Investigative Water Quality in the Shediac and Scoudouc Tributaries

Final Report

By:

The Shediac Bay Watershed Association Inc.

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Acknowledgements

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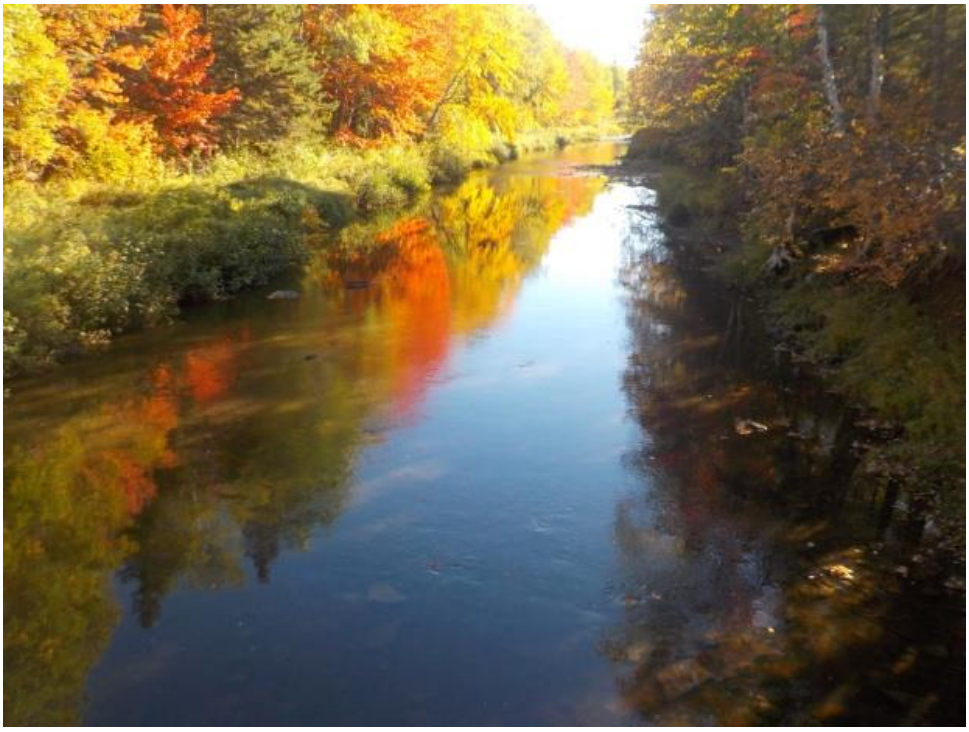
1. INTRODUCTION

The primary mandate of the Shediac Bay Watershed Association is the protection and enhancement of water quality as well as increase public awareness of environmental issues. Since the implementation of the water classification program in 1999, the SBWA has conducted a water quality monitoring program for surface water in the Shediac and Scoudouc rivers. The program has evolved and improved during the last 20 years.

A long-term water monitoring program allows the association and government agencies to detect changes or trends in water quality data. This information is used to prioritize areas that require restoration work or more in-depth investigations. This project is an extension of established sites that are upstream of previously sampled sites to help determine influences upstream of sites that have been continuously monitored over the two decades of sampling.

Education is an important part of the mandate of the Association and we will continue to work with local schools, community groups and residents to educate on the importance of a healthy watershed.

This report will highlight the monitoring results that have been undertaken in 2020 at sites upstream from established sample sites. We consider some of these upstream sites additional locations, while some are repeats of previous locations.



1.1 Overview of the Shediac Bay Watershed

The Shediac Bay watershed covers 420 km^2 of land area and stretches along 36 km of coastline, from Cap Bimet to Cap de Cocagne (Fig. 1). The Shediac Bay watershed is composed of two major river systems emptying into Shediac Bay: the Shediac River and the Scoudouc River. The Shediac and Scoudouc Rivers are characterized by dendritic patterns of small tributaries covering a watershed of 201.8 and 143.3 km^2, respectively. The Shediac River is composed of two major water arms. The northern water arm is created by the convergence of the McQuade Brook, the Weisner and the Calhoun Brook. The southern large water arm of the Shediac River is the continuation of the Batemans Brook. Water velocity in both rivers is generally weak due to the gentle regional elevation. The watershed boundaries stretch into both Kent and Westmorland counties and include both Shediac and Scoudouc rivers and their tributaries.

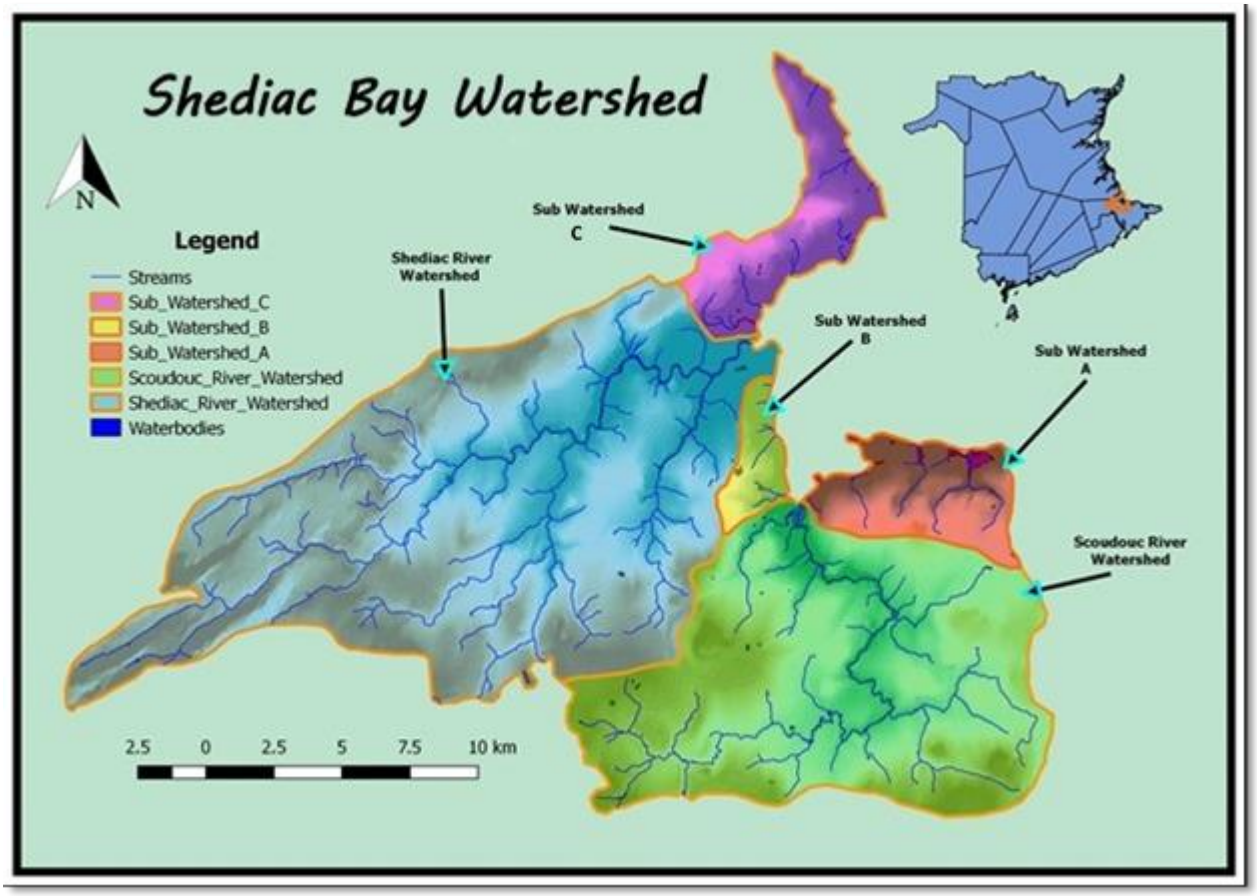


Figure 1: Map of Shediac Bay watershed boundaries and sub-watersheds

2. METHODOLOGY

2.1 Water Quality Sampling

Water quality monitoring was conducted generally once a month, seven times from July to October 2020, at 10 upstream sampling stations that flow into the major rivers and tributaries of the Shediac Bay watershed. Water quality sampling was performed using the protocol developed by the New Brunswick Department of Environment. Water samples were collected after two rainfall events in October.

Basic water quality parameters (DO, temperature, pH, conductivity and salinity) were measured using a new YSI- *Professional Plus* multi-parameter metre. Water samples were sent to *RPC Laboratory* for analysis of *E.coli*, nitrates and phosphates.

The equipment needed to conduct the sampling and collect the habitat data includes; laboratory issued sample bottles, labels, latex or nitrile gloves, clipboard, waterproof paper for field sheets, pencils, waders or rubber boots, GPS, digital camera, YSI (water conditioning metre), metre stick and survey measuring tape.

2.2 Site Information – Investigative Water Quality Sites

The following describes the sample site information for the 10 investigative water quality sites established in 2020 as upstream sites.

Table 1: Investigative Water Quality Monitoring Site Information

Site ID	Latitude	Longitude	Elevation (m) Google Earth	Location Description
AG 1	46º 11' 7.95"N	-64º 33' 29.38"W	24	On route 132, approximately back out from Shediac about 4 km, down ¾ km on Red River Road to the first stream behind the Gaunce farm property
AG 2	46º 12' 2.84"N	-64º 33' 26.25"W	6	This is a repeat sample site from previous years in the lower pasture of Connors farm, off Rt 132. It was repeated because there was some diversion work done last year in the upper pasture
AG 6	46º11' 48.20"N	-64º 33' 48.72"W	19	This site is on land owned by neighbour Fred Hodgekins at the new culvert on Rt 132 beside the Connors farm. It is a small flow tributary that eventually feeds AG 2
AG 8	46°14' 53.27"N	-64°39' 46.56"W	17	Next to the homestead, stream below where it crosses to adjacent property, low flow, drains several hayfields across the road (Rt 132)
AG 5A	46°12' 53.56"N	-64°40' 29.74"W	3	Three flows enter the culvert where we sample, the ditch, and two branches of the stream from the Scoudouc farm properties, one water source is a holding pond for irrigation
SW 5A	46°13' 57.48"N	-64°30' 43.61"W	10	This very small stream drains through the woods below the maintenance garage for Parlee Beach This is one of several small streams that cross the walking trail
FW 2A	46°12' 51.77"N	-64°34' 4.00"W	2	This site is well above the sometimes tidal site FW 2. Small trout were seen, a larger fish jumped in the culvert while we were there. SBWA plans finished a tree planting project near this site this season (2020).
WQ 8A	46°15' 11.79"N	-64°34' 16.62"W	1	This site is well above the tidal site WQ 8. It is heavily grassed in, well shaded and still had a slight flow when visited during the dry conditions of late June/early July. Woods and fields are above.
WQ 11D	46°17' 57.03"N	-64°33' 12.42"W	8	This site is well above the tidal site WQ 11 It is heavy with thick riparian vegetation along most of its length. Hayfields dominate the levels on the edge and above the stream. Being well shaded it maintained a slight but steady flow when visited during the dry conditions of late June/early July.
WQ 11E	46°17' 56.32"N	-64°33' 19.60"W	9	This site is well above the tidal site WQ 11 It is bordered by hay field on the lower side and by recently cut brush/shrub/grass on the upper side. Above is the owners relatives who maintain a population of horses in a horse barn. This is a recent addition to the property expansion and development.

