



Ministry of
Environment



Regional District of Nanaimo Community Watershed Monitoring Network

2015 Lab Analysis Summary Southern Groups

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Environmental Protection Division
Regional Operations Branch

Acknowledgements

This program would not be possible without the dedication, passion and excellent work of the participating members of the stewardship groups: Island Waters Fly Fishers, Departure Creek Streamkeepers and Vancouver Island University Fisheries and Aquaculture.

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Executive Summary

In the 2015 monitoring seasons of the Regional District of Nanaimo (RDN) Community Watershed Monitoring Network, three groups in the southern part of the region – Departure Creek Streamkeepers, Island Waters Fly Fishers and Vancouver Island University Fisheries and Aquaculture – collected lab samples for analysis of *Escherichia coli* (*E.coli*), total Phosphorus, total metals and turbidity.

The sites recommended for lab analysis were selected based on where there were exceedances of turbidity reported in the Three-year Trend Report (2012-2014) for the Community Watershed Monitoring Network (Barlak et al., 2015). Total phosphorus samples were only taken during the summer period, as this is the growing season for algae in streams and thus the period of concern for higher nutrient levels. The lab analysis was intended to further investigate what water quality issues are present in creeks and streams in our region; and what contaminants may be associated with observed turbidity exceedances. This information will assist in directing the next steps including targeted outreach, restoration projects, etc.

Program Outline

The purpose of this report is to present a summary of the lab analysis for samples collected by Island Waters Fly Fishers, Departure Creek Streamkeepers and Vancouver Island University Fisheries and Aquaculture volunteers during 2015 as an additional component of the Community Watershed Monitoring Network (CWMN) at certain sites.

Samples were taken based on the following schedule, aligned with the standard periods used by Ministry of Environment on the east coast of Vancouver Island. This follows the five samples in thirty days (5-in-30) guidelines.

Summer (Low Flow)	Fall Flush
4 Aug 2015	13 Oct 2015
11 Aug 2015	20 Oct 2015
18 Aug 2015	27 Oct 2015
25 Aug 2015	3 Nov 2015
1 Sept 2015	10 Nov 2015

The following general sampling protocols were observed:

- Point opening of bottle into the flow and lower the bottle under the surface of the water so that the full mouth is submerged (to avoid collecting surface debris).
- Make sure to not disturb the bottom sediments while taking the sample.
- Once the bottle is filled above the marked line, replace the lid and set bottle into the cooler.
- Courier all samples to the lab that afternoon in the cooler, as per arrangements made by Ministry of Environment staff.

The sites that were sampled and the lab parameters sampled for are listed below in **Table 1**. E.coli samples were taken each week during both sample periods, as were turbidity lab samples for QA/QC (quality assurance/ quality control). Total phosphorus was only sampled each week in the Summer period. Metals were sampled on the first day of the summer period and the first day of the fall period. Note that the highlight (■) indicates where the Chase River site at Park Ave was only sampled for E.coli and turbidity in the fall period.

Table 1: Lab Analysis Sites & Parameters

Group	EMS #	Site	E. Coli (10 samples per site)	Total P (5 samples per site)	Metals (2 samples per site)	QA/QC Turbidity (10 samples per site)
DCS	E290469	Departure Creek @ NeylandX	X	X	X	X
	E290470	Departure Creek off Newton	X	X	X	
	E290471	Departure Creek @ Woodstream Park	X	X	X	
	E290472	Departure Creek @ Outlet	X	X	X	
IWFF	E290479	McGarrigle Creek @ Jingle Pot	X	X		
	E290478	Millstone River @ Biggs	X	X		
	E290480	Millstone River @ East Wellington	X	X		X
	E290481	Millstone River in Barsby Park	X	X	X	X
VIU	E290485	Chase River @ Park Ave	X	X	X	X
	E290486	Cat Stream @ Park Ave above Chase River		X	X	X
	E290487	Beck Creek @ Cedar Road	X	X		X

