Gooding
Hydrology

DRAGONFLY COMMONS
221 Drake Rd
Preliminary Report on:
Potable Water Quality & Quantity,
Stormwater Drainage,
& Riparian Stream Protection

For
Fernando & Tammy Dos Santos
Saltspring Island, B.C.

By
Dave Gooding, P.Eng.
Gooding Hydrology
Saltspring Island

June 2017

Introduction
This report is intended as a preliminary study for use in the planning process, and is not intended to replace the full potable water, storm drainage, or RAR reports.

Potable Water Supply
A separate preliminary report on potable water quantity results '221 Drake well flow test prelim.pdf', giving flow test data and analysis, has previously been submitted. The recently drilled artesian well on this property can supply the 48,000 cu liters/day (30 units x 1600 l/d) required by Islands Trust (IT). Efficient use and higher pricing for high water use should reduce significantly the actual water usage from this figure.

Water samples taken, and tested by MB Labs of Sidney are attached as Appendix 1. Parameters relevant to IT Bylaw 355 Schedule H Potable Water Quality Standards are listed in Table 1 below.

Table 1: Schedule H Results

Water Quality Parameter	Standard	Lab Test Results	Comments
Arsenic	0.025 mg/l	0.0048 mg/l	
Chloride	250 mg/l	15.2 mg/l	
Fecal Coliform	0/100 ml	0	
Fluoride	1.5 mg/l	0.166 mg/l	
Hardness (as CaCO3)	80-100 mg/l	114 mg/l	See comments below
Iron	0.3 mg/l	1.93 mg/l	Treatment req'd
Manganese	0.05 mg/l	0.26 mg/l	Treatment req'd
Nitrate	45 mg/l	None Detected	
pH	6.5-8.5	7.4	
Residual Chlorine	0 mg/l	0.010 mg/l	
Sodium	200 mg/l	17.1 mg/l	
Sulphate	500mg/l	11.3 mg/l	
Total Coliforms	0/11 ml	0	
Total Dissolved Solids	500 mg/l	204 mg/l	
Turbidity	1 NTU	28.4	See comments below

Comments:
Turbidity is high, and will necessitate filtering before further treatments. This may decrease with time and usage.
Treatment to reduce Iron and Manganese levels to below the required threshold will be needed.
While there are no detected Fecal or Total Coliforms, Total Plate Count and Total Non-Coliform Bacteria are at levels which, while they do not require treatment according to the Canada Drinking Water Guidelines, do require seasonal monitoring.

Down slope properties are largely served by the municipal water system. With the large lot size and distance to any adjacent wells, use of this well is unlikely to affect water supply on any adjacent properties.

Storm Water Drainage

This lot was originally partially developed (driveway up the hill, excavation of a water storage pond in an area of high groundwater) approximately 20 to 30 years ago. This development diverted some of the groundwater flow through the pond and over the edge of the ravine to Ganges Creek. Some erosion down the ravine slope has occurred in the seasonal outflow from the pond. The driveway and its ditch intercepted flow from high groundwater and seasonal springs around, and in the swale below, the pond directly down the ditch line to Ganges Creek.

Pre-development Groundwater & Spring Water Flow Path

In addition to the IT Bylaw 355 purpose of minimal disturbance to existing surface and groundwater flows, the design for storm water drainage, and the drainage to enable construction in the area with high seasonal water table, is intended to restore flow patterns towards Ganges Creek which are already disturbed.

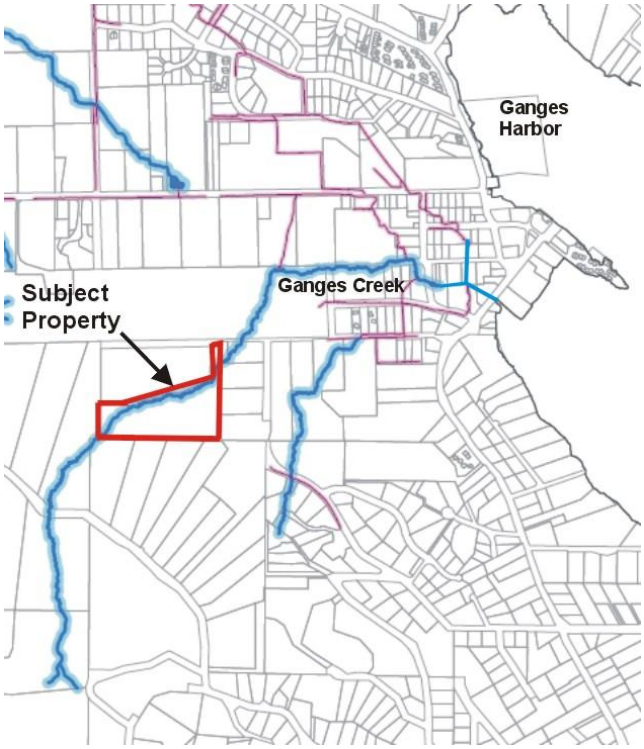
A second additional intention is to utilize the flow from the drainage of the area of high water table to augment low summer flows in Ganges Creek.

