



**CASCADE ENVIRONMENTAL**  
RESOURCE GROUP LTD

# Garibaldi Springs Lands, Squamish, BC Bio-Inventory Assessment



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## Executive Summary

Polygon Development 315 Ltd. (Polygon) proposes to re-develop the Garibaldi Spring Golf Course in Squamish, BC, for residential uses. The subject property is 48.35 ha in size and currently encompasses a club house and associated parking areas, greens, fairways, ponds, wetlands, watercourses and forested areas. The presence of environmentally valuable resources (EVR's) on site, mainly watercourses and potential for the presence of species at risk will also limit development potential. The current development proposal includes development in pods that are generally limited to areas previously cleared for the golf course. The result will be 11.02 ha of residential development, 3.48 ha of active parks, and 33.82 ha of protected ecological reserve that will consist of existing aquatic and riparian habitat in addition to restored wetland, riparian and upland forested habitat.

Watercourses include Meighan Creek and tributaries, Thunderbird Creek, No Name Creek, Newport Creek, Ponds 1, 2, 3, 4, 5, 6, 7 and 8, the Pond 5-6 wetland complex, and wetland/stream complexes associated with the above noted streams. The creeks and wetlands on site are of natural origin while the ponds were constructed during golf course development in 2002. Ponds 1 through 5 were constructed as aquatic habitat compensation while Ponds 6 through 8 were constructed as aesthetic golf course and stormwater management ponds. All watercourses on site are believed to be fish bearing. All creeks, drainages, wetlands and ponds on the subject property are subject to the Riparian Areas Regulation (RAR) under the *Riparian Areas Protection Act* and the District of Squamish's Development Permit Area 1 - Environmental Protection. The current development plans call for the near-complete infilling of Pond 5 and the complete infilling of Pond 6 and the Pond 5-6 wetland. Appropriate mitigation and compensation will be offered for any lost riparian and aquatic habitat (see Habitat Balance, Appendix 4); approval will be required by the Ministry of Forests, Lands and Natural Resource Operations and Rural Development (MFLNRORD) under the *Water Sustainability Act* and authorization required from Fisheries and Oceans Canada (DFO) under the *Fisheries Act*.

Relatively high water temperatures, low dissolved oxygen levels and low fish counts have been observed in all of the ponds. The decreased water quality is believed to be due to obstructed inlet and/or outlet channels to each pond, combined with lack of shade (shoreline vegetation). Opportunities for restoration are presented by increasing connectivity at the pond inlets and outlets and between channels, and increasing riparian vegetation, especially on the south and west sides of ponds and watercourses. Previous communications took place with Fisheries and Oceans Canada regarding the partial infilling of Pond 5 with the intention of improving fish habitat; this is included in the latest development proposal.

The lands were classified into twelve vegetated polygons and three non-vegetated polygons using Terrestrial Ecosystem Mapping (TEM). Vegetation on site ranges from maintained golf course greens to mature native forest. Soil moisture regime within the vegetated polygons ranges from wet to slightly dry.

There are no known occurrences of any plant species at risk on the subject property, nor were any observed during the site investigations. Five listed plant species, however, were identified as having the potential to occur on the site: Roell's brotherella moss (Red), Vancouver Island beggarticks flowering plant (Blue), *Atrichum flavisetum* moss (Blue), *Callicladium haldanianum* moss (Blue) and *Tripterocladium leucocladulum* moss (Blue). Removal of the vegetation and coarse woody debris in all polygons, except Polygon 0 (the fairways) and Polygon 14 (Urban), for the proposed development could result in the loss of occurrences of these species. Note, however, that the proposed development will occur within areas previously developed for golf course use, with the exception of portions of the access roads. It is recommended that a survey of the potential habitat targeting these species be conducted by a Qualified Environmental Professional knowledgeable of these species, prior to any clearing of those limited areas.

Two red listed ecological communities have potential to occur within TEM Polygons 6 and 10. The remaining naturally vegetated TEM polygons have potential to contain blue listed ecological communities at risk. The fragmentation and relatively young age class of vegetation polygons on site diminishes the value of these areas and decreases the likelihood of these ecological communities occurring on site.



Development should be confined to previously cleared areas to prevent the potential loss of these communities.

Himalayan blackberry and policeman's helmet were the only invasive plant species observed, although other invasive species are anticipated in lower densities. Himalayan blackberry was abundant along the majority of the golf course fairways. An extensive invasive species inventory should be conducted and an invasive species management plan should be prepared. Management of the invasive species present on site presents an opportunity for restoration, as the appropriate treatment/removal of these will improve the ecological condition of the site.

A variety of amphibians, reptiles, mammals and birds are known and/or expected to occur on site. The following wildlife species at risk also have the potential to occur, or have been confirmed, on the subject property:

- Western toad (Blue)
- Great blue heron (Blue)
- Green heron (Blue)
- Northern Rubber Boa (Yellow)
- Common nighthawk (Yellow)
- Western screech owl (Blue)
- Keen's myotis (Blue)
- Little brown myotis (Yellow)
- Cutthroat trout (Blue)
- Northern red-legged frog (Blue)
- Pacific water shrew (Red)
- Olive-sided flycatcher (Blue)
- Rusty blackbird (Blue)
- Peregrine Falcon, *anatum* subspecies (Red)
- Barn swallow (Blue)
- Band-tailed pigeon (Blue)
- Prairie Fossaria (Blue)
- Clodius Parnassian, *claudianus* subspecies (Blue)
- Sunset Physa (Blue)
- Striated Fingernailclam (Blue)

Preservation of aquatic and riparian areas will protect the majority of valuable habitat on site thus limiting the impacts of development on these species at risk. Critical habitat for Pacific water shrew and marbled murrelet has been mapped at a meso-scale by Environment Canada. Portions of these critical habitat polygons overlap with the subject property. Ground verification was used to better refine potential occurrence of these species on site. Suitable habitat for the marbled murrelet does not occur on site. Discussion between Cascade, the Ministry of Forests, Lands and Natural Resource Operations and Rural Development (MFLNRORD), and Environment Canada (EC) has been ongoing for several years with regards to the Pacific water shrew. It has been established that the fairways do not contain critical habitat and protecting the fairways would not be part of the Pacific water shrew recovery plan. The Pacific water shrew may occur within the riparian areas on site as two were captured on the low lying reaches of Thunderbird Creek near the Executive Suites Hotel in 2008.

Other environmentally valuable resources on site include the following:

- Wildlife trees and snags
- Coarse woody debris



- Wildlife movement corridors
- Rocky outcrops

Recommendations to preserve these features, along with a variety of other recommendations, are provided in Section 6.2 of this report.





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## 1 Introduction

### 1.1 Background

Polygon Development 315 Ltd. (Polygon) has retained Cascade Environmental Resource Group Ltd. (Cascade) to conduct a Bio-Inventory Assessment of the Garibaldi Springs Golf and Country Club lands in Squamish, BC. The property is currently zoned as Comprehensive Development Zone 12 (CD-12) with various areas allocated to a golf course, facilities, residential, commercial and fish habitat compensation channels and features, as well as other permitted uses. The proponent is proposing a re-development of portions of these lands into residential development. A development concept plan has been developed and has been submitted to the District of Squamish as part of the rezoning process.

The purpose of the Bio-Inventory Assessment is to identify environmentally valuable resources (EVRs) on or near (i.e. within 100 m of) the site and, if present, to determine the potential impacts as a result of the proposed development. The Bio-Inventory Assessment was conducted in accordance with the District of Squamish Terms of Reference for Site Bio-Inventory (DoS, 2015), consisting of a two-step process: the Preliminary Site Survey and the Detailed Assessment. The Preliminary Site Survey includes a checklist of potential EVRs (see Appendix 1) and if any are present and will be affected by the proposed development, the Detailed Assessment is to proceed. This report summarizes the findings of the Preliminary Site Survey as well as site and species specific surveys as per the Detailed Assessment, including a description of the EVRs identified on or near the site, as well as a discussion of the potential impacts of the proposed development to these, and recommendations to mitigate these impacts.

### 1.2 The Project Team

The site investigation was conducted by Vicki Legris, B.Sc., R.P.Bio., Adrien Baudouin, M.Sc., R.P.Bio., Kersti Vaino, B.Sc., R.B.Tech., Ken McNamara, B.Sc., A.Sc.T., P.Biol., of Cascade. Report writing was completed by the field team as well as Karlene Loudon, B.Sc., B.T.M., R.B.Tech., of Cascade. Support and review was provided by Mike Nelson, R.P.Bio., and mapping was completed by Todd Hellinga, B.Sc., GIS A.S, of Cascade. All project team members have extensive experience conducting environmental inventories, reviews and assessments.

## 2 Site Description and Development Plan

### 2.1 Site Description

The study area is comprised of a 48.35 ha of golf course lands including greens, fairways, clubhouse and parking areas, ponds, wetland, watercourses and forested areas of Garibaldi Spring Golf and Country Club. Its location is shown on Map 1.

Legal Description:	BCP4573,DL 511,PT4	Lot 1, Section 11, Township 50, BCP35114
PID:	025-624-938	027-416-283
UTM:	10U, 490560E, 5510896N	10U, 490355, 5510690

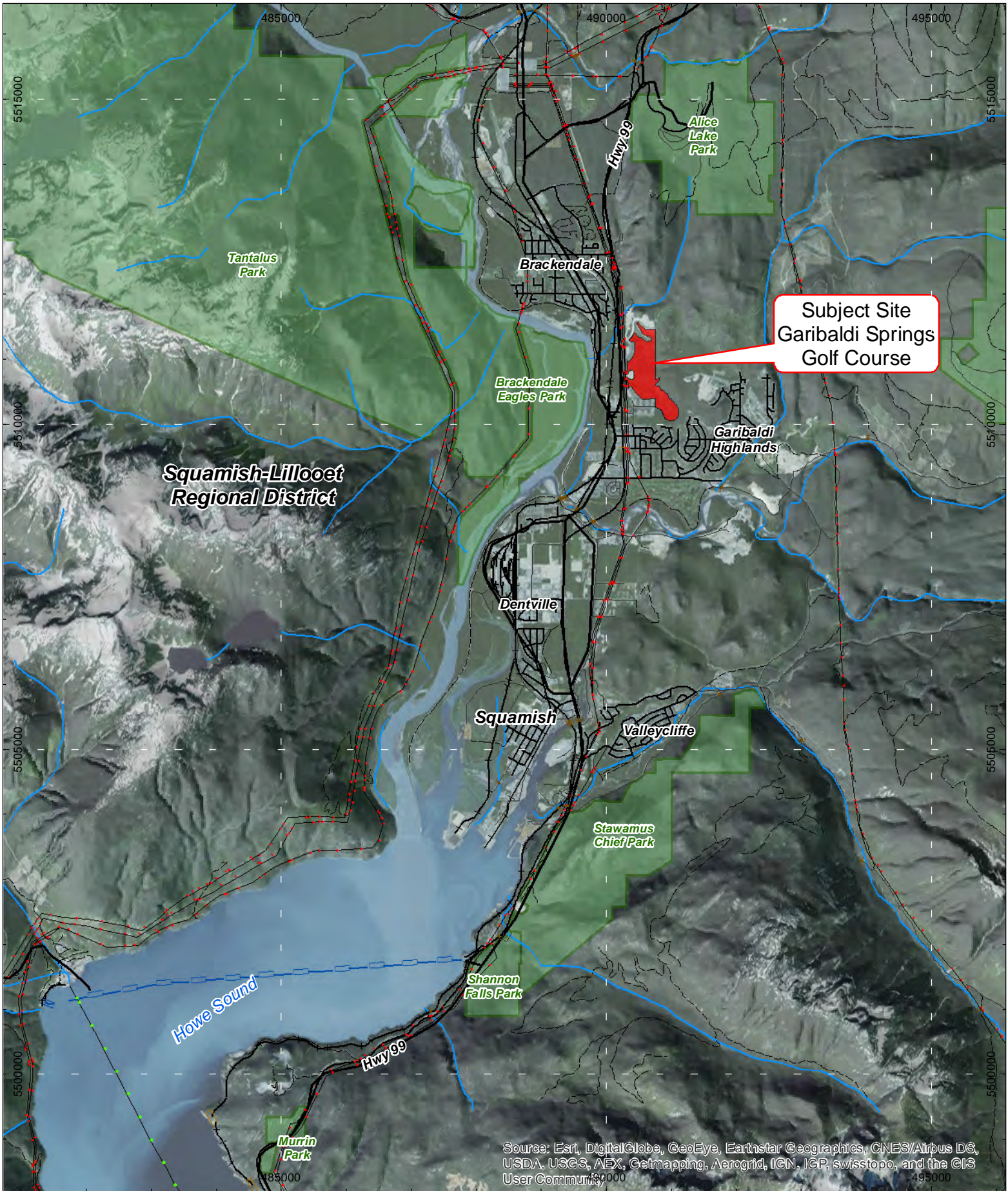
### 2.2 Proposed Development

The proposed development involves the redevelopment of the former Garibaldi Springs Golf Course which is located in the Northeast sector of Squamish adjacent to the Executive Suites Hotel at 2100 Newport Drive. This 48.35 ha site was originally developed to provide approximately 20.03 ha of golf fairways, cart paths and clubhouse. The remaining 28.32 ha are naturalized areas which will remain and be enhanced.



The proposed development will introduce 300 ground-oriented townhomes on 11.02 ha of some of the previously developed fairways. There will be a wide variety of homes ranging from single storey cottages to 3 storey row-homes. These homes will be developed within four distinct communities that will be connected by a series of paths. A small amount of the existing fairways that aren't used for housing will be redeveloped as active parks while the rest will be re-naturalized as wetland areas and both riparian and non-riparian forest habitat. The net result will be 3.48 ha of active parks and 33.82 ha of protected ecological reserve that will both be gifted to the District of Squamish.

The ecological reserve and active park areas will be delivered to the District of Squamish in the first phase of the development, while the remaining build out of the housing will take approximately 8 years. Map 2 shows the concept for development pockets allowing for setbacks from watercourses and retention and enhancement of green spaces.

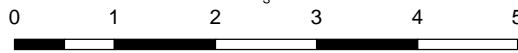
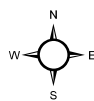


Subject Site  
Garibaldi Springs  
Golf Course

Squamish-Lillooet  
Regional District

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

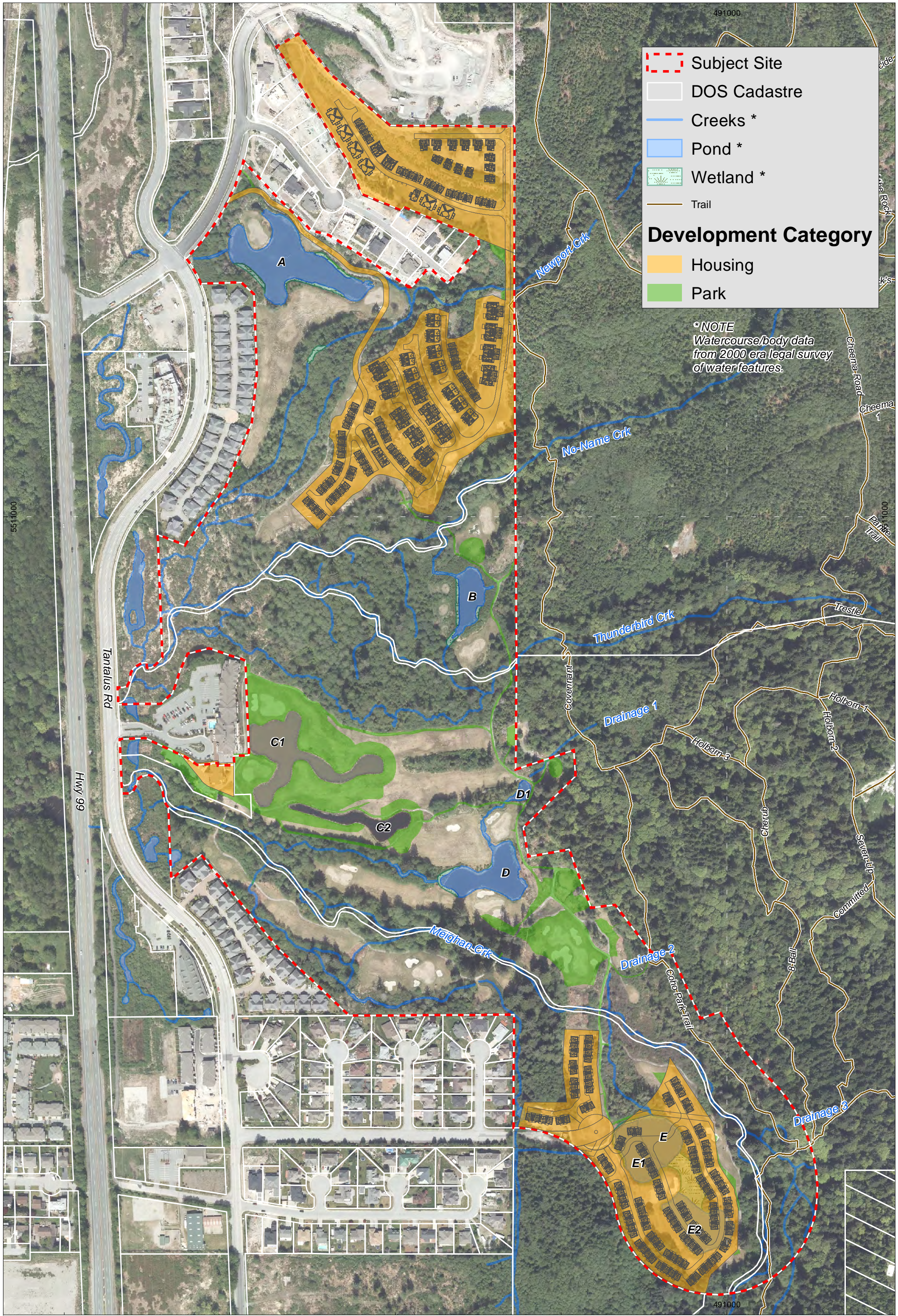
GIS Cartographer: Todd Hellinga  
Date: August 18, 2016  
CERG File#: 725-01-02  
Projection: UTM Zone 10N NAD83  
Orthophoto/Data: ESR/BC Gov



Kilometers

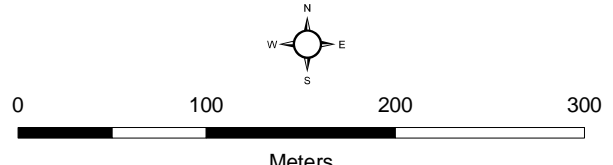
Map 1 - Location

Bio-Inventory Assessment  
Garibaldi Springs Golf Course  
Squamish, British Columbia



**Map 2 - Proposed Development**

Bio-Inventory Assessment  
 Garibaldi Springs Golf Course, Polygon Homes  
 Squamish, British Columbia



GIS Cartographer: Todd Hellinga  
 Date: June 15, 2018  
 CERG File#: 725-01-02  
 Projection: UTM 10N NAD83  
 Orthophoto/Data: DOS



### 3 Methods

A desktop search of data regarding the subject property was conducted by Karlene Loudon prior to visiting the site to determine whether there were any Environmentally Valuable Resources (EVRs) on or near (within 100 m of) the site. Site investigations were conducted by Vicki Legris, Adrien Baudouin and Kersti Vaino on June 30, July 6, 14, 20, 21 and 25, August 4, 8, 9, 17 and 30, October 17-20, December 22, 2016, with additional site investigations on April 25, 27 and 28, 20 and on May 1, 2017 by Kersti Vaino, Ken McNamara and Mike Nelson.

#### 3.1 Physical Environment

Information on the physical environment of the subject property (i.e. climate, geology, soils, geomorphology, and hydrology) were collected from a variety of sources including *An Introduction to the Ecoregions of British Columbia* (Demarchi, 1996), *A Field Guide to Site Identification and Interpretation for the Vancouver Forest Region* (Green and Klinka, 1994), Canadian Climate Normals 1981-2010 (Environment Canada, 2016), provincial mapping data (DataBC, 2016), historical and local knowledge, and observations made during site investigations. Soils were further assessed as part of the field investigations for Terrestrial Ecosystem Mapping, discussed in the following section.

#### 3.2 Terrestrial Environment

##### 3.2.1 Terrestrial Ecosystem Mapping

A standard method of ecological land classification used in BC is the Biogeoclimatic Ecosystem Classification system (BEC). This system describes the variation in climate, vegetation, and site conditions occurring within ecoregions. BEC is also hierarchical, with separate climate and site levels. There are six levels of organization with increasing specificity: zone, subzone, phase, variant, site association, and site series. At the highest level, biogeoclimatic zones are classed based on broad macroclimatic patterns; at the lowest level, site series describes the vegetation potential of the land area based on its ability to support the same climax plant association, and displaying the same soil moisture and nutrient regimes. (RISC, 1998)

Terrestrial Ecosystem Mapping (TEM) is built on the foundation of the BEC system principles. TEM provides the framework in which biotic and abiotic elements can be integrated to provide information on the spatial distribution of ecological units on the ground. This approach is used to assist in the identification of significant environmental features such as, riparian zones, streams, wetlands, valued ecosystem components (e.g. wildlife trees) and environmentally sensitive areas.

TEM units are derived by combining BEC unit information (i.e. site series) with terrain feature attributes (i.e. modifiers). Site series in this classification system describe a 'typical' set of environmental conditions focusing specifically on important site, soils, and terrain characteristics. Site series describe all land areas capable of producing the same late seral or climax plant community within a biogeoclimatic subzone or variant. These are usually related to a specified range of soil moisture and nutrient regimes within a subzone or variant, but other factors, such as aspect or disturbance history may influence site series as well. Site modifiers are used to describe atypical conditions for an ecosystem.

Site series classification reflects subtle changes in microclimate and soil conditions, which reflect on the plant species composition within the unit. Generally, site series are further classified into Terrestrial Ecosystem Mapping (TEM) units based on the structural stage of the vegetation and the geomorphology of the site.

The subject property was assessed prior to the site visits using historical data for development of the Golf Course (NES, 1994), the results of previous Terrestrial Ecosystem Mapping (Cascade, 2008a and Ecoscape et al., 2016a) and aerial photo analysis (DoS, 2016) to differentiate potential TEM polygons. During field investigations, Site Visit Forms were filled out for representative plots within each of the TEM

polygons identified in the area of the proposed development. Terrestrial Ecosystem data, including information on soils, hydrology, vegetation, and tree mensuration were collected and described on a Site Visit Form as per the Field Manual for Describing Terrestrial Ecosystems 2<sup>nd</sup> Edition (BC MOFR and BC MOE, 2010). Where there are differences between the TEM polygons as presented in Ecoscapes (2016a) and those field verified in this document, those differences are explained in the corresponding text.

### 3.2.2 Plant Species at Risk

In BC, there are two governing bodies involved with the ranking of species and/or ecological communities at risk. At the national level, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) works under the *Species at Risk Act* (SARA), and at the provincial level, the Conservation Data Centre (CDC) manages the B.C. Status List.

The Canadian government created SARA in 2002 to complement the Accord for the Protection of Species at Risk (a national effort to identify and protect threatened and endangered wildlife and their associated habitats across the country). COSEWIC is the scientific body responsible for assigning the status of species at risk under SARA. This system uses the following terminology:

- Extinct (XX)
- Extirpated (XT)
- Endangered (E)
- Threatened (T)
- Special concern (SC)
- Not at risk (NAR)
- Data deficient (DD)

A species that is listed as Endangered, Extirpated or Threatened is included on the legal list under Schedule 1 of the Act and is legally protected under SARA with Federal measures to protect and recover these species in effect.

The BC CDC designates provincial red or blue list status to animal and plant species, and ecological communities of concerns (BC MOE, 2017). The red list included indigenous species or subspecies considered to be endangered or threatened. Endangered species are facing imminent extirpation/extinction, whereas threatened groups or species are likely to become endangered if limiting factors are not reversed. The blue list includes taxa considered to be vulnerable because of characteristics that make them particularly sensitive to human activities or natural events. Although blue listed species are at risk, they are not considered endangered or threatened. Yellow listed species are all those not included on the red or blue list and may be species which are declining, increasing, common, or uncommon (BC Ministry of Sustainable Resource Management, 2002).

A search of the BC Species and Ecosystem Explorer was conducted for rare and endangered plants in the relevant biogeoclimatic zone and Forest District (BC MOE, 2017). A list of potential plant species at risk, including habitat requirements for each, was produced from the results. Potential occurrences were then designated as unlikely or possible based upon species specific habitat requirements and an on-site assessment of those habitats.

### 3.2.3 Ecological Communities at Risk

The CDC also tracks rare and endangered plant communities for the province of British Columbia. The term "ecological" is a direct reference to the integration of non-biological features such as soil, landform, climate and disturbance factors. The term "community" reflects the interactions of living organisms (plants, animals, fungi, bacteria, etc.), and the relationships that exist between the living and non-living



components of the “community”. Currently, the most common ecological communities that are known in BC are based on the Vegetation Classification component of the Ministry of Forests and Range Biogeoclimatic Ecosystem Classification, which focuses on the terrestrial plant associations of BC’s native plants.

A search of the BC Species and Ecosystem Explorer was conducted for rare and endangered plants in the relevant biogeoclimatic zone and Forest District and further narrowed down to those occurring in the relevant site series (BC MOE, 2017). A table was produced of the search results.

### **3.2.4 Invasive Species**

Invasive plant species were noted as they were observed during the site investigations.

### **3.2.5 Additional Environmentally Valuable Resources**

Prior to conducting field work, baseline sensitive ecosystems within the study area were gathered from previous assessments conducted on behalf of the District of Squamish (Ecoscapes, 2016b) through the District’s online mapping tools (DoS, 2016; DataBC, 2016).

During site investigations, all additional environmentally valuable resources on site were also noted including wildlife trees, coarse woody debris, riparian areas, rocky outcrops, and wildlife movement corridors. The general abundance and distribution of wildlife trees and coarse woody debris on site were noted.

## **3.3 Wildlife (Terrestrial and Aquatic)**

Lists of wildlife species potentially occurring on the site were compiled from available resources and local knowledge of wildlife and habitat use. During site investigations, an assessment of the available wildlife habitat was conducted and all incidental observations of wildlife species and wildlife sign were recorded. Comprehensive surveys for specific wildlife species were not conducted as part of this assessment.

The list of potential bird species was assembled from data on birds occurring in the nearby Squamish Estuary collected by the Squamish Environmental Conservation Society (formerly the Squamish Estuary Conservation Society) and the Canadian Wildlife Service (SESC, 2004; SECS, 1994; Tretheway, 1985); and from species observed on site during development and monitoring of the Garibaldi Springs Golf Course (NES, 1994; Cascade construction monitoring reports from 2002 through 2004).

In order to determine whether there were any nesting raptors, including owls, or herons within the study area, a raptor/heron nest survey and a call playback survey for cavity nesting owls were conducted as per the Resource Inventory Committee standards (BC MSRM, 2001). The raptor/heron nest survey was conducted on April 28, 2017 and consisted of a ground search for nests along transects targeting treed areas potentially containing nests. Surveyors spent 6 person hours actively searching for nests and signs of nesting activity. The call playback survey was conducted on May 1, 2017 and was conducted at 3 survey stations located across the study area. Cavity nesting owl species potentially occurring in the study area were targeted with 15 minutes of playing each species’ call and listening for a response at each station (3 repetitions of 1 minute of broadcasting followed by 4 minutes of listening). As both large predatory species (barred owl) and small prey species (western screech-owl and northern pygmy-owl) were targeted, the survey was conducted in two rounds where the smaller species were targeted at all survey stations in the first round and the larger species was targeted in the second round.

