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GABRIOLA ISLAND RIPARIAN AREA REGULATION STREAM IDENTIFICATION
UPDATED REVISED VERSION FEBRUARY 24, 2012

Prepared for:

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February 24, 2012 Dossier 11.0348

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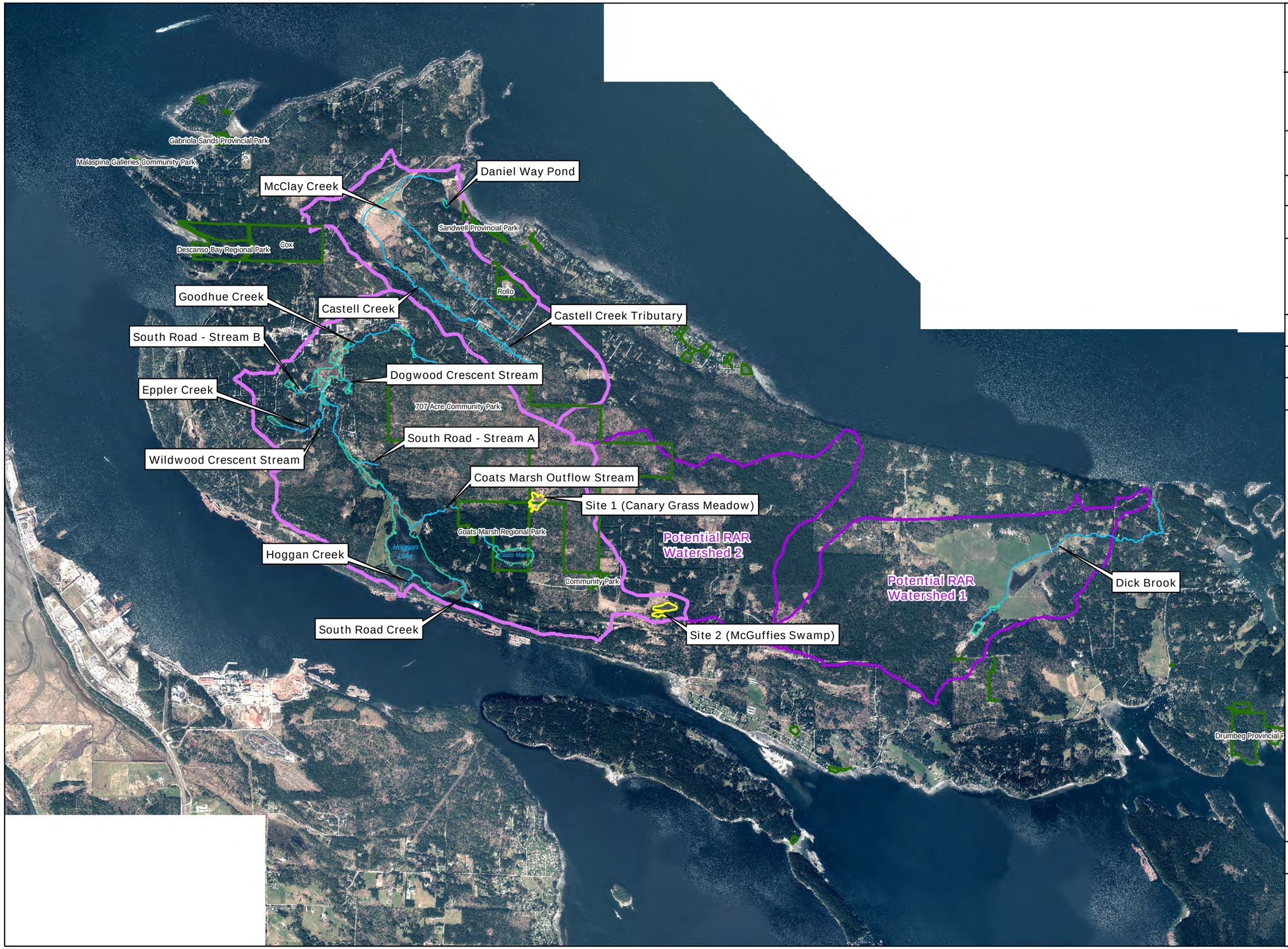

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Figure 1: Overview of RAR Applicable Streams in Focus Watersheds