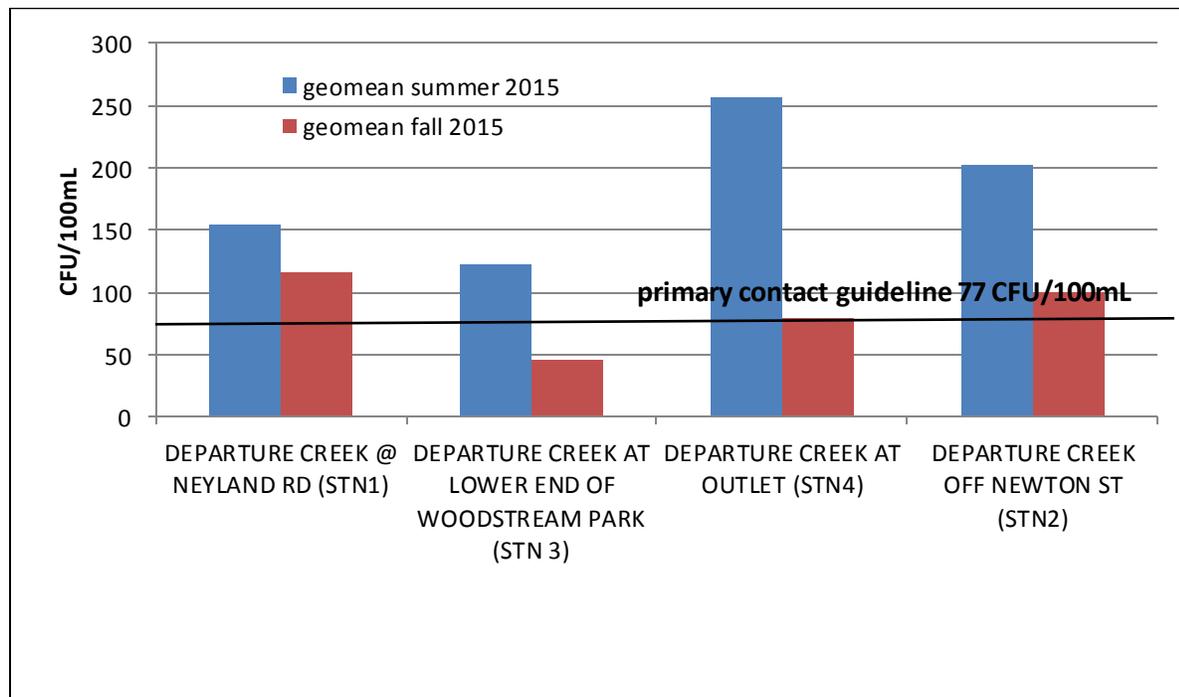
Data Summary

Departure Creek Streamkeepers

Except for one geometric mean value of 45 CFU/100mL in the fall of 2015, all DCS sites sampled for *E. coli* exceeded the primary contact recreational guideline (i.e. swimming) of a geometric mean of 77 CFU / 100 mL (based on a calculation from 5 weekly samples in 30 days), in both summer and fall of 2015 (**Figure 1**). The secondary contact guideline (i.e. fishing, boating) of a geometric mean of 385 CFU/100 mL was not exceeded at any site.

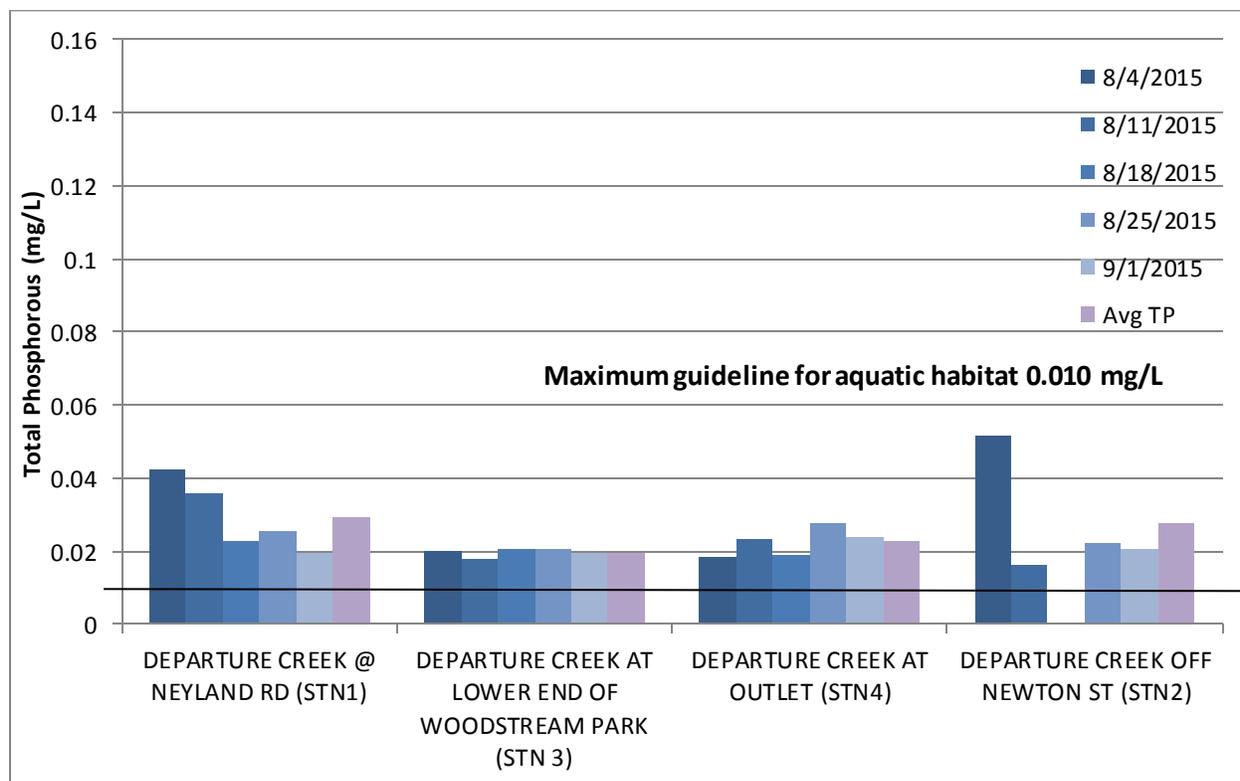
The presence of *E. coli* at levels regularly above the primary contact guideline at the Departure Creek sites could be of concern if the streams are used for swimming. Possible sources of microbiological contamination include: wildlife (deer, ducks, etc.) fecal matter or dog feces. The wildlife contributions are not avoidable, but there could be more done to encourage dog owners to pick up after their pets. This could be via signage and/or conveniently located waste receptacles and pick-up bags.