Fish occurrence data was collected from the Fisheries Inventory Species Summary database (FISS, 2016), and previous studies conducted on behalf of the Golf Course Development (NES, 1994; Cascade, 2002, 2004, 2006a, 2006b, 2007, 2008b, 2009 and 2010). Overnight minnow trapping was conducted in Pond 7 and 8 between July 20 and 21, 2016.



### 3.3.1 Rare and Endangered Wildlife Species

An online search for known species at risk occurrences was conducted (DataBC, 2016) and a search of the British Columbia Species and Ecosystems Explorer (BC MOE, 2017) was conducted to identify all species at risk potentially occurring in the applicable biogeoclimatic zone and Forest District and their habitat requirements. Potential occurrences are then designated as unlikely or possible based upon species specific habitat requirements and an on-site assessment of those habitats. Known occurrences through the Golf Course monitoring program were also documented (Cascade, 2008b).

### 3.4 Aquatic and Riparian Environment

Online mapping tools were used to identify any waterbodies on or adjacent to the subject property (DataBC, 2016; DoS, 2016). Review of previous studies conducted on the property revealed historical hydrological, fisheries and biophysical data pertaining to watercourses on the site, and detailed plans for construction of the compensation ponds and connecting channels (NES, 1994; Cascade., 2002, 2004).

The watercourses, ponds and wetlands onsite that are fish-bearing or connecting to fish-bearing waters are subject to the *Riparian Areas Regulation* (RAR) under the *Riparian Areas Protection Act* and District of Squamish Development Permit Area 11 (DPA 11) guidelines. According to the RAR and the DPA 11 guidelines, each waterbody is assigned a Riparian Assessment Area of 30 m, measured from the high water mark (HWM) of the watercourses or 10 to 30 m from the top of a ravine bank, depending on the width of the ravine. If development is proposed within this area, then an RAR assessment is required as per the Riparian Area Assessment Methodology (BC MWLAP, 2006).

The 2016 field work program included confirming the presence of watercourses on site, mapping the watercourses with a Trimble GPS unit, and flagging the high water mark (HWM) and/or top of bank (TOB) in preparation for survey by a BC Land surveyor in early 2017. A 30 m Riparian Assessment Area has been applied to these water courses for planning purposes. Stream setbacks (SPEAs – Streamside Protection and Enhancement Areas) were then calculated using both the detailed and simple RAR assessment methods.

In addition to the information gathered during the field investigations conducted in June, July, August, October and December 2016 and January 2017, information regarding the physical attributes of creeks, pond construction and connectivity was extracted from previous reports by Cascade, including:

- Garibaldi Springs Golf Course Monitoring Program: Annual Assessment of Habitat Compensation (Cascade, 2006a, 2006b, 2007 & 2008b)
- Habitat Compensation Completion Report: Garibaldi Springs Golf Course, Squamish, BC. (Cascade, 2004)
- Compensation and Mitigation Plan: Garibaldi Springs Golf Course (Cascade, 2002).

A fish sampling program in the on-site ponds was also conducted from October 17 to 20, 2016 and on April 27-28, 2017. The 2016 sampling program consisted of setting G-traps overnight in Ponds 1 through 8 and the wetland between Ponds 5 and 6. The 2017 sampling program consisted of setting G-traps overnight in Ponds 7 and 8 only.

## **4 Results**

The results of the Preliminary Site Survey (Preliminary Site Survey table in Appendix 1) and the detailed site and species specific surveys identified the environmentally valuable resources (EVRs) on or near the subject property which are described in the sections below, and shown in Map 3, 4 and 5.

### **4.1 Physical Environment**

The parameters and features discussed in this section on the physical environment are not considered EVRs, however, they are factors that may interact with the proposed development to influence the EVRs. These interactions are discussed further in Section 5 of this document.

#### **4.1.1 Climate**

The subject property lies in the Eastern Pacific Range Ecosection, within the Coast Mountains Ecoprovince in southern British Columbia (Demarchi, 1996). The climate is principally influenced by frontal systems moving in from the Pacific Ocean and over the Coast Mountains to the Interior. The town of Squamish lies within the Coastal Western Hemlock biogeoclimatic zone in the Dry Maritime (dm) variant, in which summers are typically warm and dry and winters are mild with little snowfall (Green and Klinka, 1994). Canadian Climate Normals station data from 1981 to 2010 establishes a mean annual temperature of 10.1 °C, ranging from a monthly average of 2.5 °C in December to 17.8 °C in July and August, while mean annual precipitation is 2230.2 mm, ranging from 59.3 mm in July to 391.3 mm in November (Environment Canada, 2016). Snowfall is not significant, averaging 87.0 cm per year and falling between November and April (Environment Canada, 2016).

#### **4.1.2 Geology**

The study area lies within the South Coast Mountain Range and is underlain by granitic bedrock of the Coast Plutonic Complex. The area of the subject site is underlain by quartz dioritic intrusive rocks of the Upper Jurassic Period (157 - 145 million years ago) of the Mesozoic Era (DataBC, 2016). Resting on this granitic bedrock are deposits of surficial material that are mostly estuarine / fluvial in origin, with anthropogenic material underlying the golf course (Ecoscapes, et al, 2016a).

#### **4.1.3 Soils**

The general soil type for the Coast Mountain and Islands physiographic region is of the Podzolic Order, residing in the Humo-Ferric Great Group. These soils overlay igneous intrusive rock which is resistant to weathering, thus retarding soil development. The soils of the subject site are organic in nature, have a high silty sand content, and were classified as mesic and nutrient rich.

#### **4.1.4 Geomorphology**

The subject site lies at the eastern extent of the historic floodplain of the Mamquam and Squamish Rivers, and within the eastern extent of Squamish's Flood Hazard Area (DoS, 2010). The site is situated at approximately 20 m above sea level and is isolated from the current river floodplain by the dike system. The site is generally flat within an abrupt escapement along the eastern property boundary that also intrudes into the northeast corner portion of the lot.

#### **4.1.5 Hydrology**

There are a number of surface waterbodies, including creeks, drainages, ponds and wetlands throughout the subject site. These waterbodies generally tend westward feeding into Meighan Creek and the Squamish River via Harris Slough. Their permanent nature also suggests a shallow water table throughout the majority of the site (see section 4.4 for further descriptions of these waterbodies).

## 4.2 Terrestrial Environment

### 4.2.1 Terrestrial Ecosystems Mapping

The proposed development site is classified within the dry maritime subzone (dm) of the Coastal Western Hemlock (CWH) zone. Occurring at elevations up to 650 m, this biogeoclimatic subzone extends along the Sunshine Coast, and adjacent islands, to the lower Fraser Valley (Green & Klinka, 1994).

The CWHdm has a coastal climate, which, in conjunction with existing soil conditions, results in productive forest growth. Typical tree species of this subzone include western redcedar (*Thuja plicata*), western hemlock (*Tsuga heterophylla*), Douglas-fir (*Pseudotsuga menziesii*), shore/lodgepole pine (*Pinus contorta*), bigleaf maple (*Acer macrophyllum*) and red alder (*Alnus rubra*) (Green & Klinka, 1994).

Fourteen TEM units were identified on the subject property including twelve vegetated and two non-vegetated TEM unit. The breakdown of the TEM unit codes identified on the subject property is provided in Table 1 with definitions of the codes provided in Table 2 to Table 6 below.

#### 4.2.1.1 Definitions and Descriptions

Table 1: TEM code explanations for the subject site

TEM Code Abbreviations						
Polygon number	Decile	Site Series	Site Modifier	Structural Stage	Stage Modifier	Stand Composition
0	10	GC	-	-	-	-
1	10	RF	-	5	-	M
2	6	RF	-	5	-	M
	4	RC	-	5	-	M
3	10	RC	a	3b	-	M
4	6	RF	a	5	-	C
	4	RC	a	5	-	C
5	10	RC	a	3b	-	B
6	10	RS	wt	5	-	M
7	6	CD	a	6	m	B
	4	RC	a	5	m	M
8	10	RC	a	3b	-	B
9	10	HM	g	6	m	M
10	10	SS	a	5	m	M
11	10	HM		6	s	C
12	10	RF	a	4	-	B
13	10	PD	-	-	-	-
14	10	UR	-	-	-	-

- **Decile** refers to the proportion of the ecosystem unit out of 10 found within a given polygon (the decile). A homogenous polygon is a 10.
- **Site Series** refers to the site series designation and can include microclimate and soil conditions (see Table 2).
- **Site Modifier** refers to possible site modifiers for atypical conditions (up to 2 letters can describe particular site characteristics such as aspect, slope, and soil; see Table 3).
- **Structural Stage** refers to the structural stage of the tree cover. Values range from 1 (sparse/cryptogam) – 7 (old forest) (see Table 4).
- **Stage Modifier** refers to possible canopy structure modifiers within a given structural stage (see Table 5).
- **Stand Composition** refers to possible stand composition modifiers (see Table 6).

Table 2: TEM codes for the subject site

TEM Code Designation	BEC Site Series	Interpretation (typical conditions – assumed modifiers)
RF	07	Gentle slope; lower slope position; richer nutrient regime, receiving moisture, medium textured soil
RC*	12	Treed swamp, poorly drained, level to depression, medium textured mineral soil
RS	05	Significant slope, middle slope position, deep medium textured soils; richer nutrient regime
CD	09	Active floodplain, middle fluvial bench, deep medium textured soil
HM	01	Significant slopes; middle slope position; deep medium textured soils
SS	08	Active floodplain, high fluvial bench, deep medium - textured soil
GC		Golf Course - Flat to gently rolling grass-covered throughways and open areas set out for the playing of golf. The fairways are usually separated by isolated rows or patches of trees, shrubs and small bodies of water
PD		Pond - A small body of water greater than 2 m deep, but not large enough to be classified as a lake (e.g., less than 50 ha).
UR		Urban/suburban – Non-vegetated areas within an urban/suburban setting; includes buildings and parking lots.

\* RC is the code for Western redcedar – western hemlock – skunk cabbage swamps as defined by Site Association Ws54 in “Wetlands of British Columbia, A guide to Identification” (MacKenzie & Moran, 2004).

Site series have assumed situations with respect to landscape position, soils, and moisture regimes. If a site series is atypical for any of the possible conditions, site modifiers are assigned. Table 3 describes the atypical conditions that exist on the site.

Table 3: TEM site modifiers for the subject site

Abbreviation	Criteria
a	Active floodplain – the site series occurs on an active fluvial floodplain (level or very gently sloping surface bordering a river that has been formed by river erosion and deposition), where evidence of active sedimentation and deposition is present.
g	Gullying occurring – the site series occurs within a gully, indicating a certain amount of variation from the typical, or the site series has gullying throughout the area being delineated
t	Terrace – the site series occurs on a fluvial or glaciofluvial terrace, lacustrine terrace, or rock cut terrace.
w	Warm aspect – the site series occurs on warm, southerly or westerly aspects (135°–285°), on moderately steep slopes (35%–100% slope )

Structural stages in Table 4 describe the existing dominant stand appearance or physiognomy for the ecosystem unit.

Table 4: Vegetation structural stages found on subject site

Structural Stage Code	Interpretation
3b	Tall Shrub – Dominated or characterized by shrubby vegetation that is 2 10 m tall; time since disturbance < 40 years for normal forest succession; may be perpetuated indefinitely.
4	Pole/Sapling – Trees >10 m tall, typically densely stocked, have overtopped shrub and herb layers; younger stands are vigorous (usually >10–15 years old); older stagnated stands (up to 100 years old) are also included; self-thinning and vertical structure not yet evident in the canopy – this often occurs by age 30 in vigorous broadleaf stands, which are generally younger than coniferous stands at the same structural stage
5	Young Forest - Self thinning has become evident and the forest canopy has begun to differentiate into distinct layers (dominant, main canopy and overtopped); vigorous growth and a more open stand than in the Pole/Sapling stage; begins as early as age 30 and extends to 50 – 80 years, depending on tree species and ecological conditions.
6	Mature Forest - Trees established after the last disturbance have matured; a second cycle of shade tolerant trees may have become established; understories become well developed as the canopy opens up; time since disturbance is generally 80–250 years.



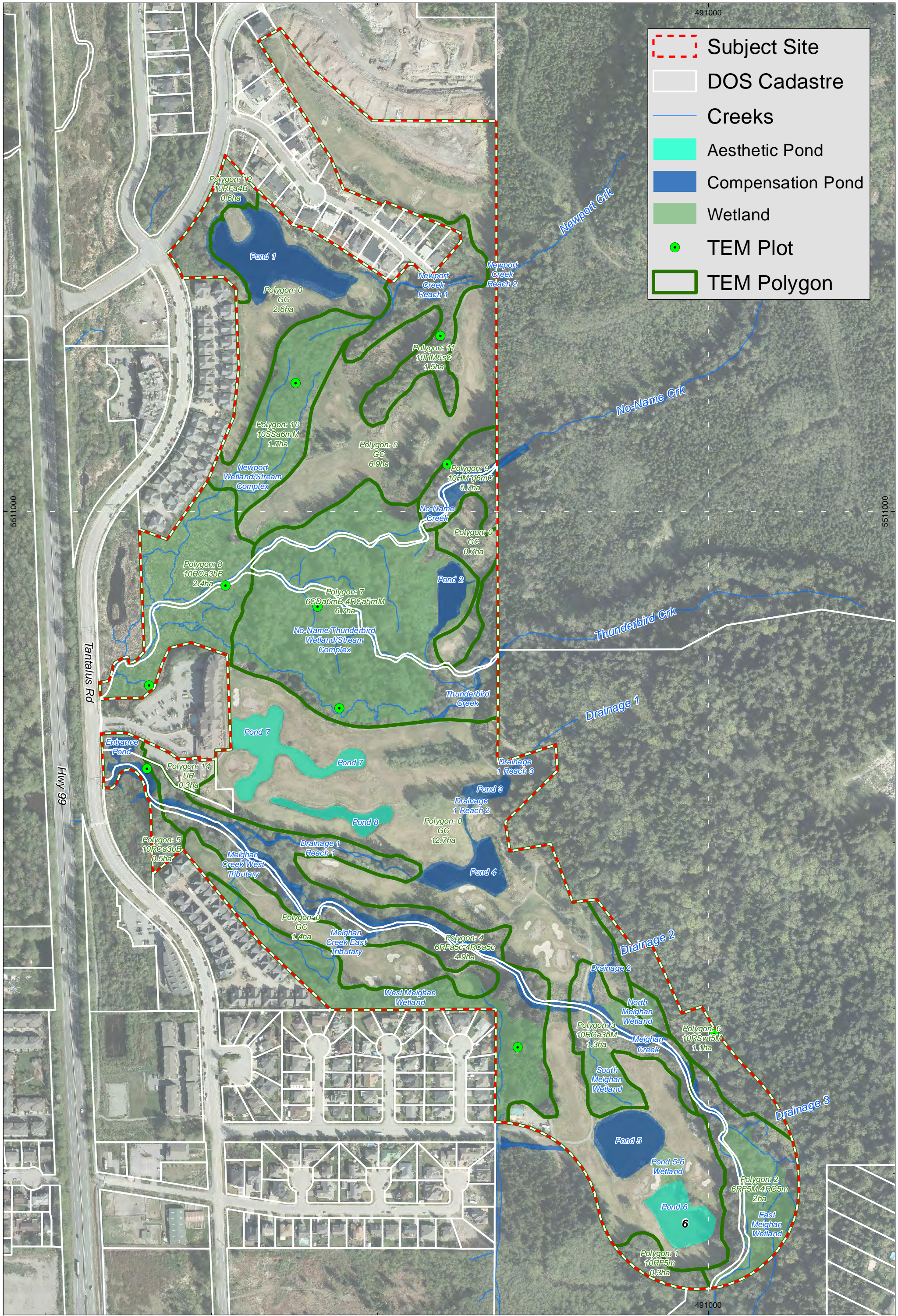
Canopy structure modifiers (Table 5) and stand composition modifiers (Table 6) describe the structure and composition of the vegetation in more detail.

Table 5: Canopy structure modifiers for the subject site

Abbreviation	Interpretation
s	Single storied – closed or open forest stand dominated by the overstorey crown class (dominant and co dominant trees); intermediate and suppressed trees account for <20% of all crown classes combined.
m	Multistoried - closed forest stand with all crown classes well represented; each of the intermediate and suppressed classes account for greater than 20% of all crown classes combined; advance regeneration is variable.

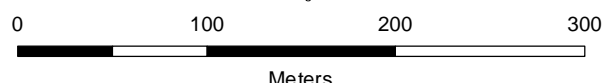
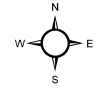
Table 6: Stand composition modifiers for the subject site

Abbreviation	Interpretation
C	Coniferous > 75 % of total tree cover is coniferous
B	Broadleaf > 75 % of total tree cover is broadleaf.
M	Neither coniferous or broadleaf account for greater than 75 % of the total tree layer cover



**Map 3 - Environmentally Valuable Resources: TEM**

Bio-Inventory Assessment  
 Garibaldi Springs Golf Course, Polygon Homes  
 Squamish, British Columbia



GIS Cartographer: Todd Hellinga  
 Date: May 4, 2017  
 CERG File#: 725-01-02  
 Projection: UTM 10N NAD83  
 Orthophoto/Data: DOS





#### 4.2.1.2 Vegetation Associations

The sections below describe the current vegetation associations and structural stages of the TEM polygons found on the subject property. The TEM polygons and the locations of each study plot are shown in Map 3. A list of vegetation observed on site is included in the following section.

The majority of the site is located in a floodplain and is characterised by flat, moist lands at approximately 20 m of elevation. The east side of the property present a steep slope rising to an elevation of approximately 50 m. As all polygons are part of the CWHdm biogeoclimatic subzone, they all contain similar species; however, each offers a slightly different species ratio depending on soil moisture and nutrient regime. All polygons within this property fall under a rich to very rich soil nutrient regime. A list of vegetation observed onsite during the site inspections is found in Table 7 below.

Table 7: Vegetation observed on site

Layer	Common Name	Scientific Name
Trees	Bigleaf maple	<i>Acer macrophyllum</i>
	Black cottonwood	<i>Populus trichocarpa</i>
	Douglas Fir	<i>Pseudotsuga menziesii</i>
	Bitter cherry	<i>Prunus emarginata</i>
	Red alder	<i>Alnus rubra</i>
	Paper Birch	<i>Betula papyrifera</i>
	Sitka Alder	<i>Alnus viridis</i>
	Sitka spruce	<i>Picea sitchensis</i>
	Western hemlock	<i>Tsuga heterophylla</i>
	Western redcedar	<i>Thuja plicata</i>
Shrubs	Black gooseberry	<i>Ribes lacustre</i>
	Black twinberry	<i>Lonicera involucrata</i>
	Devil's club	<i>Oplopanax horridus</i>
	Dull Oregon grape	<i>Mahonia nervosa</i>
	Salmonberry	<i>Rubus spectabilis</i>
	Red elderberry	<i>Sambucus racemose</i>
	Red huckleberry	<i>Vaccinium parvifolium</i>
	Red-osier dogwood	<i>Cornus sericea</i>
	Thimbleberry	<i>Rubus parviflorus</i>
	Nootka rose	<i>Rosa nutkana</i>
	Hardhack (pink spirea)	<i>Spiraea douglasii</i>
	Salal	<i>Gaultheria shallon</i>
	Sitka mountain ash	<i>Sorbus sitchensis</i>



Layer	Common Name	Scientific Name
	Vine maple	<i>Acer circinatum</i>
	Willow	<i>Salix spp.</i>
	Himalayan blackberry*	<i>Rubus armeniacus</i>
Herbs	Sword fern	<i>Polystichum munitum</i>
	Bracken fern	<i>Pteridium aquilinum</i>
	Licorice fern	<i>Polypodium glycyrrhiza</i>
	Lady fern	<i>Athyrium filix-femina</i>
	Spiny wood fern	<i>Dryopteris expansa</i>
	Fire weed	<i>Chamerion angustifolium</i>
	False lily-of-the-valley	<i>Maianthemum diatatum</i>
	Foamflower	<i>Tiarella trifoliata</i>
	Pacific bleeding heart	<i>Dicentra formosa</i>
	Wall lettuce	<i>Lactuca muralis</i>
	Skunk cabbage	<i>Symplocarpus foetidus</i>
	Small-flowered bulrush	<i>Scirpus microcarpus</i>
	Scouring rush	<i>Equisetum hyemale</i>
	Swamp horsetail	<i>Equisetum fluviatile</i>
	Sitka sedge	<i>Carex sitchensis</i>
	Sedges	<i>Carex spp.</i>
	Reed canarygrass	<i>Phalaris arundinacea</i>
	Policeman's helmet*	<i>Impatiens glandulifera</i>
	Grasses	<i>Poacea spp.</i>
Mosses	Unidentified mosses	
	Step moss	<i>Hylocomium splendens</i>
	Pipe cleaner moss	<i>Ptychomnion aciculare</i>

\* denotes invasive species



**TEM Polygon 0**

<b>Decile</b>	<b>Site Series</b>	<b>Site Modifier</b>	<b>Structural Stage</b>	<b>Stage Modifier</b>	<b>Stand Composition</b>
10	GC				

This polygon is composed of the golf course fairways and makes up 52% of the site for a total of 24.4 hectares. The vegetation is composed almost entirely of grasses and multiple paved roads/cart paths are present throughout this polygon. Representative photo of the polygon are provided below (Photo 1)



Photo 1: View of the golf course. July 14, 2016



### TEM Polygon 1

Decile	Site Series	Site Modifier	Structural Stage	Stage Modifier	Stand Composition
10	RF	-	5	-	M

TEM Polygon 1 is located in on the southern border of the property, making up 0.3 hectares and 1 % of the site. Upon field verification, Polygon 1 was assigned TEM code 10RF5M. This TEM code is slightly dryer than swamp wetland classes, Ws52 (Red alder – Skunk cabbage) and Ws54 (Western hemlock – Skunk cabbage), assigned by others (Ecoscape, 2016a). This polygon is characterised by young forest with a mix of coniferous and deciduous trees. A previous study conducted in the forest immediately south of Polygon 1 concluded that the forest is dominated by western hemlock and western redcedar, with a few remaining mature Sitka spruce and lesser extents of red alder, vine maple, bigleaf maple and black cottonwood, and a herb layer of salal, red huckleberry and sword fern (Cascade, 2015). A representative photo is provided below (Photo 2).



Photo 2: Young forest representative of Polygon 1. January 26, 2016.



**TEM Polygon 2**

Decile	Site Series	Site Modifier	Structural Stage	Stage Modifier	Stand Composition
6	RF	-	5	-	M
4	RC	-	5	-	M

Polygon 2 is 2.0 hectares in size and is located in the southeast corner of the subject site on flat, moist land at the toe of an escarpment. This polygon is a mix of site series 07 (60%) and site series 12 (40%); Meighan Creek and tributaries meander throughout and the polygon contains wetland features. Coho Park Trail also traverses this polygon. A previous study found that the stands are characterised by young forest dominated by western hemlock and western redcedar, with lesser extents of red alder, vine maple, bigleaf maple, paper birch and black cottonwood, and a herb layer dominated by salal, red huckleberry and sword fern (Cascade, 2015). Reprehensive photos are provided below (Photo 3 and Photo 4).

Upon field verification, Polygon 2 was assigned TEM code 6RF5M 4RC5M. The RC TEM code is equivalent to swamp wetland class Ws53 (Cw-Western redcedar-Sword fern-Skunk cabbage) which has overlapping soil moisture and soil nutrient regimes with Ws52 (Red alder – Skunk cabbage) and Ws54 (Western hemlock – Skunk cabbage) which were assigned by others (Ecoscape, 2016a), while the RF TEM code is slightly dryer.



Photo 3: Meighan Creek meandering through Polygon 2. July 14, 2016.



Photo 4: Meighan Creek and young forest in Polygon 2. July 14, 2016.



**TEM Polygon 3**

<b>Decile</b>	<b>Site Series</b>	<b>Site Modifier</b>	<b>Structural Stage</b>	<b>Stage Modifier</b>	<b>Stand Composition</b>
10	RC	a	3b	-	M

Polygon 3 is 1.3 hectares in size and occupies 3% of the subject property. Polygon 3 is located adjacent to Polygon 2, and Meighan Creek continues to meander through this portion; however, this land is characterised by swamp wetland maintained in a tall shrub structural stage, possibly due to the beaver activity observed in this area. Photos are provided below (Photo 5 to Photo 7).

Upon field verification, Polygon 3 was assigned TEM code 10RCa3bM. As noted in the description for Polygon 2 above, the RC TEM code has overlapping soil moisture and soil nutrient regimes with the swamp wetland codes (Ws52 and Ws54) assigned by others (Ecoscape, 2016a).



Photo 5: Wetland associated with Meighan Creek in Polygon 3. July 14, 2016.



Photo 6: Wetland characteristic of Polygon 3. July 14, 2016.



Photo 7: Beaver dam on Meighan Creek in Polygon 3. July 14, 2016.



**TEM Polygon 4**

<b>Decile</b>	<b>Site Series</b>	<b>Site Modifier</b>	<b>Structural Stage</b>	<b>Stage Modifier</b>	<b>Stand Composition</b>
60	RF	a	5	-	C
40	RC	a	5	-	C

TEM Polygon 4, located on the western portion of the property, is 4.9 hectares and makes up approximately 10% of the subject site. This polygon contains young forest estimated to be approximately 40 years old. Dominant tree species present include western hemlock, western redcedar and Sitka spruce. Soils are rich, moist to wet, silt of medium coarseness. Representative photos of the polygon are provided below (Photo 8 and Photo 9).

Upon field verification, Polygon 4 was assigned TEM code 6RFa5c which overlaps with the 4RF5tM code assigned by others (Ecoscape, 2016a); however, field verification allowed for the identification of slightly dryer patches of forest resulting in the additional assignment of TEM code 4RCa5c.



Photo 8: Young coniferous forest in Polygon 4. June 30, 2016.



Photo 9: Drainage / tributary to Meighan Creek in Polygon 4. June 30, 2016.



**TEM Polygons 5 and 8**

<b>Decile</b>	<b>Site Series</b>	<b>Site Modifier</b>	<b>Structural Stage</b>	<b>Stage Modifier</b>	<b>Stand Composition</b>
10	RC	a	3b	-	B

Polygons 5 and 8 are located along the western border of the property, north and south of the Executive Inn. Together, these polygons are 2.9 hectares and cover approximately 6% of the subject site. This polygon has a young structural stage (tall shrub) as it consists of a Pink spirea – Sitka sedge swamp wetland with shrub and herb layers only. Dominant species include pink spirea and reed canarygrass. Soils are wet and rich. Representative photos are provided below (Photo 10 and Photo 11).

Polygon 5 composes a small portion of a larger TEM polygon delineated by others. Upon field verification, Polygon 5 was assigned TEM code 10RCa3bB which overlaps with the swamp wetland assignment (7Ws3b) by others (Ecoscape, 2016a). The larger polygon also includes 20% open water and 10% marsh wetland; however, these classes were not observed in the smaller Polygon 5.

Field verification of Polygon 8 was in keeping with the assignment of swamp wetland class Ws50 (Pink spirea – Sitka sedge) by others (Ecoscape, 2016a) and overlaps with the structural stage, soil nutrient and soil moisture regimes of the other wetland classifications assigned by others including 7Ws3b 3Ws546oM and 6Ws503a 2OW 2Ws.



Photo 10: Pink spirea - Sitka sedge wetland in Polygon 8. June 30, 2016.



Photo 11: Pink spirea - Sitka sedge wetland in Polygon 8. June 30, 2016.