PROJECT:
Gabriola Island Riparian Area Regulation Stream Identification

CLIENT:
Gabriola Island Local Trust Committee

GEOGRAPHIC AREA:
Gabriola Island, BC

ASSESSED BY:
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ASSESSMENTS:
November 2011 & January 2012

MAP SCALE:	MAPPING DATE:
1:40,000	February 23, 2012
DOSSIER NO:	DRAWN BY:
11.0348	Anna Jeffries

- Mapped RAR Applicable Streams
- RAR Watershed
- Potential RAR Watershed
- Waterbody
- Non-RAR Applicable Wetland

Protected Areas

- Provincial Park
- Regional Park
- Community Park

0 250 500 1,000 1,500 m

N W E S

potential. Fish habitat attributes such as cover/security, Large Woody Debris (LWD) and spawning substrate were also noted. Representative site photographs were taken during each stream traverse (Appendix I). GPS way points were collected to depict the location of features such as barriers to upstream fish movement (e.g. waterfalls), culverts and bridges.

The edges of wetlands and lakes were not traversed, although their dimensions and attributes were recorded during the assessment. The level of orthophoto coverage, in addition to ground-truthing, allowed for the accurate digitizing of wetland/lake edges on the final maps.

In certain cases, watercourses were too deep to allow them to be practically (and safely) followed. In other instances, the density of vegetation growing in the watercourse did not make it feasible to follow the drainage with the GPS, as the external antenna would become significantly fouled and/or impeded, leading to poor GPS operating conditions. These riparian characteristics generally occurred in deeply incised agricultural ditches running through open fields, which could be clearly identified and digitized on the orthophoto layer. Small portions of many of the streams were unable to be followed due to dense vegetation cover or obstacles such as downed trees. In these cases, the GPS data collection was paused briefly and resumed on the other side of the obstacle. We have identified the portions of streams that could not be traversed due to adverse physical conditions (refer to Figures 2 – 15).

As many of the streams on Gabriola Island flow on private property, Islands Trust personnel were diligent in providing land owners with information packages to provide notice of the project. Field surveys were coordinated to be completed on dates after land owners had received the packages. The grace period was designed to allow the land owners time to understand the project and voice any concerns. In cases where land owners did not grant the survey crews permission to access the property, those streams were not surveyed.

Despite the fact that landowners had been informed of the project, in some cases fences were encountered that did not allow for streams to be traversed for short sections. In other cases, aggressive dogs were encountered that prevented access onto property. For areas where we could not gain access, or did not have permission to access, we tried to identify the stream through orthophoto interpretation. As with areas that could not be traversed as a result of physical constraints, we have indicated the portions of streams that could not be accessed due to lack of access permission (refer to Figures 2 – 15).

2.7 GPS Data Procedures and Data Limitations

After field assessments were completed, the GPS data was downloaded and viewed in MobileMapper Office software (which accompanies the ProMark 3 GPS unit). For each stream, the data was filtered to indicate point values along the streams in which the minimum number of satellites and/or PDOP values were not met. Results not meeting the minimum requirements were likely due to dense canopy/shrub cover, adjacent cliffs or ravines, and antennae shifts while negotiating obstacles in the creek bed. In these types of survey conditions, especially when completing a moving (dynamic) survey, it is often difficult or impossible to get accurate results, as the conditions, or geometric relationship above, are constantly changing (GeoBC 2011, RISC 2008). Inaccurate points, along with other obvious errors, such as "zingers" and "loops" were removed from the dataset.

The dataset was then post-processed, where necessary, using the closest permanent validated base station to the assessment area and approved by Islands Trust, located in Nanoose, BC (Appendix II). The data was converted to shapefiles and further cleaned in ArcGIS 10, using the orthophoto background as a guide. In cases where the creek line was found to be slightly shifted off a known feature (e.g. ditch evident on the orthophoto) the final creek lines and waypoints were adjusted to match the orthophoto wherever possible. In the majority of cases, these shifts were within 2 m – 3 m.

With the post-processed ProMark 3 data, in some cases the original raw data was found to be more accurate than the post-processed data. In these circumstances, the original data was used. The creek lines were also smoothed (0.001 metres) using the Smooth tool in the Advanced Editing Toolbar in ArcGIS. Smoothing the line features diminished the number of jagged stream segments, which were a result of high logging interval, and created a more natural stream appearance.

