Environmental Evaluation of the Health of the Shediac Bay

Final Report

The Shediac Bay Watershed Association Inc.

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1 Introduction

The Shediac Bay Watershed Association (SBWA) was founded in 1999 as a result of growing concerns from local community residents over the ecological health of Shediac Bay. In order to establish a long-term water quality-monitoring program, a community-based association was formed. To address growing concerns on water quality in the Shediac Bay, a new program was initiated in 2016 to assess water contamination sources in small streams and the quality of coastal habitats.

The Association has been monitoring water quality in the Shediac River and Scoudouc River watersheds since 1999. The freshwater sampling program has been ongoing at the same monitoring stations that were established for the purpose of the development of the NB Water Classification Legislation. Since the beginning of the monitoring program the focus was on freshwater samplings. Only in recent years with the Shediac Bay evaluation program has funding been acquired to collect water quality data in the saltwater ecosystems of the watershed.

During 2015, the SBWA began monitoring E.coli in Shediac Bay with 7 sampling sites along the coastline of Pointe-du-Chêne, around the mouth of the Scoudouc River and the outer edges of the Shediac River estuary. The sampling continued in 2016 with the addition of 3 new sites. The water sampling was done for *E. coli*, and was done only once a month (from May to August) due to limited capacity. Although the quantity and frequency of these samplings are insufficient to collect the amount of data needed for a complete assessment, it did provide information on where to concentrate our next efforts.

In 2016, a study was done using Environmental DNA to assess the *source* of the *E. coli* bacteria that causes water contamination and beach closures. Since E.coli is present in the lower intestines of humans and warm-blooded animals, the source of fecal contamination can be traced back to the species of which it came from by analyzing the DNA of the bacteria. The results are available online in the archives of the SBWA. This information was used to help prioritize sites for restoration and actions to help reduce bacterial contamination.

In 2017, new water quality monitoring sites were added on small streams that are found around the Shediac Bay. A total of 11 monitoring stations have been surveyed on a monthly basis from June to October. Some of these small streams have high bacterial and nutriment counts. There will be further investigations to determine the sources of contamination.

Also in 2016, a partnership was formed with the *Southern Gulf of Saint Lawrence Coalition on Sustainability* to begin the assessment of the eelgrass habitats in the Shediac Bay. The first study site, and monitoring transect, was established in the Scoudouc River estuary, and the second was done in the Shediac River estuary in 2017. In 2018, a new monitoring transect was established near Pointe-du-Chêne, at the mouth of the South Cove estuary. These transect are monitored once per year using the SeagrassNet protocol, to measure changes in density of the eelgrass beds due to the threat of the invasive green crab. A final site has been inaugurated in Grande-Digue in 2019 to cover the different areas in the bay. This site is also integrated with a coastal restoration project

coordinated with the Université de Moncton. The study sites were used to propose recommendations to the scientific committee of the Grande-Digue Dune restoration project.

Turning the attention toward coastal habitats, a "Marsh Monitoring Program" from Bird Studies Canada began in 2015 to evaluate wetlands for their health and habitat quality for various bird populations. In 2016, staff received training to perform wetland evaluations under the WESP-AC (*Wetland Ecosystem Services Protocol for Atlantic Canada*) evaluation program. The WESP-AC was designed to provide an assessment of the health of both freshwater and saltwater marshes, as well as their ecosystem benefits, functions and services. Two salt marshes were chosen for monitoring in 2018.

In order to help improve the environment and water quality, the SBWA has been planting native trees and shrubs along coastal zones. There have been two sites that were reforested in 2018 and trees were added on one site in 2019.

As always, public education is always an integral part of all SBWA projects. The SBWA continued work with the Shediac Bay Yacht club to promote best practices for boaters. The Shediac Bay Yacht club has received a Blue Flag certification in 2019. As a partner in this program the SBWA helps deliver educational materials and resources. The SBWA organized a beach sweep event hosted at the yacht club. Also an interpretation panel on eelgrass was produced and installed at the marina. Posters and educational materials were also distributed. In 2019, the Blue Flag certification has also been received by Parlee Beach Provincial Park. These certifications promote more partnerships with the marina, the provincial park and other partners for educational programs.

The SBWA also has a number of public education materials such as a series of interpretation panels installed on walking trails and other green spaces around Shediac. A video was produced on eelgrass and posted on YouTube and our website. The Association also does a variety of presentations for schools and the public.

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 the Scoudouc Rivers are characterized by small tributaries covering watersheds of 201.8 Km2 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 water arm of the Shediac River is the continuation of the Batemans Brook.

Figure 1: Map of Shediac Bay watershed boundaries

2 Water Quality Sampling in Shediac Bay

The SBWA has expanded the water quality sampling program to evaluate the smaller tributaries of the Shediac Bay. These small brooks had never been assessed for water contaminants or evaluated for surrounding land uses and buffer zones. Due to the rise of concern for the health of the Shediac Bay, 11 new sites were added along the coastline from Boudreau-Ouest to Grande-Digue in 2017, to assess possible bacterial and contamination sources. All samples are analyzed by RPC Laboratory, and all sample results are sent to the *Department of Environment and Local Government.*

The purpose of the samples taken by the SBWA is to determine priority areas where the association can implement restoration programs such as tree planting along riparian zones. The data is not used to determine the safety of the recreational uses of the bay, such as swimming advisories.

There are many different guideline criteria for determining water quality. For example, Health Canada recommended microbiological guideline values for recreational water quality. The values are based on the presence of fecal indicator bacteria, namely, *Enterococci* for marine water, and *Escherichia coli* for freshwater.

In marine water, the guideline value is set at a geometric mean of 35 enterococci/100 mL when a minimum of 5 samples are collected (average bacterial concentrations of the 5 bottles must be below 35 MPN/100 mL), and the value of a single sample must be below 70 enterococci/100 mL.

In freshwater, the guideline value is set at a geometric mean of 200 *E. coli* /100 mL when a minimum of 5 samples are collected (average bacterial concentrations of the 5 bottles must be below 200 MPN/100 mL), and the value of a single sample must be below 400 *E. coli* /100 mL.

For this project, all samples collected are single samples and are analyzed for *E. coli,* since the small tributaries are freshwater (however, 2 sites are impacted by rising tides, but *E. coli* can still be used for brackish water). All bacterial data in this report is flagged when levels exceed 400 MPN/100 mL.

Table 1: Guidelines for Health Canada Recreational Water Quality: summary table

Guidelines		
Parameter	Considerations	Guideline
Escherichia coli (Primary-Contact Recreation)*	Geometric mean concentration (minimum 5 samples) Single sample maximum concentration	≤ 200 *E. coli* /100 mL ≤ 400 *E. coli* /100 mL
Enterococci (Primary-Contact Recreation)*	Geometric mean concentration (minimum 5 samples) Single sample maximum concentration	≤ 35 Enterococci /100 mL ≤ 70 Enterococci /100 mL

3 Methodology

3.1 Water Quality Sampling

Water quality monitoring was conducted once a month from June to September 2019, at the 11 established monitoring sites in small tributaries along the coast of the Shediac Bay. Water quality sampling was performed using the protocol developed by the New Brunswick Department of Environment. Water samples were not collected after heavy rainfall events.

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* and inorganic elements.

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.

3.2 Site Information - Small Tributaries of the Shediac Bay

The following describes the sample site information for the 11 small stream water quality monitoring stations.

Table 2: Water Quality Monitoring – Small Streams Site Information

Site ID	Latitude	Longitude	Elevation (m) Google Earth	Brook Name	Location Description
WQ-1	N46°13'24.19"	W64°28'30.36"	10	Unnamed Brook	907 route NB-133, Boudreau-Ouest, Dirt Road after this address, going through the field (sample upstream of the culvert)
WQ-2	N46°13'35.25"	W64°29'48.39"	9	Unnamed Brook	725 route NB-133, Boudreau-Ouest (sample upstream from culvert)
WQ-3	N46°13'18.25"	W64°31'30.94"	13	Unnamed Brook	482 Main St., Shediac, In front of Shediac Bakery (sample upstream of culvert)
WQ-4	N46°13'11.25"	W64°32'56.17"	3	Unnamed Brook	Shediac Town Hall, 290 Main st, sample downstream culvert
WQ-5	N46°13'22.17"	W64°33'58.17"	8	Unnamed Brook	Park at Atkinson Court, walk on Route 133 (sample upstream from culvert)
WQ-6	N46°14'23.90"	W64°34'2.29"	8	Unnamed Brook	Park at Old Mill Rd (Sample upstream from culvert)
WQ-7	N46°14'43.38"	W64°34'7.29"	3	Unnamed Brook	Brook flows between Bay Vista Lodge at 3521 Route 134, Shediac Cape, (sample upstream from culvert)
WQ-8	N46°15'11.99"	W64°34'14.01"	1	Unnamed Brook	In front of Dr. Chiropractor, 3694 Route NB-134, Shediac Cape, (sample upstream of culvert)
WQ-9	N46°16'41.70"	W64°35'13.77"	1	Albert-Gallant Brook	2487 Shediac Rd., (sample downstream from culvert due to beaver flooding)
WQ-10	N46°17'8.24"	W64°34'29.13"	3	Unnamed Brook	Brook is after Antoine Rd, Grande-Digue, (sample from upstream of culvert)
WQ-11	N46°17'52.15"	W64°33'18.27"	1	Unnamed Brook	Brook is before on your left of Chemin des Sœurs, Grande-Digue, (sample from upstream of culvert)