Figure 2: Investigative Quality Sampling Sites - the big picture

Figure 3: Investigative Quality Sampling Sites - the close-up locations

2.3 Water Quality Parameters

Table 2: Terms and definitions for water chemistry and bacterial data tables

Parameter		unit	definition
Temp	T	0C	air and water temperature measured in degrees centigrade (celcius)
salinity	SAL	ppt	salinity measured in parts per thousand
dissolved oxygen	DO	mg/L or %	dissolved oxygen measured in mg/L or percentage
pH	acid/base	neutral =7	potential of hydrogen measured in the field and laboratory
phosphates	PO_4	mg/L	source is often fertilizers
nitrates	NO_3	mg/L	source can be fertilizers, sewage and manure run-off
E.coli	*E.coli*	MPN/100ml	Escherichia coli measured in most probable number per 100 milliliters
conductivity	COND	µS/cm	conductivity measured in microsiemens per centimeter in the field
total dissolved solids	TDS	mg/L	total dissolved solids measured in milligrams per liter

The water quality monitoring program analyses many chemical and physical parameters to assess the overall water quality for the protection of aquatic life. Most all results are presented in the report, but only a few key parameters will be discussed in the report, as some of these were above the recommended guidelines or they are of greater significance to the assessment of the overall water quality.

2.3.1 Water Temperature

Water temperature can fluctuate depending on the period of the day and during seasonal changes. Values are influenced by numerous factors such as the tree canopy providing shade, water velocity and depths, presence of cold springs, etc. It is considered that water above 25 or 29 degrees Celsius ($^{\circ}$C) tends to be of poor quality because less oxygen can be dissolved. Therefore, water temperature directly influences the dissolved oxygen levels. Water temperatures above 22 $^{\circ}$C is said to cause thermal stress to salmonid populations, causing them to stop feeding and search for more favourable thermal locations, one example being a spring feed inlet.

2.3.2 Salinity

For the samples taken during the season, salinity levels were negligible. We were sampling upper tributaries that consisted of freshwater run-off. Once at WQ 8A there was residual salt in the sample from a high tidal influence from the long receded full moon tide.

2.3.3 Dissolved Oxygen

Dissolved oxygen (DO) represents the concentration of oxygen in gaseous form in the dissolved in the water column. Most of the oxygen in the water comes from the surface atmosphere and is mixed in the water by turbulence and current. The measurement of the concentration of dissolved oxygen in surface waters is essential for measuring changes in water condition and evaluating

water quality. It has a direct effect on aquatic life and can be influenced by stream habitat alteration. DO is essential for the survival of fish and many other forms of aquatic life. The temperature limits the amount of oxygen that can dissolve in water; dissolved oxygen varies with temperature and tends to be lower when the water temperature is high. However, temperature is not the only cause of low-oxygen, too many bacteria and an excess amount of biological oxygen demand from the oxygen consumption used by the microorganisms (aerobic bacteria) in the oxidation of organic matter also affects the dissolved oxygen concentrations. According to the Canadian Council of Ministers of the Environment (CCME) Canadian water quality guidelines, the lowest acceptable DO concentration for aquatic life in cold water is 9.5 mg/l for early life stages and 6.5 mg/l for other life stages.

2.3.4 Potential Hydrogen (pH)

The potential hydrogen (pH) level indicates if the water is acidity or basic. It affects how much other substances, such as metals, dissolve in the water. In facts, the pH affects the solubility and toxicity of chemicals and heavy metals in water. Many aquatic organisms are sensitive to changes in pH and may be adversely affected by the pH that is either too high or too low. The pH varies naturally depending on bedrock, climate and vegetation cover, but may also be affected by industrial or other effluents, the exposure of some type of rock (for example during road construction) or drainage from mining operations. According to the CCME's Canadian water quality guidelines, pH should be between 6.5 and 9, as pH levels move away from this range it can stress animal systems and reduce hatching and survival rates in the stream.

2.3.5 Phosphates

Phosphates exist in different forms: orthophosphate, metaphosphate and organically compound contains phosphorus. These forms of phosphate occur in living and decomposing plants and animals, as free ions, chemically bonded in aqueous system or mineralized compounds in sediments, soils and rocks. Large amount of phosphate coming from cleaning products (detergents), run off from agricultural and residential fertilizer components can lead to eutrophication. Soil erosion is a major contributor of phosphorus to stream. It is recommended by Environment Canada to apply the Canadian Framework for phosphorus. Trigger ranges are based on the range of phosphorus concentrations in water that define the reference trophic status for a site. Measured phosphorus concentrations should not exceed predefined trigger ranges and should not increase more than 50% over baseline (reference) levels. Total phosphorus levels (PO_4) should be under 0.025 mg/L to maintain its unaffected trophic state.

2.3.6 Nitrate-Nitrogen

Nitrogen is essential for plant growth, but the presence of excessive amounts in water presents a major pollution problem. Nitrogen compounds may enter water as nitrates or be converted to nitrates from agricultural fertilizers, sewage, industrial and packing house wastes, drainage from livestock feeding areas, farm manures and legumes. The acceptable amount of Nitrate-nitrogen for the protection of aquatic life in freshwater is set at 2.9 mg/l (NO_3).

2.3.7 Escherichia Coli

Escherichia coli (*E.coli*) is one of many species of bacteria living in the lower intestines of mammals. The presence of *E.coli* in water is a common indicator of fecal contamination. We sample in streams influenced by a considerable amount of farmland. Some of it is hayfields, some of it is pasture and some is both after the hay harvest. The other land usage is for growing crops. The acceptable count of *E.coli* in water is set at 400 MPN/100 ml.

2.3.8 Conductivity

Conductivity is the measurement of the ability of water to pass an electrical current. It is affected by the amount of inorganic dissolved solids (nitrate, chloride, sulphate, sodium, etc.) found in the water. The conductivity level may be influenced by rainwater, agricultural or urban runoff and the geology of the area. There are no set criteria for conductivity levels for water quality, but the US Environmental Protection Agency states that stream conductivity levels ranging between 0.15 and 0.5 mS/cm usually seem to support a good mixed fisheries. Consequently, a higher conductivity level may indicate a higher amount of dissolved material in the water and the presence of contaminants.

2.3.9 Total Dissolved Solids

Total dissolved solids (TDS) comprise inorganic salts and small amounts of organic matter that are dissolved in water. The principal constituents are usually the cations calcium, magnesium, sodium and potassium and the anions carbonate, bicarbonate, chloride, sulphate and, particularly in groundwater, nitrate (from agricultural use). An aesthetic objective of *≤500 mg/L* has been established for total dissolved solids (TDS) in drinking water. At higher levels, excessive hardness, unpalatability, mineral deposition and corrosion may occur. At low levels, however, TDS contributes to the palatability of water.

2.4 CCME - Canadian Environmental Quality Guidelines

Table 3: Summary of the CCME Canadian Environmental Quality Guidelines

Parameter	condition	value mg/L	condition	value mg/L
DO (warm)	early	6	other	5.5
DO (cold)	early	9.5	other	6.5
pH	lower T	6.5	upper T	9
NO_3	short term	124	long term	2.9
PO_4	lower	0.004	upper	0.025
TDS	best	≤ 500		
Parameter	condition	value µS/cm	condition	value µS/cm
conductivity	lower	0.15	upper	0.5
E.coli	good	< 400MPN/100ml	not good	< 400MPN/100ml

2.5 Health Canada-Guidelines for Canadian Recreational Water Quality

Table 4: Guidelines for Health Canada Recreational Water Quality: Summary Table

Guidelines for Health Canada Recreational Water Quality		
Parameter	Considerations	Guideline
Escherichia coli (Primary-Contact Recreation)*	Geometric mean concentration (minimum 5 samples)	≤ 200 *E. coli* /100 mL
	Single sample maximum concentration	≤ 400 *E. coli* /100 mL
Enterococci (Primary-Contact Recreation)*	Geometric mean concentration (minimum 5 samples)	≤ 35 Enterococci /100 mL
	Single sample maximum concentration	≤ 70 Enterococci /100 mL
*Advice regarding waters intended for secondary-contact recreational activities is provided in Section 4.2. of the *Guidelines for Canadian Recreational Water Quality: Third Edition*		
https://www.canada.ca/content/dam/canada/health-canada/migration/healthy-canadians/publications/healthy-living-vie-saine/water-recreational-recreative-eau/alt/pdf/water-recreational-recreative-eau-eng.pdf		

2.6 CCME Recommendation Guidelines for the Protection of Aquatic Life (Freshwater)

Table 5: CCME Recommendation Guidelines for the Protection of Aquatic Life (Freshwater)

CCME RECOMMENDED GUIDELINES FOR THE PROTECTION OF AQUATIC LIFE (FRESHWATER) SUMMARY OF OTHER PARAMETERS					
Parameter	Description	Value	Units	Notes	
Dissolved O_{2} †	Early life stages, cold water biota†	9.5	mg/L	†	The guidelines for the lowest acceptable dissolved oxygen concentrations are divided into four different categories to accommodate the wide range of tolerances exhibited by freshwater species at various life stages, and with warmer or colder temperature preferences.
	Other life stages, cold water biota	6.5	mg/L		
	Early life stages, warm water biota	6	mg/L		
	Other life stages, warm water biota	5.5	mg/L		
pH	Lower long-term limit	6.5	—	‡	There is no limit for the protection of aquatic wildlife for E. coli. The limit of 400 MPN/100 mL for the protection of environmental and human health is used instead.
	Upper long-term limit	9	—		
E. coli ‡	Upper limit	400	MPN/100 mL		

2.6 CCME Guidance framework for Phosphorus

Table 6: CCME Guidance framework for Phosphorus

CCME Guidance Framework for Total Phosphorus (TP-L)					
Parameter	Description	Value	Units	Notes	
TP-L*	Hyper-eutrophic	>0.100	mg/L	†	The CCME recommended guidelines for the protection of aquatic wildlife (freshwater) indicates the concentrations of total phosphorus at which each condition may occur. This does not suggest that a stream with hyper-eutrophic levels of total phosphorus will necessarily exhibit hyper-eutrophic properties, for example.
	Eutrophic	0.035 - 0.100	mg/L		
	Meso-eutrophic	0.020 - 0.035	mg/L		
	Mesotrophic	0.010 - 0.020	mg/L		
	Oligotrophic	0.004 - 0.010	mg/L		
	Ultra-oligotrophic	> 0.004	mg/L	*	Total phosphorus level

3. SAMPLING RESULTS

The following section contains the results on all the data collected during the investigative water quality monitoring for 2020. All water samples are assigned with a designated field number so that it can be logged into the *Department of Environment and local Government* database.