3.0 RESULTS

3.1 Documented Stream Data

Documented fish distribution data for the Gulf Islands is limited, although Hoggan Lake is listed under FISS. Hoggan Lake (watershed code 925-380000-26400; waterbody identifier 00020COWN) covers a surface area of 19.7 ha, has a perimeter of 2.2 km and is known to provide water to adjacent properties for agricultural use.

Fish stocking records for Hoggan Lake indicate that it was stocked with rainbow trout (*Oncorhynchus mykiss*) and coastal cutthroat trout (*Oncorhynchus clarkii clarkii*) in 1927 (Habitat Wizard 2011). Both these species were observed in the lake in 1972 (FISS 2011), indicating that either the fish that were stocked established a self-sustaining population, or that the lake has always contained a natural population of fish.

3.2 Drainage Descriptions – Identified RAR Watersheds

Figures 2 through 15 indicate each RAR-applicable stream and display waypoints of features collected during each stream traverse (e.g. barriers to fish migration and culvert inflows/outflows).

3.2.1 Castell Brook – Figures 2A, 2B, and 2C

Although extensive stream alteration has resulted from past anthropogenic activities on Gabriola Island, portions of Castell Brook remain as some of the best potential fish habitat within the focal watersheds. Anecdotal evidence suggests that this stream may have once supported a population of resident fish prior to incurring alterations to riparian habitat, channel morphology, water quality and water quantity. Due to a lack of habitat attributes, most notably a seasonal flow regime, no resident fish currently exist in the stream. It is possible, however, that seasonal anadromous fish use may occur downstream of the identified barrier. Species such as chum salmon (*Oncorhynchus keta*) or pink salmon (*O. gorbuscha*), which migrate to the ocean quickly after emergence from the gravel, could potentially occur. It is possible, however, that water quality limitations currently preclude the use of the stream by fish.

At its entry point into the ocean at Lock Bay, Castell Brook flows into an estuarine marsh, which is protected from oncoming wave action by a spit to the north. To the east, south and west, the marsh is contained by intact riparian vegetation, dominated by Douglas-fir (*Pseudotsuga menziesii*) and salal (*Gaultheria shallon*).

The substrate in the marsh is comprised of soft organics. The estuarine salt marsh habitat provides important fish and wildlife habitat. It is likely that the protected salt marsh is used by rearing juvenile salmonids from other fish-bearing systems. The salt marsh also supports a range of unique plant assemblages. Due to biological attributes, the marsh has been divided into two identified Sensitive Ecosystems, listed under the Sensitive Ecosystem Inventory (SEI) as T1242A WN:ms (identified as a marsh) and T1242B WN:sp (swamp).

3.2.13 Coats Marsh Outflow Stream – Figure 14

This watercourse enters Hoggan Lake as a well defined, historically ditched system. The lower portion of the stream (downstream of South Road) flows through pasture land and is surrounded by a narrow, dense fringe of riparian vegetation consisting of hardhack, salmonberry and red alder. Fencing has been erected to prevent livestock access into the stream and associated riparian zone. Beaver activity in the form of foraging on deciduous trees and shrubs is common throughout the riparian area.

There is the potential for fish to access the lower portion of the stream, due to the direct connectivity with Hoggan Lake. Fish habitat attributes are extremely limited, however, based on the historical straightening of the channel. The side-walls of the ditch are steep, with evidence of erosion from high, concentrated flows. The substrate is comprised mainly of organic material, although short sections of alluvial deposits also occur.

Approximately 50 m from the lake, a bedrock step represents a barrier to the upstream movement of fish. Based on the length and gradient of the step, there is no reasonable potential for fish originating from the lake to pass upstream of this point. The step consists of a drop of 50% over a distance of more than 2 m. Immediately downstream of South Road, the stream exhibits more of a natural channel, with meanders and deposits of sand and gravel occurring.

The stream passes underneath South Road via a culvert and continues as a low gradient (2%) meandering stream. Upstream of South Road, riparian vegetation becomes more extensive, with continuous second growth coniferous forest adjacent to both banks. Salmonberry, bitter cherry (*Prunus emarginata*), Pacific ninebark (*Physocarpus capitatus*) and red huckleberry overhang the stream. English holly also occurs in places. Deposits of small gravel comprise the majority of the substrate. Both red-legged fogs (*Rana aurora*) and Pacific chorus frogs (*Pseudacris regilla*) were observed in the drainage upstream of South Road.