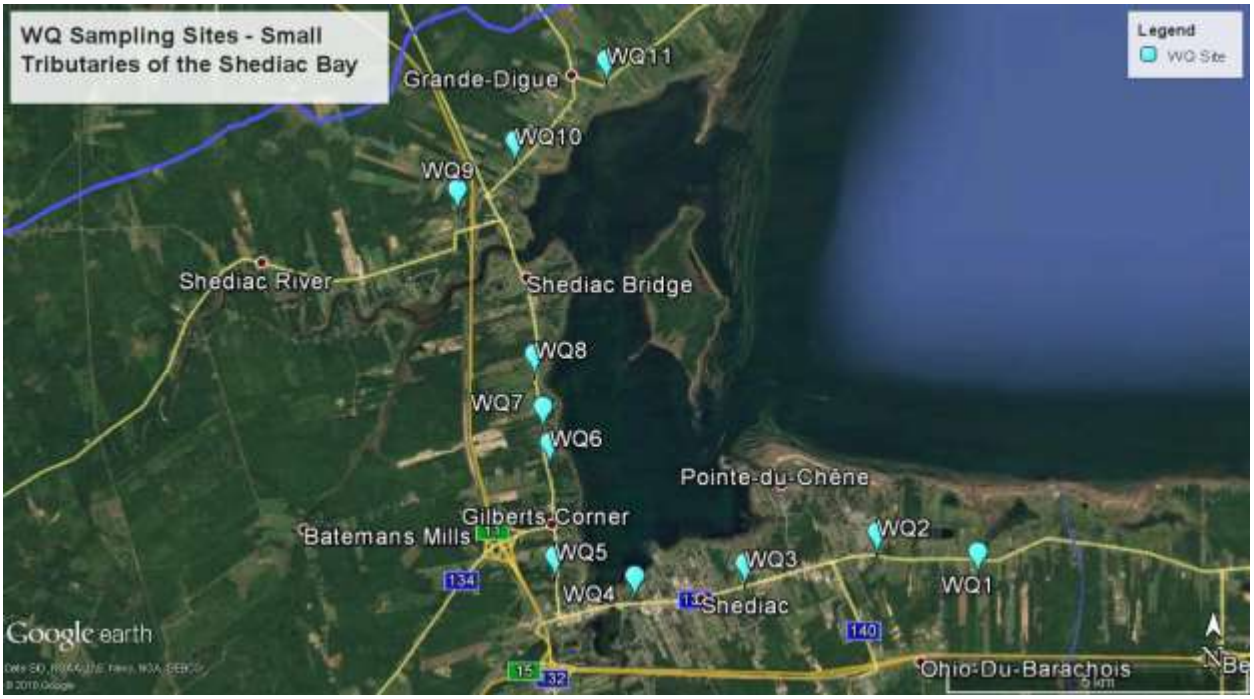


Figure 2: Water Quality Sampling Sites - Small Streams

3.3 Water Quality Parameters

3.3.1 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 thermal refugia.

3.3.2 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.

3.3.3 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.

3.3.4 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, sulfate, 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.

3.3.5 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 13 mg/l (NO_3).

3.3.6 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 should be under 0.025 mg/L to maintain its unaffected trophic state.

3.3.7 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. The acceptable count of E.coli in water is set at 400 MPN/100 ml.

3.4 CCME - Canadian Environmental Quality Guidelines (CEQGs)

Table 3: Summary of the CCME Canadian Environmental Quality Guidelines

CCME RECOMMENDED GUIDELINES FOR THE PROTECTION OF AQUATIC LIFE (FRESHWATER) SUMMARY						
Parameter	Condition	Value (mg/L)	Condition	Value (mg/L)	Equation Between Conditions	Notes
Ag	—	—	Long-Term	**0.00025**	—	The following parameters did not have CCME recommended guidelines for the protection of aquatic life and were therefore omitted from the table:
Al	pH<6.5	**0.005**	pH≥6.5	**0.1**	—	
As	—	—	Upper	**0.005**	—	
B	Short-Term	**29**	Long-Term	**1.5**	—	
Cd (Short-Term)	HARD<5.3	**0.00011**	HARD>360	**0.0077**	10^(1.016*LOG(HARD)-1.71)	
Cd (Long-Term)	HARD<17	**0.00004**	HARD>280	**0.00037**	10^(0.83*LOG(HARD)-2.46)	
Cl	Short-Term	**640**	Long-Term	**120**	—	
CLRA	Narrative; refer to CCME website for more information.				—	
Cu	HARD<82	**0.002**	HARD>180	**0.004**	0.2*EXP(0.8545*LN(HARD)-1.465)	
DO (warm) †	Early	**6**	Other	**5.5**	—	
DO (cold)	Early	9.5	Other	**6.5**	—	
E-coli ‡	—	—	Upper	**400** MPN/100mL	—	
Fe	—	—	Upper	**0.3**	—	
Mo	—	—	Upper	**0.073**	—	
NH3_T	Table; refer to CCME website for more information.				—	
NH3_Un	—	—	Long-Term	**0.019**	—	
Ni	HARD≤60	**0.025**	HARD>180	**0.15**	EXP(0.76*LN(HARD)+1.06)	
NO2	—	—	Upper	**0.197**	—	
NO3	Short-Term	**550**	Long-Term	**13.0**	—	
Pb	HARD≤60	**0.001**	HARD>180	**0.007**	EXP(1.273*LN(HARD)-4.705)	
pH	Lower L-T	**6.5**	Upper L-T	**9**	—	
Se	—	—	Upper	**0.001**	—	
Tl	—	—	Upper	**0.008**	—	
U	Short-Term	**0.033**	Long-Term	**0.015**	—	
Zn	—	—	Upper	**0.03**	—	

ALK_T	Ba	Be	HCO3
Bi	Br	Ca	CO3
Co	COND	Cr	F
HARD	K	Lang_Ind (20°C)	
Li	Mg	Mn	Na
NOX	Rb	pH (Sat)	Sb
Sn	SO4	Sr	TDS
Te	TKN	TOC	TP-L
TURB	V		

† The guideline for dissolved oxygen is separated into warm water biota, early life stages; warm water biota, other life stages; cold water biota, early life stages; and cold water biota, other life stages.

‡ There is no limit for the protection of aquatic wildlife. The limit of 400 MPN/100mL for the protection of environmental and human health is used instead.

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

Table 4: 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		

3.6 CCME Guidance framework for Phosphorus

Table 5: 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

3.6.1 Terms and Definitions

All data collected during the sampling season has been organized in 3 distinct tables: water chemistry data and *E. coli* results, nutrient results, and inorganic results. The following provides the terms and definitions of the acronyms used in the data tables.

Table 6: Terms and definitions for water chemistry and bacterial data tables

TERMS AND DEFINITIONS FOR FIELD DATA COLLECTED BY YSI AND LABORATORY SAMPLES		
Parameter	Unit	Definition
Temp	°C	Air and water temperature measured in degrees Celsius
SAL	ppt	Salinity measured in parts per thousand
Dissolved O_2	mg/L, %	Dissolved oxygen measured in milligrams per litre and percentage
E. coli	MPN/100mL	Escherichia coli concentration measured in most probable number per 100 millilitres
ALK_T	mg/L	Total alkalinity measured in milligrams per litre
CLRA	TCU	Water colour measured in true colour units
COND	µS/cm	Conductivity measured in microsiemens per centimetre in the field and laboratory
HARD	mg/L	Hardness measured in milligrams per litre
Lang_Ind (20°C)	—	Langlier index at 20 degrees Celsius
pH	—	Potential of hydrogen measured in the field and laboratory, and the saturation pH at 20 degrees Celsius
Sat (20°C)	—	The pH at which water at 20 degrees Celsius is saturated with calcium carbonate
TDS	mg/L	Total dissolved solids measured in milligrams per litre
TURB	NTU	Water turbidity measured in nephelometric turbidity units

Table 7: Terms and definitions for nutrients data tables

TERMS AND DEFINITIONS FOR NUTRIENT DATA					
Parameter	Unit	Definition	Parameter	Unit	Definition
HCO_3	mg/L	Bicarbonate measured in milligrams per litre	NH_3_Un	µg/L	Ammonia unionized at 20°C measured in micrograms per litre
Br	µg/L	Bromine measured in micrograms per litre	NO_2	µg/L	Nitrite measured in micrograms per litre
Ca	mg/L	Calcium measured in milligrams per litre	NO_3	µg/L	Nitrate measured in micrograms per litre
CO_3	µg/L	Carbonate measured in micrograms per litre	NO_X	µg/L	Nitrite + Nitrate measured in micrograms per litre
Cl	mg/L	Chloride measured in milligrams per litre	SO_4	mg/L	Sulphate measured in milligrams per litre
F	µg/L	Fluoride measured in micrograms per litre	TKN	mg/L	Total Kjedhal nitrogen measured in milligrams per litre
K	mg/L	Potassium measured in milligrams per litre	TN	mg/L	Total nitrogen calculated in milligrams per litre
Mg	mg/L	Magnesium measured in milligrams per litre	TOC	mg/L	Total organic carbon measured in milligrams per litre
Na	mg/L	Sodium measured in milligrams per litre	TP-L	µg/L	Total phosphorus measured in micrograms per litre
NH_3T	µg/L	Total ammonia measured in micrograms per litre	—	—	—

Table 8: Terms and definitions for inorganic data tables

TERMS AND DEFINITIONS FOR HEAVY METAL DATA					
Parameter	Unit	Definition	Parameter	Unit	Definition
Al	µg/L	Aluminum measured in micrograms per litre	Mn	µg/L	Manganese measured in micrograms per litre
As	µg/L	Arsenic measured in micrograms per litre	Mo	µg/L	Molybdenum measured in micrograms per litre
B	µg/L	Boron measured in micrograms per litre	Ni	µg/L	Nickel measured in micrograms per litre
Ba	µg/L	Baryium measured in micrograms per litre	Pb	µg/L	Lead measured in micrograms per litre
Cd	µg/L	Cadmium measured in micrograms per litre	Rb	µg/L	Rubidium measured in micrograms per litre
Co	µg/L	Cobalt measured in micrograms per litre	Sb	µg/L	Antimony measured in micrograms per litre
Cr	µg/L	Chromium measured in micrograms per litre	Sr	µg/L	Strontium measured in micrograms per litre
Cu	µg/L	Copper measured in micrograms per litre	U	µg/L	Uranium measured in micrograms per litre
Fe	µg/L	Iron measured in micrograms per litre	V	µg/L	Vanadium measured in micrograms per litre
Li	µg/L	Lithium measured in micrograms per litre	Zn	µg/L	Zinc measured in micrograms per litre

4 Sampling Results

The following section will describe the water quality data collected at the 11 small streams sampling sites for the 2019 field season. The surrounding land uses, as visible from aerial imagery from several years of images on Google Earth, are also described for each site. The information is meant to complement the data and provide information on potential causes for contamination.