The conceptual design of a storm water system to reduce changes in hydrologic response during high rainfall events, re-introducing as much flow from the impermeable roofs as possible to groundwater, is shown in appendix 2. The design utilizes Storm-Tech infiltration chambers surrounded by drain rock beds for each building, or set of buildings when necessary. In extreme events, the infiltration chambers are linked to allow overflow, with any road ditch drainage, to be channeled through the detention basin, which will have an outlet designed such that high inflows can be detained and released at as slow as possible a rate down the drainage swale, which was the flow path for the high groundwater and spring flow. Detailed design giving sizing of infiltration chambers to enable detention of 50% of the 2 yr 24 hr rainfall, while infiltration is occurring, will be given in a full report. Parking areas will be surfaced in drain rock to maximize infiltration, with the final design also including measures to infiltrate at least some of the runoff from the driveway system into the road surface.

Strata lots 1, 2, 3 and 27 to 30 are located in areas of high seasonal groundwater levels. A curtain drain of drain rock and a perforated pipe will be installed across the top of these lots (orange dashed line, appendix 2) with the intercepted groundwater piped across (solid orange line) to be released as surface flow in the swale shown on that drawing. Outflow from the detention pond will also be released into the same swale (redirected from where it currently overflows down the ravine bank) through a control structure which will control outflow during high rainfall events. Where the drainage swale meets the driveway ditch, a culvert will be installed under the driveway. Flow will be split at that culvert inlet, to avoid flows in excess of flows prior to the existing development from being sent onto the neighboring property, with some flow sent through the culvert and the remainder sent down the existing ditchline to Ganges Creek.

Riparian Area Regulation Stream Protection:
Fisheries Values

Ganges Creek runs into Ganges Harbour through the town of Ganges on the east coast of Saltspring Island. There is no data available for Ganges Creek in the FISS database. Colloquial information has a few salmon (Chum?) spotted returning to spawn in Ganges Creek, and personal conversation with the most knowledgeable of fish biologists on the island (Kathy Reimer, RPBio) has sea run trout utilizing the Ganges Creek's Swanson tributary lower reach for spawning and incubation. Nearly the entire Ganges Creek mainstem stream system downstream of the subject property is urbanized, with most downstream channels modified, extensive culverting, and many ditch lines diverting and extending the channel system.



At the downstream end of the property a perched 1 m dia culvert blocks upstream fish passage. Through the subject property Ganges Creek is a stable, mossy rocked, confined 2.2 m wide step-pool seasonal stream, with a full approx 100 yr old treed riparian area.

Adjacent to the area to be developed, the ravine along the downstream half is less than 60 m wide, while along the upstream half the ravine is over 60 m wide. Upstream of the proposed development, the south slope of the ravine decreases in slope, with benches, with no real TOB and the slope continuing up the hillside, no longer fitting the RAR definition of a ravine.

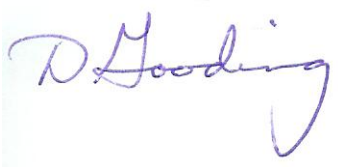
The Streamside Protection and Enhancement Area (SPEA) prescribed for Ganges Creek through this property is 10 m. In addition to the 10 m SPEA, for the length of the stream where it is in a ravine (the length adjacent to the proposed development) the entire ravine slope is protected as a riparian management area to protect the SPEA, as well as a 5 to 10 m buffer past the top of the bank (TOB) to protect the roots of trees along the TOB. These areas, and others described below, are shown in the drawing in Appendix 3 attached.