Fig. 1: Departure Creek Streamkeepers - Geometric Mean of *E. coli* (CFU/100ML)



Due to the natural variability of phosphorus levels, no BC water quality guideline exists for total phosphorus in streams. However, a phosphorus objective has been developed for Vancouver Island streams where, to prevent deterioration of aquatic life habitat and aesthetic problems, a maximum of 0.010 mg/L and average of 0.005 mg/L (based on 5 monthly samples collected between May and September) should not be exceeded. For sites sampled by the Departure Creek Streamkeepers (**Figure 2**), weekly results were higher than the maximum objective, and average values were higher than the average objective. Though weekly results for five weeks cannot be directly compared to this objective, they do suggest monthly samples would exceed both the maximum and average objective. Maximum total phosphorus values coincided with maximum *E.coli* values. These occurrences did not appear to be influenced by rain events recorded at any of the City of Nanaimo rain gauge locations.

Fig. 2: Departure Creek Streamkeepers – Maximum & average total phosphorus (mg/L)



Turbidity quality assurance/quality control (QA/QC) data for lab analysis were collected at the Neyland Rd (Stn 1) site on all dates and at the Newton St (Stn 2) site on only August 4, 2015, as shown in **Table 2**. All lab analysis data had higher values than the field data, and seven of the eleven QA/QC lab samples taken were greater than 25% different (the level at which the difference is no longer considered acceptable) from the field samples. However, only two of these samples (both sites on Aug 4, 2015) affect the determination of if the site exceeds the summer turbidity objective of a maximum of 2 NTU. This suggests that conditions for grab sample collection were not ideal (i.e. very low water making it difficult to grab an undisturbed sample) or sampling technique needs improvement (ensure grab samples are taken upstream of any water disturbance and that the bottle is not disturbing sediment upon collection). The very high lab turbidity in the Aug 4, 2015 sample from the Neyland Rd site and the moderately higher lab turbidity on the same date from the Newton St site is likely due to a combination of these two things and is likely the reason much higher *E.coli* and total phosphorous were also observed in these samples.

Table 2: Departure Creek Streamkeepers - Turbidity QAQC. Result units are in NTU.

Departure Creek Sample sites	8/4/2015	8/11/2015	8/18/2015	8/25/2015	9/1/2015	10/13/2015	10/20/2015	10/27/2015	11/3/2015	11/10/2015
NEYLAND RD (STN1) - lab	23	7.68	0.65	1.82	0.4	0.42	0.6	0.39	0.49	2.64
NEYLAND RD (STN1) - field	0.99	5.88	0.65	1.2	0.15	0.22	0.52	0.34	0.09	0.44
% difference (highlighted if >25%)	96	23	0	34	63	48	13	13	82	83
OFF NEWTON ST (STN2) - lab	2.4									
OFF NEWTON ST (STN2) - field	0.86	0.7	0.56	0.85	0.58	0.72	0.62	0.58	2.34	0.46
% difference (highlighted if >25%)	64									