Approximately 100 m upstream of South Road, the watercourse becomes poorly defined over an organic substrate through patchy slough sedge and skunk cabbage. At the Coats Marsh park boundary, the watercourse becomes extremely poorly defined for a distance of approximately 70 m, with minimal seepage over an organic substrate. In this area, connectivity by surface flow would only occur during very high flows.

Beyond the park boundary, the stream flows as a well defined ditch adjacent to residential property. A rock wall/dam has been constructed approximately 100 m downstream of Coats Marsh, which backs up the water to form a pond. Water seeps through the rock wall and there is no weir or control structure. From the eastern edge of the pond, the stream continues as a well defined, high sided channel constructed through bedrock to Coats Marsh. The outflow from Coats Marsh is via a concrete weir structure and pond leveller device, which has been placed through an active beaver dam located at the outlet.

Fish cannot gain access to the Coats Marsh outflow drainage from Hoggan Lake beyond the barrier located downstream of South Road. Furthermore, it is unlikely that the marsh supports a natural population of salmonid fish, due to past uses, most notably through complete drainage of standing water for agricultural reasons. Historical drainage of the marsh would have led to the demise of any existing resident population of fish. It is likely, however, that the marsh contains three-spined stickleback, due to their more ubiquitous nature.

Despite not supporting fish (as defined in the RAR), the wetland ecosystem known as Coats Marsh will provide an important habitat feature for a range of wildlife. The wetland also supports a unique range of hydrophytic plant assemblages adapted to living in moist conditions. The forested fringe surrounding the wetland adds to the habitat diversity, as it creates functional "edge" habitat.