4.1 WQ-1

This water quality sampling site is located in a residential area in Boudreau-West, and is accessed by a private dirt road (with landowner permission) connected to NB-Route 133. The samples are taken upstream from the culvert of the dirt road. The surrounding land uses includes: agricultural fields, several gravel pits, and the Highway 15. The buffer zones dividing the stream and the farm fields (± 10 hectares, 2 hectares, 1.3 hectares) ranges between 15 and 50 metres in density. There is a good buffer zone that separates the brook and the gravel pits (> 50 m on each side) that should prevent sediment from running off into the water.

The tributary joins the Shediac Bay approximately 1 km downstream of the sampling site. The small stream ends with a small estuary surrounded by a salt marsh. Next to this salt marsh is the Greater Shediac Sewage Commission's aeration lagoons, as well as a lift station with an outfall discharge pipe at the edge of the estuary. The water quality station is located higher than the highest tidal zone.

The water sampling results for the site WQ-1, for 2019, meets or exceeds all the recommendations for the survival of freshwater aquatic life based on pH and dissolved oxygen.

Total phosphorus levels for long-term eutrophic conditions according to the "CCME Guidance Framework for Phosphorus" were in the mesotrophic range (0.010 – 0.020 mg/L) in June, August and September; and in the meso-eutrophic (0.020-0.035 mg/L) in July.

Concentration results for the nitrate ion (NO_3) are below the short term (550 mg/L) and long term (13 mg/L) CCME recommendations for direct toxicity to sensitive freshwater life (these guidelines do not consider indirect effects due to eutrophication, nor does this interpret results for assessment of eutrophic conditions).

Bacterial levels did not exceed the maximum concentration of E. coli from the Health Canada recreational guideline (≥ 400 MPN/100 mL).

Table 9: Water chemistry data and *E. coli* results for WQ-1, 2019

SITE WQ-1: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES																		
Date (yy-mm-dd)	Temp (°C)		SAL (ppt)	DO (mg/L)	E. coli (MPN /100mL)	ALK_T (mg/L)	CLRA (TCU)	COND (µS/cm)		HARD (mg/L)	Lang_Ind (20°C)	pH (pH)			TDS (mg/L)		TURB (NTU)
	Air	Water						Field	Lab			Field	Lab	Sat (20°C)	Field	Lab	
19-06-18	17.0	9.9	0.15	11.43	141.0	—	—	0.228	—	—	—	8.18	—	—	208.75	—	—
19-07-18	18.0	13.5	0.13	10.5	357.8	—	—	0.216	—	—	—	8.05	—	—	180.70	—	—
19-08-20	23.0	14.1	0.20	10.39	146.6	—	—	0.315	—	—	—	8.20	—	—	258.70	—	—
19-09-17	—	10.5	0.15	13.04	24.2	—	—	0.229	—	—	—	8.44	—	—	208.00	—	—

Table 10: Nutrient results for WQ-1, 2019

SITE WQ-1: NUTRIENT DATA																			
Date (yy-mm-dd)	HCO3 (mg/L)	Br (mg/L)	Ca (mg/L)	CO3 (mg/L)	Cl (mg/L)	F (mg/L)	K (mg/L)	Mg (mg/L)	Na (mg/L)	NH3T (mg/L)	NH3_Un (mg/L)	NO2 (mg/L)	NO3 (mg/L)	NOX (mg/L)	SO4 (mg/L)	TKN (mg/L)	TN (mg/L)	TOC (mg/L)	TP-L (mg/L)
19-06-18	—	—	—	—	—	—	—	—	—	—	—	<0.05	0.680	0.680	—	0.3	0.6	—	**0.018**
19-07-18	—	—	—	—	—	—	—	—	—	—	—	<0.05	0.470	0.470	—	—	—	—	**0.027**
19-08-20	—	—	—	—	—	—	—	—	—	—	—	<0.05	0.610	0.610	—	—	—	—	**0.010**
19-09-17	—	—	—	—	—	—	—	—	—	—	—	<0.05	0.650	0.650	—	—	—	—	**0.015**

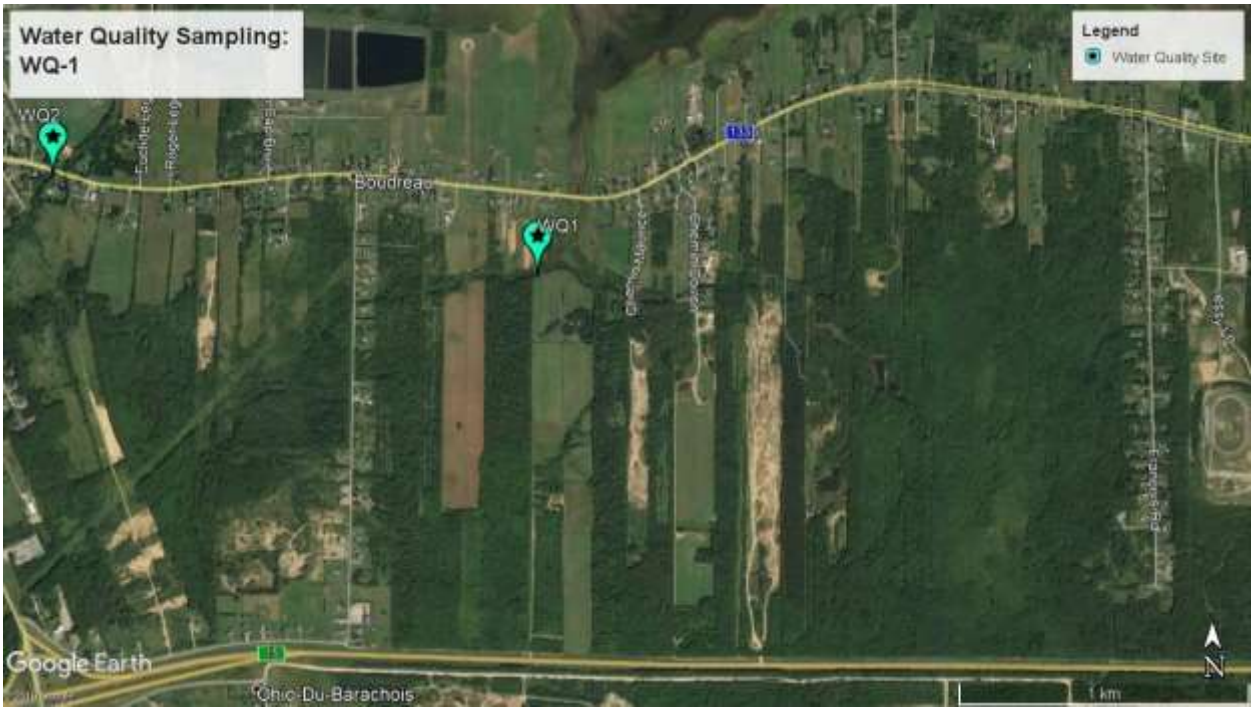


Figure 3: WQ-1 site location and surrounding land uses

Figure 4: Site photos for the water quality monitoring station WQ-1

4.2 WQ-2

This water quality sampling site is also located in a residential area in Boudreau-West, near the convenience store "Handy Andy's" on Route NB-133. The samples are taken upstream of the wooden culvert. The surrounding land uses is mainly residential, roads, and has a drive-in movie theatre upstream (300 m). Below the culvert of Route NB-133, directly following the sampling site, is the beginning of a provincially regulated freshwater wetland. The freshwater wetland is approximately 170 metres in length before transitioning to a coastal salt marsh at the highest tidal point. Within the salt marsh area is the *Ocean Surf RV Campground*. There are no trees between the campground and the wetland and brook areas, making any buffer zone only made up of wild grasses and shrubs. In the southern part of the campground, the 30-metre buffer zone is respected by the maintenance crew, by not mowing grass past a certain line. However, another part of the campground is built within the buffer zone of the estuary, with camping lots placed along the edges of a rock armoured bank. A partnership was formed with *Ocean Surf* to begin planting trees in the buffer zone, as part of a multi-year goal of enhancing the riparian zone. In 2017, 182 native trees were planted.

The water sampling results for the site WQ-2, for 2019, meets or exceeds all the recommendations for the survival of freshwater aquatic life based on pH and dissolved oxygen.

Total phosphorus levels for long-term eutrophic conditions according to the "CCME Guidance framework for Phosphorus" were in the mesotrophic range (0.010 – 0.020 mg/L) in June, August and September; and in the meso-eutrophic range (0.020 – 0.035 mg/L) from in July.