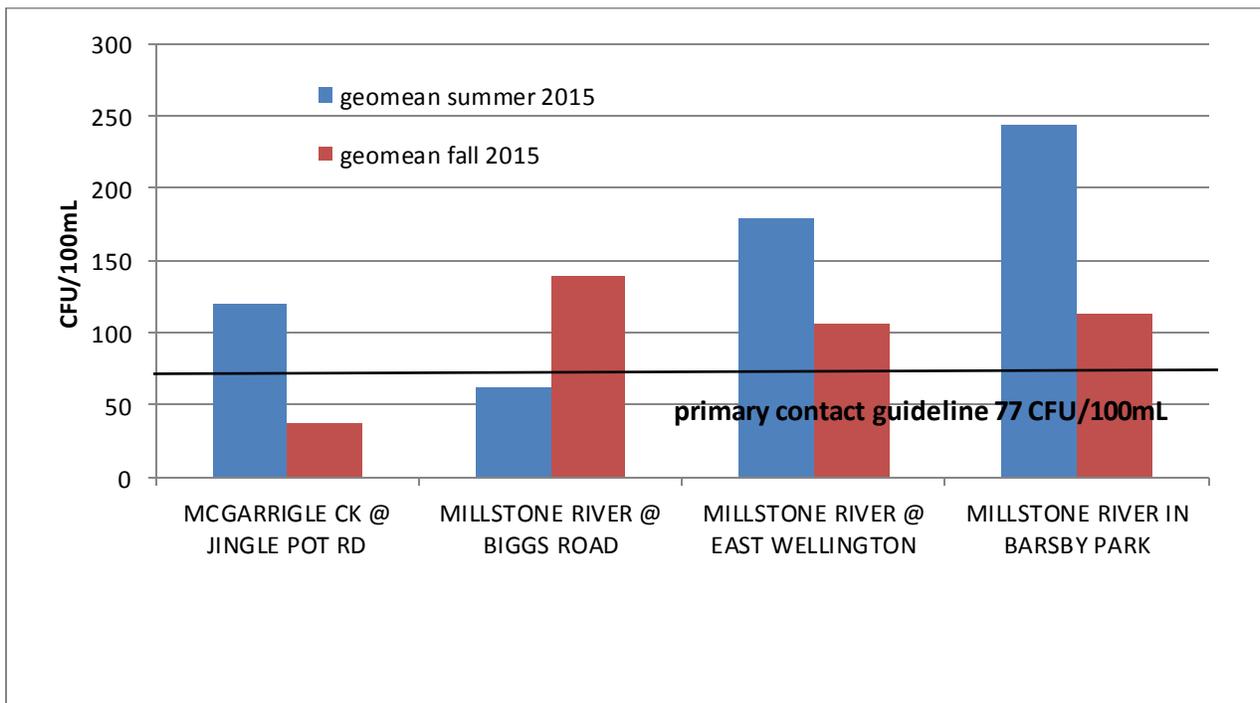
Metals data collected at Departure Creek at Neyland and Newton sites on Aug 4, 2015 showed slightly elevated levels of several parameters relative to other sites sampled the same day, though no results exceeded the acute water quality guidelines for aquatic life. These elevated levels are most likely associated with the high turbidity levels in lab samples mentioned above. The Oct 13, 2015 results at the Departure Creek sites showed values similar to those observed at other sites, of which none exceeded the acute water quality guidelines for aquatic life. These data do not show metals concerns at these sites for the dates sampled. However, metals sampling during the first fall flush event would be the best way to determine if metals inputs are occurring to these streams. If metals monitoring is continued at these sites, it would be useful to compare results to similar local streams considered to be in background condition.

Island Waters Fly Fishers

E. coli data collected by the Island Waters Fly Fishers (IWFF) in 2015 is shown in Figure 3. Except for one geometric mean value of 62 CFU/100 mL in the summer of 2015 at the Millstone at Biggs Rd site, and geometric mean value of 38 CFU/100mL in the fall of 2015 at the McGarrigle Ck at Jingle Pot Rd site, all IWFF sites and dates sampled exceeded the primary contact recreational guideline (i.e. swimming) of a geometric mean of 77 CFU / 100 mL (based on a calculation from 5 weekly samples in 30 days), in both summer and fall of 2015. The secondary contact guideline (i.e. fishing, boating) of a geometric mean of 385 CFU/100 mL was not exceeded at any site.

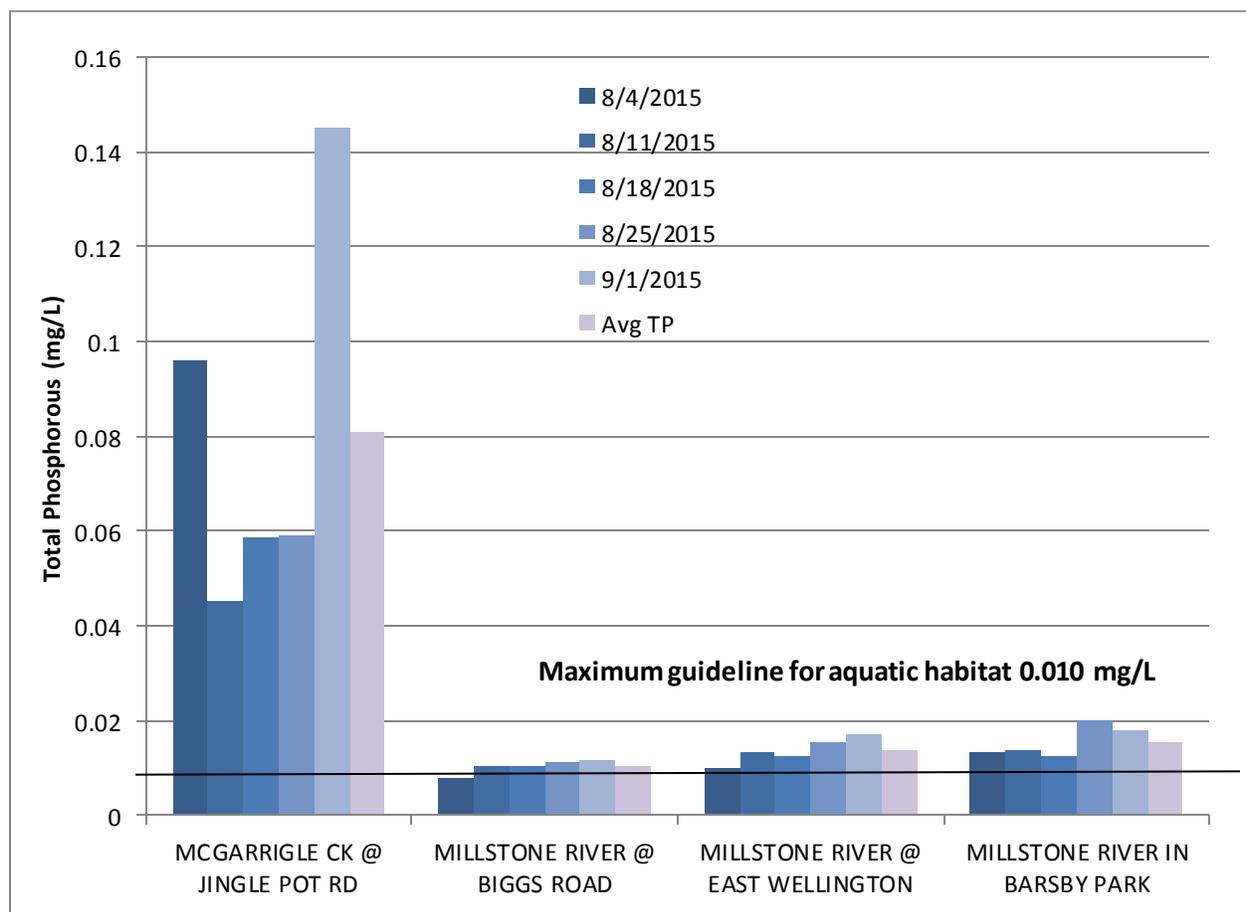
The presence of *E. coli* at levels regularly above the primary contact guideline at the McGarrigle Creek and Millstone River sites could be of concern if the streams are used for swimming. Possible sources of microbiological contamination include: wildlife (deer, ducks, etc.) fecal matter or dog feces. The wildlife contributions are not avoidable, but there could be more done to encourage dog owners to pick up after their pets. This could be via signage and/or conveniently located waste receptacles and pick-up bags. Failing septic systems may also be contributing to microbiological higher levels at these sites. Such contributions may be more measurable if the systems are overloaded during the dry period and septic runoff may be a main contributor to low stream flows at a given location, or if during a rainy period the field becomes saturated and septic influences make their way to a creek.