Approx 120 m of ditch runs down along the driveway and feeds down the 4 m high 85% gradient ravine bank into the creek just upstream of the driveway culvert. On the bench above the ravine along the south side of Ganges Creek, a 25 m diameter pond has been dug into an area of high water table, intercepting groundwater, with a seasonal overflow ditch excavated to the edge of the ravine. From there a channel has eroded down the 60% gradient ravine side slope to the creek 18 m below. This outflow ditch will be altered to no longer be released over the ravine slope, but will instead be modified to release outflows to the swale which is the original groundwater and surface water flow path.

Approximately 25 m down a swale to the NE of the pond, other seasonal seeps and springs emerge, which flows further down the swale to join the driveway west ditch 55 m above where the ditch flow drops into the ravine. Natural drainage patterns will be partially restored by installing a ditch block and cross culvert to send this second spring flow, and the upper ditch's flow, across the driveway and down the deepening swale which continues to the NNE. Due to the gradients of their channels' drops down into the ravine, the driveway ditch, and the excavated pond and its outflow ditch, are not accessible to fish. A 10 m SPEA is prescribed for the pond and swale flow, with a short area of up to 5 additional m along a steeper area outside the 10 m SPEA NE of the pond added for slope stability protection.

The full width of the thin riparian area between the driveway ditch and the driveway will be protected with a 2 m SPEA. Due to the potential for augmented flows in the ditch between the swale and the ditch outflow to Ganges Creek, the SPEA on the west side has been increased to 5 m.

These SPEAs and Management Areas are preliminary, and are those which will be proposed on the full RAR report to be submitted to FLNRO, and may be modified if requested by that agency.



Dave Gooding, P.Eng.

Appendix 1: MB Labs Water Quality Tests

Client/Code

Fernando Dos Santos [redacted]

Date 19May17 12:47p No. W133587
Source Well
Type of Sample water
No. of Samples 1

[redacted] Comments Arrival temp.: 13.0C

Sample: 221 Drake Rd

Site Code	Date	Time	CFU/100 ml TC	T-NC	CFU/100 ml FC	F-NC	CFU/100 mL E.coli
Wellhead	19May17	11:00a	0	75	0	0	0

WATER DISTRICT SCREEN

Sample	Date	Time	lactose Fermentors	Coliforms Total	Fecal	E.coli	Total Aeromonas	Sulfur Reducing/ Iron Bacteria	Yeast/Fungi	TPC*
Wellhead	19May17	11:00a	0.75	ND	ND	ND	ND	ND / ND	ND / ND	216

* all counts are colony forming units per milli-litre

TC = total coliform bacteria
FC = fecal coliform bacteria (aka Thermotolerant Coliforms)
NC = non-coliform bacteria
ND = none detected
TPC = total plate count- spread plate method - 35C/48hr TGEA
FDA/BAM 8th ed, 1995 + Revision A, 1998, May 2009
CFU = colony forming units

Results may be adversely affected if samples are submitted to the laboratory more than 24 to 30 hours after collection.

E. coli = Escherichia coli, FDA/BAM 8th ed, 1995 + Revision A, 1998
Bergy's Manual of Systematic Bacteriology vol 1, AOAC 1984; J.Clin.Micro., J.Intern.Systm.Bact.

-see following page for chemistry results-

M. Milhole
Microbiologist

W. Riggs
Sr. Microbiologist

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Client/Code

Fernando Dos Santos [redacted]

Date 19May17 12:47p No. W133587 pg2
Source Well
Type of Sample water
No. of Samples 1

[redacted]