Concentration results for the nitrate ion (NO_3) are below the short term (550 mg/L) and long-term (13 mg/L) CCME recommendations for direct toxicity to sensitive freshwater life (these guidelines do not consider indirect effects due to eutrophication, nor does this interpret results for assessment of eutrophic conditions).

Bacterial levels did exceed the maximum concentration of *E. coli* from Health Canada recreational guideline (≥ 400 MPN/100 mL), for the sample taken in September; 870.4 MPN/100 mL.

Table 11: Water chemistry data and *E. coli* results for WQ-2, 2019

SITE WQ-2: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES																		
Date (yy-mm-dd)	Temp (°C)		SAL	DO	E. coli (MPN /100mL)	ALK_T	CLRA	COND (µS/cm)		HARD	Lang_Ind	pH (pH)			TDS (mg/L)		TURB
	Air	Water	(ppt)	(mg/L)		(mg/L)	(TCU)	Field	Lab	(mg/L)	(20°C)	Field	Lab	Sat (20°C)	Field	Lab	(NTU)
19-06-18	17.0	10.7	0.19	10.91	63.0	—	—	0.279	—	—	—	7.72	—	—	250.90	—	—
19-07-18	18.0	13.3	0.18	10.51	85.6	—	—	0.296	—	—	—	7.74	—	—	248.65	—	—
19-08-20	23.0	15.9	0.20	9.34	77.8	—	—	0.344	—	—	—	7.54	—	—	271.70	—	—
19-09-17	—	11.6	0.17	11.92	**870.4**	—	—	0.267	—	—	—	7.46	—	—	233.35	—	—

Table 12: Nutrient results for WQ-2, 2019

SITE WQ-2: NUTRIENT DATA																			
Date (yy-mm-dd)	HCO3 (mg/L)	Br (mg/L)	Ca (mg/L)	CO3 (mg/L)	Cl (mg/L)	F (mg/L)	K (mg/L)	Mg (mg/L)	Na (mg/L)	NH3T (mg/L)	NH3_Un (mg/L)	NO2 (mg/L)	NO3 (mg/L)	NOX (mg/L)	SO4 (mg/L)	TKN (mg/L)	TN (mg/L)	TOC (mg/L)	TP-L (mg/L)
19-06-18	—	—	—	—	—	—	—	—	—	—	—	<0.05	0.420	0.420	—	<0.25	0.4	—	**0.015**
19-07-18	—	—	—	—	—	—	—	—	—	—	—	<0.05	0.330	0.330	—	—	—	—	**0.026**
19-08-20	—	—	—	—	—	—	—	—	—	—	—	<0.05	0.290	0.290	—	—	—	—	**0.013**
19-09-17	—	—	—	—	—	—	—	—	—	—	—	<0.05	0.370	0.370	—	—	—	—	**0.012**

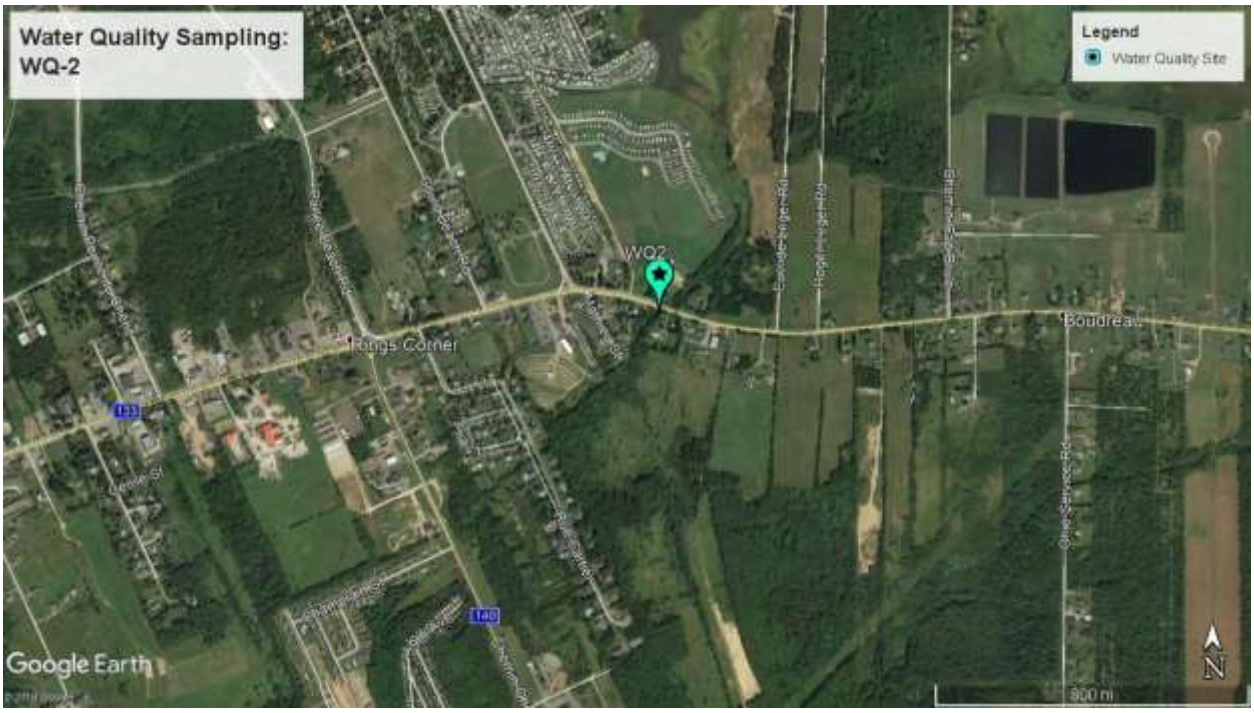


Figure 5: WQ-2 site location and surrounding land uses

Figure 6: Site photos for the water quality monitoring station WQ-2

4.3 WQ-3

This water quality sampling site is located in a residential and commercial area in the Town of Shediac, directly off Main St., next to the *Shediac Bakery*. The samples are taken upstream of the culvert. The surrounding land uses upstream is mainly a large residential sector, up to the approximate headwaters below Highway 15. It is important to note that for most of the riparian zones along this brook, there are inadequate buffer zones (< 15 m). This unnamed brook reaches the tidal zone approximately 400 metres downstream of the sampling site.

The water sampling results for the site WQ-3, for 2019, meets or exceeds all the recommendations for the survival of freshwater aquatic life based on pH and dissolved oxygen.

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 all samples except for July that was in the eutrophic range (0.035 – 0.0100 mg/L).

Concentration results for the nitrate ion (NO_3) are below the short term (550 mg/L) and long-term (13 mg/L) CCME recommendations for direct toxicity to sensitive freshwater life (these guidelines do not consider indirect effects due to eutrophication, nor does this interpret results for assessment of eutrophic conditions).

Bacterial levels did exceed the maximum concentration of *E. coli* from Health Canada recreational guideline (≥ 400 MPN/100 mL), for the sample taken in June (1,034.4 MPN/100 mL) and August (1,454.0 MPN/100 mL).

Table 13: Water chemistry data and *E. coli* results for WQ-3, 2019

SITE WQ-3: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES																		
Date (yy-mm-dd)	Temp (°C)		SAL	DO	E. coli (MPN /100mL)	ALK_T	CLRA	COND (µS/cm)		HARD	Lang_Ind	pH (pH)			TDS (mg/L)		TURB
	Air	Water	(ppt)	(mg/L)		(mg/L)	(TCU)	Field	Lab	(mg/L)	(20°C)	Field	Lab	Sat (20°C)	Field	Lab	(NTU)
19-06-18	17.0	11.9	0.15	10.52	**1034.4**	—	—	0.233	—	—	—	7.65	—	—	202.15	—	—
19-07-18	19.0	14.0	0.17	10.68	186.4	—	—	0.277	—	—	—	7.76	—	—	227.50	—	—
19-08-20	23.0	17.9	0.15	9.14	**1454.0**	—	—	0.269	—	—	—	7.54	—	—	202.80	—	—
19-09-17	—	12.6	0.14	11.89	232.4	—	—	0.220	—	—	—	7.37	—	—	186.55	—	—

Table 14: Nutrient results for WQ-3, 2019

SITE WQ-3: NUTRIENT DATA																			
Date (yy-mm-dd)	HCO3 (mg/L)	Br (mg/L)	Ca (mg/L)	CO3 (mg/L)	Cl (mg/L)	F (mg/L)	K (mg/L)	Mg (mg/L)	Na (mg/L)	NH3T (mg/L)	NH3_Un (mg/L)	NO2 (mg/L)	NO3 (mg/L)	NOX (mg/L)	SO4 (mg/L)	TKN (mg/L)	TN (mg/L)	TOC (mg/L)	TP-L (mg/L)
19-06-18	—	—	—	—	—	—	—	—	—	—	—	<0.05	0.720	0.720	—	0.4	0.8	—	**0.032**
19-07-18	—	—	—	—	—	—	—	—	—	—	—	<0.05	0.850	0.850	—	—	—	—	**0.038**
19-08-20	—	—	—	—	—	—	—	—	—	—	—	<0.05	0.710	0.710	—	—	—	—	**0.027**
19-09-17	—	—	—	—	—	—	—	—	—	—	—	<0.05	0.790	0.790	—	—	—	—	**0.024**