Fig. 3: Island Waters Fly Fishers - Geometric Mean of *E. coli* (CFU/100mL)



Island Weekly total phosphorus results (**Figure 4**) were consistently higher than the maximum objective of 0.010 mg/L, and average values were higher than the average objective of 0.005 mg/L at all sites. The McGarrigle Creek site notably had total phosphorus values four to fourteen times higher the maximum objective. Though weekly results for five weeks cannot be directly compared to this objective, they do suggest monthly samples would exceed both the maximum and average objective. Maximum total phosphorus values did not appear to coincide with rain events recorded at any of the City of Nanaimo rain gauges, nor with maximum *E.coli* values, suggesting there are phosphorus inputs into McGarrigle Creek that occur regardless of rain events. Land use classification (**Appendix 1**) upstream of McGarrigle Creek @ Jingle Pot Road (E2905479) does not clearly support one potential source of these inputs; the land use is mostly rural residential, treed/forest and a some agriculture. It is possible sources are multiple (e.g. from small farms upstream or failing septic fields). More data should be collected on total phosphorus in McGarrigle Creek to better understand potential sources. An upstream sample site for turbidity, temperature, dissolved oxygen and conductivity was added in 2016, but lab analysis was not completed.

Fig. 4: Island Waters Fly Fishers - Maximum and Average of total P (mg/L)



Turbidity data for quality assurance/ quality control lab analysis were collected at both Millstone River at East Wellington and Millstone River in Barsby Park sites on all sample dates in 2015 (**Table 3**). Only three of the twenty samples had lab values that were greater than 25% different than the field samples, suggesting that both sample conditions and grab sample protocols were generally good at these sites. There did not appear to be any clear trend of lab or field being consistently higher among all values, though more lab values were slightly higher than field values at the Barsby site, which might suggest conditions at this site made it harder to fill bottles without slight sediment disturbance. No turbidity objective was exceeded at either site based on the field data. Only the Barsby site on Aug 25, 2015 had a lab value of 2.11 NTU (exceeding the summer objective of 2 NTU) versus a field value of 1.81 NTU that did not exceed the objective.

Table 3: Island Waters Fly Fishers - Turbidity QAQC. Result Units are in NTU.