Comments Arrival temp.: 13.0C

Sample: 221 Drake Rd - Wellhead 19May17 11:00a

ELEMENTS		SAMPLE	UNITS	Maximum Limits Permissible In Drinking Water*
1) Aluminium	Al	0.150	mg/L	no limit listed
2) Antimony	Sb	<0.500	ug/L	6.00 ug/L
3) Arsenic	As	4.78	ug/L	10.0 ug/L
4) Barium	Ba	0.013	mg/L	1.00 mg/L
5) Beryllium	Be	<0.003	mg/L	no limit listed
6) Boron	B	0.484	mg/L	5.00 mg/L
7) Cadmium	Cd	<0.100	ug/L	5.00 ug/L
8) Calcium	Ca	31.2	mg/L	200 mg/L
9) Chromium	Cr	<0.010	mg/L	0.050 mg/L
10) Cobalt	Co	<0.020	mg/L	no limit listed
11) Copper	Cu	<0.008	mg/L	1.00 mg/L
12) Gold	Au	<0.040	mg/L	no limit listed
13) Iron	Fe	1.93	mg/L	0.300 mg/L
14) Lanthanum	La	<0.020	mg/L	no limit listed
15) Lead	Pb	1.48	ug/L	10.0 ug/L
16) Magnesium	Mg	8.72	mg/L	50.0 mg/L
17) Manganese	Mn	0.264	mg/L	0.050 mg/L
18) Mercury	Hg	<0.100	ug/L	1.00 ug/L
19) Molybdenum	Mo	<0.020	mg/L	no limit listed
20) Nickel	Ni	<0.050	mg/L	no limit listed
21) Phosphorus	P	<0.010	mg/L	no limit listed
22) Potassium	K	2.65	mg/L	no limit listed
23) Scandium	Sc	<0.050	mg/L	no limit listed
24) Selenium	Se	<0.500	ug/L	5.0 ug/L
25) Silicon	Si	4.23	mg/L	no limit listed
26) Silver	Ag	<0.010	mg/L	0.050 mg/L
27) Sodium	Na	17.1	mg/L	200 mg/L
28) Strontium	Sr	0.109	mg/L	no limit listed
29) Tin	Sn	<0.020	mg/L	no limit listed
30) Titanium	Ti	<0.010	mg/L	no limit listed
31) Tungsten	W	<0.050	mg/L	no limit listed
32) Vanadium	V	<0.010	mg/L	no limit listed
33) Zinc	Zn	0.238	mg/L	5.00 mg/L
Hardness (mg/L $CaCO_3$)		114	mg/L	75-150 mg/L = Moderately Hard
pH		7.38	units	6.5 to 8.5

* As per Canadian or B.C. Health Act Safe Drinking Water Regulation BC Reg 230/92, & 390 Sch 120, 2001. Task Force of Canadian Council of Resource & Envir. Ministers Guidelines for Canadian Drinking Water Quality, 2014.

Comments:

Iron: high amounts of Iron can cause staining of laundry, porcelain and plumbing fixtures; can produce an undesirable taste. Essential for health.

Manganese: not considered to be toxic; high amounts of Manganese can cause staining of laundry, porcelain and plumbing fixtures; may produce an undesirable taste.

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R. Bilodeau
Analytical Chemist

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Sr.Analytical Chemist
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Client/Code

Fernando Dos Santos

[redacted]

Date 19May17 12:47p No. W133587 pg3
Source Well
Type of Sample water
No. of Samples 1

[redacted]

Comments Arrival temp.: 13.0C

Sample: 221 Drake Rd

SAMPLE	DATE	TIME	Alkalinity (mg/L)	NH_3-N (ug/L)	Cl^- (mg/L)	Total Residual Chlorine (mg/L)	Colour (TCU)
Wellhead	19May17	11:00a	160	10.9	15.2	0.010	10.7
Lab Blank			ND	ND	ND	ND	ND
S_m			0.100	0.254	0.015	0.003	0.300
REF. VALUE			200	20.0	10.0	0.200	5.00
STD ± 2SD			198 ± 17.8	21.0 1.44	10.4 ± 0.88	0.205 ± 0.015	5.04

SAMPLE	DATE	TIME	E.C. (uS/cm)	CORROSIVITY (Is @20C)	F^- (mg/L)	S^{2-} (ug/L)	TKN (mg/L)
Wellhead	19May17	11:00a	352	-0.309	0.166	ND	ND
Lab Blank			ND		ND	ND	ND
S_m			0.300		0.01	0.007	0.012
REF. VALUE			147		1.00	50.0	0.100
STD ± 2SD			147 ± 8.13		1.05 ± 0.088	49.0 ± 3.90	0.103 ± 0.010

SAMPLE	DATE	TIME	NO_3-N (ug/L)	NO_2-N (ug/L)	SO_4^{2-} (mg/L)	T.O.C. (mg/L)
Wellhead	19May17	11:00a	ND	ND	11.3	1.61
Lab Blank			ND	ND	ND	ND
S_m			0.160	0.300	0.075	0.300
REF. VALUE			20.0	10.0	10.0	0.500
STD ± 2SD			19.9 ± 1.61	9.92 ± 0.752	10.4 ± 1.01	0.505 ± 0.040

SAMPLE	DATE	TIME	T&L (mg/L)	TDS (mg/L)	Turbidity (NTU)	UVT (%)
Wellhead	19May17	11:00a	0.026	204	28.4	84.9
Lab Blank			ND	ND	ND	ND
S_m			0.070	0.700	0.015	0.003
REF. VALUE			1.00	200	5.00	90.0
STD ± 2SD			0.998 ± 0.070	200 ± 11.2	5.03 ± 0.42	90.3 ± 0.25