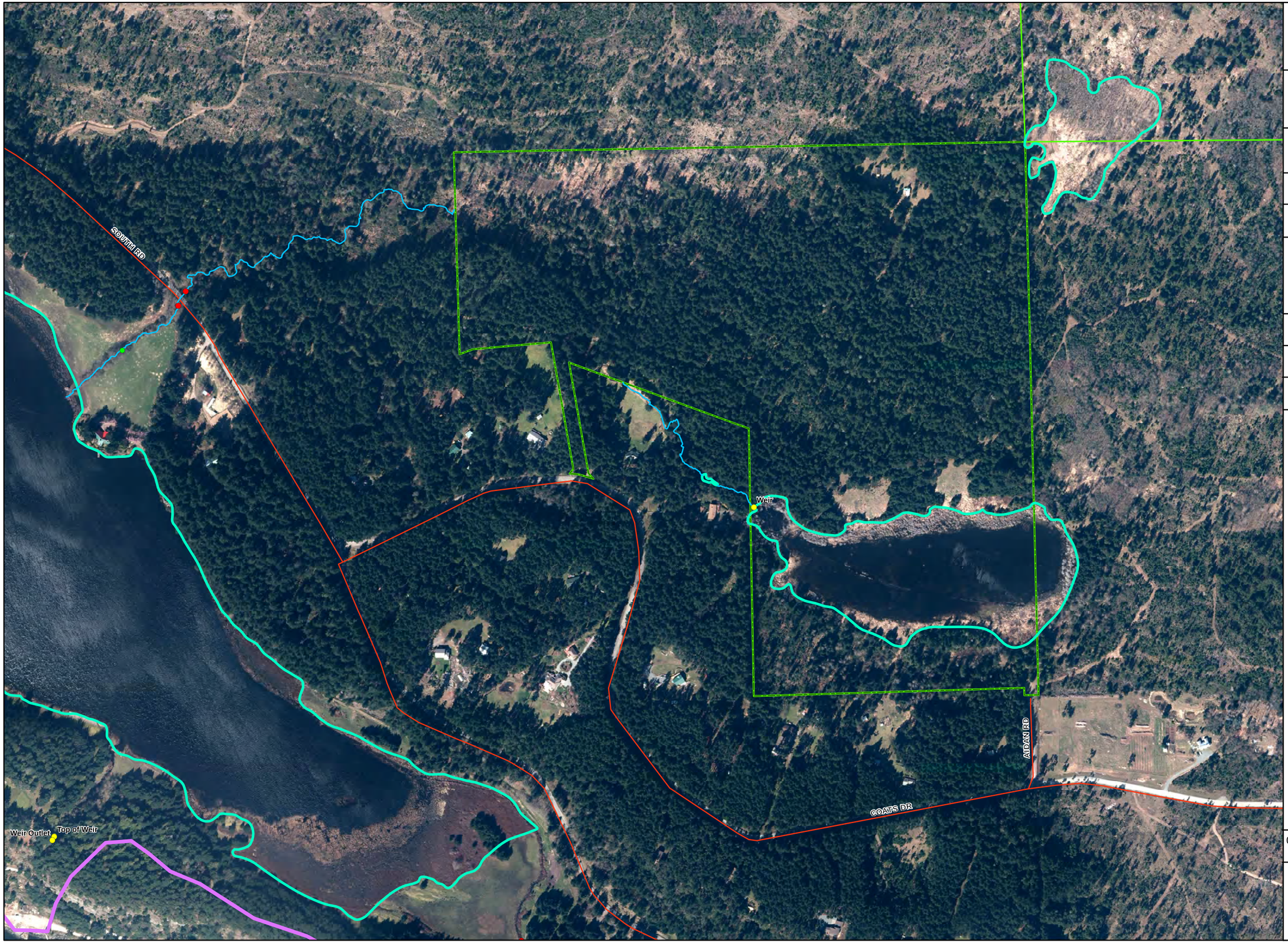

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Figure 14:
Coats Marsh Outflow Stream

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ASSESSMENTS:
November 2011 & January 2012

MAP SCALE:	MAPPING DATE:
1:5,000	January 31, 2012
DOSSIER NO:	DRAWN BY:
11.0348	Anna Jeffries

Streams
- Field Verified
- Unable to Field Verify due to physical constraints (e.g. water depth)
- Unable to Field Verify based on inability to access private property
- Barrier to upstream fish movement
- Culvert
- Waterbody
- Watershed Boundary
- Road

Protected Areas
- Provincial Park
- Regional Park
- Community Park

0 25 50 100 150 200 250 m

N W E S

4.0 DISCUSSION

Detailed background research using appropriate databases, orthophotos, existing reports and contour data associated with field reconnaissance trips, resulted in the identification of fourteen streams that apply to the provincial RAR process (17 km of mapped stream length in total). Hoggan Lake and Coats Marsh also apply to the regulation. These watercourses are subject to the RAR assessment procedure, given the fact that they meet the RAR definition of a "stream".

The mapped systems represent potential fish habitat, or systems that connect by surface flow to potential fish habitat. These creeks were mapped for inclusion into appropriate bylaws to be set up by Islands Trust to allow conformance with the provincial RAR process. The edges of Hoggan Lake and numerous wetlands located along the stream traverses were not mapped in the field as part of the assessment process, but the edges were delineated using field observations and orthophoto interpretation. It is important that these features are included as RAR-applicable water bodies. It should also be noted that many of these wetland areas have been recognized as sensitive ecosystems under the SEI.

General fish habitat attributes on all streams were low, based on a lack of habitat attributes. The watercourses with the greatest potential for fish to occur include Hoggan Lake, the upper reach of Hoggan Creek (upstream of the hydroelectric generating facility), the lower reaches of Goodhue Creek (downstream of the first wetland complex), the lower reaches of Castell Brook, which flows into Lock Bay (below the barrier to upstream fish migration), and the lower reaches of Dick Brook.

Due to the RAR methodology, any watercourses that connect by surface flow to these potential fish bearing systems, including modified watercourses and ditches, are subject to the regulation. A stream may not itself be inhabited by fish, but if it has a reasonable connection by surface flow to fish habitat, it is considered a stream under the RAR.

Two additional potential RAR watersheds were also field verified. The outflow stream of potential RAR watershed 2 (known locally as Jenkins Creek) was extremely steep, with an associated impassable waterfall over a cliff into the ocean. Based on a lack of accessibility for fish from the ocean into this watershed and a lack of available habitat to support resident fish, this watershed should not be considered under the RAR.

The outflow stream of potential RAR watershed 1 (Dick Brook) was found to offer potential fish habitat (albeit on a seasonal basis) in its lower reaches. As a result, this

stream was mapped for inclusion as a stream, as defined in the RAR methodology. The mapping for the boundary of this watershed is inaccurate, as part of the main outflow stream flows beyond the mapped boundary.

A focused search for additional drainages that do not apply to the RAR (e.g. isolated wetlands) did not form part of the scope of this assessment. Streams that apply to the definitions and methodology under the RAR in the identified watersheds (Figure 1) were included in the study. Isolated wetlands encountered during the assessment did result in the identification of two additional sensitive sites. Site 2 (McGuffies Swamp) has been identified as a sensitive ecosystem as part of the SEI. Both sites represent candidates for protection through Islands Trust bylaws. Further work is recommended to ensure that wetland and riparian ecosystems are identified throughout the island, which should also include watersheds beyond those which formed the focus of the RAR stream identification.