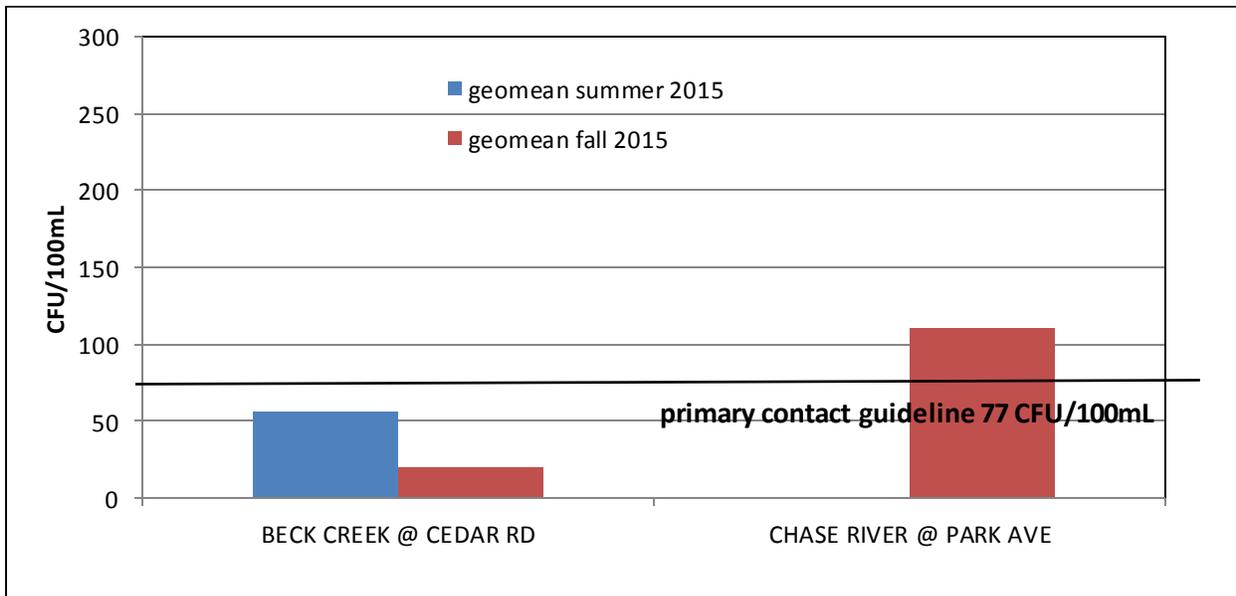
Millstone River Sample Sites	8/4/2015	8/11/2015	8/18/2015	8/25/2015	9/1/2015	10/13/2015	10/20/2015	10/27/2015	11/3/2015	11/10/2015
@ EAST WELLINGTON - lab	1.47	1.45	1.16	1.9	1.41	0.99	0.96	1.11	1.18	1.33
@ EAST WELLINGTON - field	1.47	1.69	1.2	1.94	1.37	1.56	0.91	0.97	1.12	1.52
% difference (highlighted if >25%)	0	-17	-3	-2	3	-58	5	13	5	-14
IN BARSBY PARK - lab	0.89	1.61	1.28	2.11	1.26	3.24	1	1.65	2	1.59
IN BARSBY PARK - field	1.38	1.55	1.15	1.81	1.04	3.35	1.02	1.14	1.95	1.38
% difference (highlighted if >25%)	-55	4	10	14	17	-3	-2	31	3	13

Metals data collected at Millstone River at Barsby on Aug 4, 2015 and Oct 13, 2015 showed slightly elevated values (relative to the other sites) for the Oct 13, 2015 sample date, though no values exceeded the acute water quality guideline for aquatic life. These elevated values are likely associated with the increased field turbidity observed at this site on the same date.

Vancouver Island University

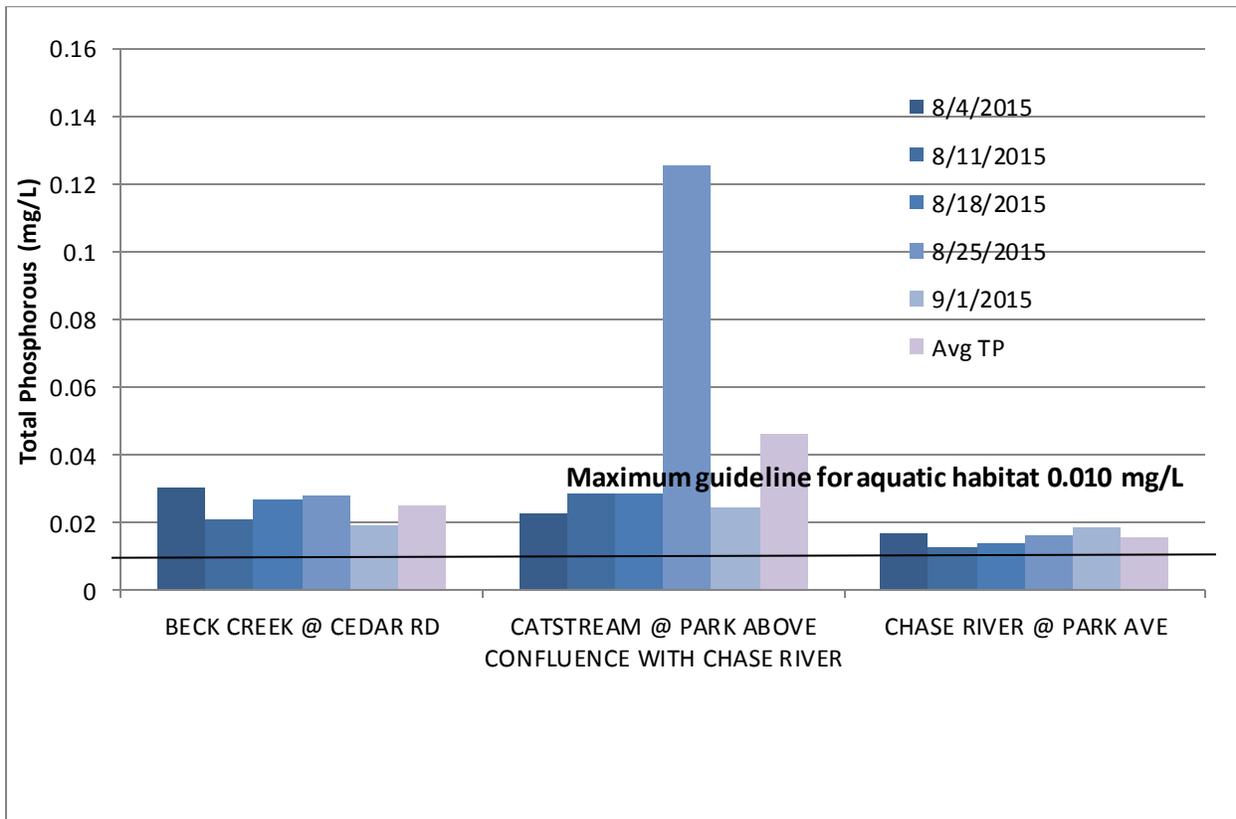
Only two of VIU's monitoring sites (Beck Creek at Cedar Rd and Chase River at Park Ave) were sampled for *E.coli* in 2015 (Figure 5). Only the Chase River site in the fall of 2015 exceeded the primary contact recreational guideline (77 CFU / 100 mL). The secondary contact guideline (i.e. fishing, boating) of a geometric mean of 385 CFU/100 mL was not exceeded at any site. It may be worth evaluating potential sources of contamination, and sampling to see if summer values are also elevated in Chase River. At this point, higher fall values are of little concern as swimming is not likely in this stream in the fall. Likely, the *E.coli* readings are linked with pet and wildlife feces, as this is a sewer serviced area.

