.0 m rain-garden along west property line (120 m in length)
- 5.0 m SPEA along north ditch (70 m in length)
- 5.0 m SPEA along east ditch (120 m in length).

In addition to 760 m^2 of communal gardens, a total of 1480 m^2 of riparian area will be preserved, which includes 857 m^2 of existing vegetated riparian area, native riparian planting in 383 m^2 and the 240 m^2 rain-garden planting. A riparian landscaping plan will need to be developed for the property, which includes native plant species. The list below includes species that would be planted in the riparian areas, as recommended by the Department of Fisheries and Oceans, Canada (DFO, 2014).

Deciduous Tree Species:

- Vine Maple Acer circinatum
- Hawthorn Crataegus douglasii*
- Pin Cherry Prunus pensylvanica*
- Choke Cherry Prunus virginiana*
- Mountain Ash Sorbus aucuparia*
- Pacific Willow Salix laslandra
- Pacific Crabapple Malus diversifolia*

Coniferous Tree Species:

- Douglas Fir Pseudotsaga 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 Synmphorocarpus albus*
- Red Huckleberry Vaccinum parviflorum*
- Nootka Rose Rosa nutkana*
- Shrub Rose Rosa rugosa*
- Pussy Willow Salix discolor

* denotes fruit-bearing species

An effort will be made to retain the existing riparian trees, especially the four large conifers present in the southeast corner of the property when finalizing the location of the site access road / driveway. The 12 hazard trees to be removed from the riparian area will be mitigated through replanting using the BC Provincial Tree Replacement (MOE, 1996), along with the trees to be removed for creation of the rain-garden along the west ditch. If the two identified trees located adjacent to the south ditch are also removed, their removal should also be mitigated through adherence to the tree replacement criteria. The BC Provincial Tree Replacement criteria is as follows:

Diameter at breast height of removed tree	Replacement requirements
0 mm - 151 mm (6") dbh	2 replacement trees (min height 1.5 m), or, 4 shrubs (for up to 50% of trees being replaced in this range)
152 mm - 304 mm (12") dbh	3 replacement trees (min height 1.5 m)
305 mm - 456 mm (18") dbh	4 replacement trees (min height 2.0 m)
457 mm - 609 mm (24") dbh	6 replacement trees (min height >¨ 2.0 m)
610 mm - 914 mm (36") dbh	8 replacement trees (min height > 2.0 m)

Based on the diameters at breast height of each of the 12 danger trees slated for removal plus the two additional trees adjacent to the south ditch and the additional 109 trees along the west ditch, 342 replacement trees will be required. Replanted trees are to be suitable native species only. The tree replacement criteria allows the client to substituted some of the trees (50%) for shrubs at a 4:1 ratio which adds diversity to the riparian area. As much of the riparian area is already vegetated, only the above noted 383 m^2 area remains for riparian restoration. This results in space constraints, as trees should be planted on 5 m centres. The proposed planting has been customized for this property, including the suggested planting of 100 trees on 5 m centres and 969 shrubs on 0.75 m centres.

Multiple copses of Japanese knotweed (*Fallopia japonica*) have been observed on site. Japanese knotweed is an aggressive, persistent, invasive species that "spreads rapidly through root systems that may extend from a parent plant up to 20 metres laterally and up to a depth of 3 metres. They thrive on freshly disturbed soil in moist locations. Knotweeds are dispersed by human activities or by water to downstream areas, and are of particular concern in riparian areas and areas prone to seasonal high water or flooding. Plants emerge in early spring and produce large leaves that can shade out other plant species. Infestations can dominate stream banks and reduce sight lines along roads, fences, and rights-of-way." (IPCBC, 2014). Eradication of this species from the subject site is recommended.

Control of Japanese knotweed is difficult (a list of appropriately qualified professionals can found on the Sea to sky Invasive Species Council web site (www.ssisc.info)). Mechanical Control (mowing and cutting) can be effective if done close to the ground, twice per month between April and August, then monthly until the first frost. This treatment needs to be repeated for at least 5 years to exhaust root reserves. Mechanically controlled areas should be monitored throughout the growing season to ensure new infestations do not develop from root fragments. All cut plant parts need to be collected and disposed of at the Squamish Landfill. Care should be taken to ensure that plant parts are not distributed during transport (IPCBC, 2014). The Sea to Sky Invasive Species Council also notes that a combination of cutting and smothering can be used (SSISC, 2014). Chemical control, typically glyphosate, is not recommended adjacent to or within riparian areas.

To prevent erosion and sedimentation of the ditches and downstream waters during development, silt fencing will be installed and maintained along susceptible banks of the ditches until construction of roadways are complete. The silt fence will be inspected, repaired and maintained on an ongoing basis, including:

- inspection after every heavy rainfall;
- removal of sediment before depths reach ½ fence height; and
- repairs as required.

In addition, any stockpiles of soil within 15 m of the ditches will be covered with plastic or geotextile.

An environmental monitoring program is required for acceptance of RAR submissions. All site alterations that could potentially impact the SPEA must be monitored by a qualified environmental monitor who will verify that:

- there are no intrusions into the SPEA and or wetland complex;
- there is appropriate sediment and erosion control measures in place during construction;
- native vegetation is used in landscaping/planting within the SPEA; and
- there is appropriate delineation of the SPEA (silt fencing) through the construction process and post-development.

At a minimum, the environmental monitor will inspect the SPEA and associated protection measures prior to and following construction, and on an as required basis during construction and riparian replanting. Upon completion of the project, the proponent will retain a qualified environmental professional (QEP) to produce a post development report. This report will confirm that the project was completed as outlined in this RAR assessment.