### TEM Polygon 6

Decile	Site Series	Site Modifier	Structural Stage	Stage Modifier	Stand Composition
10	RS	w t	5	-	M

Polygon 6 is located northeast of Polygons 2 and 3, on a steep slope of 35%, occupying 1.1 ha, or 2% of the site. This polygon is drier than its neighbouring polygons to the south due to its slope position, and is dominated by western redcedar, with lesser extents of paper birch, Douglas-fir and western hemlock. The shrub layer contains salal, dull Oregon grape, red huckleberry and vine maple. The Coho Park trail continues into Polygon 6 from Polygon 2. Photos representative of Polygon 6 are presented below.

Polygon 6 makes up a fracture of the larger overlapping TEM polygon delineated by others (Ecoscape, 2016a). Field verification resulted in the assignment of TEM code 10RSwt5M to Polygon 6, which shares the same soil nutrient regime and same soil moisture regime/structure stage as the TEM codes assigned by others, 5RF6mM and 4HM5tM, respectively. The larger polygon delineated by others also includes 10% urban residential which is not present in Polygon 6.



Photo 12: Young forest in Polygon 6. June 30, 2016.



Photo 13: Young forest in Polygon 6. June 30, 2016.



### TEM Polygon 7

Decile	Site Series	Site Modifier	Structural Stage	Stage Modifier	Stand Composition
6	CD	a	6	m	B
4	RC	a	5	m	M

This polygon is located at the middle of the subject property between No Name Creek and Thunderbird Creek, making up 6.7 hectares and 14% of the subject property. This polygon has a mix of maturing seral and young climax forest and is exposed to frequent disturbance, being within the active floodplain of No Name Creek and Thunderbird Creek. Vegetation cover is dominated by red alder with a relatively dense understory of shrubs. Representative photos of the polygon are provided below (Photo 14 to Photo 17).

Upon ground verification, Polygon 7 was assigned codes that reflect its positioning as a medium bench floodplain (6CDa6mB) and as wet forest (4RCa5mM). The code assigned by others (10RF5tB) (Ecoscape, 2016a) is slightly dryer than observed; however, the two code share the same soil nutrient regime, have overlapping structural stages and stage compositions.



Photo 14: View of the vegetation along Thunderbird Creek in TEM Polygon 7. July 6, 2016.



Photo 15: View of the vegetation along Thunderbird Creek in TEM Polygon 7. July 6, 2016.



Photo 16: View of the vegetation at the center of the TEM Polygon 7 .July 6, 2016.



Photo 17: View of the vegetation at the center of the TEM Polygon 7 .July 6, 2016.



**TEM Polygon 9**

Decile	Site Series	Site Modifier	Structural Stage	Stage Modifier	Stand Composition
10	HM	g	6	m	M

Polygon 9 is located along the east side of the property making up 0.7 hectares and 1% of the subject property. No Name Creek bisects the polygon. The terrain is characterized by a steep gradient of approximately 50% and the vegetation is characterized by a mature forest dominated by western redcedar, western hemlock with some red alder. The stand age was estimated at 80 years old. Representative photos of the polygon are provided below (Photo 18 and Photo 19).

Polygon 9 is a small polygon that overlaps with two larger polygons assigned by others (Ecoscape, 2016a). During field verification, slightly dryer and slightly less rich conditions were observed when compared to the TEM codes assigned to the two larger but overlapping polygons (10RF5tB and 10RFg5tM). A structural stage of 80 years marks the cut-off between young forest (5, as assigned by others) and mature forest (6, as assigned to Polygon 9).



Photo 18: View of the vegetation in TEM polygon 9. July 6, 2016



Photo 19: View of the vegetation in TEM polygon 9. July 6, 2016.



**TEM Polygon 10**

Decile	Site Series	Site Modifier	Structural Stage	Stage Modifier	Stand Composition
10	SS	a	5	m	M

This polygon is located along Newport Creek and its associated wetlands, making up 1.7 hectares and 4% of the subject property. This polygon is characterized by a mature climax forest and is exposed to frequent disturbance, being within the active floodplain of Newport Creek. Vegetation is composed of mix of deciduous and coniferous tree and is dominated by red alder with a relatively dense understorey dominated by salmonberry. Stand age was estimated to be between 50 and 80 years old. The water table was present 25 cm below the soil surface. Representative photos of the polygon are provided below (Photo 20 and Photo 21).

Upon field verification, Polygon 10 was assigned TEM code 10SSa5mM which better represents its position as a high floodplain bench. Field observations also confirmed the high percentage of alder, homogeneity of the polygon and young forest structural stage others which is represent in Polygon 10's code as well as the code assigned by others (Ecoscape, 2016a), 10RF5tB.



Photo 20: View of the vegetation in TEM polygon 10. July 6, 2016.



Photo 21: View of the vegetation in TEM polygon 10. July 6, 2016.



**TEM Polygon 11**

Decile	Site Series	Site Modifier	Structural Stage	Stage Modifier	Stand Composition
10	HM	-	6	s	C

Polygon 11 is located near the upper reach of Newport Creek on the East side of the property. This polygon makes up 1.5 hectares and 3% of the subject property. The terrain presents a gentle slope of approximately 21%. The forest is characterized by a mature structural stage. Vegetation cover is dominated by western redcedar with a shrub layer dominated by salal. Stand age was estimated to be approximately 80 years old. An abundance of sapsucker wells were observed on trees in this polygon. Representative photos of the polygon are provided below (Photo 22 and Photo 23).

Polygon 11 overlaps with a larger polygon delineated by others (Ecoscape, 2016a). Field verification confirmed the presence of TEM code HM (zonal) as assigned by others (4RF5tM 3HMj4M 3GC); however, slightly higher percentage of coniferous trees was observed in the field. As mentioned in the description of Polygon 9, a structural stage of 80 years marks the cut-off between young forest (5, as assigned by others) and mature forest (6, as assigned to Polygon 11).



Photo 22: View of the vegetation in TEM polygon 11. July 6, 2016



Photo 23: View of the sapsucker wells on a tree in TEM polygon 11. July 6, 2016.



### TEM Polygon 12

Decile	Site Series	Site Modifier	Structural Stage	Stage Modifier	Stand Composition
10	RF	a	4		B

This polygon is composed of dense stand of red alder, with occasional western redcedar and western hemlock. This polygon makes up 0.5 hectares, approximately 1% of the subject property. The predominantly deciduous polygon has a pole/sampling structural stage, while the occasional coniferous trees present are slightly older, with a young structural stage (Photo 24).



Photo 24: View of Polygon 12 from Dowad Drive (Google Street View, August 2014)



**TEM Polygon 13**

<b>Decile</b>	<b>Site Series</b>	<b>Site Modifier</b>	<b>Structural Stage</b>	<b>Stage Modifier</b>	<b>Stand Composition</b>
10	PD				

This polygon is composed of the various ponds present on the subject property. A total of eight ponds are present on site. Each pond is given a number from 1 to 8. A representative photo of the polygon is provided below (Photo 25)



Photo 25: View of Pond 5. July 14, 2016



**TEM Polygon 14**

<b>Decile</b>	<b>Site Series</b>	<b>Site Modifier</b>	<b>Structural Stage</b>	<b>Stage Modifier</b>	<b>Stand Composition</b>
10	UR				

This polygon is composed of the golf course clubhouse and associated parking lot, with vegetation limited to ornamental planting. It has an area of 0.3 ha and makes up less than 1% of the site. A representative photo of the polygon are provided below (Photo 26)



Photo 26: View of Polygon 14, showing driveway, parking lot and club house in background (Google Street View, August 2011)



#### 4.2.2 Plant Species at Risk

The species listed in Table 8 below have the potential to occur in the CWH biogeoclimatic zone within the Squamish Forest District based on their habitat requirements as outlined by the biogeoclimatic classification system. As with the animal species at risk, potential occurrences are designated as unlikely or possible based upon species specific habitat requirements and on-site assessment of those habitats. A targeted survey for each species was not conducted within the study area for this bio-inventory (see Section 5.2.2 for further recommended species specific surveys).

Table 8: Potential Plant Species at Risk

Scientific Name	Common Name	Habitat Requirements	Potential Occurrence	BC List Status	SARA Status
<i>Allium geyeri</i> <i>var. tenerum</i>	Geyer's Onion	Moist meadows and rocky outcrops.	Unlikely – lack of meadows and rock outcrops	Blue	-
<i>Atrichum flavisetum</i>		Banks or stumps in woods, roots of fallen trees, ravines in crevices of rock outcrops, low to moderate elevations <sup>1</sup>	<b>Possible</b>	Blue	-
<i>Bidens amplissima</i>	Vancouver Island beggarticks	Occupies a variety of wetland habitats including ditches, willow wetlands, old riverbeds, pond margins, streamsides, and tidal or non-tidal river edges.	<b>Possible</b> – site contains wetland habitat	Blue	1-SC
<i>Botrichium symplex</i> <i>var. compositum</i>	Least moonwort	Moist to wet vernal pools and ephemeral seepages.	Unlikely – not noted to be found in CWHdm	Blue	-
<i>Brachythecium holzingeri</i>	Holzinger's brachythecium moss	Occurs at base of trees and downed woody debris, typically in more mature, un-disturbed forest stands. <sup>2</sup>	Unlikely – nearest locations found in alpine areas	Blue	-
<i>Brotherella roellii</i>	Roell's brotherella	Rotten wood in cool to moist mixed deciduous and coniferous forest, usually at low elevations along valley margins on slopes, stream terraces and swampy floodplains; often in remnant second growth in city parks.	<b>Possible</b> - known populations nearby in Squamish (Brackendale and Dentville)	Red	-
<i>Bryum schleicheri</i>	-	Wet tundra on the coast and in oceanic interior ranges; wet soil or rocks at alpine elevations. Grows on soil/rocks and stream banks.	Unlikely – lack of suitable habitat	Blue	-



<i>Callicladium haldanianum</i>	-	Logs and stumps in conifer and deciduous forests; at low to moderate elevations. <sup>2</sup>	<b>Possible</b> – within undisturbed forested areas	Blue	-
<i>Claytonia washingtoniana</i>	Washington springbeauty	Moist to mesic moss rock outcrops and forests in the lowland and montane zones above 250 m; nearest known occurrence is in Horseshoe Bay.	Unlikely	Red	-
<i>Dryopteris marginalis</i>	Marginal wood fern	Moist woods in the montane zone.	Unlikely – low elevation	Red	-
<i>Grimmia anomala</i>	Grimmia dry rock moss	On rocks or in crevices of exposed rocks, 4000-7000 ft elevation.	Unlikely – low elevation	Blue	-
<i>Hygrohypnum alpinum</i>	Alpine brook-moss	Along cold, clean swiftly running mountain streams.	Unlikely – low elevation	Blue	-
<i>Peltigera gowardii</i>	Northwest waterfan	Permanent, primarily spring-fed streams in open subalpine or alpine meadows. <sup>3</sup>	Unlikely	Red	-
<i>Pinus albicaulis</i>	Whitebark pine	Within montane forests and on thin, rocky, cold soils at or near timberline.	Unlikely – low elevation	Blue	1-E
<i>Pohlia cardotii</i>	-	Found along rills at 6000-8000 ft.	Unlikely – low elevation	Blue	-
<i>Schoenoplectus americanus</i>	Olney's bulrush (American bulrush)	Saline or alkaline wet meadows in the lowland and montane zones.	Unlikely – lack of suitable habitat	Red	-
<i>Sphagnum contortum</i>	-	Low to mid elevations in rich soils nears streams; shade intolerant <sup>4</sup> , only known occurrences in BC are in Peace Region.	Unlikely	Blue	-
<i>Stellaria obtusa</i>	Blunt-sepaled starwort	Riparian/Meadow/Seeps in the montane zone above 500 m.	Unlikely – low elevation	Blue	-
<i>Tripterocladium leucocladulum</i>	-	Shaded to exposed rocks, cliffs and bark of hardwoods (oaks and maples), occurring mostly at low elevations.	<b>Possible</b> – within undisturbed portions of the site	Blue	-

Source: BC Species and Ecosystem Explorer search for the Squamish Forest District and CWH Biogeoclimatic Zone (BC MOE, 2016a).

Habitat information from BC MOE, 2016a unless otherwise cited.

<sup>1</sup> eFloras, 2017

<sup>2</sup> Coast Forest Conservation Initiative, 2011.

<sup>3</sup> BC MOE, 2015

<sup>4</sup>Vegetation and Wildlife on the Cheekeye Fan, Squamish, BC (Golder, 2014). Prepared for BMS COP LP.

#### 4.2.3 Ecological Communities at Risk

There are four blue and three red listed ecological communities associated with the CWHdm/01, CWHdm/05, CWHdm/07, CWHdm/08, CWHdm/09 and CWHdm/12 site series (TEM coeds HM, RS, RF, SS, CD and RC, respectively) in the Squamish area (Table 9). The listing of ecological communities at risk refers to large and relatively intact sites having mature and old growth structural stages, which are not present on the site. Vegetation on the subject site occurs in disturbed and fragmented polygons of young forest, mature forest and tall shrub.

Table 9: Potential Ecological Communities at Risk

Scientific Name	English Name	TEM Unit	Polygon	BC List
<i>Leymus mollis</i> spp. <i>mollis</i> - <i>Lathyrus japonicus</i>	Dune wildrye - beach pea	Not found on site	-	Red
<i>Picea sitchensis</i> / <i>Rubus spectabilis</i> Dry	Sitka spruce / salmonberry Dry	SS	10	Red
<i>Thuja plicata</i> / <i>Polystichum munitum</i> Dry Maritime	Western redcedar / sword fern Dry Maritime	RS	6	Red
<i>Populus trichocarpa</i> – <i>Alnus rubra</i> / <i>Rubus spectabilis</i>	Black cottonwood – red alder / salmonberry	CD	7	Blue
<i>Thuja plicata</i> - <i>Picea sitchensis</i> / <i>Lysichiton americanus</i>	Western redcedar - Sitka spruce / skunk cabbage	RC	2, 3, 4, 5, 7, 8	Blue
<i>Thuja plicata</i> / <i>Tiarella trifoliata</i> Dry Maritime	Western redcedar / three-leaved foamflower Dry Maritime	RF	1, 2, 4, 12	Blue
<i>Tsuga heterophylla</i> / <i>Buckiella undulata</i>	western hemlock / flat-moss	HM	9, 11	Blue

Source: BC Species and Ecosystem Explorer search for the CWHdm site series in the Squamish Forest District (BC MOE, 2017).

#### 4.2.4 Invasive Species

An extensive invasive species survey was not conducted as part of this assessment. Himalayan blackberry is abundant throughout the subject property mainly along the edge of the trails and golf course fairways. Policeman’s helmet was also observed in similar areas. Other invasive species are likely present in traces. No Japanese knotweed (*Fallopia japonica*) has been observed on site.

#### 4.2.5 Additional Environmentally Valuable Resources

##### 4.2.5.1 Wildlife Trees

Wildlife trees include significant standing snags, mature trees, and trees with broken tops. These trees are important as perching areas for raptors such as bald eagles and red tailed hawk, and foraging / nesting sites for woodpeckers, squirrels, small owls and other cavity nesters such as bats. A large number of wildlife trees were observed in TEM Polygon 1-4, 6, 7 and 9-11, while few wildlife trees were observed in TEM Polygon 8 and 5 as vegetation was mainly composed of shrubs and herbs.



#### 4.2.5.2 Coarse Woody Debris

Coarse woody debris on the forest floor is an indicator of potential species richness for forested areas. Micro habitats, decay, and nutrient cycling provide a range of life cycle opportunities for wildlife and vegetation. Coarse woody debris of varying diameters, lengths, and levels of decay (Photo 25), in addition to rotting stumps, are abundant on the forest floor in all TEM Polygon within the exception of the golf course polygon.

#### 4.2.5.3 Wildlife Movement Corridors

Wildlife tend to use routes having particular features when moving across the landscape to forage for food, disperse, find mates, or locate breeding sites. These features can include cover, shade, vegetation, or surface characteristics. Herptiles and small mammals use vegetated riparian areas adjacent to the creeks on the subject property while larger wildlife, such as black bears, have been observed throughout the Garibaldi Springs property.

#### 4.2.5.4 Rocky Outcrops

Rocky outcrops were noted along the eastern site boundary in the vicinity of Ponds 2 and 3. Rocky habitats can provide valuable habitat to reptiles, birds, and small mammals including bats, as the cracks and crevices can provide shelter and be used for denning, nesting, roosting or as hibernacula. Rocky habitats are of particular value to reptiles, which are ectothermic (i.e. have no internal means for body temperature regulation), as the rocks can retain heat and be used to regulate body temperatures.

#### 4.2.5.5 Sensitive Ecosystems

There are no sensitive ecosystems listed by the Provincial Sensitive Ecosystem Inventory near or within the study area and the nearest listing is approximately 13 km south down Howe Sound (DataBC, 2016). Environmental Sensitive Area (ESA) Mapping for the District of Squamish (DoS, 2016; Ecoscape, 2016a) shows numerous polygons throughout the study area, each with a combination of one or more of the following sensitive ecosystems: wetland, freshwater, riparian, mature trees, young forest and disturbed ecosystems. Each polygon was given an average sensitivity rating by Ecoscape (DOS, 2016a). Polygons throughout the subject lands range from low, medium to high sensitivity with the highest sensitivity focused loosely around waterbodies and mature forest. This mapping indicates that the aforementioned sensitive ecosystems are present; however, sensitive areas have been/are being refined through field work by Cascade as noted in the Terrestrial Ecosystem Mapping and Aquatic and Riparian Environments sections of this report.



Photo 27: Abundance of Coarse woody debris in Polygon 4. June 30, 2016.

### 4.3 Wildlife (Terrestrial and Aquatic)

#### 4.3.1 Wildlife

Observation of wildlife and wildlife signs were recorded as part of the site investigations. The subject site contains potential wildlife habitat due to the presence of:

- Dense coniferous forest containing mature trees and wildlife trees and snags
- Available forage (e.g. berries)
- Stream, ponds and riparian areas
- Wildlife movement corridor throughout the golf course

##### 4.3.1.1 Amphibians and Reptiles

Several amphibians or reptiles species were observed during site visits. A northern red legged frog (*Rana aurora*) was observed in Polygon 4 and multiple Garter snakes (*Thamnophis* spp.) were observed throughout the site. Neotenic northwestern salamanders (*Ambystoma gracile*) were caught in Pond 7 and 8 as bycatch in the minnow traps. Other amphibians typically found in the CWH biogeoclimatic zone include the Northern Pacific treefrog (*Hyla regilla*), rough skinned newt (*Taricha granulose*), and the long toed salamander (*Ambystoma macrodactylum*) (Green and Campbell, 1984). Red-eared slider, a turtle species introduced into British Columbia, has also been observed and photographed on Pond 1 by a neighbour (June 20, 2016).

##### 4.3.1.2 Birds

The ecosystems of the CWH biogeoclimatic zone are considered to have the greatest diversity and abundance of habitat elements in British Columbia, which results in having a broad diversity of bird species. The mosaic of habitat present on the subject property (ponds, streams, riparian areas, rocky outcrops and mature forest) provides habitat for a number of avian species. The full list of potential bird species for the subject site, based on data from the Squamish River and Estuary collected by the Squamish Environment Conservation Society (formerly the Squamish Estuary Conservation Society) and the Canadian Wildlife Service, is included in Appendix 2 (SECS, 2004; SECS, 1994; Tretheway, 1985).

Bird species observed during the survey includes: barred owl (*Strix varia*), American robin (*Turdus migratorius*), dark eyed junco (*Junco hyemalis*), red winged blackbird (*Agelaius phoeniceus*), cedar waxwing (*Bombycilla cedrorum*), northern flicker (*Colaptes auratus*), common nighthawk (*Chordeiles minor*), red breasted sapsucker (*Sphyrapicus ruber*) and spotted towhee (*Pipilo maculatus*). Species reported by neighbours (and verified by Cascade personnel, June 20, 2016) and through a review of other reports (NES, 1994, Cascade 2002, etc.) also include Canada geese (*Branta canadensis*), belted kingfisher (*Megaceryle alcyon*), great blue heron (*Ardea herodias*), green heron (*Butorides virescens*), and a variety of duck species.

Numerous snags with cavities in them were observed, indicating the presence of primary cavity nesting species on site, such as woodpeckers and sapsuckers. No open raptor or heron nests were observed within the study area. A barred owl, sometimes a cavity nester, was detected within the study area, although no signs of nesting activity were noted. No western screech-owls or Northern pygmy-owls, also both cavity nesters, were detected during the first round of call playback surveys.

##### 4.3.1.3 Mammals

Two black bears (*Ursus americanus*) and two coyotes (*Canis latrans*) were observed on the subject property. North American beaver (*Castor canadensis*) are present in Pond 1 as a lodge as well as a food cache was observed on the west side of the pond and numerous feeding signs were observed on the subject property. Other mammal species that are likely to visit the general area include large mammals

such as, cougar (*Puma concolor*), mid-size mammals such as bobcat (*Lynx rufus*) and raccoon (*Procyon lotor*) and smaller species including squirrels (*Tamiasciurus* spp.) and chipmunks (*Tamias* spp.). The Pacific water shrew (*Sorex bendirii*) has also been recorded on the site (Cascade, 2008b). A list of potential mammals for the subject site is included in Appendix 2.

#### 4.3.1.4 Fish

Meighan Creek is fish bearing and juvenile salmonids were observed during within the creek during site investigations. Cascade Environmental Resource Group Ltd. (Cascade) conducted extensive fish sampling and spawning counts in Meighan Creek for various projects in 1992 through 1996 and annually from 2002 through 2011. All data was submitted to the Fisheries Information Summary System (FISS, 2016). The cumulative data available on FISS states that Meighan Creek is an active, but declining, spawning and rearing channel. Species presence includes:

- Steelhead / rainbow trout (*Oncorhynchus mykiss*)
- Cutthroat trout (*O. clarkia*)
- Coho salmon (*O. kisutch*)
- Chum salmon (*O. Keta*)
- Dolly Varden char (*Salvelinus malma*)
- Threespine stickleback (*Gasterosteus aculeatus*)
- Sculpin (General)
- Lamprey (General)

Thunderbird Creek is fish-bearing; however, a waterfall located near the very northeastern property boundary precludes upstream fish migration. Fish data for Thunderbird Creek is merged with Meighan Creek on FISS; therefore, it is assumed that the lower reach of Thunderbird Creek has the same fish species present as Meighan Creek. Fish sampling conducted by Cascade in 1992, using electrofishing methods, did indeed find the same fish species present as in Meighan Creek, although almost all fish (on average) were smaller in Thunderbird Creek than in Meighan Creek (NES, 1994).

The results of the fish population survey conducted in 1992 indicate that the upstream reaches of Thunderbird Creek and Meighan Creek (just below the falls) have the highest fish densities on the subject site. It is likely that the upstream reach of No Name Creek also has similarly high fish densities. The downstream reaches of Meighan Creek, Thunderbird Creek and No Name Creek are utilized for fish passage by coho and chum salmon during spawning and during outward migration to Howe Sound (NES, 1994).

Newport Creek and its associated wetlands are also fish bearing. Juvenile salmonids were also observed within the Newport Creek and No Name Creek during site investigations conducted for this Biophysical Impact Assessment. Pond 1, 2, 3, 4 and 5 were constructed during the building of the golf course and are known to support populations of fish as the ponds are connected to fish bearing creeks (Cascade, 2006a, 2006b, 2007, 2008b). Coho salmon were captured in both spring and fall G-trap sampling in both spring and fall within Ponds 1 through 5. Fish sampling via G-trap sampling from October 17 to 20, 2016 found coho salmon only in Pond 5. Threespine stickleback were found in all the ponds (see Appendix 3 for 2016 / 2017 fish sampling results).

Ponds 6 and the connecting wetland between Pond 5 and 6 were also constructed during golf courses development. They were isolated and were not intended to be fish habitat. During the later stages of golf course construction, Pond 6 was connected via a culvert under the wetland to Pond 5 which drains into Meighan Creek. As noted fish have been captured in Pond 5, and in the October 17 to 20, 2016 fish sampling program coho salmon, rainbow trout, cutthroat trout and threespine stickleback were confirmed within Pond 6 and within the wetland connecting Ponds 5 and 6.

Ponds 7 and 8 were constructed during golf course development for aesthetic purposes and were not intended to be fish habitat. The design specifications called for an outlet structure that precluded fish movements into the pond; however, those features were not constructed. Threespine stickleback were



caught in Pond 7 and 8 during the October 17 to 20, 2016 fish inventory and larger fish were observed displaying feeding behavior by jumping out of the water in order to hunt invertebrates. The April 27 – 28, 2017 G-trap sampling program confirmed threespine stickleback in both ponds, and coho salmon in Pond 7. Fish presence within these ponds is expected to have occurred through backflow up the outflow culverts that connects Meighan Creek with Pond 7. An additional culvert connects pond 7 to Pond 8.

#### 4.3.2 Wildlife Species at Risk

The table below includes CDC listed (i.e. red and blue listed) species that have the potential to occur on or near the subject site; species designated at SARA Schedule 1 are also noted. This potential is based on broad habitat preferences delineated by forest district and biogeoclimatic zone.