3.1 Tributary to Scoudouc River – AG 1

Table 7: Water chemistry, nutrient data and *E. coli* results for AG 1, 2020

date	site	temp	°C	ppt	mg/L		mg/L	mg/L	MPN/100ml	µS/cm	mg/L
		air	**H_2O**	**Sal**	**DO**	**pH**	PO_4	**NO_3**	***E.coli***	**Cond**	**TDS**
2020-07-16	AG 1	16	9.2	0.15	8.94	7.75	**0.008**	1.36	187	0.212	197.60
2020-08-26		14	10.9	0.16	7.31	7.54	**0.018**	1.27	173	0.237	210.60
2020-09-10		18	11.0	0.16	7.55	7.51	**0.010**	1.33	238	0.245	216.45
2020-10-01		25	12.9	0.16	**4.81**	7.43	**0.015**	0.89	189	0.250	211.25
2020-10-08		12	11.1	0.14	**5.53**	7.59	**0.032**	0.63	**2613**	0.217	189.80
2020-10-14		17	12.2	0.16	7.62	7.57	**0.020**	0.77	**1153**	0.237	204.10
2020-10-28		0	5.4	0.14	9.32	6.94	**0.010**	0.77	41	0.180	186.30

Figure 4: AG 1 Site location and surrounding view showing stream length and land uses

The farm fields on both sides of the tributary are used for the cultivation of hay, corn crops and as cattle pastures. The tributary has a good riparian zone as it travels to the Scoudouc River. It originates in a treed area and ends in a treed area just before the river. Trout have been seen in this stream over the sampling years. The upper stream does pass through some country residential area. This stream never dried up during the sampling season.

Figure 5: AG 1 Site location and close up view showing culvert site where sample was taken

The water sampling results for the site AG 1, for 2020, meets or exceeds all the recommendations for the survival of freshwater aquatic life based on pH and dissolved oxygen. There was one DO level below 5.5 in October.

Total phosphorus levels for long-term eutrophic conditions, according to the *CCME Guidance framework for Phosphorus*, were in the mesotrophic range (0.008 – 0.020 mg/L) from July to October, and once in October in the eutrophic range (0.032). Refer to table 5 to see the color coding used in the table above

Concentration results for the nitrate ion (NO3) are well below the short term (124 mg/L) for the hot summer months and below long term (2.9 mg/L) CCME recommendations for direct toxicity to sensitive freshwater life for all months. The sampling range was 0.63 to 1.36 mg/L

Bacterial levels did not exceed the maximum concentration of *E. coli* from the Health Canada recreational guideline (≥ 400 MPN/100 mL) for all samplings except for two samplings in early October. These two elevated levels in October were very high, October 8th, 2613 and October 14th, 1153 (MPN/100 mL).

Conductivity stayed between acceptable levels of 0.15 and 0.5 for all samplings. Similarly all total dissolved solid values were less than an acceptable level of 500 mg/L

3.2 Tributary to Scoudouc River – AG 2

Table 8: Water chemistry, nutrient data and *E. coli* results for AG 2, 2020

date	site	temp	°C	ppt	mg/L		mg/L	mg/L	MPN/100ml	mS/cm	mg/L
		air	H_2O	Sal	DO	pH	PO_4	NO_3	*E.coli*	Cond	TDS
2020-07-16	AG 2	17	15.2	0.16	6.78	7.63	0.049	0.40	11199	0.266	212.55
2020-08-26		14	15.6	0.16	6.13	7.77	0.041	<0.05	3076	0.267	216.45
2020-09-10		18	16.9	0.16	5.97	7.70	0.050	<0.05	12997	0.287	221.65
2020-10-01		25	16.2	0.17	7.24	7.75	0.033	0.25	2723	0.292	227.50
2020-10-08		12	12.1	0.20	8.08	7.52	0.340	1.09	24196	0.316	272.36
2020-10-14		17	13.9	0.16	8.94	7.51	0.056	0.78	17329	0.266	219.05
2020-10-28		0	2.2	0.18	12.7	7.32	0.028	0.59	1071	0.212	244.40

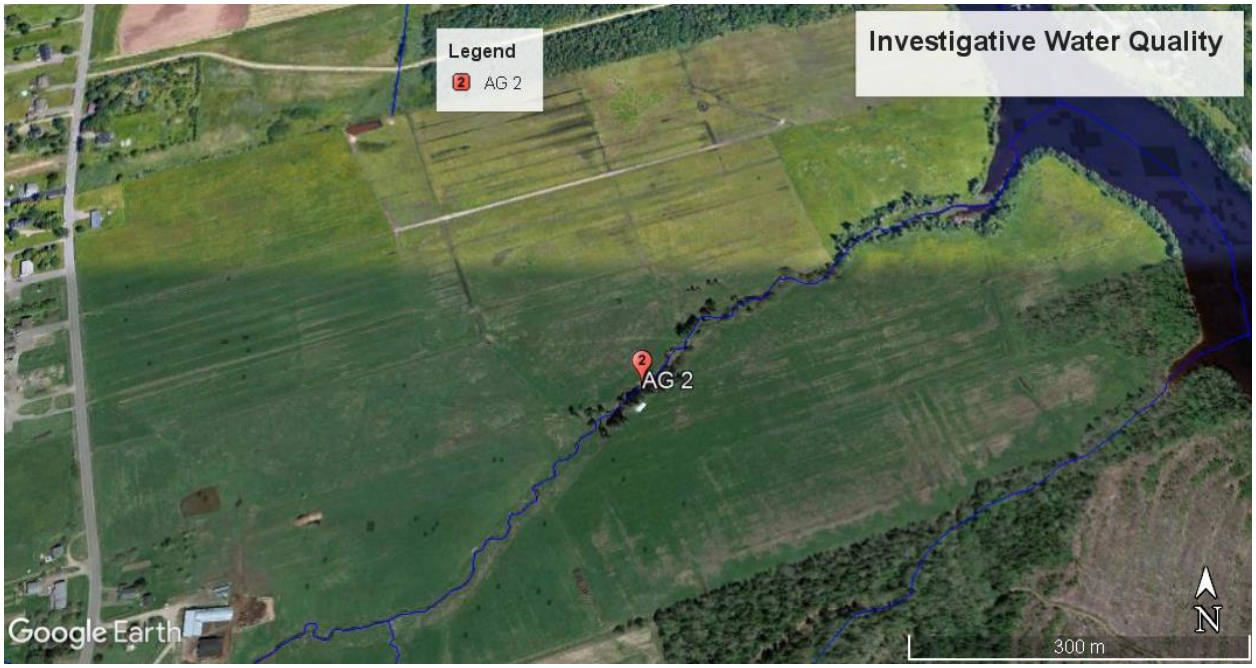


Figure 6: AG 2 Site location and surrounding view showing stream length and land uses

The farm fields on both sides of the tributary are used for the cultivation of hay, corn crops and as cattle pastures. The tributary has a poor to non-existent riparian zone as it travels to the Scoudouc River, mostly through pastured land where small tree plantings would result in cow consumption or trampling. There are some older trees lining the stream at the lower end before it enters the Scoudouc River. This stream never dried up during the sampling season, though feeder streams did and the flow was diminished in the warmer summer months. This site was repeated from the previous year to see if there was any improvement related to remediation work done in the upper pasture.

Figure 7: AG 2 Site location and close up view showing stream site where sample was taken

The water sampling results for the site AG 2, for 2020, meets or exceeds all the recommendations for the survival of freshwater aquatic life based on pH and dissolved oxygen. There was one DO level slightly below 6.00 in September. Several small fish juveniles were observed during the seasonal sampling.

Total phosphorus levels for long-term eutrophic conditions, according to the *CCME Guidance framework for Phosphorus*, were in the eutrophic range (0.008 - 0.020 mg/L) for the samples in the months of July, August, September and mid-October. Early and late October were meso-eutrophic and samples on the 8th of October were high, or hyper - eutrophic at 0.340 mg/L. Refer to table 5 to see the color coding used in the table above.

Concentration results for the nitrate ion (NO3) are well below the short term (124 mg/L) for the hot summer months and below long term (2.9 mg/L) CCME recommendations for direct toxicity to sensitive freshwater life for all months. The sampling range was <0.05 to 1.09 mg/L

Bacterial levels did exceed the maximum concentration of *E. coli* from the Health Canada recreational guideline (≥ 400 MPN/100 mL) for all samplings. The higher elevated levels ranged from 1071 in late October after a rain event to a high of 24196 on the first week of October (8th) (MPN/100 mL). These are the highest levels we recorded all season.

Conductivity stayed between acceptable levels of 0.15 and 0.5 for all samplings. Similarly all total dissolved solid values were all less than an acceptable level of 500 mg/L for all samplings.