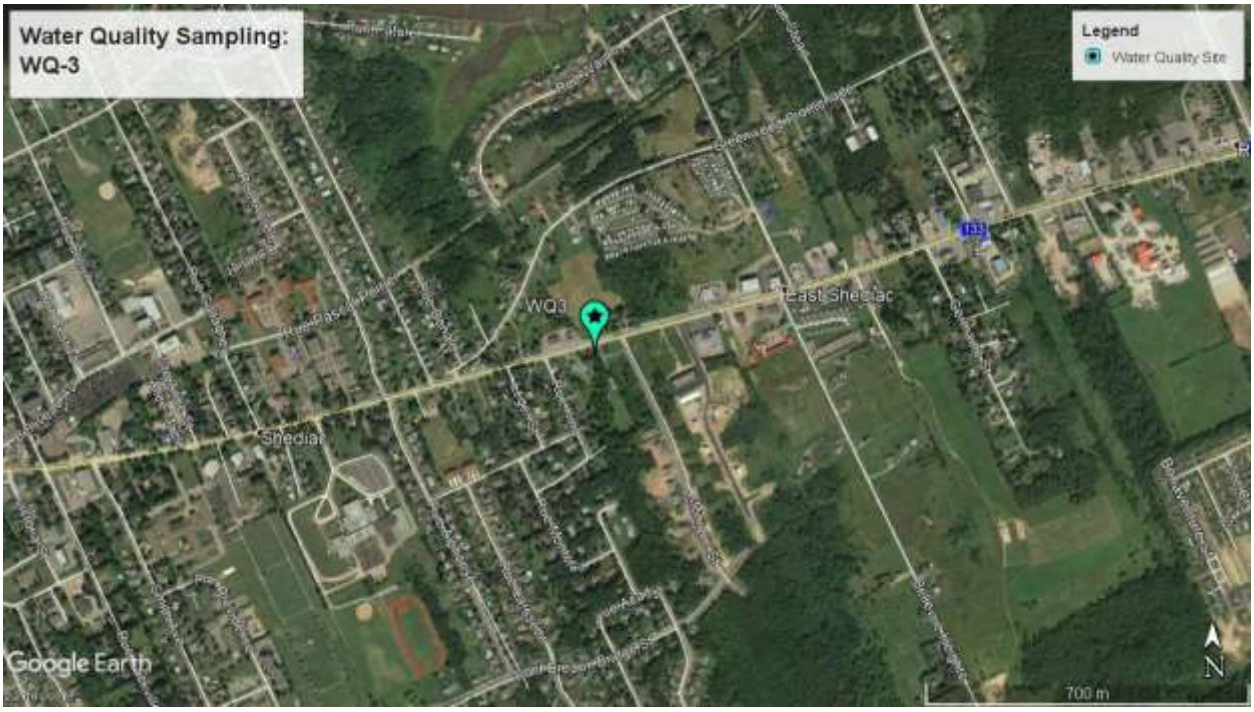


Figure 7: WQ-3 site location and surrounding land uses

Figure 8: Site photos for the water quality monitoring station WQ-3

4.4 WQ-4

This water quality sampling site is located behind the Town of Shediac's city hall. There is a culvert where this brook exits the underground canal along the edge of the parking lots for Town Hall and *Auberge Gabrièle's Inn & Restaurant,* and the sample is taken directly below this culvert. The surrounding land uses for small unnamed brook is mainly residences, business parking lots and roads. A part of this brook is channelled in an underground pipe somewhere along Chelsey Street, before reaching Main Street. There is also a dog park upstream (600 metres) next to a drainage ditch that connects to this brook. The SBWA built its first rain garden below this dog park, in an effort to capture stormwater runoff from the park and from the surrounding area (parking lot of the *Vestiaire St-Joseph* and Centennial Park). The brook flows into the Shediac Bay approximately 200 metres downstream from the sampling site, and is unaffected by normal tides.

The water sampling results for the site WQ-4, for 2019, meets or exceeds all the recommendations for the survival of freshwater aquatic life based on pH and dissolved oxygen.

Total phosphorus levels for long-term eutrophic conditions according to the "CCME Guidance Framework for Phosphorus" were in the mesotrophic range (0.010 – 0.020 mg/L) in July and August; and in the meso-eutrophic (20 - 35 mg/L) in June and September.

Concentration results for the nitrate ion (NO_3) are below the short term (550 mg/L) and long-term (13 mg/L) CCME recommendations for direct toxicity to sensitive freshwater life (these guidelines do not consider indirect effects due to eutrophication, nor does this interpret results for assessment of eutrophic conditions).

Bacterial levels did exceed the maximum concentration of *E. coli* from Health Canada recreational guideline (≥ 400 MPN/100 mL), for the sample taken in August; 581.8 MPN/100 mL.

Table 15: Water chemistry data and *E. coli* results for WQ-4, 2019

SITE WQ-4: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES																		
Date (yy-mm-dd)	Temp (°C)		SAL (ppt)	DO (mg/L)	E. coli (MPN /100mL)	ALK_T (mg/L)	CLRA (TCU)	COND (µS/cm)		HARD (mg/L)	Lang_Ind (20°C)	pH (pH)			TDS (mg/L)		TURB (NTU)
	Air	Water						Field	Lab			Field	Lab	Sat (20°C)	Field	Lab	
19-06-18	17.0	10.5	0.35	10.42	17.2	—	—	0.510	—	—	—	7.45	—	—	461.50	—	—
19-07-18	19.0	13.2	0.32	10.48	157.8	—	—	0.500	—	—	—	7.57	—	—	422.50	—	—
19-08-20	23.0	15.0	0.36	9.21	**581.8**	—	—	0.590	—	—	—	7.36	—	—	474.50	—	—
19-09-17	—	13.5	0.38	11.33	105.8	—	—	0.600	—	—	—	7.14	—	—	500.50	—	—

Table 16: Nutrient results for WQ-4, 2019

SITE WQ-4: NUTRIENT DATA																			
Date (yy-mm-dd)	HCO3 (mg/L)	Br (mg/L)	Ca (mg/L)	CO3 (mg/L)	Cl (mg/L)	F (mg/L)	K (mg/L)	Mg (mg/L)	Na (mg/L)	NH3T (mg/L)	NH3_Un (mg/L)	NO2 (mg/L)	NO3 (mg/L)	NOX (mg/L)	SO4 (mg/L)	TKN (mg/L)	TN (mg/L)	TOC (mg/L)	TP-L (mg/L)
19-06-18	—	—	—	—	—	—	—	—	—	—	—	<0.05	1.900	1.900	—	<0.25	1.8	—	**0.023**
19-07-18	—	—	—	—	—	—	—	—	—	—	—	<0.05	1.680	1.680	—	—	—	—	**0.018**
19-08-20	—	—	—	—	—	—	—	—	—	—	—	<0.05	1.870	1.870	—	—	—	—	**0.018**
19-09-17	—	—	—	—	—	—	—	—	—	—	—	<0.05	2.200	2.200	—	—	—	—	**0.024**

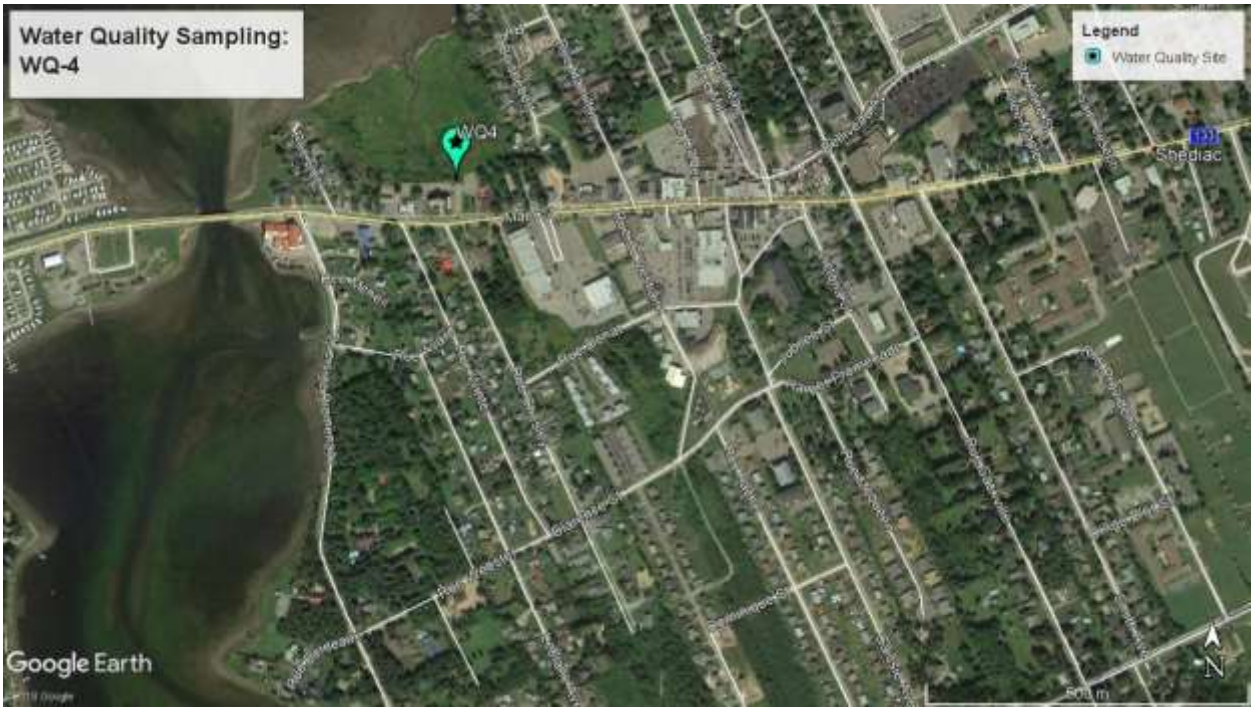


Figure 9: WQ-4 site location and surrounding land uses

Figure 10: Site photos for the water quality monitoring station WQ-4

4.5 WQ-5

This water quality sampling site is also located off Route 133, past *Guy's Frenchys* heading towards Gilbert's Corner. The stream crosses the road 75 m past Atkinson Court. The samples are taken upstream from the culvert. The sample site is located approximately 90 m from the tidal zone and the beginning of a salt marsh. The surrounding land uses is mainly residential, forested land, and farm fields. The riparian area around the residential properties have little buffer (< 15 m), but this constitutes small sections of the brook. However, there are good buffer zones between the farmlands and the head ponds of this brook; 25 m – 50 m in tree density. There is a thinner buffer zone where the pond discharges into the brook, approximately 20 m between the bank and a field. Another brook joins these ponds upstream, supplying water from the other side of Highway 11, up to Route 134 (Lakeville Road). In this area, there is more cultivated land where the brook passes, but there is no buffer zone visible from aerial imagery. There is no indication that animals, such as cows, are being pastured in that field, but the lack of a buffer around this brook passing around and through these fields may be impacted by sediment and could explain the higher levels of total phosphorus.