Table 10: Potential Rare and Endangered Wildlife Species

Scientific Name	Common Name	Habitat Requirements	Potential Occurrence	BC List Status	SARA Status
<i>Accipiter gentilis laingi</i>	Northern Goshawk, laingi subspecies	Low elevation old growth and mature second-growth forests	Unlikely	Red	1 T
<i>Acipenser medirostris</i>	Green Sturgeon	Coastal marine waters, estuaries and the lower reaches of large rivers.	Unlikely	Red	1 SC
<i>Anaxyrus boreas</i>	Western Toad	Various aquatic and terrestrial habitats including riparian areas around ponds, lakes, reservoirs and slow moving rivers/streams.	<b>Possible</b>	Blue	1 SC
<i>Ardea herodias fannini</i>	Great Blue Heron, fannini subspecies	Aquatic areas <0.5 m deep, fish bearing streams and rivers, undisturbed nesting in tall trees.	<b>Confirmed</b>	Blue	1 SC
<i>Argia vivida</i>	Vivid Dancer	Spring fed stream or pools.	Unlikely	Blue	
<i>Ascaphus truei</i>	Coastal Tailed Frog	Clear, cold swift moving mountain streams with coarse substrates in older forest sites.	Unlikely	Blue	1 SC
<i>Brachyramphus marmoratus</i>	Marbled Murrelet	Nest in old growth forests in coastal areas; in salt water usually within 2 km of shore.	Unlikely, although critical mapped habitat noted – see Section 5.3.1.1 and Map 4	Blue	1 T
<i>Butorides virescens</i>	Green Heron	Aquatic areas, especially slow moving, shallow waters with good riparian cover; nest in vegetation over water or sometimes in dry woodlands.	<b>Confirmed</b>	Blue	
<i>Charina bottae</i>	Northern Rubber Boa	Woodlands, meadows and clearings, not far from water, often under rotting logs or stumps, rocks or bark of dead fallen trees, from sea level to about 3,500 m.	<b>Possible</b>	Yellow	1 SC



Scientific Name	Common Name	Habitat Requirements	Potential Occurrence	BC List Status	SARA Status
<i>Chordeiles minor</i>	Common Nighthawk	Open coniferous forests, savanna, grasslands, fields, vicinity of cities and towns. Nesting on bare ground in open areas.	<b>Confirmed</b>	Yellow	1 T
<i>Cicindela hirticollis</i>	Hairy necked Tiger Beetle	No habitat information provided. All known occurrences in Metro Vancouver area.	Unlikely	Blue	
<i>Contia tenuis</i>	Sharp tailed Snake	Moist pastures, meadows, oak woodlands, broken chaparral, and edges of coniferous or hardwood forests. Most known occurrences are on Vancouver Island and the Gulf Islands; the only mainland population located in Pemberton.	Unlikely	Red	1 E
<i>Contopus cooperi</i>	Olive sided Flycatcher	Various forest habitats: openings within forests and forest edges, subalpine coniferous forest, mixed forest, burned over forest, bogs and forested wetlands, along forested riparian areas. Mostly nests in conifers with tall dead standing trees nearby.	<b>Possible</b> – non-breeding	Blue	1 T
<i>Cypseloides niger</i>	Black Swift	Forages at high altitudes over forests and in open areas. Nests behind or next to mountain waterfalls and wet cliffs, or in caves. <sup>2</sup>	Unlikely	Blue	E
<i>Erynnis propertius</i>	Propertius Duskywing	Open oak or mixed woodlands with the food-plant oaks.	Unlikely	Red	
<i>Euphagus carolinus</i>	Rusty Blackbird	Breeds in boreal forest and taiga. Migrates and winters near wetlands, moist or flooded (primarily coniferous) forests, scrub along the edges of lakes. Occurs to a lesser degree in human-made habitats such as pastures, plowed fields, sewage treatment ponds and small landfill sites.	<b>Possible</b> – non-breeding	Blue	1 SC
<i>Euphyes vestris</i>	Dun Skipper	Grassland/shrub, vernal pools and seasonal seeps.	Unlikely	Red	1 T
<i>Falco peregrinus anatum</i>	Peregrine Falcon, <i>anatum</i> subspecies	Cliff edges near water, interior rivers and wetlands.	<b>Possible</b> – forage only	Red	1 SC



Scientific Name	Common Name	Habitat Requirements	Potential Occurrence	BC List Status	SARA Status
<i>Galba bulimoides</i>	Prairie Fossaria	Habitat preferences not fully known. Descriptions vary, including perennial-water habitats (lakes, ponds and slow-moving streams), seepage areas and small streams; characteristically in seasonal flowing water.	<b>Possible</b>	Blue	
<i>Galba dalli</i>	Dusky Fossaria	Habitat preferences not fully known, but potentially include lakes, ponds, rivers and marshes across southern BC. Only 4 known occurrences, two of which are not confirmed.	Unlikely – disturbed nature of watercourses	Blue	
<i>Gulo luscus</i>	Wolverine, <i>luscus</i> subspecies	Large home ranges in alpine and arctic tundra, boreal and mountain forests, may overwinter in riparian areas usually having snow.	Unlikely	Blue	
<i>Gyraulus crista</i>	Star Gyro	Utrophic ponds, ologitrophic lakes, slow moving streams and seasonal ponds in central and eastern BC.	Unlikely	Blue	
<i>Hirundo rustica</i>	Barn Swallow	Open areas, fields, ponds with vertical nesting habitat, especially buildings.	<b>Possible</b> – non-breeding	Blue	
<i>Megascops kennicottii</i>	Western Screech Owl, <i>kennicottii</i> subspecies	Lower elevations in woodland, especially broadleaf and riparian woodland, also moist coniferous forests; often in riparian zones; nests in tree cavities.	<b>Possible</b>	Blue	1 T
<i>Myotis keenii</i>	Keen's Myotis	Associated with coastal forest habitat. Mostly, but not restricted to, old growth.	<b>Possible</b> – as foraging habitat	Blue	3
<i>Myotis lucifugus</i>	Little Brown Myotis	Nests in caves, hollow trees, human made structures. Foraging usually in woodlands near water.	<b>Possible</b> – foraging habitat	Yellow	1 E
<i>Oncorhynchus clarkii</i>	Cutthroat Trout, <i>clarkii</i> subspecies	Low gradient coastal streams and estuarine habitats.	<b>Confirmed</b>	Blue	
<i>Ophiogomphus occidentis</i>	Sinuous Snaketail	Sunny stream banks and sandy lakeshore beaches at low elevations.	Unlikely – no sandy lakeshores and the sunny stream banks are heavily disturbed	Blue	



Scientific Name	Common Name	Habitat Requirements	Potential Occurrence	BC List Status	SARA Status
<i>Oreamnos americanus</i>	Mountain Goat	Steep alpine and subalpine habitat.	Unlikely	Blue	
<i>Parnassius clodius claudianus</i>	Clodius Parnassian, <i>claudianus</i> subspecies	Moist riparian habitats along low-elevation streams, wet subalpine meadows and subalpine riparian areas. On the BC coast the larval foodplant is Pacific bleeding heart, <i>Dicentra formosa</i> (Fumariaceae). Found in southwestern mainland BC near the coast and on Vancouver Island.	<b>Possible</b>	Blue	
<i>Parnassius clodius pseudogallatinus</i>	Clodius Parnassian, <i>pseudogallatinus</i> subspecies	Mountainous regions at elevations generally over 1200 m.	Unlikely	Blue	
<i>Patagioenas fasciata</i>	Band tailed Pigeon	Breeds from near sea level to 760 m elevation in edges and openings in mature coniferous, mixed and deciduous forests, city yards and parks, wooded groves, open bushland, golf courses and orchards.	<b>Possible</b>	Blue	1 SC
<i>Pekania pennanti</i>	Fisher	Large tracts (>100 ha) of dense forests at low to mid elevation <2500 m.	Unlikely	Blue	
<i>Physella propinqua</i>	Rocky Mountain Physa	Only 14 records in BC. Broad habitat types from central to southern BC. Habitat information is not available, but may include lakes and rivers.	Unlikely	Blue	
<i>Physella virginea</i>	Sunset Physa	Only 7 records in BC over broad habitat types (lakes, rivers, creeks and sloughs)	<b>Possible</b>	Blue	
<i>Rana aurora</i>	Northern Red legged Frog	Wetlands, pools, and riparian areas of upland forests.	<b>Confirmed</b>	Blue	1 SC
<i>Salvelinus confluentus – coastal lineage</i>	Bull Trout – Coastal Lineage	Specific habitat requirements including deep pools in cold rivers <15°C and lakes to small, steep gradient streams. Most commonly in cold, clean, complex and connected watercourses below 12°C <sup>3</sup>	Unlikely – extensive fish surveys yielded no bull trout, likely due to high water temperatures	Blue	



<i>Scientific Name</i>	Common Name	Habitat Requirements	Potential Occurrence	BC List Status	SARA Status
<i>Sorex bendirii</i>	Pacific Water Shrew	Semi aquatic; moist riparian habitats of streams and marshes below 850 m in coniferous/mixed forests usually within 200 m of water <sup>1</sup>	<b>Confirmed</b> - see Section 5.3.1.1 and Map 4	Red	1 E
<i>Sphaerium striatinum</i>	Striated Fingernailclam	Lotic (flowing) and lentic (still lake or pond) environments and on mud, sand, gravel and rock substrates and is most abundant at water depths of less than 2 m	<b>Possible</b>	Blue	
<i>Strix occidentalis</i>	Spotted Owl	Old growth, dense, multi-layer canopy coniferous forest with a range of snags and nesting hollows available.	Unlikely	Red	1 E
<i>Ursus arctos</i>	Grizzly Bear	Non-forested or partially forested sites with a wide range of foraging behaviours and choice of habitats.	Unlikely	Blue	

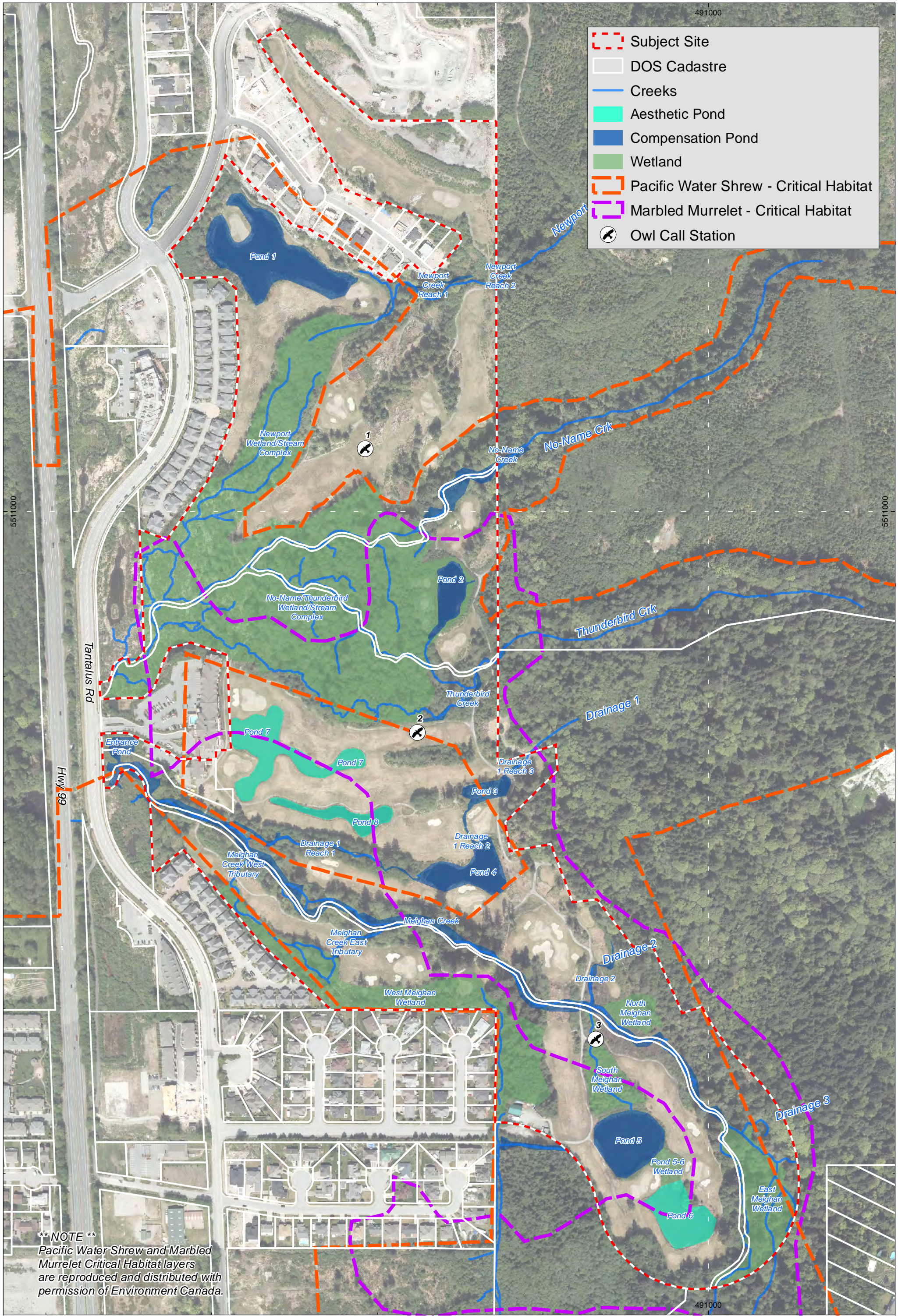
Source: BC Species and Ecosystem Explorer search for the Squamish Forest District and CWH Biogeoclimatic Zone (BC MOE, 2017).

Habitat information from BC MOE, 2017 unless otherwise cited.

<sup>1</sup> Craig *et al.*, 2010.

<sup>2</sup> COSEWIC, 2015

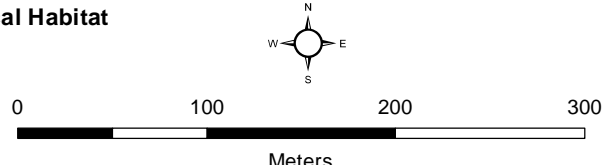
<sup>3</sup> COSEWIC, 2012c



**\*\* NOTE \*\***  
 Pacific Water Shrew and Marbled Murrelet Critical Habitat layers are reproduced and distributed with permission of Environment Canada.

**Map 4 - Environmentally Valuable Resources: SAR and Critical Habitat**

Bio-Inventory Assessment  
 Garibaldi Springs Golf Course, Polygon Homes  
 Squamish, British Columbia



GIS Cartographer: Todd Hellinga  
 Date: May 4, 2017  
 CERG File#: 725-01-02  
 Projection: UTM 10N NAD83  
 Orthophoto/Data: DOS





#### **4.4 Aquatic and Riparian Environment**

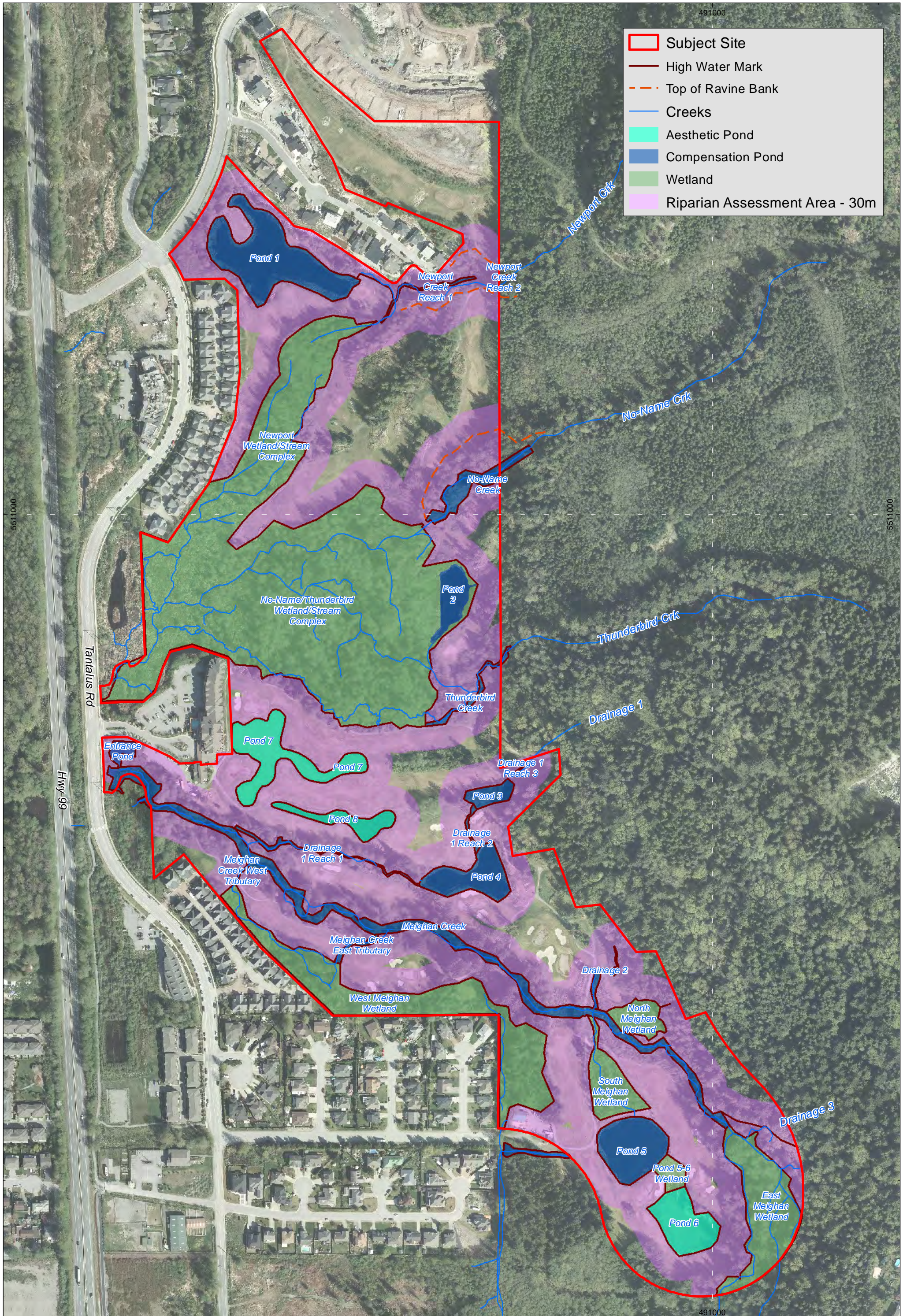
The subject site contains multiple creeks, ponds and wetland areas as shown in Map 5. The major watercourses on the site include Newport Creek, No Name Creek, Thunderbird Creek and Meighan Creek. These creeks and their tributaries flow into wetland complexes at the eastern edge of the property, and drain into Harris Slough via culverts under Tantalus Road, Highway 99 and CN Rail. During low to moderate flows, Harris Slough discharges to the Squamish River, but during flood events its waters can be pumped to the lower Mamquam River as well.

Fish species present on the subject site are described in Section 4.3.1.4. All creeks and wetlands on the property are expected to provide habitat for salmonids and other fish species. Ponds 1, 2, 3, 4, and 5 are connected to fish-bearing streams and were designed and constructed during building of the golf course to provide fish habitat. Ponds 6, 7 and 8 are also man-made and were not intended to provide fish habitat; however, salmonids are known to be present in Ponds 6 and 7, with course fish in Pond 8. Riparian habitats are also attractive to many bird, mammal and amphibian species, which utilize them for drinking, cover, movement, forage, breeding and preening areas.

The high water mark (HWM) and top of bank (TOB) of the watercourses on site were delineated using a Trimble GPS unit, subsequently surveyed by a BC Land Surveyor, with the Riparian Assessment Areas shown on Map 5.

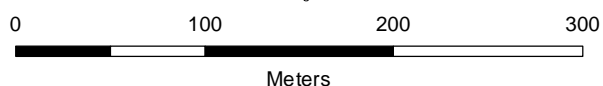
Prior to initial golf course construction, an Environmental Impact Assessment of the property was conducted by Nelson Environmental Services (NES, 1994). The larger watercourses onsite were surveyed and the smaller watercourses were mapped using a Trimble GPS unit. Staff gauges and stream gauging stations were established on Meighan Creek and Thunderbird Creek and a stage discharge curve was established for these creeks. A water quality monitoring program and an aquatic biophysical survey were also conducted for Meighan, Thunderbird, and No Name Creeks, and Meighan and Thunderbird Creeks were electrofished for the purpose of a fish population inventory.

On-site compensation works for the golf course were completed in 2004 and included construction of the five fish-bearing ponds with wetland and open water features, fisheries channels connecting the compensation ponds to fish bearing water on-site, and planting of riparian vegetation surrounding these new channels and ponds (Cascade, 2004).



**Map 5 - Environmentally Valuable Resources:  
Riparian Assessment Areas**

Bio-Inventory Assessment  
Garibaldi Springs Golf Course, Polygon Homes  
Squamish, British Columbia



GIS Cartographer: Todd Hellinga  
Date: May 4, 2017  
CERG File#: 725-01-02  
Projection: UTM 10N NAD83  
Orthophoto/Data: DOS





#### 4.4.1 Meighan Creek

Meighan Creek enters the subject property from the south, where it flows at a gradient of approximately 0.5 % through mature forest composed of Sitka spruce, western hemlock and western redcedar. Stream widths in this area are approximately 6 m, and multiple tributaries and drainages flow into this section of Meighan Creek (Photos 26 to 29). Meighan Creek then continues through a wetland area on the subject site, and joins a connector watercourse to Pond 5. Multiple beaver dams and access channels were observed in this wetland area. From here, Meighan Creek flows west to the constructed wetland complex on the western border of the property, where it flows into culverts under Tantalus Road and Highway 99.

Flow measurements were taken weekly for Meighan Creek from January to November 1992. Meighan Creek flows were found to be fairly steady and continuous, with total discharge varying from 0.066 m/s<sup>3</sup> on October 26, 1994 to 0.261 m/s<sup>3</sup> on December 19, 1994 (NES, 1994).

Water quality sampling conducted for Meighan Creek in 1992 found that all samples fell within Canadian drinking water guidelines, and all parameters (except one instance of low dissolved oxygen) fell within the acceptable limits for the protection of freshwater aquatic life. The low level of dissolved oxygen is potentially due to the groundwater and storm drain source of Meighan Creek. Nutrient levels were usually higher in Meighan Creek than for other streams on the subject site. The nitrogen to phosphorus ratio indicated that phosphorus was the limiting nutrient for primary production in Meighan Creek. Bed material consists of predominantly fines at the downstream end of Meighan Creek, and fines, small and large gravels and a limited quantity of cobbles in the upstream section of the creek (NES, 1994).

For the purposes of calculating the streamside protection and enhancement area (SPEA) under the *Riparian Areas Regulation* (RAR), 11 channel widths were measured on Meighan Creek, with an average width of 8.20 m. Further discussion of the RAR and DPA 11 can be found in Section 5.4 of this document.

##### 4.4.1.1 Meighan Creek Tributaries

###### Drainage 1

Drainage 1 consists of three reaches. Reach 1 is located between Meighan Creek and Pond 4 (described below). This reach was constructed during the construction of the golf course. It has a gradient of approximately 1%, flowing through a band of riparian vegetation with a red alder canopy, a shrub layer of juvenile red alder, western redcedar, western hemlock, vine maple, red elderberry, salmonberry, Himalayan blackberry, and a herb layer with skunk cabbage and spiny wood fern. Eleven channel widths were measured on Drainage 1 Reach 1, with an average channel width of 1.84 m.

Reach 2 is located between Pond 4 and Pond 3 (described below). This reach was also constructed during the construction of the golf course. It has a gradient of <1%, flowing through a band of herbaceous riparian vegetation consisting of cattail, small-flowered bulrush, hardhack and grasses, which obscure the channel. Eleven channel widths were measured on Drainage 1 Reach 2, with an average channel width of 2.66 m.

Reach 3 is located upstream of Pond 3. This steep reach has a gradient ranging from 22 to 31%. Riparian vegetation consists of bigleaf maple, black cottonwood, western redcedar, with a shrub layer of salmonberry, vine maple and some Himalayan blackberry. Eleven channel widths were measured on Drainage 1 Reach 3, with an average channel width of 1.28 m.

###### Drainage 2

Drainage 2 consists of two reaches, low gradient Reach 1, and a steeper Reach 2 upstream. Reach 1 is located within a wetland adjacent to Meighan Creek. Vegetation within this reach has been modified through removal of trees for golf course playability. It has a gradient of approximately 1%, flowing through riparian vegetation consisting of skunk cabbage, hardhack, red alder, willow, Himalayan blackberry, Sitka mountain ash, western redcedar, western hemlock, Nootka rose, cattail, horsetail and



grasses. Eleven channel widths were measured on Drainage 2 Reach 1, with an average channel width of 1.34 m.

Upstream of the wetland, Drainage 2 steepens, with Reach 2 having an average gradient of 16%. The lower part of the watercourse has been channelized through the golf course. Riparian vegetation consists of western redcedar, western hemlock, bigleaf maple, and red alder, with a shrub layer dominated by salmonberry and a herb layer that includes lady fern, sword fern, and deer fern. Eleven channel widths were measured on Drainage 2 Reach 2, with an average channel width of 1.10 m.

### **Drainage 3**

Drainage 3 consists of a single reach on the subject site but extends upstream, off-site, for some distance. On site this reach is located in the East Meighan Wetland, and has a gradient of <1%. Riparian vegetation consists of a red alder canopy, with a shrub layer of vine maple, salmonberry, and some prickly current, and a herb layer that includes skunk cabbage, deer fern, and sword fern. Eleven channel widths were measured on Drainage 3, with an average channel width of 2.14 m.

### **Drainage 4**

Drainage 4 is a short channel that connects the South Meighan Wetland to Meighan Creek. Riparian vegetation consists of red alder, with salmonberry and red-osier dogwood in the shrub layer. Hardhack, grasses, lady fern and skunk cabbage are found in the herb layer. The gradient is <1%. Due to its short length, only 8 channel widths were measured on Drainage 4, with an average channel width of 4.7 m.

### **Drainage 5**

Drainage 5 is also a short channel that connects the South Meighan Wetland to Meighan Creek. Riparian Vegetation is dominated by vine maple, hardhack, cattail, fireweed, skunk cabbage and grasses. The gradient is <1%. Eleven channel widths were measured on Drainage 5, with an average channel width of 4.19 m.

#### **4.4.2 Thunderbird Creek**

Thunderbird Creek flows through Sitka spruce / red alder forest from the eastern border of the property at a gradient of approximately 2%; upstream of the eastern property border an escarpment and 15 m waterfall pose a barrier to fish (Photo 30). Thunderbird Creek flows through the centre of the subject site at a gradient of 0 to 0.5 % and into a wetland complex where it joins No Name Creek and Newport Creek.

Flow measurements from 1992 indicate that Thunderbird Creek is more prone to flash flows than Meighan Creek, with higher peaks and lower base flows. Bed material in Thunderbird Creek is exclusively fines in the downstream section, and a mixture of fines, small and large gravels, a high quantity of cobbles and a lesser amount of boulders in the upstream section. Ten spawned out coho carcasses were observed in the upstream reach of Thunderbird Creek during a field survey in January 1992 (NES, 1994).

Water quality sampling from this study period found that Thunderbird Creek samples fell within Canadian drinking water guidelines and acceptable limits for the protection of freshwater aquatic life, with the exception of one instance of a pH reading of 6.47 (6.5 to 8.5 is the acceptable range stipulated in the guidelines) and one instance of low dissolved oxygen in July 1992 (possibly due to the relatively high temperature and slow velocity of Thunderbird Creek at that time). The nitrogen to phosphorus ratio indicated that phosphorus was also the limiting nutrient for primary production in Thunderbird Creek.

For the purposes of calculating the streamside protection and enhancement area (SPEA) under the *Riparian Areas Regulation* (RAR), 11 channel widths were measured on Thunderbird Creek, with an average width of 2.57 m.



Photo 28: Meighan Creek upstream portion. July 14, 2016.



Photo 29: View of Meighan Creek and associated wetland area. July 14, 2016.



Photo 30: Meighan Creek wetland area. July 14, 2016.



Photo 31: Beaver dam on Meighan Creek. July 14, 2016.



Photo 32: View of Thunderbird Creek upstream section. November 2, 2015.



#### 4.4.3 No Name Creek

No name Creek enters the subject property from the east, approximately 250 m north of Thunderbird Creek (Photo 31). The escarpment and a 30 m waterfall is a barrier to fish passage upstream of the property. No Name Creek flows west through the site at a gradient of approximately 1.5 %, into Thunderbird Creek and the wetland area at the western property border.

Bed material in No Name Creek is exclusively fines in the downstream section, and varying amounts of fines, small and large gravels, and cobbles in the upstream section. Water quality sampling in 1992 found that all No Name Creek samples fell within Canadian drinking water guidelines and acceptable limits for the protection of freshwater aquatic life. The nitrogen to phosphorus ratio indicated that phosphorus was also the limiting nutrient for primary production in No Name Creek (NES, 1994). One spawned out coho carcass was observed during the 1992 biophysical survey.

For the purposes of calculating the streamside protection and enhancement area (SPEA) under the *Riparian Areas Regulation* (RAR), 11 channel widths were measured on No-Name Creek, with an average width of 2.89 m.



Photo 33: Upstream section of No Name Creek. July 25, 2016.

#### 4.4.4 Newport Creek

Newport Creek enters the subject property from the eastern border, approximately 200 m north of No Name Creek (Photos 32 – 35). Newport Creek passes through a culvert under a trail at the eastern border of the property, and flows west through the site into a wetland / stream complex that drains to the south into the wetland area on the western property border. During a site visit conducted on July 20, 2016, Newport Creek exhibited a dry creek bed upstream of the culvert near the eastern border of the property, indicating subsurface flow in this area. Surface flow appeared approximately 20 m south of the eastern property border, at the culvert outflow. The outlet to Newport creek has been modified several times in the past, and at one time flowed exclusively into constructed Pond A. The current alignment was developed to deliver a portion of the flows to the wetland complex downstream to facilitate coho rearing (Cascade, 2006).