Conclusions

Hummingbird Lane Joint Venture plans to subdivide 1038 Finch Drive in Squamish, BC, a 0.848 ha (2 acre) property, into 8 single family lots centered on a large (0.077 to 0.093 ha) community garden. Four ephemeral, non-fish bearing, unnamed ditches delineate the rectangular property's boundaries. Vegetation on the property is currently limited to thin strips along the property boundaries. The long, narrow shape of the property lends itself to increased riparian area at the northern and southern property boundaries, but limits the land available on the east and west boundaries. Recommended SPEAs include 5.0 m for south ditch with an additional 5.0 m strip of community garden adjacent, 5.0 m for east ditch and north ditch and the creation of a 2.0 m wide rain-garden in west ditch. The creation of a rain-garden in west ditch will provide the functionality of the previous ditch, and allow for bio-infiltration. The increased SPEA widths and additional riparian planting on south, east and north ditch will result in more riparian vegetation on site than currently exists. A compensation planting plan will be implemented and invasive species will be removed.

Please do not hesitate to contact the undersigned should you have any questions or comments.

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Cascade Environmental Resource Group Ltd.

With support and review provided by:

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References

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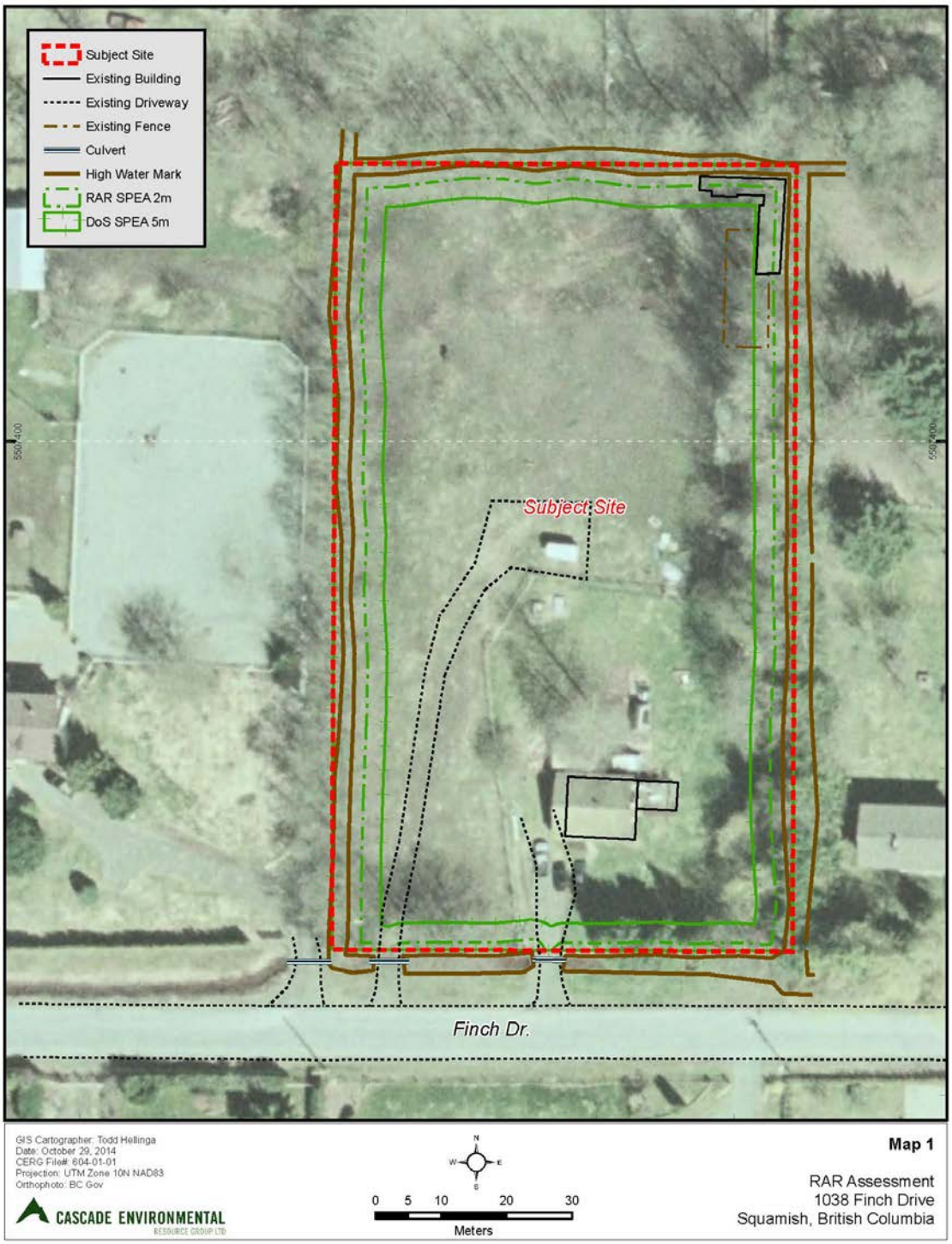
Ministry of Environment. 2014. Fisheries Information Summary System (FISS) [http://www.env.gov.bc.ca/fish/fiss/] [Accessed October 27, 2014].

Ministry of Environment. 1996. BC Provincial Tree Replacement Criteria. Ecosystem Planning & Protection.

Sea to Sky Invasive Species Council (SSISC). 2014. [http://www.ssisc.info/] [Accessed October 28, 2014].

Map 1: Watercourses on and adjacent to 1038 Finch Drive, with their appropriate RAR and District of Squamish (DOS) setbacks.



Map 2: Proposed development, setbacks and rain-garden at 1038 Finch Drive.