3.3 Tributary to Scoudouc River – AG 6

Table 9: Water chemistry, nutrient data and *E. coli* results for AG 6, 2020

date	site	temp	°C	ppt	mg/L		mg/L	mg/L	MPN/100ml	mS/cm	mg/L
		air	H_2O	Sal	DO	pH	PO_4	NO_3	*E.coli*	Cond	TDS
2020-07-16	AG 6	17	16.2	0.66	3.36	7.08	0.029	<0.05	<10	1.060	851.50
2020-08-26		13	14.1	2.20	4.91	7.03	0.065	0.73	146	3.280	2671.50
2020-09-10		DND	17.0	1.58	3.17	7.09	0.078	<0.05	30	2.560	1963.00
2020-10-01		25	16.6	2.44	8.13	7.32	0.027	0.06	10	3.820	2957.50
2020-10-08		11	13.3	1.56	5.50	7.18	0.220	0.06	5475	2.390	1969.50
2020-10-14		17	12.7	0.34	7.82	7.37	0.135	<0.05	9208	0.520	442.00
2020-10-28		0	6.0	1.32	5.35	6.81	0.039	0.05	>24196	1.630	1657.50

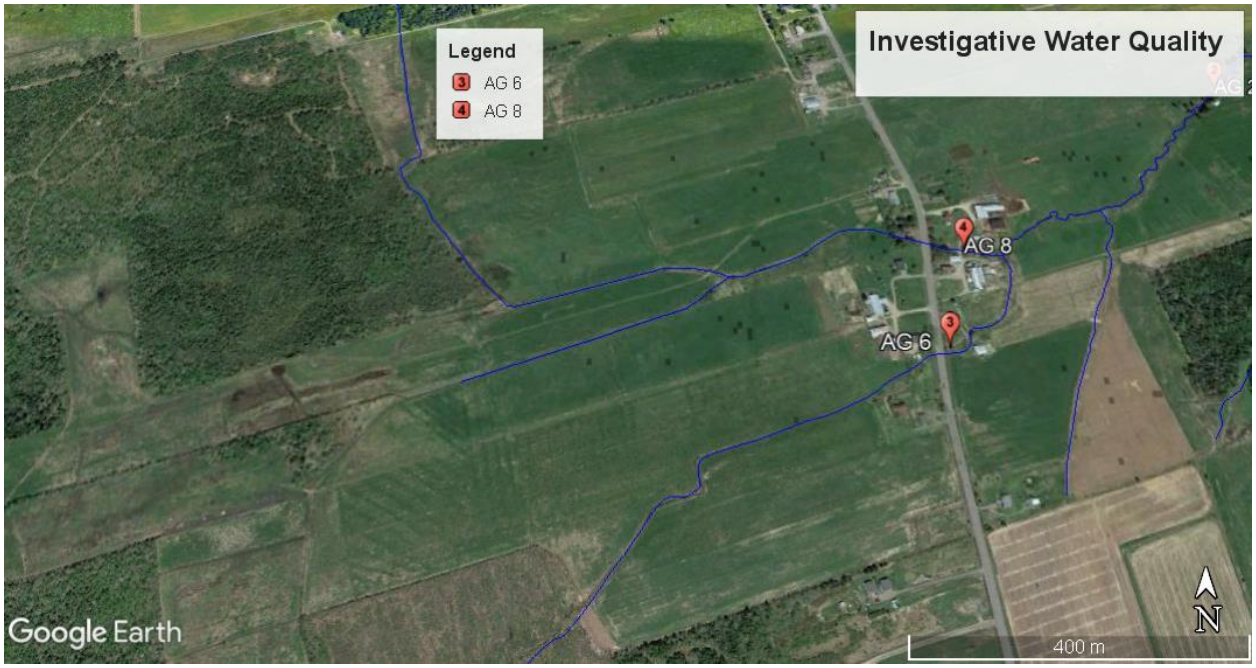


Figure 8: AG 6 Site location and surrounding view showing stream length and land uses

The small stream for sample AG 6 flows through mostly hayfields. It is very small and supports water flow mostly after rains draining the fields across the road. It was very dry during the summer sampling and only a trickle fed the small pool at the culvert outlet. The landowner across the road has some pasture sections.

Figure 9: AG 6 Site location and close up view showing stream site in relation to the 2 closest farms

The water sampling results for the site AG 6, for 2020, meets or exceeds all the recommendations for the survival of freshwater aquatic life based on pH. The dissolved oxygen was very low for 6 of 8 samplings. The lowest were in the hot summer months when there was no water flow, ranging from 3.17 to 4.91 for July, August and September. They rose in October with rain events and renewed water flow and ranged from 5.35 to 8.13 all measured in mg/L.

Total phosphorus levels for long-term eutrophic conditions, according to the *CCME Guidance framework for Phosphorus*, were in the meso-eutrophic range (0.020 - 0.035 mg/L) for the samples in the months of July and early October. August and September were eutrophic as was late October. On the 8th and 14th of October, sample were high, or hyper - eutrophic at 0.220 and 0.135 mg/L. Refer to table 5 to see the color coding used in the table above.

Concentration results for the nitrate ion (NO3) are well below the short term (124 mg/L) for the hot summer months and below long term (2.9 mg/L) CCME recommendations for direct toxicity to sensitive freshwater life for all months. The sampling range was <0.05 to 0.73 mg/L.

Bacterial levels did exceed the maximum concentration of *E. coli* from the Health Canada recreational guideline (≥ 400 MPN/100 mL) for the last three samplings in October, the last one being extremely so at greater than 24196 MPN/100mL. Levels were low for the first 4 samplings, ranging from less than10 to 146 probably due to stagnant and non-moving water, meaning no new water was entering the system.

Conductivity stayed between acceptable levels of 0.15 and 0.5 for all samplings. However, all total dissolved solid values except one on the 14th of October were above then acceptable level of 500 mg/L, ranging from 851.50 to 2957.50.

3.4 Tributary to Scoudouc River – AG 8

Table 10: Water chemistry, nutrient data and *E. coli* results for AG 8, 2020

date	site	temp	°C	ppt	mg/L		mg/L	mg/L	MPN/100ml	mS/cm	mg/L
		air	H_2O	Sal	DO	pH	PO_4	NO_3	*E.coli*	Cond	TDS
2020-07-16	AG 8	17	13.1	0.46	1.84	7.12	0.048	0.34	<10	0.720	611.05
2020-08-26		13	12.4	0.18	3.77	7.25	0.066	0.42	121	0.279	239.20
2020-09-10		18	13.9	0.16	3.61	7.30	0.125	0.46	987	0.271	2236.00
2020-10-01		25	17.4	0.11	7.49	7.36	0.071	0.30	10	0.193	147.55
2020-10-08		11	12.1	0.20	3.52	7.19	0.051	1.41	880	0.319	274.95
2020-10-14		17	10.3	0.19	6.04	7.11	0.106	1.23	187	0.279	251.55
2020-10-28		0	5.1	0.25	7.05	7.13	0.064	0.36	233	0.315	331.50

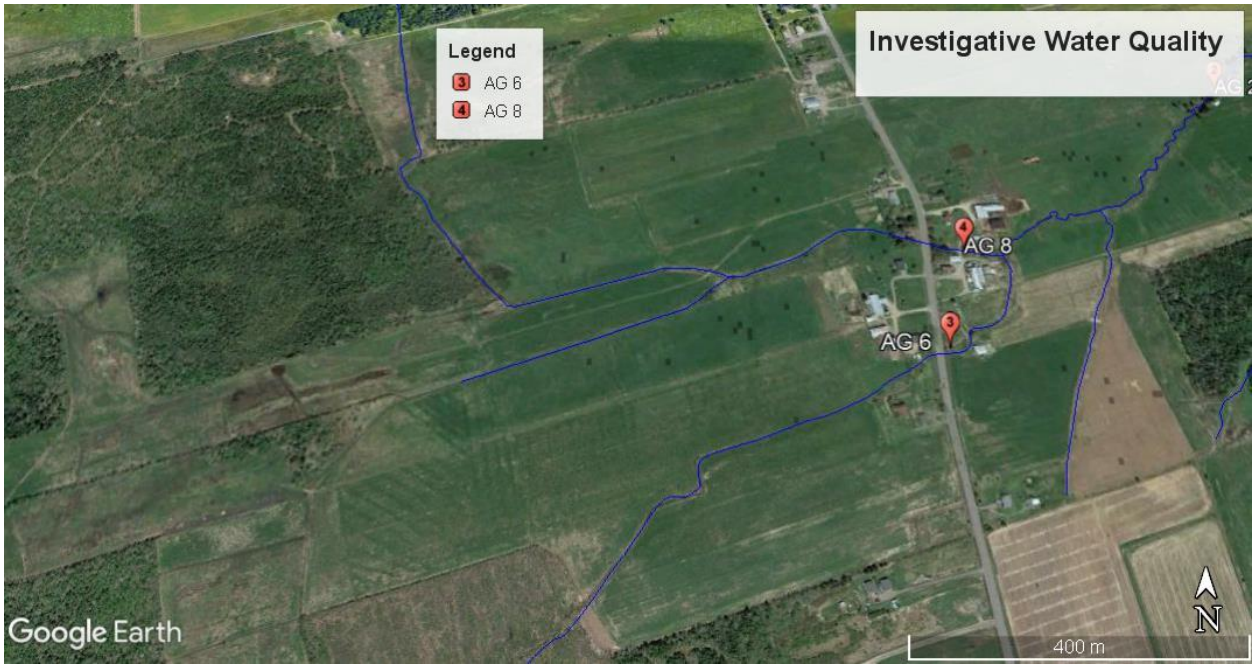


Figure 10: AG 8 Site location and surrounding view showing stream length and land uses

The small stream for sample AG 8 flows through mostly hayfields with a portion bordering a wooded area. It is very small stream and supports water flow mostly after rains draining the fields across the road. It was very dry during the summer sampling and only a trickle fed the small pool at the culvert outlet. Not sure if the landowner across the road has some pasture sections. There were always small pools even though the stream was dry for most of the summer sampling. There was one larger trout seen in one of the pools in the culvert under the road earlier in the season (July).

Figure 11: AG 8 Site location and close up view showing stream site in relation to the AG2 farm

The water sampling results for the site AG 8, for 2020, meets or exceeds all the recommendations for the survival of freshwater aquatic life based on pH. The dissolved oxygen was very low for 4 of 7 samplings, all below 4.00 and 3 of the 4 in the first 3 months sampled.

The lowest were in the hot summer months when there was no water flow, ranging from 1.84 to 3.61 for July, August and September. They rose in October with rain events and renewed water flow and ranged from 6.04 to 7.49, with one low value of 3.52 on the 8th of October all measured in mg/L.

Total phosphorus levels for long-term eutrophic conditions, according to the *CCME Guidance framework for Phosphorus*, were in the eutrophic range (0.035 - 0.100 mg/L) for the samples in the months of July, August and 1st two and last samples in October. September and the 14th of October were in the hypo-eutrophic range with values of 0.125 and 0.106 mg/L respectively. Refer to table 5 to see the color coding used in the table above.

Concentration results for the nitrate ion (NO3) are well below the short term (124 mg/L) for the hot summer months and below long term (2.9 mg/L) CCME recommendations for direct toxicity to sensitive freshwater life for all months. The sampling range was 0.30 to 1.41 mg/L.

Bacterial levels did exceed the maximum concentration of *E. coli* from the Health Canada recreational guideline (≥ 400 MPN/100 mL) for September (987) and the 8th of October (880). Levels were low for the other 5 samplings, ranging from less than10 to 233 probably due to stagnant and non-moving water, but it rose in October after extra rain event sampling.