Newport Creek has a width of approximately 3 m, and transitions from a gradient of 22 % to a gradient of 0.5 %. Bed material is exclusively fines in the downstream portion a mixture of fines, small and large gravels, and cobbles in the mid-section, and moss-covered forest floor in the upstream section.



For the purposes of calculating the streamside protection and enhancement area (SPEA) under the *Riparian Areas Regulation* (RAR), Newport Creek was divided into 2 reaches, a downstream low gradient reach (Reach 1 - 0.5%) and an upstream high gradient reach (Reach 2 - 22%). Eleven channel widths were measured in each reach, with an average width of 1.46 m in the lower Reach 1, and 3.0 m in upper Reach 2.



Photo 34: Upstream portion of Newport Creek. July 20, 2016.



Photo 35: Newport Creek upstream of wetland/stream complex. July 21, 2016.



Photo 36: Newport Creek stream/wetland complex. July 21, 2016.

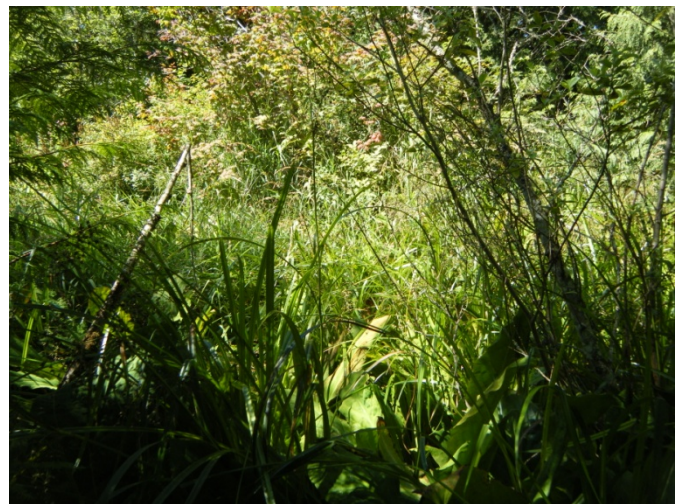


Photo 37: View of wetland area downstream of Newport Creek. July 21, 2016.

#### 4.4.5 Ponds

##### Pond 1

Pond 1 was constructed in 2002 as a fish bearing compensation pond and is located in the northern most portion of the golf course lands (Photo 38). The pond has an open area of approximately 10.239 m<sup>2</sup> and has a wetland shelf along its west, south and east shores.

It is fed from the southeast by Newport Creek and drains into a constructed channel at its northwest end, eventually flowing into Thunderbird Creek via another constructed compensation channel which was referred to as New 5 during golf course construction. Both the inlet and outlet channels were also constructed as compensation channels and were intended to be fish passable. The inlet was designed to be 1-1.5 m wide and 90 m long, and was constructed to direct overland flows and intermittent flows from Newport Creek to Pond 1. The outlet channel was constructed to be 2 m wide and 35 m long and was designed to provide a permanent secure source of water to the compensation channel New 5 located adjacent to Tantalus Road. In September 2006, no connection was observed at the outlet to Newport Creek and recommendations were made to improve this connection and thereby improve water quality (low dissolved oxygen and high temperatures) and coho numbers (Cascade, 2006a). The degree of connectivity is unknown at this time; however, fish presence has been established. A connectivity and water quality survey and, possibly fish sampling, should be conducted and restoration works, if required, could be offered as compensation for the proposed development.

Original riparian setbacks on Pond 1 included both in-play and out-of-play areas. The southeast end of the pond was in-play and was therefore planted with a variable 0-5 m setback with low shrub (hardhack, salmonberry, and rose) in 2002. The trees along the east edge of the pond were also in-play and were planted in low shrub (primarily snowberry). All other areas along the perimeter of the pond were considered out-of-play and riparian vegetation was retained or planted appropriately.



Photo 38: View of Pond 1. July 20, 2016.

##### Pond 2

Pond 2 was also constructed in 2002 and is located in the eastern portion of the golf course lands, between Thunderbird and No Name Creeks (Photo 39). The pond has an open area of approximately 1,769 m<sup>2</sup> as measured from 2013 ortho aerial photographs (DOS, 2016) and has a wetland shelf mainly along its west and southwest shores.

Pond 2 is fed by overland and subsurface drainage from the slope to the east and flows into an outlet channel (referred to as Drainage NE2 in previous reports by Cascade) to its northwest and eventually into



No Name Creek. The 40 m long outlet channel was constructed as a compensation channel and provides fish passage from Pond 2 to No Name Creek. Gravel was placed at the mouth of the inlet channel during pond construction to provide opportunity for spawning (Cascade, 2004). In September 2006, the outlet to the pond was observed to be blocked due to a small earthen barrier, coho numbers were low and water temperature was high (Cascade, 2006a). The degree of connectivity is unknown at this time; however, fish presence has been established. A connectivity and water quality survey and, possibly fish sampling, should be conducted and restoration works, if required, could be offered as compensation for the proposed development.

The majority of riparian areas around Pond 2 were in-play. Western redcedar, western hemlock, black cottonwood, Pacific crab apple, black hawthorn, Pacific ninebark, red-osier dogwood, vine maple and short shrub, including hardhack, thimbleberry and salmonberry, with a fringe of sedges and rushes near the pond were planted during construction. Red alder has also regenerated. (Cascade, 2004).



Photo 39: View of Pond 2. August 4, 2016.

### **Pond 3**

Pond 3 was constructed in 2002 and is located on the eastern portion of the golf course lands, between Thunderbird and Meighan Creeks. Pond 3 typically has a wetted surface area of approximately 258 m<sup>2</sup> as measured from 2013 ortho aerial photographs (DOS, 2016), but its highwater mark indicates season inundation up to 1099 m<sup>2</sup>.

Pond 3 was designed to collect Drainage 1 flows, overland flow and subsurface drainage from the slope to the east. Pond 3 drains into Pond 4 via a Drainage 1, Reach 2, previously described. The degree of connectivity between Pond 3 and Pond 4, can be limited by lows flows and a dry channel in summer months, and by dense instream vegetation with Drainage 1 Reach 2. Fish are known to occur in Pond 3. A connectivity and water quality survey and, possibly fish sampling, should be conducted and restoration works, if required, could be offered as compensation for the proposed development.

### **Pond 4**

Pond 4 was also constructed in 2002 and is located on the eastern portion of the golf course lands, between Thunderbird and Meighan Creeks. Pond D4 is approximately 3,851 m<sup>2</sup> with a wetland shelf along its western shores and receives water from Pond 3 via Drainage 1, Reach 2.

Pond 4 drains from its west end via a channel (Drainage 1, Reach 1; referred to as Drainage M7 in previous reports by Cascade) and eventually into Meighan Creek. Both the inlet and outlet channels were constructed as compensation channels and were to be fish passable. The inlet channel was

constructed to be 1-6 m wide and 70 m long. The outlet channel was constructed to be 2-4 m wide and 50 m long and was designed to provide intermittent fish passage to Meighan Creek (Cascade, 2004). The intermittent outlet channel was observed to be dry in September 2006 and the pond yielded lower fish numbers with higher water temperatures and lower dissolved oxygen than previous years. A connectivity survey, and possibly fish sampling, should be conducted and restoration works, if required, could be offered as compensation for the proposed development.

The wetland shelf was planted with native wetland species during the summer 2003 including beaked sedge, small-flowered bulrush, common rush, and cattail. Riparian planting around Pond 4 included low shrub, tall shrub and trees, specifically western redcedar, western hemlock, Douglas-fir, vine maple, black cottonwood, willow sp., black hawthorn, red-osier dogwood, Pacific ninebark, snowberry, salmonberry, thimbleberry, and hardhack. (Cascade, 2004)

### **Pond 5**

Pond 5, as well as Pond 6 and the adjoining wetland were constructed in 2002 and 2003 and are located on the southeastern-most portion of the golf course lands, west of Meighan Creek (Photo 25). Pond 5, is approximately 5,011 m<sup>2</sup>.

Pond 5 is directly connected to the fish bearing waters of Meighan Creek via an approximately 150 m long channel/wetland (South Meighan Wetland) and provides wetland and open water pond habitat. Pond 5 is fed from ground water seepage and was formerly used for golf course irrigation. To ensure that the water level within the pond is maintained, water from an on-site groundwater well was pumped into the pond, during golf course operations (Cascade, 2004).

Pond 5, as well as the adjacent wetland were offered as habitat compensation for golf course development. The riparian areas of Pond 5 were planted with trees and shrubs including red elderberry, Pacific crab apple, bitter cherry, Indian plum, black hawthorn, red-osier dogwood, twinberry, hardhack, thimbleberry, salmonberry, and rose. Some natural regeneration has occurred. (Cascade, 2004)

Notably, a District of Squamish water main lies along the north perimeter of Pond 5. District access for maintenance of this water main is provided by a service road that runs adjacent to the north bank of Pond 5.

### **Pond 6**

Pond 6, is approximately 3,857 m<sup>2</sup> as measured from 2013 ortho aerial photographs (DOS, 2016), and is connected to Pond 5 by a shallow wetland and a submerged culvert. Pond 6 was not constructed or intended as fish habitat and was not part of the golf course compensation program. The entire riparian area was designed to be in-play and was given hard grass edges. While the degree of connectivity is unknown at this time, the presence of anadromous coho salmon in both Pond 6 and the adjacent wetland indicate that connectivity to Pond 5 is sufficient for fish passage, at least seasonally. A connectivity and water quality survey and, possibly fish sampling, should be conducted and restoration works, if required, could be offered as compensation for the proposed development.

### **Pond 7**

Pond 7 is located in the western portion of the golf course lands, between Meighan Creek and Thunderbird Creek, immediately east of the Executive Suites Hotel & Resort. Pond 7 is approximately 6,088 m<sup>2</sup>.

This pond was constructed for aesthetic purposes and was not designed to be fish habitat nor was it offered as compensation (Cascade, 2002). It now provides stormwater retention for the Executive Suites Hotel. The proposed design was to construct an outlet that was not fish passable; however, threespine stickleback were caught and larger fish were observed within these ponds in 2016. The spring 2017 sampling also found coho and northwestern salamanders in the pond. Fish presence within the pond is expected to have occurred through backflow up the outflow culvert that connects Pond 7 to Meighan Creek during high water conditions.

As Pond 7 was not designed to be connected to fish habitat, no riparian setbacks were assigned during construction and no riparian planting was done. The pond is surrounded by in-play areas with minimal vegetation beyond turf.

#### **Pond 8**

As with Pond 7, Pond 8 is located in the western portion of the golf course lands, between Meighan Creek and Thunderbird Creek, immediately east of the Executive Suites Hotel & Resort. Pond 8 is approximately 2,505 m<sup>2</sup>.

Pond 8 was also constructed for aesthetic purposes and was not designed to be fish habitat nor was it offered as compensation (Cascade, 2002). No riparian planting was conducted during construction, and the pond is surrounded by in-play areas with minimal vegetation beside fairway grasses. The Pond 8 is connected to Pond 7 via a CSP culvert (and Pond 7 is in turn connected to Meighan Creek via a culvert). While no salmonids were captured in Pond 8 during the 2016 and 2017 sampling program, threespine stickleback and northwest salamander were found.

### **4.4.6 Wetland Complexes**

#### **Pond 5/6 Wetland**

As its name implies, Pond 5/6 Wetland connects Pond 5 with Pond 6. The wetland was constructed in 2002 and 2003 as habitat compensation for construction of the golf course, and has an approximate area of 1,056 m<sup>2</sup>. The wetland was planted with beaked sedge, common rush, small flowered bulrush and cat-tail and the wetland shelf planted with sedges and rushes during the summer 2004 (Cascade, 2004). The wetland is known to be fish bearing, as multiple species were captured during the 2016 and 2017 sampling program.

#### **East Meighan Wetland**

East Meighan Wetland is bordered by Meighan Creek to the west, and steeply rising lands to the east. It contains an eastern fork of Meighan Creek, as well as the lower reach of Drainage 3. This features is classified as a swamp wetland class Ws53 (Cw-Western redcedar-Sword fern-Skunk cabbage).

#### **South Meighan Wetland**

South Meighan Wetland consists of a stream swamp that connects Pond 5 to Meighan Creek. This features is classified as a swamp wetland class Ws53 (Cw-Western redcedar-Sword fern-Skunk cabbage), but also has characteristics of swamp wetland class Ws52 (Red alder – Skunk cabbage) and Ws54 (Western hemlock – Skunk cabbage).

#### **North Meighan Wetland**

North Meighan Wetland is bordered by Meighan Creek to the south, and steeply rising lands to the north and east. It contains the lower reach of Drainage 2. Vegetation is as described for that drainage, and the wetland is classified similarly to South Meghan Wetland.

#### **West Meighan Wetland**

West Meighan Wetland consist of constructed, naturalized and natural channels and stream side wetlands fed from wet areas west of Coho Park and north of Pat Goode Park. The waters in this feature tend northwestward, and eventually flow into Meighan creek via Tributaries 4 and 5. Historically, this wetland has consisted of slow moving backwater channels and continues to do so. The constructed portions of the channels within this wetland were revegetated with riparian species during construction of the golf course. Portions of this wetland have large amounts of FeO<sub>2</sub> precipitate, resulting in cloudy red water when disturbed and thick layers of precipitate on instream vegetation. This represents the native condition of this wetland. Water with the channels generally flows from late fall through spring, and is typically stagnant or dry during summers. As with the other wetlands on site this feature is classified as a swamp wetland class Ws53 (Cw-Western redcedar-Sword fern-Skunk cabbage) which has overlapping



soil moisture and soil nutrient regimes with Ws52 (Red alder – Skunk cabbage) and Ws54 (Western hemlock – Skunk cabbage) which were assigned by others (Ecoscape, 2016a), while the RF TEM code is slightly dryer.

### **No Name / Thunderbird Wetland/Stream Complex**

This large central wetland includes the main stems of both No Name and Thunderbird Creeks, as well as distributaries, and other low lying frequently inundated areas. The upstream portion is considered a medium bench floodplain, with a mix of maturing seral and young climax forest that is exposed to frequent disturbance, being within the active floodplain of No Name Creek and Thunderbird Creek. Vegetation cover is dominated by red alder with a relatively dense understory of salmonberry, with skunk cabbage within the herb layer. The tree canopy transitions from predominantly deciduous with the occasional mature Sitka spruce and western redcedar to a more mixed forest upstream.

The downstream portion of the No Name / Thunderbird Wetland/Stream Complex, where the creeks converge with Newport Creek, transitions into a swamp wetland class Ws50 (Pink spirea – Sitka sedge).

### **Newport Wetland/Stream Complex**

The Newport Wetland/Stream Complex consists of two branches of Newport Creek, as well as numerous other low lying frequently inundated areas. Vegetation is composed of mix of deciduous and coniferous tree and is dominated by red alder with a relatively dense understory dominated by salmonberry and a herb layer that includes numerous sedges and skunk cabbage, that are frequently inundated. The area is characterized as a high floodplain bench. The downstream portion of this wetland, where Newport, No Name and Thunderbird Creeks converge, transitions into a swamp wetland class Ws50 (Pink spirea – Sitka sedge), which has a young structural stage (tall shrub). Dominant species include pink spirea, reed canarygrass, and small-flowered bulrush.



## **5 Discussion**

The sections below discuss the potential impacts on the Environmentally Valuable Resources (EVRs) that were identified on or near the subject property, as discussed in Section 4 above.

### **5.1 Physical Environment**

As previously stated, the elements of the physical environment are not considered environmentally valuable resources (EVRs) and the discussion in this section instead focuses on how these elements may interact with the proposed development to potentially impact the EVRs identified on and near the site.

#### **5.1.1 Climate**

The current climate at the site's location will not influence the impacts of the proposed development on the identified EVRs. As the climate changes, however, the International Panel on Climate Change (IPCC) predicts an increase in the frequency, intensity and/or amounts of precipitation in mid-latitude locations and an increase in extreme high sea levels as global ocean levels rise, which can result in inundation, coastal erosion, and salt water intrusion in lower elevation areas (IPCC, 2013).

#### **5.1.2 Geology**

The geology of the subject property is not expected to have any influence on the potential impacts to EVRs from the proposed development.

#### **5.1.3 Soils**

The organic and humic to mesic nature of the soils on site, in combination with the shallow water table, may mean that dewatering is required during development of the site. Dewatering has the potential to affect the water quality in the receiving watercourses and measures must be developed and monitored by a Qualified Environmental Professional to ensure that water quality is maintained. This should be included in the overall Erosion and Sediment Control Plan (ESCP) for the site (see the section on Hydrology below).

Soils will also become compacted during development, which can affect the hydrology of the site and the ability of native vegetation to become established and grow. As such, soil compaction should be minimized and limited only to the proposed development footprint.

The importation of new soils to the site has the potential to introduce invasive plant species. All imported fill should be from a source that is guaranteed to be invasive species free.

#### **5.1.4 Geomorphology**

Being located at approximately 20 m above sea level but within Squamish's Flood Hazard Area, certain measures can be taken to protect future development, including flood proofing ground floor parking and constructing habitable use areas above the protected flood elevations. A Flood Hazard Plan (FHP) will need to be developed in the design stage of the development to address flood issues. As well as addressing flood issues related to the development, the FHP will need address the potential impacts of implementing the plan, which could include altering the local hydrology, potentially increasing soil moisture content within forested areas left at natural grade and potential impacts to vegetated habitats.

#### **5.1.5 Hydrology**

Development can alter the site's hydrology through vegetation removal, soil compaction and surface hardening, all of which reduce the rate of water percolation into the ground and increase surface pooling and overland flow. These activities should therefore be restricted to the development footprint only.

Ground saturation and sub-surface flow patterns are expected to change following development. A Stormwater Management Plan that addresses these changes should be developed during the detailed design stage of the development to ensure that the quantity and quality of stormwater resulting from the development is appropriately dealt with.

Sediment-laden water is expected to be produced during dewatering and all in-water works, including bridge and culvert removals, replacements and upgrades, the infilling of ponds, and aquatic compensation habitat creation and channel enhancements. An Erosion and Sediment Control Plan (ESCP) should be developed prior to the construction phase of the development to ensure that sediment-laden water from the site is not discharged into, or otherwise enter, the watercourses. The ESCP should include provision for environmental monitoring by a Qualified Environmental Professional during all of these works.

## **5.2 Terrestrial Environment**

### **5.2.1 Terrestrial Ecosystem Mapping**

The results of the Terrestrial Ecosystem Mapping were used to determine the potential for species and ecosystems at risk to occur on the subject property, which are discussed separately in the sections below.

### **5.2.2 Plant Species at Risk**

There are no known occurrences of any plant species at risk on the subject property, nor were any observed during the site investigations. Five species, however, were identified as having the potential to occur on the site: Roell's brotherella moss (Red), Vancouver Island beggarticks flowering plant (Blue), *Atrichum flavisetum* moss (Blue), *Callicladium haldanianum* moss (Blue) and *Tripterocladium leucocladulum* moss (Blue). Each species is discussed below.

#### **Roell's Brotherella**

Roell's brotherella is a type of moss and has been listed by COSEWIC as endangered and may be included on SARA Schedule 1 in the future; the populations in BC are the only extant populations in the world (COSEWIC, 2010). It is known to grow on rotten logs, stumps, and at the base of live trees, including bigleaf maple and red alder (COSEWIC, 2010; BC MOE, 2016a); however, its habitat requirements are not well known. Within the study area, this plant has potential to occur on rotting wood in mixed deciduous and coniferous forests and may occur in most TEM polygons with the exception of Polygons 0, 5 and 8. The COSEWIC assessment report (2010) identifies road construction, new housing developments and recreational activities as the main threats to this species.

#### **Vancouver Island Beggarticks**

Vancouver Island beggarticks is a vascular plant in the aster family and is included on the SARA Schedule 1, Part 4 as Special Concern. This species grows in wetland habitats including ditches, willow wetlands, old riverbeds, pond margins and streamsides (BC MOE, 2016a). Distribution of the species is limited by the availability of suitable wetland habitat. It requires fluctuating water levels on an annual basis for germination and seed set (BC MOE, 2016a). It has the potential to be present in all TEM polygons with the exception of Polygon 0.

#### ***Atrichum flavisetum***

*Atrichum flavisetum* is a blue listed moss species. It occurs on banks or stumps in wooded areas, on the roots of fallen trees, in ravines, or in crevices in rock outcrops (eFloras, 2017). It occurs at low to moderate elevations within portions of BC, Washington, Eastern Europe and Asia (eFloras, 2017). It has the potential to occur on undisturbed banks, within forested areas and on rock outcrops on the subject site.

#### ***Callicladium haldanianum***

*Callicladium haldanianum* is a blue listed moss species with the potential to occur in the North Coast and North Island Central Coast, Squamish and Chilliwack Forest Districts, and is associated with the Coastal Western Hemlock biogeoclimatic zone (Coast Forest Conservation Initiative, 2011). It is found on logs and stumps in coniferous and deciduous forests, occasionally at the base of trees. It occurs at low to moderate elevations. It grows in flat or loose extensive mats that are usually devoid of other species (Coast Forest Conservation Initiative, 2011). This species may occur within undisturbed forested areas on the subject property.

### ***Tripterocladium leucocladulum***

*Tripterocladium leucocladulum* is a blue listed moss species that is endemic to the Pacific Northwest (BC MOE, 2016a). It occurs in BC, Washington, Idaho, Oregon and California. It forms dense silky mats on shaded to exposed rocks, cliffs and the bark of hardwoods such as Garry oak, tan oak, canyon live oak and bigleaf maple. It occurs mostly at low elevations (BC MOE, 2016a). This species may occur within undisturbed portions of rock outcrops and on the bark of bigleaf maples within the subject property.

Best management practices should be followed to prevent the irreversible loss of occurrences of these rare and relatively unknown species. Removal of the vegetation and coarse woody debris in all polygons, except Polygon 0, for the proposed development could result in the loss of occurrences of these species. It is recommended that a survey of the potential habitat targeting these species be conducted by a Qualified Environmental Professional (QEP) knowledgeable of these species, prior to any clearing. Surveys for mosses can be conducted at any time of year, provided that there is no snow on the ground, while surveys for the Vancouver Island beggarticks should be conducted in the spring or summer. For any occurrences of these species, the substrate should be carefully relocated to an area adjacent to, but outside of, the proposed development area, having similar vegetation cover, slope and aspect and placed at the same orientation. For occurrences on non-mobile substrates (i.e. at the base of live trees), it is recommended that these trees be felled by hand and the moss encrusted section of stem be relocated accordingly. While this method and its results are untested, this option is preferential to not relocating the mosses. If these species are found within non-mobile rock outcrops, the areas should be protected from development or a strategy for relocation of the species should be devised by a QEP.

## **5.2.3 Ecological Communities at Risk**

Two red listed ecological communities have the potential to occur within TEM Polygons 6 and 10, while the remaining naturally vegetated TEM polygons have the potential to contain blue listed ecological communities at risk. Since listed ecological communities tend to occur in mature and old growth forests, the value of those on the subject property is somewhat diminished. There are no old growth forests and the oldest vegetation is found in the mature forests in Polygons 7 to 10, which are on the younger side of this classification as the oldest trees are estimated to be 80 years old (there are however several isolated veteran trees). The structural stages in the other TEM polygons are even younger. Despite their fragmentation and relatively young age classes, intrusion into these areas should be avoided. The proposed development is largely confined to areas previously cleared for the golf course development (Polygon 0) with existing forested vegetation being removed only in Polygon 1 and non-riparian portions of Polygon 11.

## **5.2.4 Invasive Species**

Management of the invasive species on site presents an opportunity for restoration, as the appropriate treatment or removal of these will improve the ecological condition of the site. Himalayan blackberry and policeman's helmet were the only invasive species observed. Himalayan blackberry was abundant along the majority of the golf course fairways, while policeman's helmet appeared to be confined to cart path verges in the vicinity of No Name and Thunderbird Creeks. Other invasive species are anticipated to occur in lower densities. An extensive invasive species inventory should be conducted prior to development and an invasive species management plan (ISMP) should be prepared. An ISMP is typically a requirement of the District of Squamish for a site alteration permit (required for any soil



movement and/or vegetation clearing). It is important that all fill materials and machinery are free of invasive species to prevent the introduction of additional invasive species on the site.

## **5.2.5 Other Environmentally Valuable Resources**

### **5.2.5.1 Wildlife Trees**

Wildlife trees on the subject site, particularly mature trees and snags, may present safety concerns both during and after construction due to the potential for wind fall and limb drop. Precautions should be taken to identify and manage potential hazard trees, while maintaining as many of these as possible for wildlife habitat. An assessment of the site should be conducted by a certified Wildlife/Danger Tree Assessor prior to the removal of any wildlife trees. As the majority of the wildlife trees on the subject property are located within the riparian areas, these will be retained within the riparian setback areas with the development plan being proposed. The assessment should include appropriate mitigation/compensation. In the event that valued wildlife trees need to be removed for safety concerns, appropriate mitigation and compensation measures should be followed that conform to the Best Management Practices for Tree Topping, Limbing and Removal in Riparian Areas (MOE, 2009), Riparian Restoration Guidelines (BC MOE, 2008) and the Tree Replacement Criteria (BC MELP, 1996).

### **5.2.5.2 Coarse Woody Debris**

The presence of coarse woody debris (CWD) on the subject site presents valuable habitat to species of small mammals, reptiles and amphibians, including some species at risk, as well as potentially some moss species at risk. The proposed development is mainly located in the area of the golf course fairway where little to no CWD is present and therefore the proposed development should have minimal impact on the amount of CWD. Coarse woody debris in forested areas to be developed and resulting from the removal of trees should be retained on site and relocated to the wetland and riparian restoration areas. This will provide wildlife habitat and an opportunity to further enhance this habitat. As many pieces of varying sizes and stages of decay should be retained and relocated as possible.

### **5.2.5.3 Wildlife Movement Corridors**

The proposed development of the fairways could require medium and large mammals, which currently travel through these vacant lands, to alter their movement patterns, likely displacing them to the remaining forested riparian areas that offer more challenging travel conditions but greater cover. Amphibians, reptiles and small mammals, which frequent riparian areas, may be subject to increased predation from the displaced predators. Wildlife movement corridors should be maintained through the subject property and between waterways to prevent further fragmentation of available habitat.

The proposed development will be limited to the previously disturbed golf course fairways and the vegetated riparian areas will remain and be enhanced. The development proposal includes the restoration of riparian and upland non-riparian forested areas, which will increase the size of forested areas on the site and will thus improve wildlife movement corridors through the site. These forested areas will provide corridors along the creeks and along the length of the site, providing east-west and north-south corridors through the site (Map 2).

Several of the existing cart paths which currently pass through the riparian areas will be deactivated or removed, thus removing these barriers to the movement of small wildlife. Wildlife crossing tunnels will be installed under the carpaths that are being retained and roadways in order to maintain and improve habitat connectivity for small animals (Map 3 in Appendix 4).

### **5.2.5.4 Rocky Outcrops**

The rocky outcrops identified on site should remain undisturbed and the existing vegetation retained in order to maintain habitat conditions. As the outcrops are located beyond the footprint of the proposed



development, they are not expected to be directly impacted. Indirect impacts, such as light pollution, should be minimized in the vicinity of these outcrops.

### 5.2.5.5 Sensitive Ecosystems

Development should be designed to protect high value sensitive ecosystems including wetlands, freshwater, riparian areas and mature forest as recorded by Ecoscape (2016a) and observed during field observations. The *Riparian Areas Regulation* (RAR) assessment will result in setback recommendations for wetlands, freshwater and riparian areas, many of which areas contain mature and/or wildlife trees. The proposed development has been designed to protect and enhance these aquatic and associated riparian areas.