The water sampling results for the site WQ-5, for 2019, meets or exceeds all the recommendations for the survival of freshwater aquatic life based on pH and dissolved oxygen.
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) in June and September, and in the eutrophic range (0.004 – 0.010 mg/L) in July and August.

Concentration results for the nitrate ion (NO_3) are below the short term (550 mg/L) and long-term (13 mg/L) CCME recommendations for direct toxicity to sensitive freshwater life (these guidelines do not consider indirect effects due to eutrophication, nor does this interpret results for assessment of eutrophic conditions).

Bacterial levels did not exceed the maximum concentration of *E. coli* from Health Canada recreational guideline (≥ 400 MPN/100 mL).

Table 17: Water chemistry data and *E. coli* results for WQ-5, 2019

SITE WQ-5: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES																	
Date (yy-mm-dd)	Temp (°C)		SAL	DO	E. coli (MPN /100mL)	ALK_T	CLRA	COND (µS/cm)		HARD	Lang_Ind	pH (pH)			TDS (mg/L)		TURB (NTU)
	Air	Water	(ppt)	(mg/L)		(mg/L)	(TCU)	Field	Lab	(mg/L)	(20°C)	Field	Lab	Sat (20°C)	Field	Lab	
19-06-18	17.0	14.9	0.30	9	42.6	—	—	0.488	—	—	—	7.70	—	—	392.25	—	—
19-07-18	19.0	16.2	0.31	9.31	57.6	—	—	0.540	—	—	—	7.61	—	—	416.00	—	—
19-08-20	23.0	17.4	0.33	8.09	80.8	—	—	0.570	—	—	—	7.44	—	—	435.50	—	—
19-09-17	—	12.4	0.31	12.11	100.8	—	—	0.477	—	—	—	7.29	—	—	408.20	—	—

Table 18: Nutrient results for WQ-5, 2019

SITE WQ-5: NUTRIENT DATA																		
Date (yy-mm-dd)	HCO3 (mg/L)	Br (mg/L)	Ca (mg/L)	CO3 (mg/L)	Cl (mg/L)	F (mg/L)	K (mg/L)	Mg (mg/L)	Na (mg/L)	NH3T (mg/L)	NH3_Un (mg/L)	NO2 (mg/L)	NO3 (mg/L)	NOX (mg/L)	SO4 (mg/L)	TKN (mg/L)	TN (mg/L)	TOC (mg/L)	TP-L (mg/L)
19-06-18	—	—	—	—	—	—	—	—	—	—	—	<0.05	<0.05	<0.05	—	0.4	0.4	—	0.030
19-07-18	—	—	—	—	—	—	—	—	—	—	—	<0.05	0.060	0.060	—	—	—	—	0.035
19-08-20	—	—	—	—	—	—	—	—	—	—	—	<0.05	<0.05	<0.05	—	—	—	—	0.039
19-09-17	—	—	—	—	—	—	—	—	—	—	—	<0.05	0.100	0.100	—	—	—	—	0.027

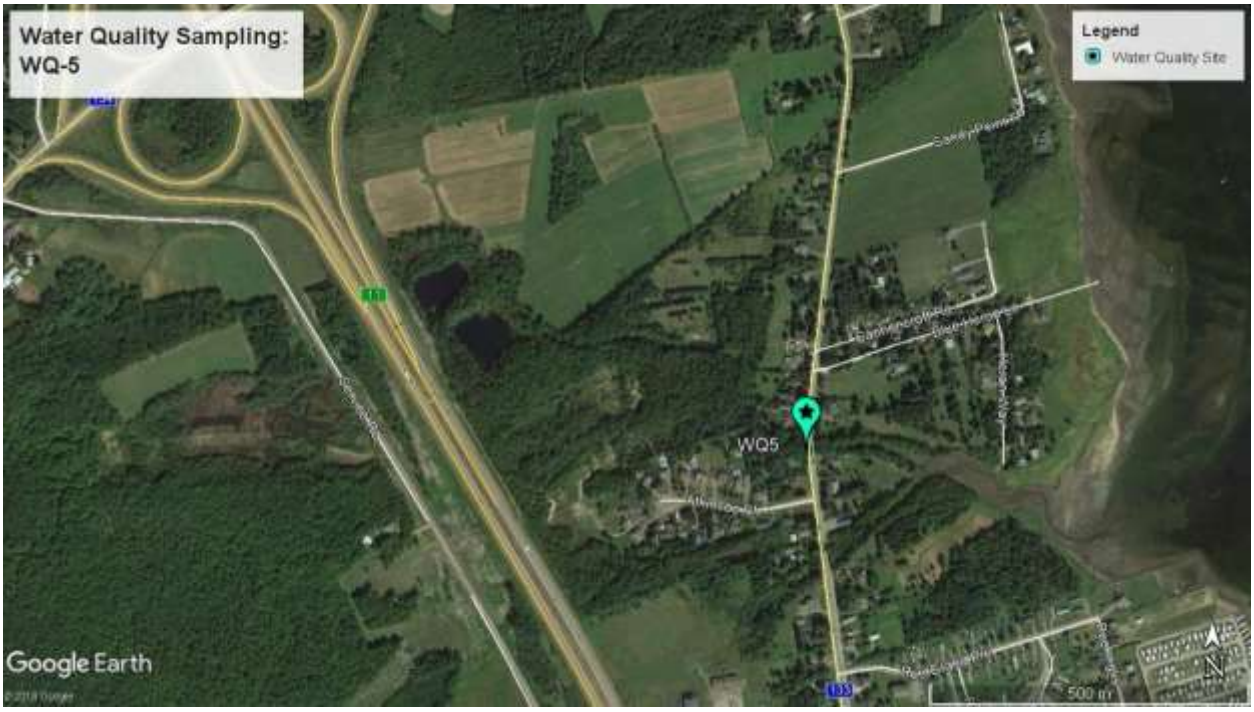


Figure 11: WQ-5 site location and surrounding land uses

Figure 12: Site photos for the water quality monitoring station WQ-5

4.6 WQ-6

This water quality sampling site is located off Route 134, past the Shediac Cape School, right next to Old Mill Road. The vehicle is parked on Old Mill Road, and the samples are taken downstream of the culvert crossing Route 134, to capture the water coming from both directions; coming from along Old Mill Road and along Route 134. The sample site is located approximately 175 m from the tidal zone. The surrounding land uses includes; residential, active farm fields for cultivation and pasture (cows seen on aerial imagery), and a gravel pit. There is very little or no buffer along the brook as it flows through the fields. It is unknown if cows are held in this area on a regular basis, but there are obvious cow tracks that criss-crosses the brook in one particular area and animals visible in aerial views from several years. There is also no buffer between the gravel pit area and the brook. Passed the gravel pit heading upstream is a more forested lot, with healthier riparian zones. The next parcel of land and leading up to the end of the brook near Highway 11 are more cow pastures, as animals, cow tracks and cattle fencing can be seen on aerial imagery. There is more vegetation in the buffer zones in this field, with tree density ranging from 5 – 30 metres.

The water sampling results for the site WQ-6, for 2019, meet the recommendations for the survival of freshwater aquatic life based on pH and dissolved oxygen.

Concentration results for the nitrate ion (NO_3) are below the short term (550 mg/L) and long-term (13 mg/L) CCME recommendations for direct toxicity to sensitive freshwater life (these guidelines do not consider indirect effects due to eutrophication, nor does this interpret results for assessment of eutrophic conditions).

Total phosphorus levels for long-term eutrophic conditions according to the "CCME Guidance framework for Phosphorus" were in the mesotrophic range (0.010 – 0.020 mg/L) in each sample.

Bacterial levels did not exceed the maximum concentration of *E. coli* from Health Canada recreational guideline (≥ 400 MPN/100 mL).