Conductivity stayed between acceptable levels of 0.15 and 0.5 for all samplings. However, all total dissolved solid values except one on the 16th of July (611.05) and one on the 10th of September (2236) were below acceptable level of 500 mg/L, ranging from 147.55 to 331.50.

3.5 Tributary to Mouth of Scoudouc River – AG 5A

Table 11: Water chemistry, nutrient data and *E. coli* results for AG 5A, 2020

date	site	temp	°C	ppt	mg/L		mg/L	mg/L	MPN/100ml	mS/cm	mg/L
		air	H_2O	Sal	DO	pH	PO_4	NO_3	*E.coli*	Cond	TDS
2020-07-16	AG 5A	19	16.5	0.68	7.37	6.75	0.445	0.08	216	1.090	871.00
2020-08-26		16	14.6	1.16	0.54	6.70	0.282	0.28	1017	1.800	14056.00
2020-09-10		18	14.5	0.90	0.96	6.54	0.115	<0.05	41	1.410	1144.00
2020-10-01		25	14.1	1.30	0.87	6.52	0.102	<0.05	52	1.990	1638.00
2020-10-08		11	13.7	0.30	9.02	7.48	0.053	<0.05	830	0.483	401.05
2020-10-14		17	12.9	0.44	9.43	7.26	0.045	0.05	457	0.670	678.50
2020-10-28		0	4.5	1.16	8.30	6.74	0.028	0.13	41	1.370	1469.00

Figure 12: AG 5A Site location and surrounding view showing stream length and land uses

This is a special stream as it flows into a holding pond below the Scoudouc Farms growing operation. The pond is brown in the figure. This farming operation is mostly agricultural growing crops for their produce stand. We assume fertilizers are the major soil additive, of what composition we do not know. Influences to the small stream would probably result after rain events where extra nutrients could run into the stream. Also there is a ditch that feeds the sample location at the culvert that crosses the road.

The lower section below the stream is also used for agricultural purposes. It might be useful to sample in the Scoudouc River above and below the farm property at some future time period.

Figure 13: AG 5A Site location and close up view showing stream site in relation to the AG2 farm

The water sampling results for the site AG 5A, for 2020, meets or exceeds all the recommendations for the survival of freshwater aquatic life based on pH, though most all values but two (Oct 8th 7.48, Oct 14th 7.26) were slightly below neutral 7.00. The dissolved oxygen was good in July at 7.37 mg/L. The next three samplings were well below acceptable levels, 0.54, 0.96 and 0.87 mg/L for August, September and 1st of October. After the rains for the rest of October, levels increased and allowed DO to bounce back to healthy levels (9.02. 9.43, 8.30 mg/L).

Total phosphorus levels for long-term eutrophic conditions, according to the *CCME Guidance framework for Phosphorus*, were in the hypo-eutrophic range (>0.100 mg/L) for the samples in the months of July, August, September and 1st sample in October. The next two samples (mid-October) were eutrophic and the last was meso-eutrophic. Refer to table 5 to see the color coding used in the table above.

Concentration results for the nitrate ion (NO3) are well below the short term (124 mg/L) for the hot summer months and below long term (2.9 mg/L) CCME recommendations for direct toxicity to sensitive freshwater life for all months. The sampling range was between <0.05 and 0.28 mg/L for all samples.

Bacterial levels did exceed the maximum concentration of *E. coli* from the Health Canada recreational guideline (≥ 400 MPN/100 mL) for August (1017), the 8th of October (830) and especially the 14th of October (457). Levels were low for the other 3 samplings, ranging from 41 to 216 for un-explain reasons.

Conductivity values were beyond the acceptable levels of 0.15 and 0.5 for all samplings except the sample taken on the 8th of October which was 0.483. The high conductivity values ranged from a minimum of 0.670 to a maximum of 1.990 mS/cm. As a refresher, these elevated values can be influenced by the amount of inorganic dissolved solids (nitrate, chloride, sulphate, sodium, etc.) found in the water. Also, the conductivity level may be influenced by rainwater, agricultural or urban runoff and the geology of the area, so at this location, probably mostly agricultural run-off.

All total dissolved solid values except one on the 8th of October (401.05) were above the acceptable level of 500 mg/L, ranging from 678.50 to 14056.00 mg/L.

3.6 Tributary to Inner Shediac Bay near Pointe du Chene – SW 5A

Table 12: Water chemistry, nutrient data and *E. coli* results for FW 5A, 2020

date	site	temp	°C	ppt	mg/L		mg/L	mg/L	MPN/100ml	mS/cm	mg/L
		air	H_2O	Sal	DO	pH	PO_4	NO_3	*E.coli*	Cond	TDS
2020-07-16	SW 5A	18	15.0	0.38	4.12	7.24	2.300	<0.05	906	0.630	507.50
2020-08-26		18	15.4	0.12	2.26	7.14	0.338	<0.05	7270	0.213	169.00
2020-09-10		14	14.0	0.17	4.11	7.49	1.400	<0.05	8164	0.276	227.50
2020-10-01		25	15.9	0.49	1.24	6.48	0.040	<0.05	183	0.810	637.00
2020-10-08		13	12.9	0.36	3.37	7.06	0.040	<0.05	345	0.560	468.00
2020-10-14		17	12.2	0.31	4.82	6.81	0.058	<0.05	85	0.477	414.05

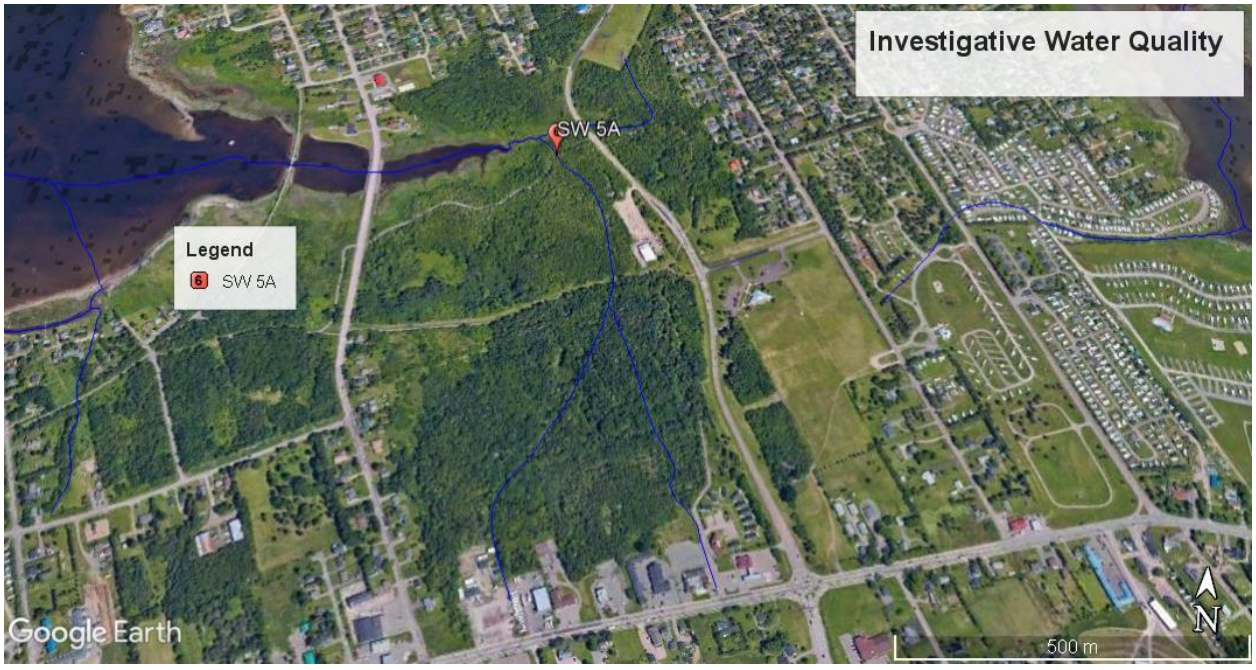


Figure 14: SW 5A Site location and surrounding view showing stream length and land uses

This location is a very small stream that meanders through the wooded area between the Parlee Beach maintenance buildings and the stream that enter Shediac Bay where the bird platform is. Its upper headwaters appear to originate on Main Street, Shediac, near some residential buildings.

Figure 15: SW 5A Site location and close up view showing stream site in relation to walking trail

The water sampling results for the site SW 5A, for 2020, meets or exceeds all the recommendations for the survival of freshwater aquatic life based on pH. Some were slightly below 7.00, most were slightly above. The dissolved oxygen was poor for every sample over the study. The range was between a low of 1.24 to a high of 4.82 which is well below an acceptable 6.5 to 9.5 mg/L range.

Total phosphorus levels for long-term eutrophic conditions, according to the *CCME Guidance framework for Phosphorus*, were in the hypo-eutrophic range (>0.100 mg/L) for the samples in the months of July, August and September (2.300, 0.338, and 1.400). The next three samples (mid-October) were in the eutrophic range and the last was meso-eutrophic. Refer to table 5 to see the color coding used in the table above.

Concentration results for the nitrate ion (NO3) are well below the short term (124 mg/L) for the hot summer months and below long term (2.9 mg/L) CCME recommendations for direct toxicity to sensitive freshwater life for all months. The sampling values were all <0.05.

Bacterial levels did exceed the maximum concentration of *E. coli* from the Health Canada recreational guideline (≥ 400 MPN/100 mL) for July (906), August (7270) and September (8164). For the month of October, all levels were below 400 MPN/100mL (183, 345, 85, 20).

Conductivity values were below the acceptable levels of 0.15 and 0.5 for August, September and the last two samplings in October at 0.213, 0.216, 0.477, and 0.451 respectively.
The high conductivity values occurred in July (0.630) and the first two samplings in October (0.810, 0.560). There were two slightly higher than acceptable 500 mg/L samples of 507.50 in

July and 637.00 on the 1st of October. The rest were below and ranged from a low of 169.00 to a high just below the 500 threshold at a value of 468.00 mg/L.
All total dissolved solid values except two, one in July (507.50) and the other on the 1st of October (637.00) were above the acceptable level of 500 mg/L. The remainder samples were all below the acceptable guideline and ranged from 169.00 to 468.00 mg/L.