Fig. 5: Vancouver Island University - Geometric Mean of *E.coli* (CFU/100mL)



Three sites were sampled by VIU for total phosphorus in 2015 (Figure 6). The weekly results for total phosphorus were consistently higher than the maximum objective of 0.010 mg/L, and average values were higher than the average objective of 0.005 mg/L at all sites. Though weekly results for five weeks cannot be directly compared to this objective, they do suggest monthly samples would exceed both the maximum and average objective. The August 25th, 2015 sample at Cat Stream that is 12 times the maximum objective may have to do with an isolated run-off event (i.e. car washing or lawn fertilizing with subsequent sprinkling). High phosphorus values on other dates do not appear to be associated with rainfall events, thus these data suggest that there are regular phosphorus inputs into Beck Creek, Cat Stream and Chase River. Further data collection and land use mapping should occur to determine potential phosphorus sources.

Fig. 6: Vancouver Island University - Maximum and Average of total P (mg/L)



Turbidity data for quality assurance / quality control lab analysis were collected at all three sites in both summer and fall in 2015, except for the Chase River site where only one sample was collected on Aug 4, 2015 in the summer data set. Only thirteen of the twenty-six samples collected had lab values that were greater than 25% different than the field samples (**Table 4**), suggesting that both sample conditions and grab sample protocols were generally good at these sites. Fourteen of the twenty six samples had lab values higher than field values; a trend that occurred on more dates at the Beck Creek site than the other two sites, which might suggest conditions at Beck Creek made it harder to fill bottles without slight sediment disturbance. This trend made four of the summer sample dates at Beck Creek exceed the summer turbidity objective of 2 NTU based on the lab data, whereas only one site would have exceeded based on the field data. Turbidity QA/QC values do not suggest that sampling error contributed greatly to the Aug 25, 2015 total phosphorous spike at the Cat Stream site, but rather support that this was a true event due to an isolated run-off event, as suggested above. Turbidity at Cat Stream on this date (19.6 NTU field value and 24.1 NTU lab value) greatly exceeded the summer turbidity objective of 2 NTU. Fall values at all sites met the fall turbidity objective of 5 NTU.

Table 4: Vancouver Island University - Turbidity QAQC. Result Units in NTU.

Sample Sites	8/4/2015	8/11/2015	8/18/2015	8/25/2015	9/1/2015	10/13/2015	10/20/2015	10/27/2015	11/3/2015	11/10/2015
BECK CREEK @ CEDAR RD - lab	4.97	2.29	4.14	2.29	2.33	0.81	0.64	0.64	3.27	2.17
BECK CREEK @ CEDAR RD - field	1.05	1.17	0.76	2.5	1.93	0.79	0.56	0.83	4.14	1.49
% difference (highlighted if >25%)	79	49	82	-9	17	2	13	-30	-27	31
CAT STREAM @ PARK - lab	1.22	0.91	0.65	24.1	1.36	0.87	0.63	1.49	0.87	1.1
CAT STREAM @ PARK - field	1.25	1.59	0.95	19.6	0.81	0.98	0.98	1.34	1.23	1.18
% difference (highlighted if >25%)	-2	-75	-46	19	40	-13	-56	10	-41	-7
CHASE RIVER @ PARK AVE - lab	1					0.69	0.4	0.81	0.98	1.14
CHASE RIVER @ PARK AVE - field	0.67	0.77	0.76	0.73	1.01	0.38	0.48	0.77	0.93	1.17
% difference (highlighted if >25%)	33					45	-20	5	5	-3

Metals data collected at Chase River at Park Ave. and Cat Stream at Park Ave. on Aug 4, 2015 and Oct 13, 2015 showed no values that exceeded the acute water quality guidelines for aquatic life.