Table 19: Water chemistry data and *E. coli* results for WQ-6, 2019

SITE WQ-6: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES																		
Date (yy-mm-dd)	Temp (°C)		SAL	DO	E. coli (MPN /100mL)	ALK_T	CLRA	COND (µS/cm)		HARD	Lang_Ind	pH (pH)			TDS (mg/L)		TURB
	Air	Water	(ppt)	(mg/L)		(mg/L)	(TCU)	Field	Lab	(mg/L)	(20°C)	Field	Lab	Sat (20°C)	Field	Lab	(NTU)
19-06-18	18.0	13.6	0.21	8.93	37.0	—	—	0.343	—	—	—	7.75	—	—	287.30	—	—
19-07-18	20.0	14.5	0.23	9.44	74.6	—	—	0.386	—	—	—	7.72	—	—	313.95	—	—
19-08-20	23.0	15.6	0.24	7.95	56.4	—	—	0.403	—	—	—	7.47	—	—	319.80	—	—
19-09-17	—	11.9	0.19	11.3	92.8	—	—	0.301	—	—	—	7.31	—	—	260.65	—	—

Table 20: Nutrient results for WQ-6, 2019

SITE WQ-6: NUTRIENT DATA																			
Date (yy-mm-dd)	HCO3 (mg/L)	Br (mg/L)	Ca (mg/L)	CO3 (mg/L)	Cl (mg/L)	F (mg/L)	K (mg/L)	Mg (mg/L)	Na (mg/L)	NH3T (mg/L)	NH3_Un (mg/L)	NO2 (mg/L)	NO3 (mg/L)	NOX (mg/L)	SO4 (mg/L)	TKN (mg/L)	TN (mg/L)	TOC (mg/L)	TP-L (mg/L)
19-06-18	—	—	—	—	—	—	—	—	—	—	—	<0.05	1.010	1.010	—	0.4	1.1	—	**0.016**
19-07-18	—	—	—	—	—	—	—	—	—	—	—	<0.05	0.610	0.610	—	—	—	—	**0.020**
19-08-20	—	—	—	—	—	—	—	—	—	—	—	<0.05	0.980	0.980	—	—	—	—	**0.014**
19-09-17	—	—	—	—	—	—	—	—	—	—	—	<0.05	0.810	0.810	—	—	—	—	**0.014**

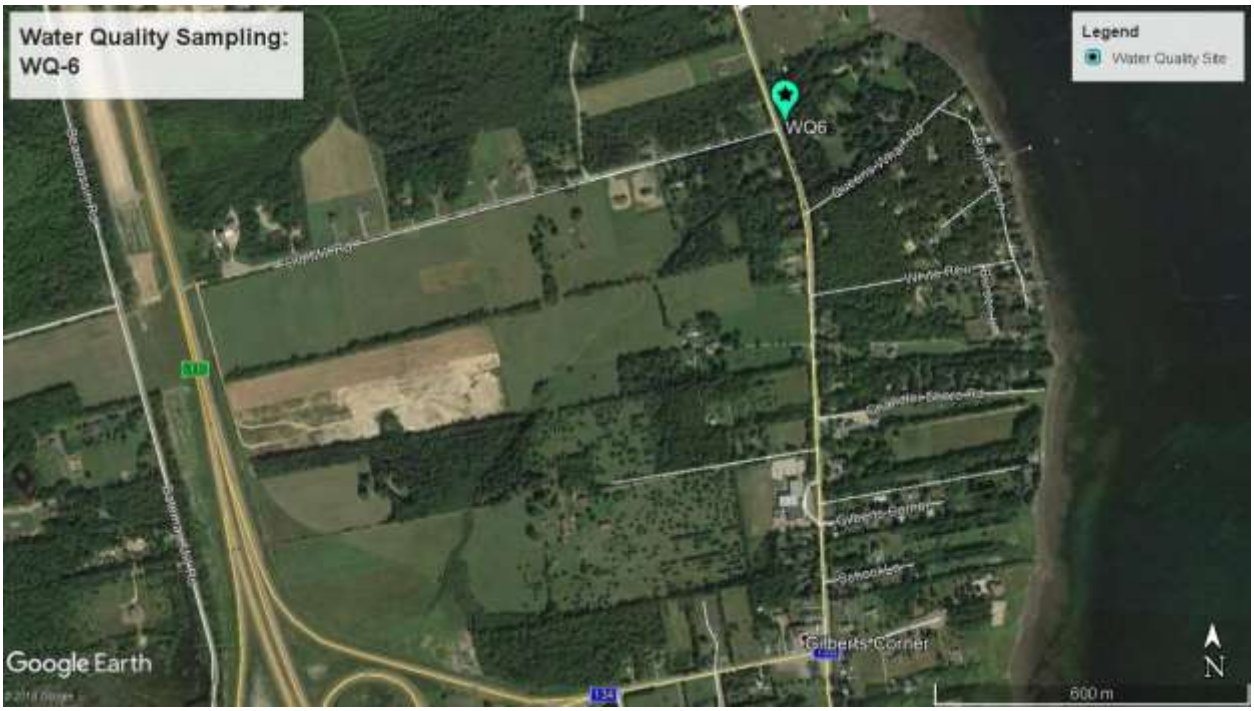


Figure 13: WQ-6 site location and surrounding land uses

Figure 14: Site photos for the water quality monitoring station WQ-6

4.7 WQ-7

This water quality sampling site is located off Route 134, on the property of *Bay Vista Lodge*. The samples are taken upstream of the culvert crossing the main road. The sample site is located approximately 160 m from the tidal zone and the beginning of a salt marsh. The surrounding land uses is mainly residential the cottages of *Bay Vista*. This brook is very short; the only obvious source of water being a pond (1,700 m^2) approximately 200 m away. The brook does not appear on GeoNB, only a separate brook nearby which flows into the same coastal wetland. This other nearby brook leads up to a gravel pit approximately 550 metres upstream from Route 134, but it is surrounded by forested lots.

The water sampling results for the site WQ-7, for 2019, meet the recommendations for the survival of freshwater aquatic life based on pH. However, levels of dissolved oxygen dropped below the recommendation (6.5 mg/L) for general cold water organisms in July and August (6.42 mg/L and 5.27 mg/L respectively).

Concentration results for the nitrate ion (NO_3) are below the short term (550 mg/L) and long-term (13 mg/L) CCME recommendations for direct toxicity to sensitive freshwater life (these guidelines do not consider indirect effects due to eutrophication, nor does this interpret results for assessment of eutrophic conditions).

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) in June, July and September; and in the eutrophic range (0.035 – 0.100 mg/L) in August.

Bacterial levels did not exceed the maximum concentration of *E. coli* from Health Canada recreational guideline (≥ 400 MPN/100 mL).

Table 21: Water chemistry data and *E. coli* results for WQ-7, 2019

SITE WQ-7: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES																	
Date (yy-mm-dd)	Temp (°C)		SAL	DO	E. coli (MPN /100mL)	ALK_T	CLRA	COND (µS/cm)		HARD	Lang_Ind	pH (pH)			TDS (mg/L)		TURB
	Air	Water	(ppt)	(mg/L)		(mg/L)	(TCU)	Field	Lab	(mg/L)	(20°C)	Field	Lab	Sat (20°C)	Field	Lab	(NTU)
19-06-18	18.0	7.3	0.16	7.84	71.8	—	—	0.279	—	—	—	7.61	—	—	212.55	—	—
19-07-18	20.0	18.1	0.15	6.42	75.8	—	—	0.272	—	—	—	7.57	—	—	203.45	—	—
19-08-20	23.0	19.9	0.15	5.27	42.6	—	—	0.279	—	—	—	7.35	—	—	200.850	—	—
19-09-17	12.0	13.5	0.15	9.15	37.0	—	—	0.251	—	—	—	7.27	—	—	209.30	—	—

Table 22: Nutrient results for WQ-7, 2019

SITE WQ-7: NUTRIENT DATA																			
Date (yy-mm-dd)	HCO3 (mg/L)	Br (mg/L)	Ca (mg/L)	CO3 (mg/L)	Cl (mg/L)	F (mg/L)	K (mg/L)	Mg (mg/L)	Na (mg/L)	NH3T (mg/L)	NH3_Un (mg/L)	NO2 (mg/L)	NO3 (mg/L)	NOX (mg/L)	SO4 (mg/L)	TKN (mg/L)	TN (mg/L)	TOC (mg/L)	TP-L (mg/L)
19-06-18	—	—	—	—	—	—	—	—	—	—	—	<0.05	<0.05	<0.05	—	0.4	0.3	—	0.024
19-07-18	—	—	—	—	—	—	—	—	—	—	—	<0.05	0.07	0.07	—	—	—	—	0.034
19-08-20	—	—	—	—	—	—	—	—	—	—	—	<0.05	0.07	0.07	—	—	—	—	0.036
19-09-17	—	—	—	—	—	—	—	—	—	—	—	<0.05	0.06	0.06	—	—	—	—	0.027

Figure 15: WQ-7 site location and surrounding land uses

Figure 16: Site photos for the water quality monitoring station WQ-7

4.8 WQ-8

This water quality sampling site is located off Route 134, in front of a chiropractor's office (3694 Route NB-134, Shediac Cape). The site is within the tidal zone, being approximately 75 metres from the outlet into the Shediac Bay. The samples are taken upstream from the culvert. The surrounding land uses includes; residences, farmlands and a chicken farm. The farm fields possess little to no buffer around the lots; mainly wide open fields with little tree line density. There is a settling pond behind the chicken farm buildings, with a thin band of vegetation surrounding it (> 10 m). Observations taken during the sampling includes dark colouration and bad odours in the water.

The water sampling results for the site WQ-8, for 2019, meet the recommendations for the survival of freshwater aquatic life based on pH. However, levels of dissolved oxygen dropped below the recommendation (6.5 mg/L) for general cold water organisms in July and August (0.06 mg/L and 6.13 mg/L respectively).

Total phosphorus levels for long-term eutrophic conditions according to the "CCME Guidance Framework for Phosphorus" were in the meso-eutrophic range (20 -35 mg/L) in September, in the eutrophic range (35 – 100 mg/L) in July, and in the hyper-eutrophic range (>100 mg/L) in June and August.

Concentration results for the nitrate ion (NO_3) are below the short term (550 mg/L) and long-term (13 mg/L) CCME recommendations for direct toxicity to sensitive freshwater life (these guidelines do not consider indirect effects due to eutrophication, nor does this interpret results for assessment of eutrophic conditions).