## 5.3 Wildlife (Terrestrial and Aquatic)

### 5.3.1 Wildlife

In general, preserving or rehabilitating the environmentally valuable resources, as discussed in the sections above, will serve to protect wildlife values and mitigate development impacts. Additional protection measures are discussed in the sections below.

#### 5.3.1.1 Amphibians, Reptiles and Mammals

Best management practices stated in the *Guideline for Amphibian and Reptile Conservation during Urban and Rural Land Development in British Columbia* (BC MOE, 2014b) and within *Develop with Care* (BC MOE, 2014a) should be adhered to, along with the specific recommendations for species at risk, as detailed in Section 5.3.2. In addition to maintaining wildlife movement corridors, as discussed in Section 5.2.5.3 above, the intact riparian areas on the property should be protected and further fragmentation of riparian habitat should be avoided. The current development plan will maintain these areas as well as widen them in places by restoring previously disturbed golf course fairways with riparian vegetation. In addition, several existing golf cart paths currently bisecting these areas will be removed and restored to riparian habitat. Where cart paths will be retained as footpaths and where roads pass through riparian areas, vertical pony walls will be used to prevent small wildlife from crossing on the roads and wildlife crossing tunnels will be installed beneath these to provide alternative means of passage across the roads.

The proposed development, including residential developments, active parks, and roads and footpaths, should be designed to minimize light pollution. Artificial light at night has the potential to disrupt migrations, feeding and other ecological functions both in terrestrial and aquatic ecosystems (Perkin et al., 2011). Outdoor lighting should conform to the principles of the International Dark Sky Association by discouraging upward lighting and spill lighting, and directing illumination to target areas (City of Toronto, 2007). Rocky outcrops should also be retained in their existing condition.

#### 5.3.1.2 Birds

Under the *Wildlife Act*, birds and active nests are legally protected in British Columbia, while the nests of some raptors and herons are further protected year round. Section 34 of the BC *Wildlife Act* (BC MOE, 1996) states:

*A person commits an offence if the person, except as provided by regulation, possesses, takes, injures, molests or destroys*

*(a) a bird or its egg,*

*(b) the nest of an eagle, peregrine falcon, gyrfalcon, osprey, heron or burrowing owl or,*

*(c) the nest of a bird not referred to in paragraph (b) when the nest is occupied by a bird or its egg.*

Vegetation clearing should occur outside of the typical bird breeding period of April 1 to July 31 to ensure that no active nests are disturbed. If clearing is to take place during this window, a nesting bird survey should be completed by a Qualified Environmental Professional prior to any clearing and any active nests protected with suitable buffers, as determined by the QEP. While the nests of raptors and herons listed in Section 34(b) are further protected year-round, no nests of these species were observed during any site visits and the nest search that was conducted of the study area. A repeat survey should be carried out prior to vegetation clearing to identify and protect any new nests.

Controlled alien species and those listed in Schedule C of the *Wildlife Act* Designation and Exemption Regulation are not covered by the *Wildlife Act*, however, no birds in either of these categories were identified within the study area.

Migratory birds, as defined in Article I of the *Migratory Birds Convention Act*, are also protected under this *Act*, which prohibits the possession of a migratory bird, its nest, or its egg.

### 5.3.2 Wildlife Species at Risk

The Canadian *Species at Risk Act* does not apply to private land in the absence of an issued Emergency Order. All protection of habitat on private land designated as critical in a recovery strategy is voluntary and commonly referred to as stewardship.

The Garibaldi Spring Golf Course is situated within an area where critical habitat for Pacific water shrew (*Sorex bendirii*) (Environment Canada, 2014a) and marbled murrelet (*Brachyramphus marmoratus*) (Environment Canada, 2014b) has been identified within the respective recovery strategies. Recovery strategies are generally prepared at a meso-scale and, as such, site specific habitat conditions are not considered. This “broad brush” approach often results in non-habitat or poor habitat being classified as critical. Such is the case on the subject site where much of the site is golf course or disturbed, making for low value habitat for both marbled murrelet and Pacific water shrew. Stewardship efforts should concentrate on habitat that is truly of value to the species of concern.

Twenty wildlife species at risk, including the Pacific water shrew and marbled murrelet, have potential to occur on site. The following paragraphs detail the habitat preferences, likelihood of occurrence, potential impacts of the development and proposed mitigation measures for each of these species at risk.

#### Keen’s Myotis and Little Brown Myotis

Keen’s myotis (Blue) is a long-eared bat that is well adapted for and forages in old growth forests, however, is not restricted to these habitats (COSEWIC, 2003). They tend to roost in crevices in rocks and beneath boulders and the only known hibernacula have been found in caves on northern Vancouver Island (COSEWIC, 2003). Little brown myotis are more abundant in older forests where snags and hollow trees are available for roosting in (COSEWIC, 2013). The maternity colonies of this species can occur in rock crevices or in tree cavities (COSEWIC, 2013).

These species potentially use the site for foraging habitat only, and will suffer the loss of foraging habitat in the subject development area as well as the loss of adjacent foraging lands that are subject to development by others. As these species do not use this site for breeding or for hibernacula, their residences will not be affected by the proposed development.

#### Cutthroat Trout

Cutthroat trout (Blue) prefer gravelly, lowland streams and lakes (COSEWIC, 2012c). Small, cool, clean streams with gravel are needed for spawning (COSEWIC, 2012c). Cutthroats are known to occur in Meighan Creek (FISS, 2016) and may also be present in the other creeks and ponds on the subject property due to the interconnection of all the watercourses. Several creek crossings are being proposed on the roads and footpaths as detailed on Map 2, including two road crossings of Newport Creek. Low impact creek crossings, such as clear-span bridges, should be used in fish bearing streams. In water works should be minimized whenever possible and must be conducted during the window of least risk for



instream works. Approvals will be required by DFO and the MFLNRORD for any instream works and fish salvages will be required prior to any works that would impact a watercourse.

### **Pacific Water Shrew**

The Pacific water shrew (Red, 1 E) is a semi-aquatic shrew associated with skunk cabbage marshes, red alder-dominated riparian and stream habitats, and dense wet forests of western redcedar (COSEWIC, 2006). The Pacific water shrew (PWS) is known to occur in the Squamish area through the capture of two specimens on the low lying reaches of Thunderbird Creek near the Executive Suites Hotel on April 22, 2008 (Cascade, 2008a). Since this time, Environment Canada have mapped critical habitat for the PWS in Squamish which roughly consists of the area within 100 m of Thunderbird and Meighan Creeks and tributaries (Environment Canada, 2014a). The critical habitat polygon has not been refined to reflect onsite habitat features and, as such, includes both fairways and vegetated riparian areas. Portions of the forested riparian areas within 100 m of a watercourse would be considered as providing the attributes desirable for that species (based on the terrestrial ecosystem site series known to occur in this area) (Craig et al., 2010 and Craig, 2007). The poor habitat of the graminoid vegetated fairways, however, and redevelopment of these areas has been a source of discussion between Cascade, the Ministry of Forests, Lands and Natural Resource Operations and Rural development (MFLNRORD), and Environment Canada (EC) for several years.

The federal *Species at Risk Act* (SARA) speaks to not destroying critical habitat as defined in federal recovery strategies and action plans, although, as noted above SARA is not applicable to private lands in the absence of an issued Emergency Order. Nevertheless, communications with Environment Canada have established that the fairways do not contain critical habitat and protecting the fairways would not be part of the Pacific water shrew recovery plan (Environment Canada, email December 23, 2015). Potential development sites, shown in Map 2, have been focused on previously disturbed fairways and forested areas greater than 30 m from watercourses. Where this forested habitat is contiguous with riparian habitat, and therefore considered to be of moderate quality, this will be compensated for with restored riparian habitat, which, once established, will ultimately provide higher quality habitat for this species. In addition to preserving the identified critical PWS habitat on site, fencing should be installed adjacent to the built portion of the proposed development to restrict riparian access by people and pets.

### **Western Screech-Owl**

There are known occurrences of western screech owls (Blue, 1 T) in the Squamish River Estuary (SECS, 2004; SECS, 1994; Tretheway, 1985) and based on the habitat observed the western screech owl may be present on site. As a Threatened species listed on Schedule 1 of the *Species at Risk Act*, the residences (i.e. occupied nests) of this species are protected. Being in such close proximity to developed urban areas in the town of Squamish, however, it is unlikely that there would be any nesting pairs on site without this being known. This species is known to nest in mature trees in residential areas (COSEWIC, 2012a) and therefore has the potential to occur on site, although the likelihood is low. It is recommended that vegetation clearing take place outside of the bird breeding season, which begins in April, to preclude the necessity to conduct further studies to confirm the presence or absence of screech owl nests at the subject site.

As a precautionary measure, it is further recommended that nesting opportunities be maintained on or near the subject property. Nesting cavities and dead or dying trees in which cavities could be excavated by woodpecker should be assessed for suitability. This species nests in natural cavities, such as rotted out branch cavities, as well as those excavated by larger woodpeckers such as pileated woodpeckers and northern flickers (COSEWIC, 2012a). Preferred trees have diameters at breast height of 25 cm or greater, and include deciduous trees such as black cottonwood and bigleaf maple, and occasionally coniferous trees, all of which are found on site in TEM Polygon 1 (COSEWIC, 2012a). Dense conifer and mixed deciduous/coniferous forests have been identified as necessary for survival (COSEWIC, 2012a).

Observed potential nesting cavities and/or trees should be retained in place (the preferred option) or potential nests relocated (by erecting as snags in a suitable location nearby), if possible. If neither of these options are possible, snags can be created or, as western screech owls are known to nest readily

in suitable nest boxes, nest boxes can be installed (COSEWIC, 2012a; BC MOE, 2014c). Relocated or created snags and nest boxes should be installed in suitable dense habitat either on or adjacent to the subject property (i.e. on the river side of the dike). As suitable cavities are used both for nesting and perching, at least two cavities or nest boxes should be maintained or installed in close proximity to one another, to support a nesting pair (COSEWIC, 2012a). Instructions for constructing and erecting suitable nest boxes can be found online (Audubon, 2002; Strong, 2015). As the majority of the potential nesting trees observed on site were located within the forested riparian areas, these will be retained with the proposed development.

### **Green Heron**

Green heron (Blue) forage in slow moving or shallow water, and nest in dense trees or tall shrubs within 1 km of foraging habitat. They breed as either solitary pairs or widely spread in small colonies, and nests can be used for multiple years. The species is migratory and is at the northern extent of its range in southern British Columbia. Green herons seem to adapt well to coexistence with humans and have bred within the limits of many small to large cities in BC, including Vancouver. (BC MOELP, 1996)

Green heron have been observed on site and suitable foraging areas, including slow moving streams as well as shallow ponds and wetlands, are available within the golf course lands. Dense trees and tall shrubs are also available within 1 km of these waterbodies, so the possibility of nesting on site cannot be excluded. Riparian setbacks will protect the foraging habitat, however, any clearing of dense trees or tall shrubs within 1 km of these waterbodies has the potential to impact nesting habitat. A song bird nest survey will be required if clearing occurs during the bird nesting season of April 1 and July 31. Green herons nest between May 16 and July 31, and old nests may be important platforms for male courtship displays (BC MOELP, 1996), therefore, they should not be destroyed if found.

### **Great Blue Heron**

Great blue heron (Blue, 1 SC) tend to forage along the seacoast, in fresh and saltwater marshes, along rivers and in grasslands. Smaller numbers of herons forage in kelp forests, from wharves and at anthropogenic waterbodies (e.g., ornamental ponds and fish farms). They nest in woodlands near large eelgrass (*Zostera marina*) meadows, along rivers, and in estuarine and freshwater marshes. Nesting colony locations are dynamic, especially in areas of high disturbance. They are mostly arboreal nesters and colonies are typically situated in forests near water. Some colonies are used for many years (usually 25 years), but most colonies and especially those with fewer than 25 nests, are relocated every few years (COSEWIC, 2008).

Great blue herons have been observed on the golf course lands. The multitude of fish-bearing wetlands, ponds and channels offers foraging habitat for the blue heron, and these areas will be protected by riparian setbacks. Since great blue herons nest in conspicuous colonies, whose locations tend to be well known, and no nests were observed, it is highly unlikely that there would be any nesting on the subject site.

### **Red-Legged Frog**

Red-legged frog (Blue, 1 SC) occurs in the Squamish area and was observed on site in TEM Polygon 1 (Photo 36 and Photo 37). Habitat for red-legged frog includes a variety of permanent and temporary freshwater bodies adjacent to areas having significant forest cover and emergent vegetation (BC MOE, 2016b). Suitable terrestrial habitat includes dense riparian vegetation that maintains cool and moist conditions, loose soils, coarse woody debris, and leaf litter (BC MOE, 2016b). All of these habitat features are found in the riparian areas of Newport Creek, No Name Creek, Thunderbird Creek, Meighan Creek and associated wetlands and drainages.

Although young frogs can be found up to 500 m from the breeding sites (BC MOE, 2016b), best management practices for red-legged frogs recommend protecting habitat up to 30-150 m from the high water mark (BC MOE, 2014b). As the proposed development plan will protect the riparian setbacks, this habitat will be protected and it is expected that the development would have minimal impact on the red-legged frog population. It should be noted that roads and footpaths and active parks within the riparian



areas may provide barriers for movement of this species among this habitat. Wildlife crossing tunnels will be installed under roads and footpaths in order to reduce habitat fragmentation and road kill. A search for any frogs should be conducted by a Qualified Environmental Professional prior to any clearing or work occurs on site and any frogs found be relocated outside of the work area, following the appropriate handling protocols for amphibians (BC MOE, 2014b). This might require the installation of isolation fencing along the boundary of the development area to prevent the frogs from returning (as per BC MOE, 2014b).



Photo 40: Northern red legged frog observed on June 30, 2016 in TEM Polygon 1

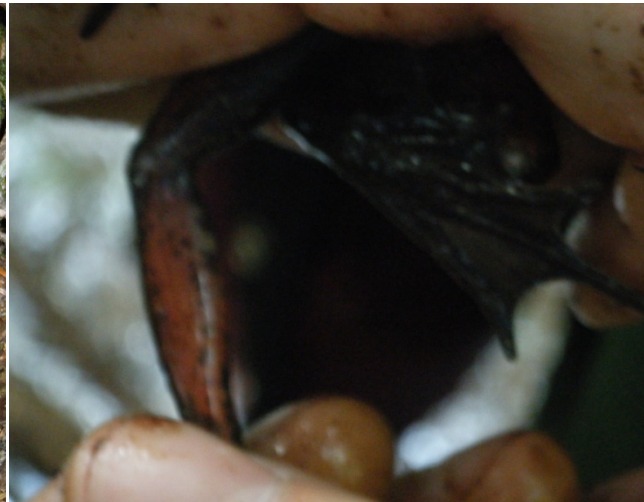


Photo 41: View of the red underside of the leg of the northern red legged frog. June 30, 2016.

### **Western Toad**

Western toads (Blue) breed in a variety of habitat, typically in slow moving waters along the margin of lakes, ponds and streams such as those found on the subject property. During breeding season, large numbers tend to congregate at waterbodies and actively search for mates. They then migrate between breeding habitat and non-breeding upland habitat, including a large variety of habitats such as grasslands, meadows and many different forest types from sea level to the alpine. They are known to migrate up to 1 km from their breeding areas. Western toads have small home ranges of around 0.1 ha and if any do breed on the property, it can be expected that they could migrate to anywhere on the subject property. (BC MOE, 2014d)

Best management practices recommend maintaining a 30 m core area from the high water mark of any watercourse (BC MOE, 2014b). In addition, habitat connectivity should be maintained throughout the site by maintaining corridors of suitable habitat between the ponds and the forested wetland associated with the creeks. The current development plan proposes to maintain the riparian areas and such corridors around the creeks and wetland complexes. Roads, footpaths and areas of active park around the ponds may represent a barrier to dispersal and can fragment the habitat. Under road wildlife crossing tunnels will be installed in order to reduce habitat fragmentation and road kill. A search for western toads should also be conducted pre-clearing, and if any are found, these should be similarly relocated outside of the work area.

### **Rubber Boa**

Rubber boas (Yellow, 1 SC) are frequently found near rocks in forests and clearings in humid mountainous regions or dry lowland areas and are sometimes found in disturbed areas. Specific habitats are required for thermoregulation and overwintering, which include loose soils suitable for burrowing, leaf



litter, woody debris, rocks, outcrops and talus slopes. Rock outcrops, large woody debris and leaf litter on site may provide such suitable habitat.

The *Management Plan for the Northern Rubber Boa* (BC MOE, 2016a) includes a threat classification table in which it is stated that residential and commercial development have a negligible impact on the species, while the severity of any impact would be high. The low threat rating is due in part to the widespread distribution of the species, which counters localized disturbances (BC MOE, 2016a). As the proposed development could directly impact individuals of the species, if present at the site, it is recommended that searches for rubber boas be conducted if clearing of non-fairway lands is considered, concurrently with the amphibian searches, prior to any vegetation clearing and grubbing activities. As they are not easily located during summer, when the snakes tend to take shelter under cover objects during the day, searching under these objects may be required in order to locate them (BC MOE, 2016a).

### **Common Nighthawk**

Common nighthawk (Yellow, 1 T) has been audibly observed foraging above the subject property on July 6, 2016 during the TEM plot survey. The species breeds in a variety of habitat such as short grass prairies, pastures, marshes, lakeshores, river banks, rocky outcrops and urban parks (COSEWIC, 2007). Grassy areas, rock outcrops and urban park habitat are present on the subject property.

The species lays eggs directly on soil or bare rock, therefore in order to minimize the impact on the species, it is recommended that a nest survey should be conducted prior to any ground disturbance on the golf course fairways or on rock outcrops during the bird nesting window of April 1 to July 31.

### **Marbled Murrelet**

The marbled murrelet (Blue, 1 T) is a small seabird that forages in marine nearshore habitat (< 1 km from land) or in sheltered waters (COSEWIC, 2012b). They usually nest within 50 km of the sea, in lower elevation old growth forest providing large trees (typically greater than 30 m tall) with large, mossy boughs (COSEWIC, 2012b). Portions of the existing golf course are within areas where critical habitat for marbled murrelet has been identified in the recovery plan (Environment Canada, 2014b).

Nesting habitat requirements for marbled murrelet are summarized in COSEWIC (2012b), and include:

- Trees of sufficient height to allow stall landings and jump-off departures; trees are typically higher than 30 m with nest trees above the canopy height.
- Openings in the canopy for unobstructed flights access, as is often the case in old grown forests.
- Large branches (15 to 74 cm in diameter) to provide a nest site and landing pad.
- Soft substrate for nest cup, usually a thick moss pad.

As previously mentioned, critical habitat maps are generally prepared at a meso-scale and as such site-specific habitat conditions are not considered. The golf course fairways and adjacent forested lands do not contain the attributes and features required to provide critical habitat, specifically, the existing habitat on the subject site does not meet the criteria for nesting habitat for marbled murrelet. The key requirement for nesting habitat is old growth forest. Surveys of the native vegetation during development of the golf course (NES, 1994), for Terrestrial Ecosystem Mapping for the District of Squamish (Cascade, 2008a and Ecoscapes, 2016a), and during more recent site investigation for this bio-inventory indicate that the bulk of the remaining native vegetation is considered young forest, with a smaller amount of mature forest. No old-growth forest is found on site and the handful of veteran trees on site were examined and found to not contain suitable nesting habitat features.. As such, there is no justification for embarking on a stewardship program to preserve habitat designated as critical when it does not have the necessary attributes for that designation.

### **Other Non-breeding Bird Species at Risk**

The olive-sided flycatcher (Blue, 1 T), rusty blackbird (Blue, 1 SC), Peregrine falcon, *anatum* subspecies (Red, 1 SC), and barn swallow (Blue) all have the potential to use the site during migration or for perching



or foraging. Site conditions do not meet the nesting habitat requirements of these species. As the majority of forested areas on site will be left un-developed, it is unlikely that the migration, perching or foraging activities of these bird species will be impacted. The restoration of currently cleared golf course fairways may even improve the habitat available for these species.

### **Band-tailed Pigeon**

The band-tailed pigeon (Blue, 1 SC) breeds in western regions of the Americas from coastal BC to northern Argentina. Those that breed in south coastal BC often winter in California; however, a few remain in BC for the winter. In BC, these pigeons breed in scattered monogamous pairs from near sea level to 760 m elevation in edges and openings in mature coniferous, mixed and deciduous forest, yards, city parks, wooded groves, open bushland, golf courses and orchards. In BC, they aggregate in favoured feeding areas that offer flowering and berry-producing trees and shrubs, from spring through fall, and are noticeable when relatively large flocks migrate in the fall. Population declines were historically due to overhunting; however, population surveys suggest stabilization of the population between 1998 and 2008. Forestry may negatively affect their habitat by creating dense second-growth forest with few berry-producing shrubs. (COSEWIC, 2008)

Suitable habitat is limited but does exist within the study area. A minimal amount of berry-producing plants provide some foraging habitat. As the majority of the vegetated areas on site will be left un-developed, therefore, it is unlikely that this species will be impacted by the proposed development and the restoration of currently cleared golf course fairways may improve the habitat available to this species. Should vegetation clearing occur during the breeding season of April 1 to July 31, a bird nest survey should be conducted by a Qualified Environmental Professional prior to clearing. Particular attention should be focused along forest edges and openings within the study area. Any active nest will be protected with a species-specific buffer until vacated. The study area does not provide obligate habitat for the band-tailed pigeon and the development of these lands is not expected to impact the survival of individuals or the population.

### **Clodius Parnassian, claudianus subspecies**

*Clodius Parnassian, claudianus* subspecies (Blue) is a white butterfly with dark grey markings (BC MOE, 2016a). It occurs in moist riparian habitats along low-elevation streams, wet subalpine meadows and subalpine riparian areas. On the BC coast the larval foodplant is Pacific bleeding heart, which is a native plant found on site. This butterfly's range includes the southwestern mainland of BC near the coast and Vancouver Island (BC MOE, 2016a). Suitable riparian areas do exist on site. As the riparian areas on site will be protected by riparian buffers, however, it is unlikely that this species will be negatively impacted by the proposed development.

### **Prairie Fossaria, Sunset Physa and Striated Fingernailclam**

The prairie fossaria (Blue) is a species of freshwater snail. Its habitat preferences are not fully known and habitat descriptions vary widely, including perennial-water habitats (lakes, ponds and slow-moving streams), seepage areas and small streams. They are believed to characteristically occur in seasonal flowing water. Their range is thought to include the western and middle parts of the United States and the southern portions of BC. (BC MOE, 2016a).

The sunset physa (Blue) is a freshwater snail. There are only 7 records in BC and these records are spread over broad habitat types including lakes, rivers, creeks and sloughs. Its range spans from BC, where it is fairly common throughout, to California. The habitat preferences of this species are not well defined. (BC MOE, 2016a)

The striated fingernailclam (Blue) is a small clam that occurs in both lotic (flowing) and lentic (still lake or pond) environments. It occurs on mud, sand, gravel and rock substrates and is most abundant at water depths of less than 2 m, although it has been found down to 13.5 m depths. Its range includes most of North America, including 52 of 62 states, provinces and territories. (BC MOE, 2016a)

It is possible that one or more of these freshwater species occur within the creeks, ponds and wetlands on the subject property. The watercourses on the subject property are protected by the Riparian Areas Regulation, however, and the natural watercourses, along with many of the man-made ponds, will not be subject to development. The man-made nature of the two ponds that will be infilled makes occurrences of these species in these ponds very unlikely. It is therefore not expected that these species will be negatively impacted by the development if they do exist on site.

## 5.4 Aquatic and Riparian Environment

### 5.4.1 Riparian Areas Regulation (RAR) and Development Permit Area 1 (DPA 1)

All lands within 30 m of a fish bearing watercourse, or a watercourse that flows into fish bearing waters, within the District of Squamish, and as identified on Schedule K-1 of the District of Squamish Official Community Plan Bylaw No. 2500, 2017, are within Development Permit Area 1 – Environmental Protection, and are subject to a *Riparian Areas Regulation* (RAR) assessment. The protection of riparian areas falls into Section 34.7 Aquatic Guidelines (Riparian Areas and Wetlands) of DPA 1.

The principal objectives of these guidelines is to “protect and avoid degradation of fish and aquatic habitat, associated riparian areas and wetlands; preserve ravines, watercourses, riparian areas and wetlands in their natural state and maintain natural channel alignments wherever possible, unless significant environmental benefit can be gained through alteration; and maintain and apply standards for adequate setbacks, stormwater retention, preservation of natural channels, and other preventative measures during and after the development process to protect fish-bearing stream from pollution, siltation and related degradation.”

The DPA 1 guidelines stipulate how the riparian buffer or SPEA (streamside protection and enhancement area) should be determined, based on the nature of the development, the fish bearing status of the watercourse, the permanence of the watercourse, and whether the waterbody is a natural or an artificial watercourse. In accordance with Table 34-2 of the DPA 1 guidelines, the subject property is classified as Category 2, an existing neighbourhood with subdivision potential (existing neighbourhoods are defined as a neighbourhood that is serviced by municipal sewer or water). Category 2 is further divided into a) lands with development potential of  $\leq 3$  units and b) lands with development potential  $> 3$  units. The project lands would, therefore, be characterised as Category 2b under this definition.

Table 34-2 of the DPA 1 guidelines refers to natural streams, which are defined as, “any stream that is not an artificial watercourse.” Under DPA1, artificial watercourses are defined as, “a constructed watercourse made for drainage purposes, such as a ditch or swale, and does not include fish habitat constructed to compensate for or restore damaged habitat.” All of the watercourses on the subject property are therefore considered natural watercourses under this DPA. For the purposes of calculating the riparian buffers, all the natural streams on site were considered to be fish bearing and permanent as they contained water for more than 6 months of the year.

Under the DPA1 guidelines (Table 34-2), the riparian buffers for natural streams (including wetlands and ponds) would be calculated using the RAR Simple Assessment Method, given the neighbourhood categorization, subdivision potential and the nature of the streams. The Simple Assessment Method requires consideration of three factors:

- 1) The status of the existing and potential vegetation (with vegetation potential occurring in all areas not occupied by permanent structures).
- 2) The fish bearing status and potential fish bearing status of the stream, and
- 3) Whether the stream flow is permanent or non-permanent.



Based on these considerations, the riparian setback, or SPEA, for the natural streams, wetlands and ponds on site would be 30 m. The only exception would be the setback from Meighan Creek in the vicinity of the entrance road and existing clubhouse parking, where the setback would be 15 m, with the entrance road and parking area being retained within the buffer as an existing condition. See below for a discussion on proposed variation from these setbacks.

Additionally, the RAR requires that fencing is installed that delineates the SPEA boundaries and thus prevents encroachment by people and pets and that identifies these areas as sensitive habitat.

### **Variation from the RAR Simple Assessment Method**

The DPA 1 guidelines (Table 34-2) state that “buffer averaging may be considered” where the RAR Simple Assessment Method is used to calculate the riparian setback, “if the reasons or alternative measures are acceptable to the District”. Consideration for variation may include: biophysical conditions; parcel size; and existing and proposed roads and services utility right-of-ways.