SD = standard deviation
STD = secondary standard calibrated to primary standard reference material
S_m = standard deviation at zero analyte concentration; method detection limit is generally considered to be 3x S_m value
ND = none detected n/a = not applicable

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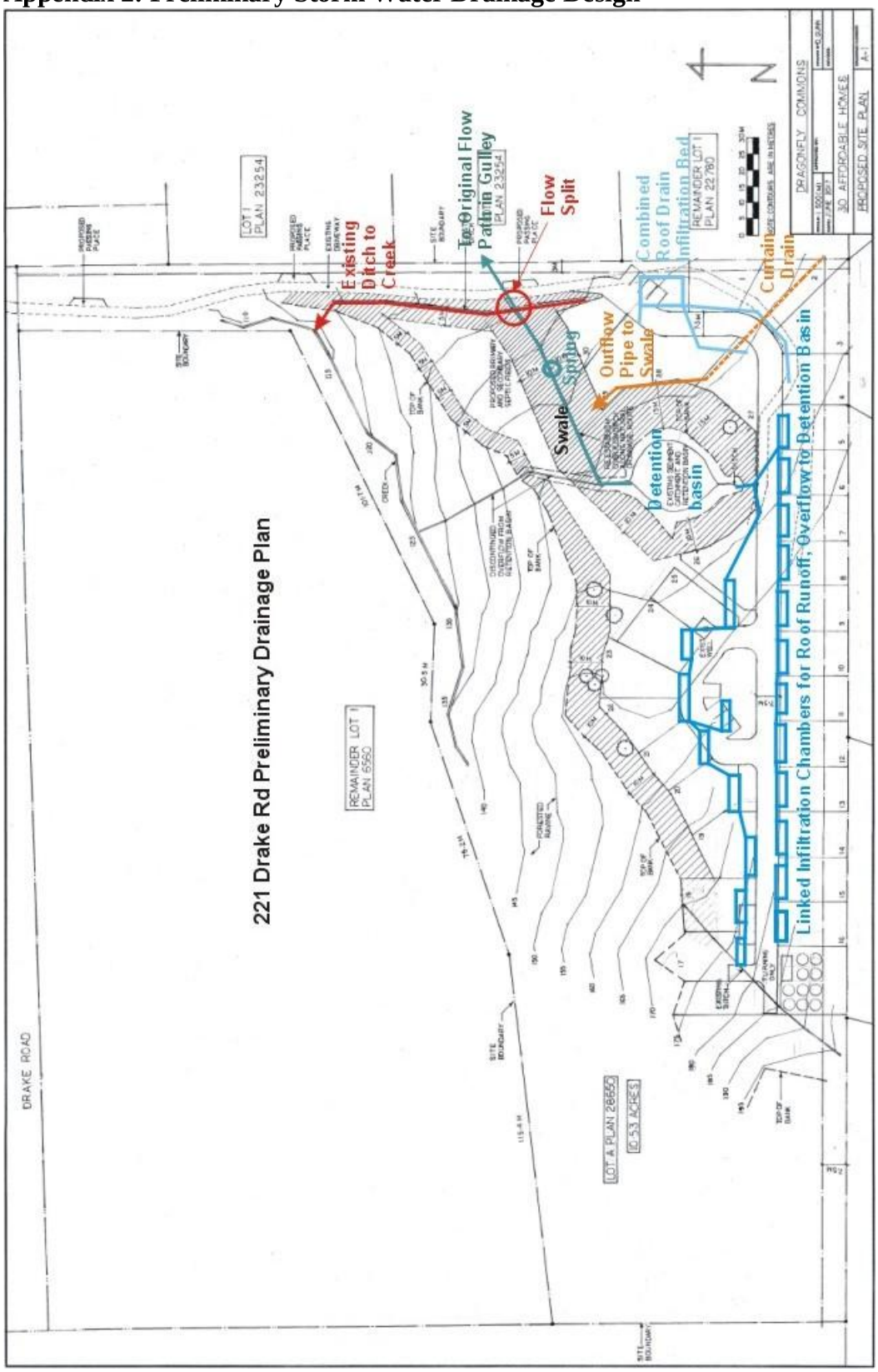
Appendix 2: Preliminary Storm Water Drainage Design



Appendix 3: Preliminary RAR Riparian Protected and Management Areas