3.7 Tributary to Inner Shediac Bay near Cornwall Point– FW 2A

Table 13: Water chemistry, nutrient data and *E. coli* results for FW 2A, 2020

date	site	temp	°C	ppt	mg/L		mg/L	mg/L	MPN/100ml	mS/cm	mg/L
		air	H_2O	Sal	DO	pH	PO_4	NO_3	*E.coli*	Cond	TDS
2020-07-16	FW 2A	18	14	0.28	9.18	7.78	0.013	0.46	63	0.450	368.55
2020-08-26		18	14.7	0.25	6.88	7.64	0.027	0.39	738	0.416	337.35
2020-09-10		18	14.6	0.40	6.64	7.63	0.015	0.48	368	0.650	533.00
2020-10-01		25	14.4	0.47	6.95	7.53	0.020	0.14	134	0.760	617.60
2020-10-08		13	12.0	0.19	4.36	7.87	0.058	0.05	402	0.292	253.50
2020-10-14		17	11.1	0.47	9.58	7.41	0.088	0.06	546	0.690	611.00
2020-10-28		1	4.8	0.43	11.35	7.25	0.016	<0.05	109	0.540	572.00

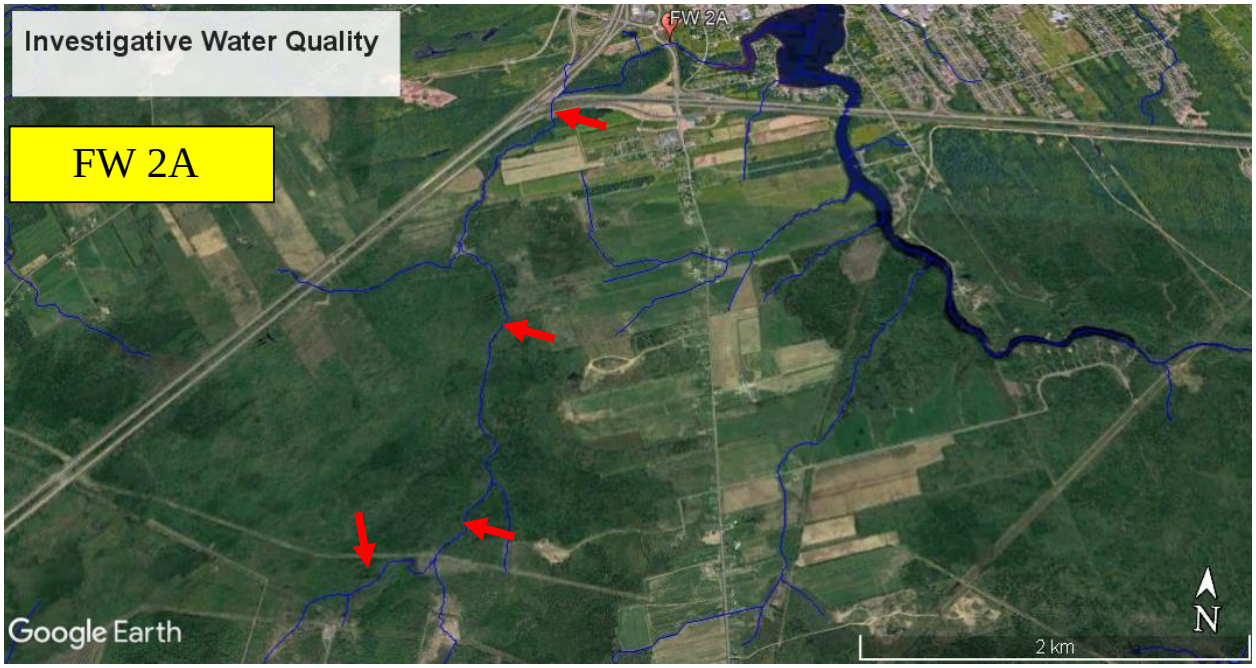


Figure 16: FW 2A Site location and surrounding view showing stream length and land uses

This is a big stream that originates in a wooded area and passes through agricultural operations that include mostly haying operations. Also along its path are sections of planted corn fields most seasons. By the time it reaches the last highway it goes through a beaver dam in the last culvert below the traffic circle. A tree planting project was carried out this fall on the upper banks beside the sample location.

Figure 17: FW 2A Site location and close up view showing stream site in relation to traffic circle

The water sampling results for the site FW 2A, for 2020, meets or exceeds all the recommendations for the survival of freshwater aquatic life based on pH. All samples were slightly above 7.00. The dissolved oxygen was very good showing good aeration for every sample over the study except for one sample on the 8th of October at 4.36.

Total phosphorus levels for long-term eutrophic conditions, according to the *CCME Guidance framework for Phosphorus*, varied over the season. Samples were in the mesotrophic range (0.010-0.020 mg/L) for the months of July (0.013), September (0.015), 1st October (0.020), and 28th October (0.016). August sample was meso-eutrophic at 0.027. The middle two samples in October were in the eutrophic range at 0.058 and 0.088 mg/L respectively. Refer to table 5 to see the color coding used in the table above.

Concentration results for the nitrate ion (NO3) are well below the short term (124 mg/L) for the hot summer months and below long term (2.9 mg/L) CCME recommendations for direct toxicity to sensitive freshwater life for all months. The sampling values ranged from <0.05 to 0.48 that represented higher in the summer and lower in the fall (October).

Bacterial levels did exceed the maximum concentration of *E. coli* from the Health Canada recreational guideline (≥ 400 MPN/100 mL) for August (738), slightly above on October 8th (402) and higher on the 14th of October (546). The other four samplings ranged from 63 to 368 MPN/100mL.

Conductivity values were below the acceptable levels of 0.15 and 0.5 for July, August and the 8th of October. The other 4 samples all exceeded guidelines and ranged from 0.540 to 0.760 mS/cm. The high conductivity values occurred in September (0.650), the 1st of October (0.760) and the last two samplings in October (0.690, 0.540).

All total dissolved solid values except four, one in September (533.00), another on October 1st (617.60), a third on 14th of October (611.00) and the fourth on the 28th of October (572.00) were above the acceptable level of 500 mg/L. The remainder samples were all below the acceptable guideline and ranged from 253.50 to 368.55 mg/L.

3.8 Tributary to Inner Shediac Bay near Shediac Cape– WQ 8A

Table 14: Water chemistry, nutrient data and *E. coli* results for WQ 8A, 2020

date	site	temp	°C	ppt	mg/L		mg/L	mg/L	MPN/100ml	mS/cm	mg/L
		air	H_2O	Sal	DO	pH	PO_4	NO_3	*E.coli*	Cond	TDS
2020-07-16	WQ 8A	18	16	0.10	8.64	7.87	0.021	0.36	86	0.169	133.60
2020-08-26		18	15.9	17.49	0.32	7.33	0.324	<0.05	> 24196	23.540	18466.00
2020-09-10		DND	14.1	11.50	0.74	7.27	2.480	<0.05	> 24196	15.280	12525.50
2020-10-01		25	15.4	0.24	3.05	7.44	0.680	<0.05	727	0.409	325.00
2020-10-08		13	12.1	0.56	9.28	7.79	0.081	<0.05	712	0.850	728.00
2020-10-14		17	12.4	0.36	6.20	7.43	0.340	<0.05	1274	0.570	487.50
2020-10-28		2	4.1	0.31	8.95	7.30	0.030	0.17	85	0.392	425.75

Figure 18: WQ 8A Site location and surrounding view showing stream length and land uses

This is a tiny diameter stream in the upper marsh of shoreline site WQ 8. It shows as lying between two fields that are primarily haying operations. It had minimal flow during the summer months. To the far left is a hobby chicken operation parallel to the sample location. What impact it has is probably minimal but further testing would be needed to determine any run-off influence.

Figure 19: WQ 8A Site location and close up view showing stream in relation to single house

The water sampling results for the site WQ 8A, for 2020, meets or exceeds all the recommendations for the survival of freshwater aquatic life based on pH. All samples were slightly above 7.00 but less than 8.00. The dissolved oxygen was not as good showing adequate aeration only for samples in July (8.64), October 8th (9.28) and October 28th (8.95). Numbers were low for August (0.32), September (0.74), October 1st (3.05) and just below acceptable on October 14th (6.20), all values in mg/L.

Total phosphorus levels for long-term eutrophic conditions, according to the *CCME Guidance framework for Phosphorus*, varied over the season. Samples were in the hypo-eutrophic range (>0.100 mg/L) for the months of August (0.324), September (2.480), 1st October (0.680), and 14th October (0.340). July sample (0.021) and October 28th sample (0.030) were meso-eutrophic. The October 8th sample was eutrophic at 0.081 mg/L. Refer to table 5 to see the color coding used in the table above.

Concentration results for the nitrate ion (NO3) are well below the short term (124 mg/L) for the hot summer months and below long term (2.9 mg/L) CCME recommendations for direct toxicity to sensitive freshwater life for all months. The sampling values ranged from <0.05 to 0.36 that represented one sample higher in July (0.36) and another last sample in October (0.17).

Bacterial levels did not exceed the maximum concentration of *E. coli* from the Health Canada recreational guideline (≥ 400 MPN/100 mL) for only two sample collections, those being July (86) and 28th October (85). The other five samplings were well above the standard. They were very high at in August and September, both >24196. The values were not as bad but still high on October 1st (727), 8th of October (712) and higher again on 14th of October at (1274).

Conductivity values were below the acceptable levels of 0.15 and 0.5 for July, 1st of October and the28th of October. The other 4 samples all exceeded guidelines and ranged from 0.850 and 0.570

(8th and 14th October) to a very high 23.540 and 15.280 (August and September) all measured in mS/cm.
All total dissolved solid values except three, one in August (18466.00), another in September (12525.50) and the sample on October 8th (728.00), were above the acceptable level of 500 mg/L. The remainder samples were all below the acceptable guideline and ranged from 133.60 to 487.50 mg/L.

3.9 Tributary to Upper Shediac Bay in Grande Digue – WQ 11D

Table 15: Water chemistry, nutrient data and *E. coli* results for WQ 11D, 2020

Date	site	temp	°C	ppt	mg/L		mg/L	mg/L	MPN/100ml	mS/cm	mg/L
		air	H_2O	Sal	DO	pH	PO_4	NO_3	*E.coli*	Cond	TDS
2020-07-16	WQ11D	19	15.4	0.10	3.22	7.40	0.021	0.07	52	0.175	139.10
2020-08-26		17	15.3	0.09	3.55	7.27	0.028	0.07	2755	0.155	124.15
2020-09-10		18	15.5	0.10	2.93	7.56	0.052	<0.05	1414	0.181	143.65
2020-10-01		25	16.1	0.08	6.13	7.36	0.017	<0.05	428	0.142	111.15
2020-10-08		13	13.4	0.09	9.35	7.96	0.030	0.08	884	0.151	126.10
2020-10-14		17	11.8	0.08	8.72	7.32	0.040	<0.05	2382	0.128	111.15
2020-10-28		4	4.6	0.07	11.96	7.46	0.024	<0.05	216	0.089	94.90

Figure 20: WQ 11D Site location and surrounding view showing stream length and land uses

This farm property has two streams. This stream runs all summer, though at a much reduced flow during the dry summer. Small fish were seen, as was quite a bit of old garbage. This could be a candidate for a stream survey in the future. As far as we can tell, it originates in a treed area and borders hay fields.