Conclusions

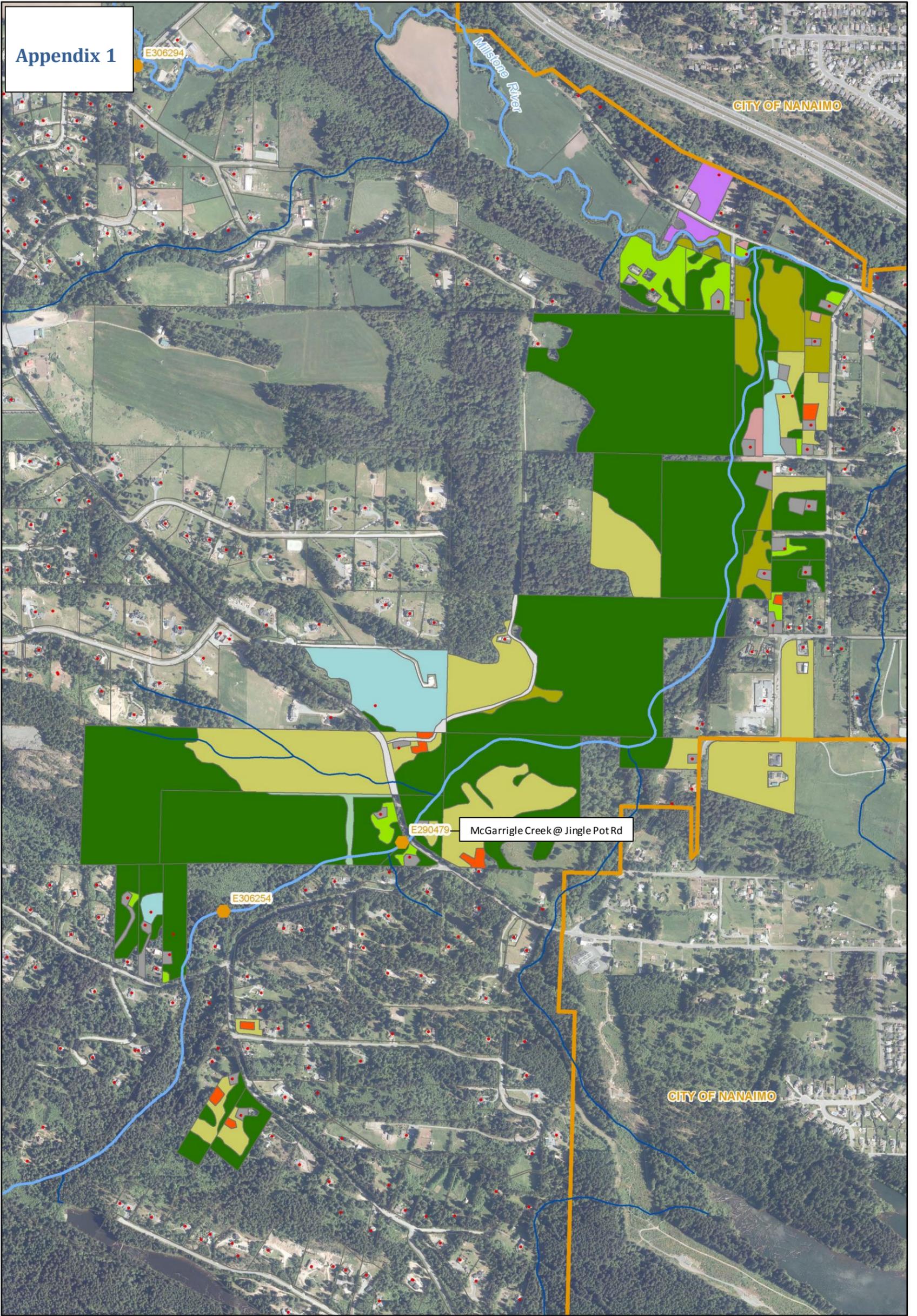
There are obvious anthropogenic impacts at most of these sites, though not all parameters (e.g. metals) show the potential of exceeding guidelines. The infrequency of metals sampling and dates on which sampling occurred likely did not capture the most probable time to see impacts. To better answer the question of potential metals inputs, total metal sampling should occur for five weekly samples in 30 days to coincide with a first flush event. More phosphorus data collection should also occur. Total phosphorus sampling should occur monthly from May through September, and additional sites upstream of existing sites considered for monitoring based on land use mapping exercises determining potential sources of phosphorus.

It is recommended that effort be put into reducing impacts by promoting best practices on the land base in urban watersheds. This includes picking up pet waste and disposing of wastes properly, minimizing use of chemicals on gardens and farmland, etc.

References

Barlak, Rosie and Epps, Deb. 2015. Regional District of Nanaimo Community Watershed Monitoring Network Three Year Trend Report. British Columbia Ministry of Environment. Nanaimo, B.C. Available online at: <http://www.rdn.bc.ca/cms/wpattachments/wpID2844atID7783.pdf>

Appendix 1



Landuse Classification Along McGarrigle Creek