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5.0 REFERENCES

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APPENDIX I – PHOTOS

Coats Marsh Outflow Stream

Looking north east over Hoggan Lake from the point where Coats Marsh outflow stream enters the lake.

Looking south west over Hoggan Lake from the point where Coats Marsh outflow stream enters the lake. Note raft of trumpeter swans on the lake.

Looking upstream (north) over the fringe of riparian vegetation adjacent to the stream immediately upstream of the confluence with Hoggan Lake.

Typical characteristics of the lower reach of the stream. Note lack of natural sinuosity and high sided, eroded banks.

Bedrock step located downstream of South Road. Resident fish from Hoggan lake would not be able to move upstream of this feature. The gradient is too steep, no plunge pool exists and the water is shallow and fast over the smooth bedrock.

Looking north (upstream) along the stream immediately downstream of South Road. Note the limited degree of sinuosity.

Outflow of the culvert under South Road.

Above and below: typical conditions of the Coats Marsh outflow stream to the north (upstream) of South Road. Note general lack of channel definition.

Above and below: extremely poorly defined characteristics of the stream at the point where it crosses the Coats Marsh park boundary.

Looking downstream (north west) along the stream where it flows through residential property after emerging from the Coats Marsh park area.

Constructed rock dam located on residential property downstream of Coats Marsh.

Looking south east over the pond created by the rock dam pictured below.

Looking downstream (north west) along the Coats Marsh outflow stream immediately below Coats Marsh. Note lack of natural sinuosity, resulting from historical straightening activities.

Weir and pond leveler representing the origin of the Coats Marsh outflow stream.

Looking east over Coats Marsh. Note recent inundation of the wetland margins, likely caused by the action of beavers at the main outlet.

Site 2 – McGuffies Swamp

Looking south over the dense hardhack vegetation typical of the Site 2 wetland.

APPENDIX II – BASE STATION INFORMATION SHEET

NRCan GSD - ACP Report

****
CANADIAN ACTIVE CONTROL SYSTEM
ACTIVE CONTROL POINT (NAD83CSRS)
****

SITE IDENTIFICATION

Site name : NANOOSE
ID code : NANO
Geodetic Station No : 957000
Location : Nanoose, BC

(Complete WCDA station log sheets available here:
ftp://wcda.pgc.nrcan.gc.ca/pub/siteinfo/)

SITE INFORMATION

NANO is a continuously tracking GNSS site of as (CACS). The GNSS station is located on NANO is a continuously tracking GNSS site. This station is part of the Western Canada Deformation Array (WCDA) as well as the Canadian Active Control System (CACS). Station is located on Winchelsea Island, British Columbia.

The GNSS reference mark consists of a brass plate with a forced centered stainless steel bolt. The brass plate is embedded on top of a 1.5 m high concrete pier, 0.600 m in diameter, anchored in bedrock.

STATION COORDINATES

Reference system : NAD83CSRS

X = -2335726.11 m Y = -3451609.49 m Z = 4812009.79 m

Latitude : N49 17' 41.3010
Longitude : W124 05' 11.2637
Ellipsoidal Height : 6.82 m

Geoid Separation (HT2.0) : -17.121 m
Orthometric Height (CGVD28) : 23.9 m
Adjustment Net : M02706
Epoch : 2002.0

Note(s):

The coordinates above are the most accurately known positions for this station relative to the NAD83CSRS coordinate system. Although these coordinates are very accurate within the Canadian Spatial Reference System and with respect to the defined NAD83 datum, they may not be consistent with NAD83 coordinates officially adopted and published by provincial agencies for monumented geodetic control points.

CGVD28 - Canadian Geodetic Vertical Datum 1928, mean sea level (adopted, public vertical reference system). The average height of the surface of the sea for all stages of the tide. Usually determined by averaging height readings observed hourly over a minimum period of 19 years.

GPS EQUIPMENT ON SITE

The following equipment is presently in operation at the site:

GPS Receiver : LEICA GRX1200GGPRO
Antenna Type : LEIAT504GG LEIS
Frequency Standard Type : Internal
Meteorological Sensor : None
Antenna Height: 0.100

FOR FURTHER INFORMATION CONTACT :

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