The proponent is seeking a variation from the method to be applied to determine the riparian buffer width. In areas that have been previously disturbed and developed as golf course, the proponent is proposing to use the RAR Detailed Assessment Method, as described in *Riparian Areas Regulation Assessment Methodology* version 3.3 (MWLAP and DFO, April 2006, with errata dated December 2012; schedule of the Riparian Area Regulation). In areas not previously disturbed, the Simple Assessment Method would be used. In general, the Detailed Assessment Method would provide for a 24.6 m riparian buffer adjacent to Meighan Creek and 15 m buffers adjacent to the smaller waterbodies, wetlands and ponds on site (Map 6). Where the Detailed Assessment Method would be used, a large percentage of the buffer is currently maintained as golf course fairway. The proposed development plan calls for rehabilitation of the current fairways within the buffers to provide vegetated riparian habitat, except in areas proposed to be used as active parks.

The advantages of using the Detailed Assessment Method versus the Simple Assessment Method are:

1. The Simple Assessment Method was initially designed for application in urban areas of dense development. The Detailed Assessment Method fits the context of the site because the area is already modified for golf and natural habitat preservation opportunities within the developed portion of the golf course are limited.
2. The golf course features would persist as a pre-existing condition under the Simple Assessment Method.
3. Under the Detailed Assessment Method, the requirement for measures within the SPEA provide the qualified environmental professional (QEP) the opportunity to mitigate low value habitat through enhancement.
4. The detailed methodology provides additional opportunities to enhance riparian values within the SPEA and fish habitat, by virtue of offsetting the effects of reduced setbacks.

The obvious disadvantage of using the Detailed Assessment Method versus the Simple Assessment Method is that the riparian buffers would be smaller, however, as indicated above, the extended buffer provided by using the Simple Assessment Method could be maintained in its current state, i.e. grassy area, which would have limited habitat value compared to the enhanced buffer that is being proposed by using the Detailed Assessment Method.

### **5.4.2 Aquatic Habitat**

As previously discussed, all of the streams, ponds and wetlands will be protected under the provincial Riparian Areas Regulation and the District of Squamish Development Permit Area 1. These watercourses are further protected under the provincial *Water Sustainability Act* and federal *Fisheries Act*. Any works affecting these watercourses will therefore also require approval from the Ministry of Forests,

Lands and Natural Resource Operations and Rural Development (MFLNRORD) and Fisheries and Oceans Canada (DFO).

Low impact creek crossings such as clear span bridges and/or arch/box culverts will be used where new and replacement stream crossings are required in order to preserve the aquatic habitat at these locations. A number of culverts will be removed where existing cartpaths will be removed and the aquatic habitat restored, providing an opportunity for enhancement of the aquatic habitat.

Water quality in all of the waterbodies on the property must be maintained and any development activities anticipated to have any effect on this (i.e. instream works and dewatering) should have appropriate mitigation measures developed and be monitored by a QEP. Salvages for fish and amphibians must be conducted prior to any instream works, for which permits are required from the Ministry of Forests, Lands and Natural Resource Operations and Rural Development and Fisheries and Oceans Canada.

### **Streams and Wetlands**

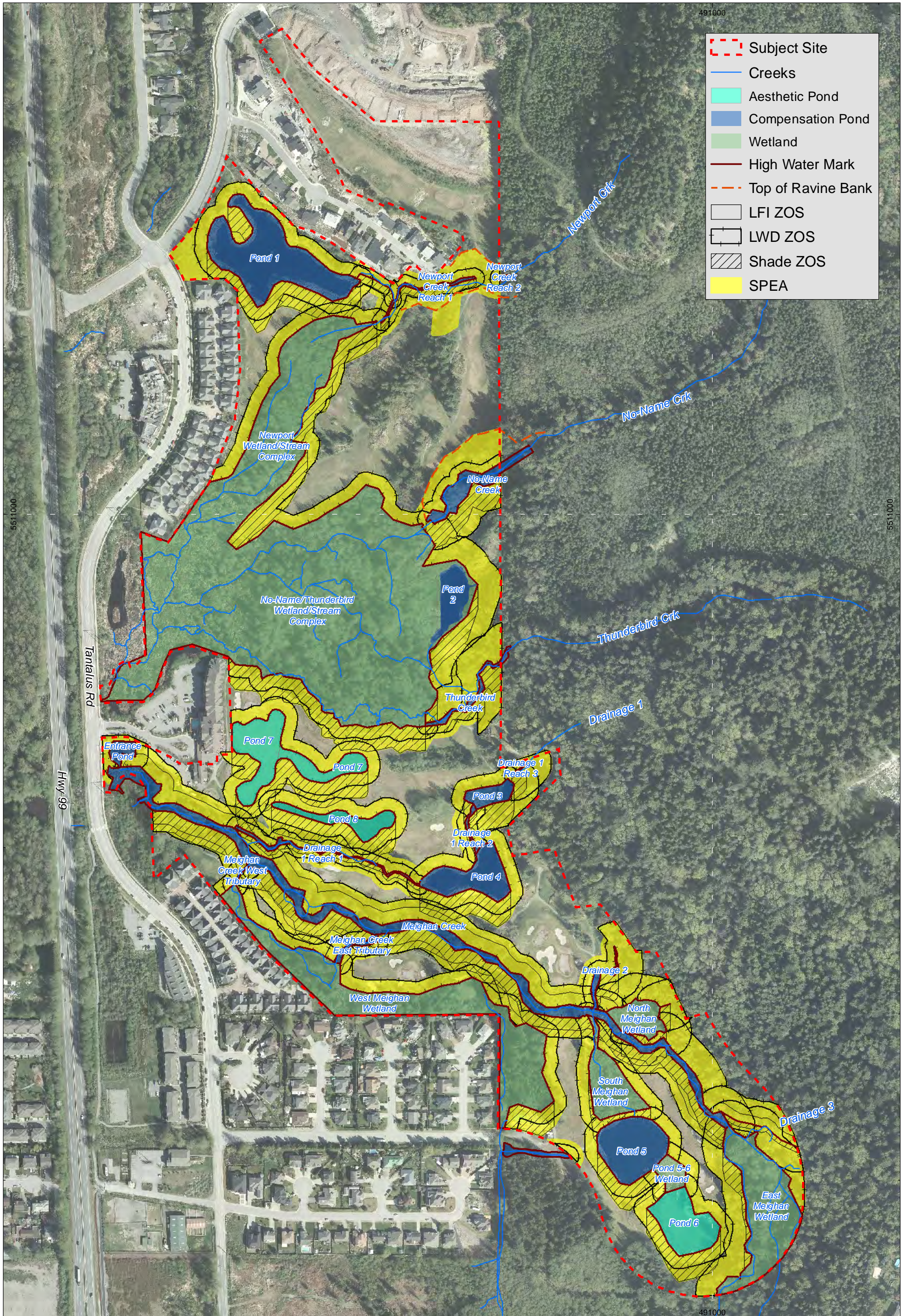
The streams and wetlands identified on the subject property are being protected within the riparian buffers and will therefore not be affected by the proposed development. A number of culverts are proposed to be removed along existing cart paths that will be eliminated while a number of bridge replacements and improvements will also be carried out. As per above, provincial and federal approvals will be required for all of these works, appropriate mitigation measures will have to be developed and monitored by a QEP to protect water quality, and the watercourses must be salvaged for fish and amphibians prior to the works.

### **Ponds**

The proposed development plan calls for the retention of Ponds 1 through 4 as well as Ponds 7 and 8. An emergency access road is proposed along the north side of Pond 1, which is expected to intrude slightly into the pond. Vertical pony walls will be used to minimize the intrusions into the pond. The proposed plan also calls for the complete infilling of Pond 6 and the near-complete infilling of Pond 5. Previous communications have taken place with Fisheries and Oceans Canada (DFO) (circa 2010, between Mike Nelson of Cascade, Doug Day of the GSGC and Francesca Knight of DFO) in regards to the partial infilling of Pond 5 with the intention of decreasing sun exposure on the pond surface and thus decreasing water temperatures and improving downstream fish habitat (Cascade, 2016a). It is the intention of the proponent to provide off-setting measures (compensation) for the loss of these features, via the creation of wetland habitat, based on the area of the ponds. A preliminary habitat balance with pre and post development scenarios is provided in Appendix 4.

### **Habitat Enhancements**

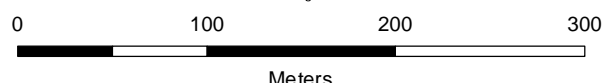
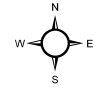
Relatively high water temperatures, low dissolved oxygen levels and low fish counts were observed in all of the fish-bearing ponds (Pond 1, 2, 4 and 5) in September 2006 and in all the ponds in 2016/2017. The decreased water quality is believed to be due to obstructed inlet and/or outlet channels to each pond, combined with lack of shade (shoreline vegetation). Each pond, inlet and outlet should be inspected for restoration potential including increasing connectivity and increasing riparian vegetation, especially on the south and west sides of ponds and watercourses. Channel connectivity enhancements are being proposed between Pond 2 and No-Name Creek, between Ponds 3 and 4, and between Pond 4 and Drainage 1.



- Subject Site
- Creeks
- Aesthetic Pond
- Compensation Pond
- Wetland
- High Water Mark
- Top of Ravine Bank
- LFI ZOS
- LWD ZOS
- Shade ZOS
- SPEA

**Map 6 - Environmentally Valuable Resources:  
Streamside Protection and Enhancement Areas**

Bio-Inventory Assessment  
Garibaldi Springs Golf Course, Polygon Homes  
Squamish, British Columbia



GIS Cartographer: Todd Hellinga  
Date: May 4, 2017  
CERG File#: 725-01-02  
Projection: UTM 10N NAD83  
Orthophoto/Data: DOS



## 6 Conclusion and Recommendations

### 6.1 Conclusions

This report details the findings of the preliminary site assessment as well as site and species specific detailed assessments of environmentally valuable resources (EVRs) on or near (within 100 m of) the subject property, in addition to a discussion of potential impacts on these as a result of the proposed development. Opportunities for restoration are also discussed.

EVRs identified on or near the site include the potential occurrences of 25 species at risk as well as several habitat features, as listed below:

#### Plant Species at Risk

- Roell's brotherella (Red listed moss species)
- Vancouver Island beggarticks (Blue listed flowering plant)
- *Atrichum flavisetum* (Blue listed moss),
- *Callicladium haldanianum* (Blue listed moss)
- *Tripterocladium leucocladulum* (Blue listed moss)

#### Wildlife Species at Risk:

- Western toad (Blue)
- Great blue heron (Blue)
- Green heron (Blue)
- Northern Rubber Boa (Yellow)
- Common nighthawk (Yellow)
- Western screech owl (Blue)
- Keen's myotis (Blue listed bat)
- Little brown myotis (Yellow listed bat)
- Cutthroat trout (Blue)
- Northern red-legged frog (Blue)
- Pacific water shrew (Red)
- Olive-sided flycatcher (Blue)
- Rusty blackbird (Blue)
- Peregrine Falcon, anatum subspecies (Red)
- Barn swallow (Blue)
- Band-tailed pigeon (Blue)
- Prairie Fossaria (Blue listed freshwater snail)
- Clodius Parnassian, claudianus subspecies (Blue listed butterfly)
- Sunset Physa (Blue listed freshwater snail)
- Striated Fingernailclam (Blue listed freshwater clam)

#### Habitat Features

- Creeks and drainages
- Wetlands
- Ponds
- Riparian areas
- Wildlife movement corridors
- Wildlife trees and snags
- Coarse woody debris
- Rocky outcrops



Many opportunities for restoration are present on the subject property. Invasive species can be removed and replaced with desirable native species to improve the habitat quality. Areas currently cleared for golf course fairways can be restored to riparian and upland forested habitat by re-planting with native species. The replanting of riparian vegetation where it is currently lacking around the golf course ponds will provide shade to the ponds and, in turn, moderate water temperatures during summer months. Opportunity to restore the functionality of the previous compensatory habitat also exists. The connectivity of inlet and outlet channels can be improved, in turn, improving water quality and dissolved oxygen levels. The current development proposal also includes the restoration of wetlands in the old golf course fairways as compensation for the infilling of golf course ponds. Any pieces of the coarse woody debris needing to be removed can be relocated to the riparian areas in order to improve habitat in these areas.

Recommendations to mitigate the potential impacts from the proposed development on EVRs on and near the site are provided in the following section.

## **6.2 Recommendations**

Based on the results of the preliminary site survey and detailed site and species assessments, the following recommendations are made to minimize potential negative impacts on the identified EVRs arising from the proposed development:

### Vegetation:

1. Minimize the removal of vegetation, particularly of wildlife trees and snags, and avoid vegetation clearing in riparian areas. Ensure that new construction is confined to areas previously disturbed by the golf course clearing and outside of riparian setback areas. Where possible, wildlife trees and snags that must be removed can be relocated and installed as snags within forested areas to remain.
2. Have a Qualified Environmental Professional (QEP) conduct a targeted survey for Roell's brotherella and Vancouver Island Beggarticks, *Atrichum flavisetum*, *Callicladium haldanianum* and *Tripterocladium leucocladulum* in any area to be cleared of natural vegetation. If any are found, relocate to similar habitat adjacent to the proposed development. Surveys for the Beggarticks should be conducted in the spring or summer prior to land clearing, while surveys for the three moss species should be conducted at any time of year prior to clearing.
3. A comprehensive invasive species survey and management plan that incorporates the recommendations included in this report should be developed by a QEP and implemented for the subject property. The plan should be prepared prior to any land clearing or earthworks, as part of the District of Squamish's Site Alteration Permit.

### Additional EVRs:

4. A Wildlife/Danger Tree Assessment should be conducted along the forest edges by a certified assessor to identify and manage potential danger trees, while maintaining as many as possible for wildlife habitat. A Wildlife/Danger Tree Assessment is also required for the Riparian Areas Regulation (RAR) detailed assessment methodology and should be conducted prior to filing the RAR assessment reports with the province and the District of Squamish. The assessment should include appropriate mitigation/compensation in the event that valued wildlife trees need to be removed for safety concerns. Any mitigation/compensation within the riparian areas should conform to the Best Management Practices for Tree Topping, Limbing and Removal in Riparian Areas (MOE, 2009), Riparian Restoration Guidelines (BC MOE, 2008) and the Tree Replacement Criteria (BC MELP, 1996).
5. Retain as many pieces of coarse woody debris (CWD) as possible and any pieces needing to be moved, or resulting from the removal of trees, should be relocated to the wetland and riparian restoration areas.



6. Preserve connectivity for wildlife among riparian habitats and install wildlife crossing tunnels under paths and roadways to preserve connectivity for small mammals, amphibians and reptiles. Any planting within riparian areas should include plant species that generate low vegetative cover, suitable for Pacific water shrew.

Wildlife:

7. All vegetation removal should occur outside of bird nesting season (April 1 to July 31) or should be surveyed for the presence of active bird nests by a QEP prior to any clearing. Particular attention should be focused along forest edges and openings where band-tailed pigeon nests may occur.
8. A search for common nighthawk nests should be conducted prior to any ground disturbance on the golf course fairways or rock outcrops between April 1 and July 31.
9. Conduct additional call playback surveys (4-5 in total) for western screech-owls during the breeding season (i.e. mid-March to late May) to confirm whether any occur within the study area (BC MSRM, 2001). If a nest is located, this should be protected year round by a 200 m buffer with an additional 100 m quiet buffer during the nesting period of February 17 – September 6 (BC MOE, 2014c).
10. A search for any red-legged frogs, western toads, or rubber boas should be conducted by a QEP prior to any clearing and any individuals found should be relocated to suitable riparian areas. Note that this may require installation of isolation fencing along the development area boundary.
11. A salvage for fish and amphibians should be conducted prior to any work impacting a watercourse, which will require permits from MFLNRORD and DFO.
12. Minimize light pollution within preserved forested and riparian areas and around rocky outcrops by avoiding lighting in these areas and directing lighting away from these areas. Outdoor lighting should conform to the principles of the International Dark Sky Association by discouraging upward lighting and spill lighting, and directing illumination to target areas (City of Toronto, 2007).

Riparian Environment:

13. Complete a Riparian Areas Regulation (RAR) assessment of the waterbodies onsite and ensure that the Streamside Protection and Enhancement Areas are protected throughout construction. The RAR assessment needs to be filed with the province and the District of Squamish prior to development (which includes subdivision, vegetation clearing and building). Any variations to the RAR and DPA 1 as well as compensation and potential restoration works to ponds, riparian areas or connective channels should be proposed at that time.
14. As part of RAR requirements and stewardship activities to protect the Pacific water shrew, riparian areas adjacent to the development will be fenced and informative signage relating to the preservation and restricted uses of these areas will be installed. Access by people and pets will be restricted where appropriate to protect and allow for regeneration of high quality riparian habitat.

Aquatic Environment:

15. Low impact creek crossings such as clear span bridges and/or arch culverts/box culverts should be used where new and replacement stream crossings will be installed. Permitting for stream crossings will be required from the MFLNRORD under the *Water Sustainability Act* and from DFO under the *Fisheries Act*.
16. Approval from the MFLNRORD under the *Water Sustainability Act* and Authorization from DFO under the *Fisheries Act* will be required for infill Pond 6 and partially infill Pond 5. An appropriate mitigation and off-setting plan will need to be developed as compensation for any habitat losses, both aquatic and riparian.



17. A Stormwater Management Plan that appropriately deals with the anticipated stormwater flows expected on the subject property following development and an Erosion and Sediment Control Plan that ensures that sediment-laden water from the site is not discharged into, or other enter, the watercourses during site preparation, construction and post-construction are both required to be developed.
18. Water quality in waterbodies on or adjacent to the site must be maintained throughout all works and any construction activities anticipated to have any potential effect on water quality (i.e. dewatering or in-stream works) should have mitigation measured developed and monitored by a QEP.

General:

19. Minimize soil compaction and restrict this to the proposed development footprint.
20. Development and construction of the property should follow guidelines and recommendations outlined in: *Environmental Best Management Practices for Urban and Rural Land Development* (BC MOE, 2014a). This includes best management recommendations for storm water, pollution prevention and wildlife and ecosystem management.

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## 9 Statement of Limitations

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This document should not be construed to be:

- A Phase 1 - Environmental Site Assessment
- A Stage 1 – Preliminary Site Investigation (as per the Contaminated Sites Regulation of the Environmental Management Act)



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## 10 Appendices



**Appendix 1 – Preliminary Site Survey Table**

Environmentally Valuable Resources on or near development site	Yes	No	Un-known	Comments
<b>Terrestrial ecosystems in relatively unmodified state:</b>				
• conifer-dominated older forests or mature forests (>100 years old)		X		
• conifer-dominated second growth forests (60-100 years old)	X			<b>See Section 4.2.1.2 (TEM Polygon 7, 9 and 10)</b>
• grasslands/shrub /herb communities		X		
• deciduous woodlands	X			<b>See Section 4.2.1.2 (TEM Polygon 5 and 8)</b>
• coastal bluffs		X		
• sparsely vegetated (e.g., sand dunes)		X		
• cliffs/rock faces/talus slopes		X		
<b>Ecosystems at risk:</b>				
• ecological communities on Conservation Data Centre Red or Blue Lists	X			<b>See Sections 4.2.3 &amp; 5.2.3</b>
• sensitive ecosystems (ecosystem types identified by Sensitive Ecosystems Inventories)	X			<b>See Sections 4.2.5 and 5.2.5</b>
• areas identified as environmentally sensitive areas by local governments	X			<b>See Map 4 (Species at Risk Critical Habitat Map), Sections 4.2.5.5 and 5.2.5.5</b>
<b>Aquatic or riparian ecosystems:</b>				
• seasonal or permanent watercourses (streams, creeks, rivers, ditches)	X			<b>See Sections 4.4 and 5.4</b>
• seasonal or permanent wetlands	X			
• groundwater springs and seepages, or vernal pools		X		
• lakes or ponds	X			
• riparian ecosystems beside these aquatic ecosystems	X			
• vegetated gullies		X		

<b>Species at risk and their habitats:</b>				
species at risk identified by COSEWIC	X			<b>See Sections 4.2.2 and 5.2.2 (Plants) &amp; Sections 4.3.2 and 5.3.2 (Wildlife)</b>
species on provincial Red and Blue Lists	X			
regionally significant species	X			
habitats for any of these species	X			
<b>Significant habitat features, e.g.,:</b>				
• wildlife trees	X			<b>See Sections 4.2.5.1 and 5.2.5.1</b>
• rotting logs and other coarse woody debris	X			<b>See Sections 4.2.5.2 and 5.2.5.2</b>
• caves		X		
• cliffs and rocky outcrops	X			<b>See Sections 4.2.5.4 and 5.2.5.4</b>
• seasonally flooded fields		X		
• hedges and shelterbelts		X		
• old buildings potentially used by bats or birds		X		
• other				
<b>Areas of significant use by wildlife—e.g.,:</b>				
• wildlife travel corridors	X			<b>See Sections 4.2.5.3 and 5.2.5.3</b>
• ungulate winter ranges; spring forage sites		X		
• den sites (badger, snake, etc.)		X		
• perch trees, raptor or heron nest sites	X			<b>See Sections 4.2.5.1 and 5.2.5.1</b>
• other				

If the following elements occur on the development site, recommendations for applying restoration measures may be needed:

<b>Potential for restoration on development site</b>	<b>Yes</b>	<b>No</b>	<b>Un-known</b>	<b>Comments</b>
• Streams in culverts	X			<b>See Sections 4.4 and 5.4</b>
• Degraded ecosystems, including riparian zones	X			<b>See Section 4.2.1.2 (TEM Polygon 0 – Golf course) and Section 6.1 (Conclusions)</b>
• Invasive species control	X			<b>See Sections 4.2.4 and 5.2.4</b>



## Appendix 2 – Potential Wildlife Species

**Table A-1: Potential Bird Species**

Common Name	Scientific Name
Blackbird - Brewer's	<i>Euphagus cyanocephalus</i>
Blackbird - Red-winged	<i>Agelaius phoeniceus</i>
Bufflehead	<i>Bucephala albeola</i>
Bushtit	<i>Psaltriparus minimus</i>
Chickadee - Black-capped	<i>Parus atricapillus</i>
Chickadee – Chestnut-backed	<i>Parus rufescens</i>
Cormorant – Double Crested	<i>Phalacrocorax auritus</i>
Creeper – Brown	<i>Certhia americana</i>
Crossbill – Red	<i>Loxia curvirostra</i>
Crow - Northwestern	<i>Corvus caurinus</i>
Dipper – American	<i>Cinclus mexicanus</i>
Duck – Wood	<i>Aix sponsa</i>
Eagle – Bald	<i>Haliaeetus leucocephalus</i>
Falcon - Peregrine	<i>Falco peregrinus</i>
Finch - Purple	<i>Carpodacus purpureus</i>
Finch - House	<i>Carpodacus mexicanus</i>
Flicker - Northern	<i>Colaptes auratus</i>
Flycatcher – Hammond's	<i>Empidonax hammondii</i>
Flycatcher – Pacific-slope	<i>Empidonax difficilis</i>
Flycatcher – Willow	<i>Empidonax trailii</i>
Gadwall	<i>Anas strepera</i>
Goldeneye – Barrow's	<i>Bucephala islandica</i>
Goldeneye – Common	<i>Bucephala clangula</i>
Goldfinch - American	<i>Carduelis tristis</i>
Goose – Canada	<i>Branta canadensis</i>
Grebe – Eared	<i>Podiceps nigricollis</i>
Grebe – Pied-billed	<i>Podilymbus podiceps</i>
Grosbeak - Black-headed	<i>Pheucticus melanocephalus</i>
Gull – Glaucus Wing	<i>Larus glaucescens</i>
Gull – Mew	<i>Larus canus</i>
Hawk- Red-tailed	<i>Buteo jamaicensis</i>



<b>Common Name</b>	<b>Scientific Name</b>
Heron – Great Blue	<i>Ardea Herodias fannini</i>
Hummingbird - Rufous	<i>Selasphorus rufus</i>
Jay - Steller's	<i>Cyanocitta stelleri</i>
Junco - Dark-eyed	<i>Junco hyemalis</i>
Killdeer	<i>Charadrius vociferus</i>
Kingbird - Western	<i>Tyrannus verticalis</i>
Kingfisher – Belted	<i>Ceryle alcyon</i>
Kinglet - Golden –crowned	<i>Regulus satrapa</i>
Kinglet - Ruby –crowned	<i>Regulus calendula</i>
Loon - Common	<i>Gavia immer</i>
Loon – Yellow Billed	<i>Gavia adamsii</i>
Mallard	<i>Anas platyrhynchos</i>
Merganser – Common	<i>Mergus merganser</i>
Merganser – Hooded	<i>Lophodytes cucullatus</i>
Nighthawk – Common	<i>Chordeiles minor</i>
Nuthatch - Red-breasted	<i>Sitta canadensis</i>
Osprey	<i>Pandion haliaetus</i>
Owl – Barred	<i>Strix varia</i>
Owl – Great Horned	<i>Bubo virginianus</i>
Owl – Northern Pygmy	<i>Glaucidium gnoma</i>
Owl – Western Screech	<i>Megascops kennicottii</i>
Pine Siskin	<i>Carduelis pinus</i>
Pigeon – Band-tailed	<i>Columbia fasciata</i>
Pigeon – Rock	<i>Columbia livia</i>
Pipit – American	<i>Anthus rubescens</i>
Raven – Common	<i>Corvus corax</i>
Robin – American	<i>Turdus migratorius</i>
Sandpiper – Spotted	<i>Actitis macularia</i>
Sapsucker – Red-breasted	<i>Sphyrapicus ruber</i>
Sparrow - Fox	<i>Passerella iliaca</i>
Sparrow - House	<i>Passer domesticus</i>
Sparrow - Golden-crowned	<i>Zonotrichia atricapilla</i>
Sparrow - Lincoln's	<i>Melospiza lincolni</i>



<b>Common Name</b>	<b>Scientific Name</b>
Sparrow - Savannah	<i>Passerculus sandwichensis</i>
Sparrow – Song	<i>Melospiza melodia</i>
Sparrow - White-crowned	<i>Zonotrichia leucophrys</i>
Starling - European	<i>Sturnus vulgaris</i>
Swallow - Barn	<i>Hirundo rustica</i>
Swallow – Northern Rough-winged	<i>Stelgidopteryx serripennis</i>
Swallow - Tree	<i>Tachycineta bicolor</i>
Swallow - Violet-green	<i>Tachycineta thalassina</i>
Tanager – Western	<i>Piranga ludoviciana</i>
Teal – Cinnamon	<i>Anas cyanoptera</i>
Thrush – Hermit	<i>Catharus guttatus</i>
Thrush – Swainson’s	<i>Catharus ustulatus</i>
Thrush – Varied	<i>Ixoreus naevius</i>
Towhee - Spotted	<i>Pipilo erythrophthalmus</i>
Vireo - Hutton’s	<i>Vireo huttoni</i>
Vireo – Warbling	<i>Vireo gilvus</i>
Vulture – Turkey	<i>Cathartes aura</i>
Warbler – MacGillivray’s	<i>Oporornis tolmiei</i>
Warbler – Orange-crowned	<i>Vermivora celata</i>
Warbler – Townsend’s	<i>Dendroica townsendii</i>
Warbler – Wilson’s	<i>Wilsonia pusilla</i>
Warbler – Yellow	<i>Dendroica petechia</i>
Waxwing – Cedar	<i>Bombycillia cedrorum</i>
Widgeon – American	<i>Anas americana</i>
Woodpecker - Downy	<i>Picoides pubescens</i>
Woodpecker – Hairy	<i>Picoides villosus</i>
Woodpecker - Pileated	<i>Dryocopus pileatus</i>
Wood-Pewee – Western	<i>Contopus sordidulus</i>
Wren – Winter	<i>Troglodytes</i>
Yellowthroat – Common	<i>Geothlypis trichas</i>

Sources: SECS, 2004; SECS, 1994; Tretheway, 1985.