Figure 21: WQ 11D Site location and close up view showing stream site in relation to single farm

The water sampling results for the site WQ 11D, for 2020, meets or exceeds all the recommendations for the survival of freshwater aquatic life based on pH. All samples were above 7.00 and below 8.00. The dissolved oxygen was not as good showing adequate aeration only for samples in October (6.13-11.96). Numbers were low for July (3.22), August (3.55)and September (2.93), all values in mg/L.

Total phosphorus levels for long-term eutrophic conditions, according to the *CCME Guidance framework for Phosphorus*, varied over the season. Samples were in the meso-eutrophic range (0.020-0.035 mg/L) for the months of July (0.021), August (0.028), 8th October (0.030) and 28th October (0.024). October 1st sample was meso-trophic at 0.017. September (0.052) and 14th of October (0.040) were in the eutrophic range. Refer to table 5 to see the color coding used in the table above.

Bacterial levels did not exceed the maximum concentration of *E. coli* from the Health Canada recreational guideline (≥ 400 MPN/100 mL) for July (52) and 28th October (216). The other five samplings were well above the standard. They were high in August (2755), September (1414), October 1st (428), 8th of October (884) and higher again on 14th of October at (2382).

Bacterial levels did exceed the maximum concentration of *E. coli* from the Health Canada recreational guideline (≥ 400 MPN/100 mL) for August (738), slightly above on October 8th (402)

and higher on the 14th of October (546). The other four samplings ranged from 63 to 368 MPN/100mL.

Conductivity values were above the acceptable levels of 0.15 and 0.5 for July, August and September and October 8th. The other 4 samples were below guidelines and ranged from 0.089 to 0.142 mS/cm. All total dissolved solid values were all below the acceptable 500 guideline and ranged from 94.90 to 143.65 mg/L.

3.10 Tributary to Upper Shediac Bay in Grande Digue – WQ 11E

Table 16: Water chemistry, nutrient data and *E. coli* results for WQ 11E, 2020

date	site	temp	°C	ppt	mg/L		mg/L	mg/L	MPN/100ml	mS/cm	mg/L
		air	H_2O	Sal	DO	pH	PO_4	NO_3	*E.coli*	Cond	TDS
2020-07-16	WQ11E	19	21.1	0.09	8.78	8.33	0.018	<0.05	657	0.168	117.65
2020-08-26		18	19.2	0.11	6.61	7.86	0.073	<0.05	1918	0.205	150.15
2020-09-10		18	18.5	0.10	7.62	7.93	0.013	<0.05	85	0.180	133.25
2020-10-01		25	22.2	0.09	7.92	8.21	0.015	<0.05	30	0.183	125.45
2020-10-08		13	12.6	0.08	8.60	7.87	0.007	<0.05	161	0.134	114.40
2020-10-14		17	15.7	0.09	9.76	7.63	0.025	<0.05	703	0.156	122.20
2020-10-28		4	6.3	0.09	13.3	7.77	0.004	<0.05	160	0.120	121.55

Figure 22: WQ 11E Site location and surrounding view showing stream length and land uses

This is a man made channel that originates from a spring in the owner's backyard. It had a very low flow in the summer hot months and a regular flow in October. The upper land was hayfield and recently cleared border forest. The owner's relatives are building a house after already putting up a building (barn) for a horse raising operation. Below the ditched stream is a hayfield and a section for procuring soil.

Figure 23: WQ 11E Site location and close up view showing stream site in relation to single farm

The water sampling results for the site WQ 11E, for 2020, meets or exceeds all the recommendations for the survival of freshwater aquatic life based on pH. All samples were above 7.00, one even 8.33. The dissolved oxygen was very good showing good aeration for every sample over the study, with one being very high at 13.30 on the 28th of October.

Total phosphorus levels for long-term eutrophic conditions, according to the *CCME Guidance framework for Phosphorus*, varied over the season. One sample was meso-eutrophic (0.025) on October 14th. July (0.018), September (0.013) and the 1st October (0.015) were mesotrophic. The August sample was eutrophic at 0.073. The samples on October 8th (0.007) and October 28th (0.004) were oligotrophic. Refer to table 5 to see the color coding used in the table above.

Concentration results for the nitrate ion (NO3) are all well below the short term (124 mg/L) for the hot summer months and below long term (2.9 mg/L) CCME recommendations for direct toxicity to sensitive freshwater life for all months. The sampling values were all <0.05.

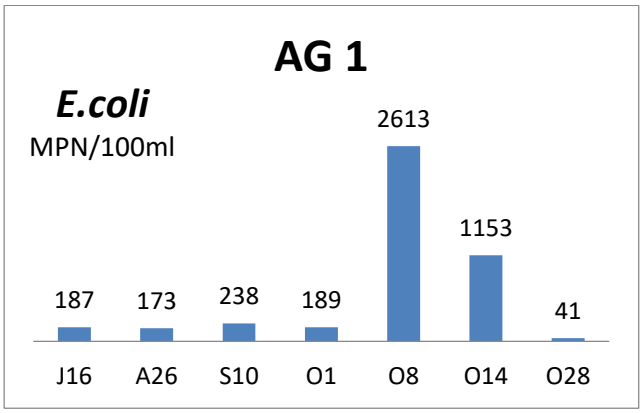
Bacterial levels did exceed the maximum concentration of *E. coli* from the Health Canada recreational guideline (≥ 400 MPN/100 mL) for July (657), August (1918) and October 14th (703). The other four samplings ranged from 30 to 161 MPN/100 mL.

Conductivity values were all below the acceptable levels of 0.15 and 0.5 mS/cm for the whole season of sampling. They ranged from 120 (low) to 0.205 (high).

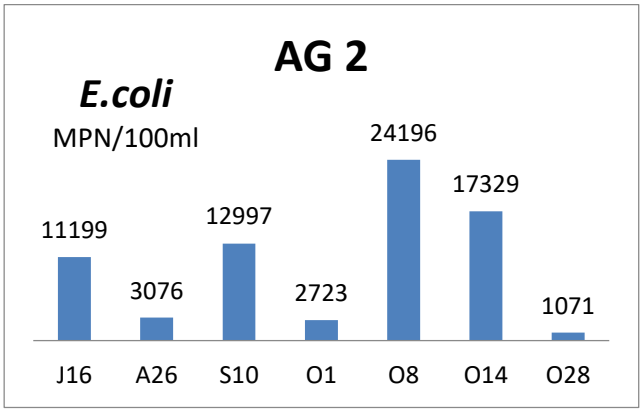
All total dissolved solid values were below the acceptable level of 500 mg/L. They ranged from 114.40 to 150.15 mg/L.

4. SUMMARY OF *E.COLI* RESULTS FOR ALL SITES

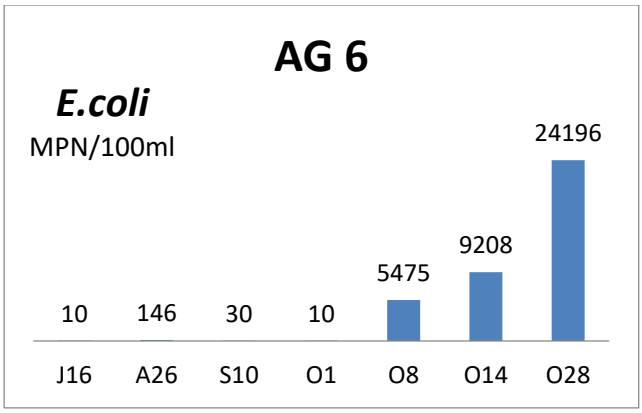
For the graphs that follow, the horizontal axis represents the sample dates referenced earlier. The abbreviations are for July 16th (J6), August 26th (A26), September 10th (S10), October 1st (O1), October 8th (O8), October 14th (O14) and October 28th (O28). All the graphs would have different x-axis ranges so they were omitted and actual values posted at the top of each bar. That makes the patterns over the sampling season easy to visualize relative to each other.



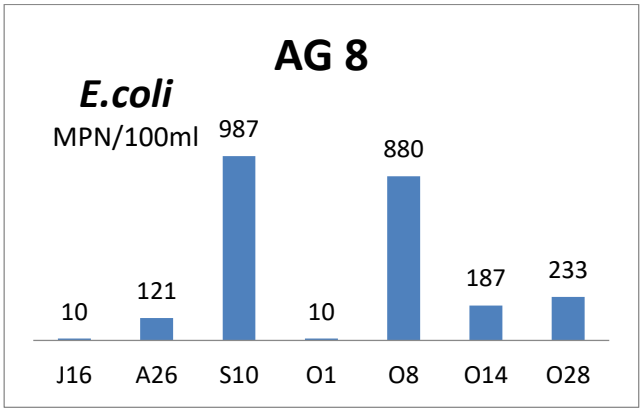
This site had below standard levels all summer into the 1st of October. We might speculate the high numbers in mid-October could have been due to field fertilization with a subsequent drop-off after rains had finished flushing out the fields. However, we have to look more carefully at what is happening in surrounding watershed adjacent to the stream.



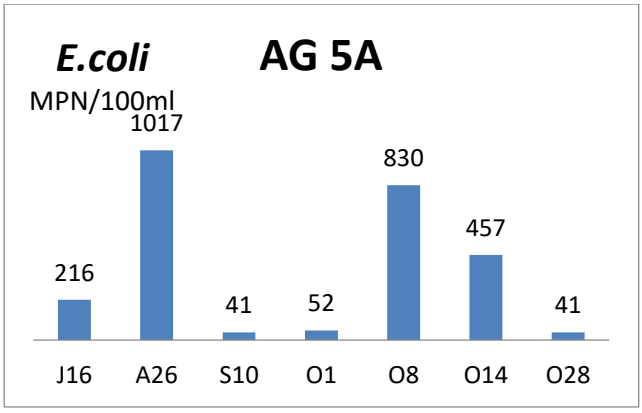
This is our most problematic site. The cattle on this farm graze freely on both sides of the stream. Numbers all exceed the standard 400 MPN/100ml. We are working with the owner and he has tried some remediation which has helped somewhat. Even if we limited the cattle from entering the stream, it's a pasture and rain events would wash excrement towards the stream. The lower numbers could be the result of the owner moving cattle to recently cut hayfields to graze



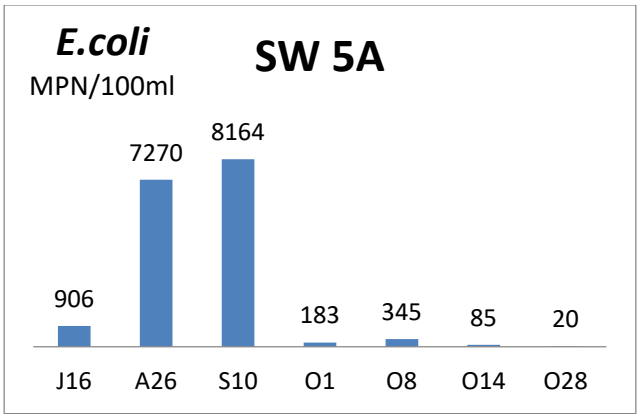
This sample station is below a culvert that was replaced early in the sample season. It primarily drains hayfields from across the road and was mostly dry during the summer therefore having little water with low *E.coli*. After the October rains, numbers went up significantly, possibly due to manure spreading, but this would have to be checked next year.



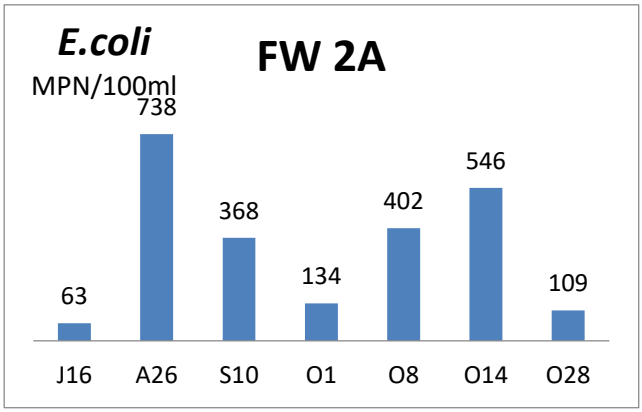
This stream behaved differently than AG 6 which is nearby. It also was dry except for holding pools and some underground minimal flow during most of the sampling season. The peak on September 10th is unexplainable. As AG 6, it drains from mainly hayfields and showed increased levels of *E.coli* later in October, though only excessive on October 8th.



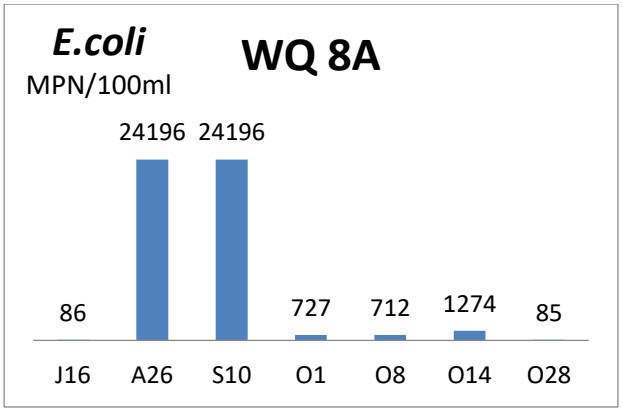
This site is a fluctuating site with a peak in August due to whatever unknown factor. A ditch water source enters where we sample. Upstream is a produce operation and the stream does exit from a holding pond we assume is used for irrigation. We have not tested the pond. The peaks in October could be due to field fertilization, but this would require further investigation.



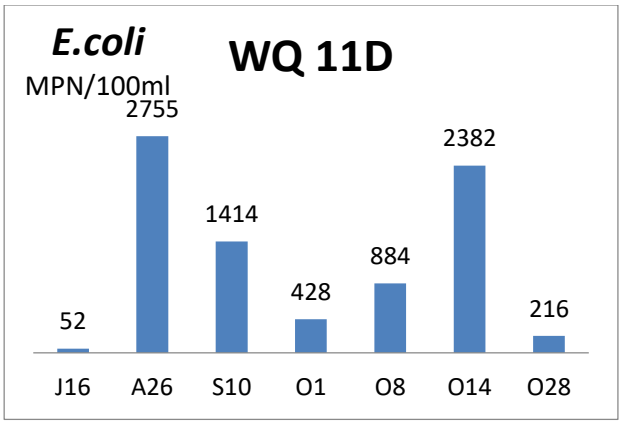
The site that drains into the stream that feeds location under the walking trail is not a high flow source. It was very dry all summer into the rains in October. It flows through a wooded area and when we sampled, it was in left over pools with little water. August and September levels were very high, with stagnant water and but normalized with the rains in October.



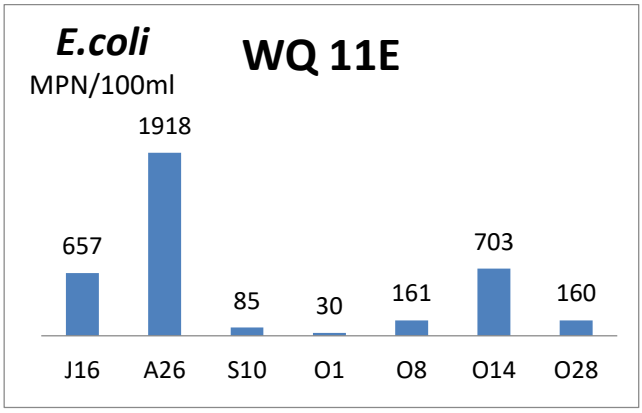
The outlet where we sample is downstream from a long meandering brook. There is a beaver dam at the other end of the culvert. MPN number only exceeded the 400 threshold in August and 14th of October. This stream primarily runs through hayfield operations where some fertilization probably occurs in the fall.



The source of the high MPN numbers here is unknown. There is a small hobby farm operation on the property next door. This feeder stream to the bay is small and had very little flow all season. Five of seven samples exceeded the guideline. The small stream is heavily mowed and has haying operations on both sides.



Again, another example of a stream originating in a wooded area then is flowing past an old farming homestead, hayfields before emptying into the ocean waters. Numbers were high all season except for the first and last sampling. This stream would be a good candidate for a stream survey.



Three samples exceeded guidelines, July, August and October 14th. There is a horse operation in the field above the spring fed stream. The ditch is man-made and is the outflow of the spring on the owners property. Because of the supposed purity of the spring it is unusual that high *E.coli* numbers even occur. Hayfield surround the stream as it makes its way to the ocean outlet.

5. DISCUSSION

It seems a general pattern of late is for our summers to become increasingly slightly hotter.

Longer periods without rainfall combined with extreme heats can cause water levels to drop and become warmer than is safe for cold water loving aquatic species.

SBWA does not by any means proclaim to be water quality experts. The purpose of this project is to collect samples, organize the data, look at surrounding land uses and buffer zones, then pass on the information to experts.

Our sampling is simply a snapshot of the results on that collection day. We can point out trends from our limited sampling results, but changes occur so quickly that general patterns are not always evident. It would be very expensive to monitor water quality changes on a daily or even

weekly basis. As an eNGO, we do not have the resources or capacity for this. Our goal is to look for gross abnormalities from the general patterns and hope to identify possible causes, which can vary depending on all the factors that can affect our results.

Many of the monitored parameters can have a wide range of negative impacts on various aquatic species when concentrations exceed their threshold of tolerance. This threshold varies depending on species, life stage, and sometimes concentrations of other parameters.

Most sites were under the limits for *E. coli* based on Health Canada Recreational Guidelines. There were site that exceeded the guideline for some or most of the sample times. Of note would be 2 samples at AG1 in October, all samples at AG 2, 3 late October samples at AG 6, a couple at AG 8, three at AG 5A, three at SW 5A, three at FW 2A, five at WQ 8A, five at WQ 11D and three at WQ 11E. Follow up testing at these sites would be recommended. Also, going further upstream would be useful.

Dissolved oxygen levels were fair overall, with poorest levels during the hot, dry summer months. AG 6 and AG 8 were poor but these are small collectors and except for holding locations, generally had limited flow. SW 5A had the poorest results with very low oxygen for all samplings. The other locations had their poorest readings generally during the hot summer samplings. Nearly all locations had better readings after precipitation commenced in the fall.

The phosphate readings were all over the scale and no obvious patterns emerged. Conductivity and Total Dissolved Solids for most samplings did not exceed extremes for all sites.

6. CLOSING COMMENTS

The Shediac Bay Watershed Association had a successful year in 2019-2020, thanks to the support of the NB Environmental Trust Fund. The Association has met its targets regarding the monitoring and partnerships created to improve water quality in the Shediac Bay watershed. Sampling results will help in the development of the watershed management plan for the Shediac Bay Watershed. The watershed management plan will be a good base for the SBWA to prepare an action plan to address contamination sources. Recommendations from this report will help guide future activities of the association.

Habitat restoration projects for fish have been funded by different organizations in 2020-21, including, the NB Wildlife Trust Fund and the NB Environmental Trust Fund. The support received allowed for more projects to be realized. The restoration sites will be monitored in future years to ensure our activities will have positive impacts on water quality and fish populations.

Partnerships are essential for environmental groups to accomplish their work. The Association is building good relationships with the town of Shediac, the local schools and other local groups. We hope to diversify our activities to involve more people in the protection of water quality in Shediac Bay. The next step for the association is to start working more with the agricultural sector.

The Shediac Bay Watershed Association will continue to monitor water quality in the Shediac and Scoudouc rivers and implement environmental improvement initiatives in the years to come thanks to the support or the NB Environmental Trust Fund.

7. RECOMMENDATIONS

1. Find out when farmers generally apply fertilizers or manure to hay and crop fields
2. Sample further downstream of AG 1
3. Try to get farms in Scoudouc to reduce cattle stream crossing in AG 2
4. Sample where AG 6 and AG 8 meet and enter AG 2 site
5. Sample AG 6 and AG 8 only after a rain event if at all
6. Sample above AG 5A with landowners permission
7. Probably eliminate SW 5A, its just a trickle in the woods except after spring run-off
8. Consider FW 2A for a stream survey, and possibly sample nearer headwaters
9. Probably eliminate WQ 8A, ther is not much water farther up, or sample only after a rain
10. Consider WQ 11D for a stream survey, and possibly sample nearer headwaters
11. Keep sampling WQ 11E, especially as recent horse operation develops
12. Sample the spring source at least once at WQ 11E

8. BIBLIOGRAPHY

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