**Table A-2: Potential Mammal Species**

<b>Common Name</b>	<b>Scientific Name</b>
Bats	<i>Myotis</i> spp.
Beaver	<i>Castor canadensis</i>
Black bear	<i>Ursus americanus</i>
Black-tailed deer	<i>Odocoileus hemionus columbianus</i>
Bobcat	<i>Lynx rufus</i>
Chipmunks	<i>Sciuridae</i> spp.
Common water shrew	<i>Sorex palustris</i>
Cougar	<i>Puma concolor</i>
Coyote	<i>Canus latrans</i>
Harbour seal	<i>Phoca vitulina</i>
Long-tailed weasel	<i>Mustela frenata</i>
Mink	<i>Mustela vison</i>
Mice	<i>Peromyscus</i> spp.
Pacific water shrew	<i>Sorex bendirii</i>
Raccoon	<i>Procyon lotor</i>
River otter	<i>Lontra canadensis</i>
Spotted skunk	<i>Spilogale gracilis</i>
Squirrels	<i>Tamiasciurus</i> spp.
Voies	<i>Microtus</i> spp.

### Appendix 3 – Fish Sampling Data

Daily Fish Collection				
Date: 16/07/21		Project Number:725-01-02		
Time:9:00		Field Crew: VL, AB		
Location: Garibaldi Springs		Weather: Sunny warm		
Waterbody Name: Big pond C1		Waterbody Type: Pond		
Location on Waterbody: MT 1		UTM Coordinates: 490436.77 E 5510718.11 N		
MOE licence number: SU16-230153		DFO licence number:		
Water Quality Data				
Turbidity (NTU): -		Visibility: <input type="checkbox"/> Clear <input type="checkbox"/> Lightly Turbid <input type="checkbox"/> Moderately Turbid   x Turbid		
Water Temperature (°C): -		Conductivity (µS/cm): -		
pH: -		D.O. (mg/L): -		
Fish Collection Data				
Method(s) Used: <input type="checkbox"/> EF   x MT <input type="checkbox"/> NS		Project Type: x Inventory <input type="checkbox"/> Salvage		
Minnow Trapping (MT)				
Number of Traps:1	Traps Set at:   x Surface <input type="checkbox"/> Midwater <input type="checkbox"/> Bottom		Trap Depth (m):0.3 m	
Time Set:9:00	Time Retrieved:9:00	Soak Time (hrs):24		
Individual Fish Data				
Species	Length (mm)	Weight (g)	Stage	Total Caught
Stickleback	40			3
Stickleback	30			4
NW Salamander				1



Total number of fish collected: 7 (and salamander)

Comments (additional species caught):

Daily Fish Collection				
Date: 16/07/21		Project Number:725-01-02		
Time: 9:00		Field Crew: VL, AB		
Location: Garibaldi Springs		Weather: Sunny Warm		
Waterbody Name: Big pond C1		Waterbody Type: Pond		
Location on Waterbody: MT 2		UTM Coordinates: 490436.77 E 5510718.11 N		
MOE licence number: SU16-230153		DFO licence number:		
Water Quality Data				
Turbidity (NTU): -		Visibility: <input type="checkbox"/> Clear <input type="checkbox"/> Lightly Turbid <input type="checkbox"/> Moderately Turbid <input checked="" type="checkbox"/> Turbid		
Water Temperature (°C): -		Conductivity (µS/cm): -		
pH: -		D.O. (mg/L): -		
Fish Collection Data				
Method(s) Used: <input type="checkbox"/> EF <input checked="" type="checkbox"/> MT <input type="checkbox"/> NS		Project Type: <input checked="" type="checkbox"/> Inventory <input type="checkbox"/> Salvage		
Minnow Trapping (MT)				
Number of Traps:1	Traps Set at: <input type="checkbox"/> Surface <input type="checkbox"/> Midwater <input checked="" type="checkbox"/> Bottom		Trap Depth (m):0.3 m	
Time Set:9:00	Time Retrieved:9:00		Soak Time (hrs):24	
Individual Fish Data				
Species	Length (mm)	Weight (g)	Stage	Total Caught



Stickleback	40			1
NW Salamander				3
Total number of fish collected: 1 (and 3 salamander)				
Comments (additional species caught):				

Daily Fish Collection	
Date: 16/07/21	Project Number:725-01-02
Time:9:00	Field Crew: VL, AB
Location: Garibaldi Springs	Weather: Sunny warm
Waterbody Name: Big pond C1	Waterbody Type: Pond
Location on Waterbody: MT 3	UTM Coordinates: 490436.77 E 5510718.11 N
MOE licence number: SU16-230153	DFO licence number:
Water Quality Data	
Turbidity (NTU): -	Visibility: <input type="checkbox"/> Clear <input type="checkbox"/> Lightly Turbid <input type="checkbox"/> Moderately Turbid <input checked="" type="checkbox"/> Turbid
Water Temperature (°C): -	Conductivity (µS/cm): -
pH: -	D.O. (mg/L): -
Fish Collection Data	
Method(s) Used: <input type="checkbox"/> EF <input checked="" type="checkbox"/> MT <input type="checkbox"/> NS	Project Type: <input checked="" type="checkbox"/> Inventory <input type="checkbox"/> Salvage
Minnow Trapping (MT)	
Number of Traps:1	Traps Set at: <input type="checkbox"/> Surface <input type="checkbox"/> Midwater <input type="checkbox"/> Bottom
Trap Depth (m):0.3 m	



Time Set:9:00	Time Retrieved:9:00	Soak Time (hrs):24		
Individual Fish Data				
Species	Length (mm)	Weight (g)	Stage	Total Caught
				0
Total number of fish collected: 0				
Comments (additional species caught):				

Daily Fish Collection	
Date: 16/07/21	Project Number:725-01-02
Time:9:00	Field Crew: VL, AB
Location: Garibaldi Springs	Weather: Sunny warm
Waterbody Name: Big pond C1	Waterbody Type: Pond
Location on Waterbody: MT 4	UTM Coordinates: 490430.95 E 5510658.52 N
MOE licence number: SU16-230153	DFO licence number:
Water Quality Data	
Turbidity (NTU): -	Visibility: <input type="checkbox"/> Clear <input type="checkbox"/> Lightly Turbid <input type="checkbox"/> Moderately Turbid <input checked="" type="checkbox"/> Turbid
Water Temperature (°C): -	Conductivity (µS/cm): -
pH: -	D.O. (mg/L): -
Fish Collection Data	
Method(s) Used: <input type="checkbox"/> EF <input checked="" type="checkbox"/> MT <input type="checkbox"/> NS	Project Type: <input checked="" type="checkbox"/> Inventory <input type="checkbox"/> Salvage



Minnow Trapping (MT)				
Number of Traps:1		Traps Set at: <input type="checkbox"/> Surface <input type="checkbox"/> Midwater <input type="checkbox"/> Bottom		Trap Depth (m):0.3 m
Time Set:9:00		Time Retrieved:9:00		Soak Time (hrs):24
Individual Fish Data				
Species	Length (mm)	Weight (g)	Stage	Total Caught
				0
Total number of fish collected: 0				
Comments (additional species caught):				

Daily Fish Collection	
Date: 16/07/21	Project Number:725-01-02
Time:9:00	Field Crew: VL, AB
Location: Garibaldi Springs	Weather: Sunny warm
Waterbody Name: Big pond C1	Waterbody Type: Pond
Location on Waterbody: MT 5	UTM Coordinates: 490430.95 E 5510658.52 N
MOE licence number: SU16-230153	DFO licence number:
Water Quality Data	
Turbidity (NTU): -	Visibility: <input type="checkbox"/> Clear <input type="checkbox"/> Lightly Turbid <input type="checkbox"/> Moderately Turbid <input checked="" type="checkbox"/> Turbid
Water Temperature (°C): -	Conductivity (µS/cm): -



pH: -		D.O. (mg/L): -		
Fish Collection Data				
Method(s) Used: <input type="checkbox"/> EF <input checked="" type="checkbox"/> MT <input type="checkbox"/> NS		Project Type: <input checked="" type="checkbox"/> Inventory <input type="checkbox"/> Salvage		
Minnow Trapping (MT)				
Number of Traps:1		Traps Set at: <input type="checkbox"/> Surface <input type="checkbox"/> Midwater <input type="checkbox"/> Bottom		Trap Depth (m):0.3 m
Time Set:9:00		Time Retrieved:9:00		Soak Time (hrs):24
Individual Fish Data				
Species	Length (mm)	Weight (g)	Stage	Total Caught
NW salamander				1
Total number of fish collected: 1 salamander				
Comments (additional species caught):				

Daily Fish Collection	
Date: 16/07/21	Project Number:725-01-02
Time: 9:00	Field Crew: VL, AB
Location: Garibaldi Springs	Weather: Sunny warm
Waterbody Name: small pond (non-fish habitat) C2	Waterbody Type: Pond
Location on Waterbody: MT 6	UTM Coordinates: 490493.48 E 5510641.05 N
MOE licence number: SU16-230153	DFO licence number:



Water Quality Data				
Turbidity (NTU): -		Visibility: <input type="checkbox"/> Clear <input type="checkbox"/> Lightly Turbid <input type="checkbox"/> Moderately Turbid <input checked="" type="checkbox"/> Turbid		
Water Temperature (°C): -		Conductivity (µS/cm): -		
pH: -		D.O. (mg/L): -		
Fish Collection Data				
Method(s) Used: <input type="checkbox"/> EF <input checked="" type="checkbox"/> MT <input type="checkbox"/> NS		Project Type: <input checked="" type="checkbox"/> Inventory <input type="checkbox"/> Salvage		
Minnow Trapping (MT)				
Number of Traps:1	Traps Set at: <input type="checkbox"/> Surface <input type="checkbox"/> Midwater <input type="checkbox"/> Bottom		Trap Depth (m):0.3 m	
Time Set:9:00	Time Retrieved:9:00	Soak Time (hrs):24		
Individual Fish Data				
Species	Length (mm)	Weight (g)	Stage	Total Caught
				0
Total number of fish collected: 0				
Comments (additional species caught):				

Daily Fish Collection	
Date: 16/07/21	Project Number:725-01-02
Time: 9:00	Field Crew: VL, AB
Location: Garibaldi Springs	Weather: Sunny warm



Waterbody Name: small pond (non-fish habitat) C2		Waterbody Type: Pond		
Location on Waterbody: MT 7		UTM Coordinates: 490548.59 E 5510629 N		
MOE licence number: SU16-230153		DFO licence number:		
Water Quality Data				
Turbidity (NTU): -		Visibility: <input type="checkbox"/> Clear <input type="checkbox"/> Lightly Turbid <input type="checkbox"/> Moderately Turbid <input checked="" type="checkbox"/> Turbid		
Water Temperature (°C): -		Conductivity (µS/cm): -		
pH: -		D.O. (mg/L): -		
Fish Collection Data				
Method(s) Used: <input type="checkbox"/> EF <input checked="" type="checkbox"/> MT <input type="checkbox"/> NS		Project Type: <input checked="" type="checkbox"/> Inventory <input type="checkbox"/> Salvage		
Minnow Trapping (MT)				
Number of Traps:1	Traps Set at: <input type="checkbox"/> Surface <input type="checkbox"/> Midwater <input type="checkbox"/> Bottom		Trap Depth (m):0.3 m	
Time Set:9:00	Time Retrieved:9:00	Soak Time (hrs):24		
Individual Fish Data				
Species	Length (mm)	Weight (g)	Stage	Total Caught
				0
Total number of fish collected: 0				
Comments (additional species caught):				



Daily Fish Collection				
Date: 16/07/21		Project Number:725-01-02		
Time: 9:00		Field Crew: VL, AB		
Location: Garibaldi Springs		Weather: Sunny warm		
Waterbody Name: small pond (non-fish habitat) C2		Waterbody Type: Pond		
Location on Waterbody: MT 8		UTM Coordinates: 490548.59 E 5510629 N		
MOE licence number: SU16-230153		DFO licence number:		
Water Quality Data				
Turbidity (NTU): -		Visibility: <input type="checkbox"/> Clear <input type="checkbox"/> Lightly Turbid <input type="checkbox"/> Moderately Turbid <input checked="" type="checkbox"/> Turbid		
Water Temperature (°C): -		Conductivity (µS/cm): -		
pH: -		D.O. (mg/L): -		
Fish Collection Data				
Method(s) Used: <input type="checkbox"/> EF <input checked="" type="checkbox"/> MT <input type="checkbox"/> NS		Project Type: <input checked="" type="checkbox"/> Inventory <input type="checkbox"/> Salvage		
Minnow Trapping (MT)				
Number of Traps:1	Traps Set at: <input type="checkbox"/> Surface <input type="checkbox"/> Midwater <input type="checkbox"/> Bottom		Trap Depth (m):0.3 m	
Time Set:9:00	Time Retrieved:9:00	Soak Time (hrs):24		
Individual Fish Data				
Species	Length (mm)	Weight (g)	Stage	Total Caught
NW salamander				1
Total number of fish collected: 1 salamander				



Comments (additional species caught):



Daily Fish Log				
MOE licence number: SU16-230154		DFO licence number: XR 337 2016		
Project number: 725-01-05		Site number: Pond E		
Contractor:		Field team: SF, KV, RB		
Date: 2016/10/17		Waterbody name: Unnamed pond at Garibaldi Springs Golf Course		
Weather: Overcast, rain, 10°C		Waterbody location: Squamish		
Fish Collection Summary Information				
Turbidity/Visibility: 7.62 NTU lightly turbid		GPS co-ordinates(D/S end- U/S end): 10 U 490873 5510218 Accuracy:		
Water temperature (°C): 11		Conductivity (µS/cm): 91.2		
pH: 7.22		D.O: 4.92		
Block nets: n/a		Start time: 11:15	End time:10:15	
Electrofishing specifications		Minnow trap specifications		
Pass number: -	Seconds:-	Trap number: 6		
Voltage: -	Frequency: -	Trap depth: ~1.5 m		
EF Length(m): -	EF Width(m): -	Soak time (hrs): 23		
Individual Fish Data				
Species	Length (mm)	Weight (g)	Stage	Total caught
TSB	30			22
TSB	40			7
TSB	50			7
CO	55			1



RB	60			1
RB	65			1
NWS	165			1
<b>Total number of fish collected: 39</b>				
<b>Comments: 1 salamander</b>				

<b>Daily Fish Log</b>		
MOE licence number: SU16-230154	DFO licence number: XR 337 2016	
Project number: 725-01-05	Site number: Pond E2	
Contractor:	Field team: SF, KV, RB	
Date: 2016/10/17	Waterbody name: Unnamed pond at Garibaldi Springs Golf Course	
Weather: Overcast, rain, 10°C	Waterbody location: Squamish	
<b>Fish Collection Summary Information</b>		
Turbidity/Visibility: 23.3 moderately turbid	GPS co-ordinates(D/S end- U/S end): 10 U 490939 5510143 Accuracy:	
Water temperature (°C): 12	Conductivity (µS/cm): 110.0	
pH: 7.10	D.O: 2.70	
Block nets: n/a	Start time: 10:45	End time: 09:30
<b>Electrofishing specifications</b>		<b>Minnow trap specifications</b>
Pass number: -	Seconds:-	Trap number: 6
Voltage: -	Frequency: -	Trap depth: ~1.5 m
EF Length(m): -	EF Width(m): -	Soak time (hrs): 22:45
<b>Individual Fish Data</b>		



Species	Length (mm)	Weight (g)	Stage	Total caught
TSB	30		(2 mort)	33
TSB	40		(2 mort)	29
TSB	50			5
RB	82			2
RB	90			1
CO	55		(1 mort)	1
CO	60			4
CO	65			3
NWS	60			2
NWS	105			1
NWS	140		(1 mort)	2
NWS	150			1
<b>Total number of fish collected: 78 + 5 mort</b>				
<b>Comments: 7 salamanders + 1 mort</b>				



Daily Fish Log				
MOE licence number: SU16-230154		DFO licence number: XR 337 2016		
Project number: 725-01-05		Site number: Wetland E		
Contractor:		Field team: SF, KV, RB		
Date: 2016/10/17		Waterbody name: Unnamed wetland at Garibaldi Springs Golf Course		
Weather: Overcast, rain, 10°C		Waterbody location: Squamish		
Fish Collection Summary Information				
Turbidity/Visibility (NTU): 8.44 clear		GPS co-ordinates(D/S end- U/S end): 10 U 490892 5510305 Accuracy:		
Water temperature (°C): 11		Conductivity (µS/cm): 58.8		
pH: 7.10		D.O. (mg/L):9.69		
Block nets: n/a		Start time: 11:30	End time: 10:30	
Electrofishing specifications		Minnow trap specifications		
Pass number: -	Seconds:-	Trap number: 4		
Voltage: -	Frequency: -	Trap depth: ~15 cm		
EF Length(m): -	EF Width(m): -	Soak time (hrs): 23		
Individual Fish Data				
Species	Length (mm)	Weight (g)	Stage	Total caught
TSB	30			1
TSB	40			2
TSB	50			1
RB	50			1
RB	55			1
RB	70			1
CO	45			1
CO	55			6
CO	60			8
CO	65			2
CO	70			2



CT	55		1
<b>Total number of fish collected: 27</b>			
<b>Comments:</b>			

<b>Daily Fish Log</b>				
MOE licence number: SU16-230154		DFO licence number: XR 337 2016		
Project number: 725-01-05		Site number: Pond A		
Contractor:		Field team: SF, KV, RB		
Date: 2016/10/17		Waterbody name: Unnamed pond at Garibaldi Springs Golf Course		
Weather: Overcast, rain, 10°C		Waterbody location: Squamish		
<b>Fish Collection Summary Information</b>				
Turbidity/Visibility: 3.25 clear		GPS co-ordinates(D/S end- U/S end): 10 U 490466 5511261 Accuracy:		
Water temperature (°C): 11		Conductivity (µS/cm): 75.0		
pH: 7.44		D.O:7.28		
Block nets: n/a		Start time: 12:30	End time: 11:30	
<b>Electrofishing specifications</b>		<b>Minnow trap specifications</b>		
Pass number: -	Seconds:-	Trap number: 8		
Voltage: -	Frequency: -	Trap depth: ~1.5 m		
EF Length(m): -	EF Width(m): -	Soak time (hrs): 23		
<b>Individual Fish Data</b>				
Species	Length (mm)	Weight (g)	Stage	Total caught
TSB	30-50			148



NWS	70			1
NWS	90			1
<b>Total number of fish collected: 148</b>				
<b>Comments: 2 salamanders</b>				

<b>Daily Fish Log</b>				
MOE licence number: SU16-230154		DFO licence number: XR 337 2016		
Project number: 725-01-05		Site number: Pond C1		
Contractor:		Field team: SF, KV, VL		
Date: 2016/10/19		Waterbody name: Unnamed pond at Garibaldi Springs Golf Course		
Weather: Overcast, rain, 10°C		Waterbody location: Squamish		
<b>Fish Collection Summary Information</b>				
Turbidity/Visibility: 5.85 Clear		GPS co-ordinates(D/S end- U/S end): 10 U 490436 5510713 Accuracy:		
Water temperature (°C): 9		Conductivity (µS/cm): 75.2		
pH: 7.02		D.O: 2.50		
Block nets: n/a		Start time: 0915	End time: 0930	
<b>Electrofishing specifications</b>		<b>Minnow trap specifications</b>		
Pass number: -	Seconds:-	Trap number: 8		
Voltage: -	Frequency: -	Trap depth: ~1.5 m		
EF Length(m): -	EF Width(m): -	Soak time (hrs): 21:15		
<b>Individual Fish Data</b>				
Species	Length	Weight (g)	Stage	Total



	(mm)			caught
TSB	30		(1 mort)	6
TSB	40			7
TSB	50			1
RB	120			1
NWS	70			3
<b>Total number of fish collected: 14 + 1 mort</b>				
<b>Comments: 3 salamanders</b>				

<b>Daily Fish Log</b>				
MOE licence number: SU16-230154		DFO licence number: XR 337 2016		
Project number: 725-01-05		Site number: Pond C2		
Contractor:		Field team: SF, KV, VL		
Date: 2016/10/19		Waterbody name: Unnamed pond at Garibaldi Springs Golf Course		
Weather: Overcast, rain, 10°C		Waterbody location: Squamish		
<b>Fish Collection Summary Information</b>				
Turbidity/Visibility (NTU): 5.49 clear		GPS co-ordinates(D/S end- U/S end): 10 U 490494 5510649 Accuracy:		
Water temperature (°C): 9		Conductivity (µS/cm): 48.5		
pH: 7.00		D.O. (mg/L): 4.57		
Block nets: n/a		Start time: 9:30	End time: 9:45	
<b>Electrofishing specifications</b>		<b>Minnow trap specifications</b>		
Pass number: -	Seconds:-	Trap number: 4		
Voltage: -	Frequency: -	Trap depth: ~1.5 m		
EF Length(m): -	EF Width(m): -	Soak time (hrs): 24:15		
<b>Individual Fish Data</b>				
Species	Length (mm)	Weight (g)	Stage	Total caught
TSB	30		1 mort	2



TSB	40			3
TSB	50			1
<b>Total number of fish collected: 6 + 1 mort</b>				

<b>Daily Fish Log</b>				
MOE licence number: SU16-230154		DFO licence number: XR 337 2016		
Project number: 725-01-05		Site number: Pond D		
Contractor:		Field team: SF, KV, VL		
Date: 2016/10/19		Waterbody name: Unnamed pond at Garibaldi Springs Golf Course		
Weather: Overcast, rain, 10°C		Waterbody location: Squamish		
<b>Fish Collection Summary Information</b>				
Turbidity/Visibility: 3.11 clear		GPS co-ordinates(D/S end- U/S end): 10 U 490676 5510540 Accuracy:		
Water temperature (°C): 9		Conductivity (µS/cm): 41.2		
pH: 6.78		D.O:4.05		
Block nets: n/a		Start time: 9:45	End time: 10:00	
<b>Electrofishing specifications</b>		<b>Minnow trap specifications</b>		
Pass number: -	Seconds:-	Trap number: 4		
Voltage: -	Frequency: -	Trap depth: ~1.5 m		
EF Length(m): -	EF Width(m): -	Soak time (hrs): 24:15		
<b>Individual Fish Data</b>				
<b>Species</b>	<b>Length (mm)</b>	<b>Weight (g)</b>	<b>Stage</b>	<b>Total caught</b>
TSB	40			14
TSB	50			2
TSB	80			3
RB	100			1
<b>Total number of fish collected: 20</b>				
<b>Comments:</b>				

<b>Daily Fish Log</b>				
MOE licence number: SU16-230154		DFO licence number: XR 337 2016		
Project number: 725-01-05		Site number: Pond D1		
Contractor:		Field team: SF, KV, VL		
Date: 2016/10/19		Waterbody name: Unnamed pond at Garibaldi Springs Golf Course		
Weather: Overcast, rain, 10°C		Waterbody location: Squamish		
<b>Fish Collection Summary Information</b>				
Turbidity/Visibility: 2.21 clear		GPS co-ordinates(D/S end- U/S end): 10 U 490745 5510660 Accuracy:		
Water temperature (°C): 9		Conductivity (µS/cm): 38.9		
pH: 6.32		D.O: 4.04		
Block nets: n/a		Start time: 10:00	End time: 09:50	
<b>Electrofishing specifications</b>		<b>Minnow trap specifications</b>		
Pass number: -	Seconds:-	Trap number: 2		
Voltage: -	Frequency: -	Trap depth: ~0.15 m		
EF Length(m): -	EF Width(m): -	Soak time (hrs): 23:50		
<b>Individual Fish Data</b>				
Species	Length (mm)	Weight (g)	Stage	Total caught
TSB	40			13
TSB	50			3
<b>Total number of fish collected: 16</b>				
<b>Comments:</b>				



Daily Fish Log				
MOE licence number: SU16-230154		DFO licence number: XR 337 2016		
Project number: 725-01-05		Site number: Pond B		
Contractor:		Field team: SF, KV, VL		
Date: 2016/10/19		Waterbody name: Unnamed pond at Garibaldi Springs Golf Course		
Weather: Overcast, rain, 10°C		Waterbody location: Squamish		
Fish Collection Summary Information				
Turbidity/Visibility: 5.93 clear		GPS co-ordinates(D/S end- U/S end): 10 U 490707 5510906 Accuracy:		
Water temperature (°C): 9		Conductivity (µS/cm): 21.6		
pH: 6.33		D.O: 4.21		
Block nets: n/a		Start time: 10:30	End time: 10:30	
Electrofishing specifications		Minnow trap specifications		
Pass number: -	Seconds:-	Trap number: 4		
Voltage: -	Frequency: -	Trap depth: 0.15 m and ~1.5 m		
EF Length(m): -	EF Width(m): -	Soak time (hrs): 24		
Individual Fish Data				
Species	Length (mm)	Weight (g)	Stage	Total caught
TSB	30			1
<b>Total number of fish collected: 1</b>				
<b>Comments:</b>				



Daily Fish Log				
MOE licence number: SU17-256743		DFO licence number: -		
Project number: 725-01-02		Site number: Pond 7 (formerly Pond C1)		
Contractor:		Field team: KV, KMN		
Date: 2017/04/27		Waterbody name: Unnamed pond at Garibaldi Springs Golf Course		
Weather: Sun and cloud, 12°C		Waterbody location: Squamish		
Fish Collection Summary Information				
Turbidity/Visibility: 9.46NTU Moderately turbid		GPS co-ordinates(D/S end- U/S end): 10, 490465 E, 5510715 N Accuracy:		
Water temperature (°C): 17		Conductivity (µS/cm): 47.3		
pH: 6.63		D.O: 6.33		
Block nets: n/a		Start time: 1530	End time:1330	
Electrofishing specifications		Minnow trap specifications		
Pass number: -	Seconds:-	Trap number: 14		
Voltage: -	Frequency: -	Trap depth: 1-1.5 m		
EF Length(m): -	EF Width(m): -	Soak time (hrs): 22		
Individual Fish Data				
Species	Length (mm)	Weight (g)	Stage	Total caught
Stickleback	30-50			117 (+ 3 mortalities)
Northwest Salamander	70-110			9
Coho	70			2



	75			1
	85			1
	90			2
	95			3
	120			1
	130			1
<b>Total number of fish collected: 128 + 3 mortalities</b>				
<b>Comments: 9 salamanders</b>				

<b>Daily Fish Log</b>	
MOE licence number: SU17-256743	DFO licence number: -
Project number: 725-01-02	Site number: Pond 8 (formerly Pond C2)
Contractor:	Field team: KV, KMN
Date: 2017/04/27	Waterbody name: Unnamed pond at Garibaldi Springs Golf Course
Weather: Sun and cloud, 12°C	Waterbody location: Squamish
<b>Fish Collection Summary Information</b>	
Turbidity/Visibility: 3.86 NTU Lightly turbid	GPS co-ordinates(D/S end- U/S end): 10, 490584 E, 5510622 N Accuracy:
Water temperature (°C): 18	Conductivity (µS/cm): 19.9
pH: 6.54	D.O: 6.50
Block nets: n/a	Start time: 1500    End time:1400
<b>Electrofishing specifications</b>	<b>Minnow trap specifications</b>
Pass number: -    Seconds:-	Trap number: 10



Voltage: -	Frequency: -	Trap depth: 1-1.5 m		
EF Length(m): -	EF Width(m): -	Soak time (hrs): 22		
Individual Fish Data				
Species	Length (mm)	Weight (g)	Stage	Total caught
Stickleback	30-50			129 (+ 1 mortality)
Northwest Salamander	75-85			3
<b>Total number of fish collected: 129 + 1 mortality</b>				
<b>Comments: 3 salamanders</b>				



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## **Appendix 4 – Habitat Balance**