Bacterial levels exceed the maximum concentration of *E. coli* from Health Canada recreational guideline (≥ 400 MPN/100 mL) in June (2,014.0 MPN/100 mL) and August (12,997.0 MPN/100 mL).

Table 23: Water chemistry data and *E. coli* results for WQ-8, 2019

SITE WQ-8: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES																		
Date (yy-mm-dd)	Temp (°C)		SAL	DO	E. coli (MPN /100mL)	ALK_T	CLRA	COND (µS/cm)		HARD	Lang_Ind	pH (pH)			TDS (mg/L)		TURB
	Air	Water	(ppt)	(mg/L)		(mg/L)	(TCU)	Field	Lab	(mg/L)	(20°C)	Field	Lab	Sat (20°C)	Field	Lab	(NTU)
19-06-18	18.0	18.4	24.14	7.75	**2014.0**	—	—	33.130	—	—	—	7.17	—	—	24654.70	—	—
19-07-18	21.0	18.9	23.10	**3.67**	228.0	—	—	32.120	—	—	—	6.91	—	—	23634.00	—	—
19-08-20	23.0	17.3	1.30	7.33	**12997.0**	—	—	2.000	—	—	—	7.18	—	—	1579.590	—	—
19-09-17	12.0	14.3	18.09	**3.81**	171.0	—	—	23.470	—	—	—	**6.26**	—	—	19019.00	—	—

Table 24: Nutrient results for WQ-8, 2019

SITE WQ-8: NUTRIENT DATA																			
Date (yy-mm-dd)	HCO3 (mg/L)	Br (mg/L)	Ca (mg/L)	CO3 (mg/L)	Cl (mg/L)	F (mg/L)	K (mg/L)	Mg (mg/L)	Na (mg/L)	NH3T (mg/L)	NH3_Un (mg/L)	NO2 (mg/L)	NO3 (mg/L)	NOX (mg/L)	SO4 (mg/L)	TKN (mg/L)	TN (mg/L)	TOC (mg/L)	TP-L (mg/L)
19-06-18	—	—	—	—	—	—	—	—	—	—	—	<0.05	0.060	0.060	—	1.8	2.3	—	**0.140**
19-07-18	—	—	—	—	—	—	—	—	—	—	—	<0.05	1.130	1.130	—	—	—	—	**0.044**
19-08-20	—	—	—	—	—	—	—	—	—	—	—	<0.05	0.400	0.400	—	—	—	—	**0.183**
19-09-17	—	—	—	—	—	—	—	—	—	—	—	<0.05	1.300	1.300	—	—	—	—	**0.027**

Figure 17: WQ-8 site location and surrounding land uses

Figure 18: Site photos for the water quality monitoring station WQ-8

4.9 WQ-9

This water quality sampling site is located in the Ruisseau Albert-Gallant, off Babineau Access Road, 320 m after turning to the left off Viaduc Road (turning to the right is Shediac River Road). The samples are taken downstream of the culvert, due to flooding on the other side caused by a beaver dam at the mouth of the culvert, creating conditions unfit for chest waders. The sample site is located approximately 300 m from the tidal zone. The surrounding land uses is mainly residences and large agricultural fields. There is a farming lot (1.2 hectares) along the right side of the brook (looking upstream), with no buffer zone along the total length of its riverbank (100 metres). On the left side of the sampling site is a much larger cultivated farm field; 14.6 Hectares and another lot 5.3 Hectares. The drainage from these fields flows down to the ditch along Shediac River Rd. and Babineau Access Rd., and may flow down to the brook's culvert. There are no trees around any of these farm fields. There is also the presence of the large junkyard of *Bastarache's Auto Salvage*, but there is approximately 1 km of forested buffer between the salvage lot and the head ponds of the brook (as delineated on GeoNB).

The water sampling results for the site WQ-9, for 2019, meet the recommendations for the survival of freshwater aquatic life based on pH and dissolved oxygen.

Concentration results for the nitrate ion (NO_3) are below the short term (550 mg/L) and long-term (13 mg/L) CCME recommendations for direct toxicity to sensitive freshwater life (these guidelines do not consider indirect effects due to eutrophication, nor does this interpret results for assessment of eutrophic conditions).

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) in July, August and September, and in the eutrophic range (0.035 – 0.100 mg/L) in June.

Bacterial levels did not exceed the maximum concentration of *E. coli* from Health Canada recreational guideline (≥ 400 MPN/100 mL).

Table 25: Water chemistry data and *E. coli* results for WQ-9, 2019

SITE WQ-9: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES																	
Date (yy-mm-dd)	Temp (°C)		SAL	DO	E. coli (MPN /100mL)	ALK_T	CLRA	COND (µS/cm)		HARD	Lang_Ind	pH (pH)			TDS (mg/L)		TURB
	Air	Water	(ppt)	(mg/L)		(mg/L)	(TCU)	Field	Lab	(mg/L)	(20°C)	Field	Lab	Sat (20°C)	Field	Lab	(NTU)
19-06-18	22.0	19.3	0.12	15.47	73.8	—	—	0.226	—	—	—	8.67	—	—	165.10	—	—
19-07-18	21.0	17.6	0.07	10.46	222.4	—	—	0.123	—	—	—	8.67	—	—	93.60	—	—
19-08-20	24.0	19.5	0.09	9.45	230.6	—	—	0.165	—	—	—	7.78	—	—	119.500	—	—
19-09-17	12.0	12.6	0.13	9.28	47.0	—	—	0.219	—	—	—	8.66	—	—	182.00	—	—

Table 26: Nutrient results for WQ-9, 2019

SITE WQ-9: NUTRIENT DATA																			
Date (yy-mm-dd)	HCO3 (mg/L)	Br (mg/L)	Ca (mg/L)	CO3 (mg/L)	Cl (mg/L)	F (mg/L)	K (mg/L)	Mg (mg/L)	Na (mg/L)	NH3T (mg/L)	NH3_Un (mg/L)	NO2 (mg/L)	NO3 (mg/L)	NOX (mg/L)	SO4 (mg/L)	TKN (mg/L)	TN (mg/L)	TOC (mg/L)	TP-L (mg/L)
19-06-18	—	—	—	—	—	—	—	—	—	—	—	<0.05	<0.05	<0.05	—	1.3	0.4	—	0.045
19-07-18	—	—	—	—	—	—	—	—	—	—	—	<0.05	0.11	0.110	—	—	—	—	0.032
19-08-20	—	—	—	—	—	—	—	—	—	—	—	<0.05	0.06	0.060	—	—	—	—	0.022
19-09-17	—	—	—	—	—	—	—	—	—	—	—	<0.05	0.36	0.36	—	—	—	—	0.022

Figure 19: WQ-9 site location and surrounding land uses

Figure 20: Site photos for the water quality monitoring station WQ-9

4.10 WQ-10

This water quality sampling site is located off Route 530 (Grande-Digue Rd.), 100 m after Chemin Antoine. The samples are taken upstream of the culvert. The sample site is located approximately 130 m from the tidal zone. The surrounding land uses is mainly residences and a possible agricultural fields (> 1 ha.). There is a buffer zone that separates the field and the brook (average 5-15 m in thickness).

The water sampling results for the site WQ-10, for 2019, meet the recommendations for the survival of freshwater aquatic life based on pH. However, levels of dissolved oxygen dropped below the recommendation (6.5 mg/L) for general cold water organisms in August (5.61 mg/L).

Total phosphorus levels for long-term eutrophic conditions according to the "CCME Guidance Framework for Phosphorus" were in the meso-eutrophic range (20 -35 µg/L) in June, July and September, and in the eutrophic range (35 – 100 µg/L) in August.

Concentration results for the nitrate ion (NO_3) are below the short term (550 mg/L) and long-term (13 mg/L) CCME recommendations for direct toxicity to sensitive freshwater life (these guidelines do not consider indirect effects due to eutrophication, nor does this interpret results for assessment of eutrophic conditions).

Concentrations of aluminum exceeded the CCME water quality guideline (100 µg/L when the pH is ≥6.5) in all samples except September. Concentrations of iron also exceeded the guidelines (300 µg/L) in all samples except September. Bacterial levels exceed the maximum concentration of *E. coli* from Health Canada recreational guideline (≥ 400 MPN/100 mL) in July and August; 2599.4 MPN/100 mL and 1158.8 MPN/100 mL respectively.

Table 27: Water chemistry data and *E. coli* results for WQ-10, 2019

SITE WQ-10: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES																	
Date (yy-mm-dd)	Temp (°C)		SAL	DO	E. coli (MPN /100mL)	ALK_T (mg/L)	CLRA (TCU)	COND (µS/cm)		HARD (mg/L)	Lang_Ind (20°C)	pH (pH)			TDS (mg/L)		TURB (NTU)
	Air	Water	(ppt)	(mg/L)				Field	Lab			Field	Lab	Sat (20°C)	Field	Lab	
19-06-18	22.0	17.5	0.06	8.81	**444.8**	—	—	0.107	—	—	—	8.57	—	—	82.55	—	—
19-07-18	21.0	16.4	0.07	9.64	244.6	—	—	0.125	—	—	—	8.02	—	—	96.85	—	—
19-08-20	24.0	18.5	0.13	**5.61**	**3972.6**	—	—	0.237	—	—	—	7.47	—	—	175.50	—	—
19-09-17	12.0	12.4	0.05	11.46	**774.6**	—	—	0.077	—	—	—	7.99	—	—	66.30	—	—

Table 28: Nutrient results for WQ-10, 2019

SITE WQ-10: NUTRIENT DATA																			
Date (yy-mm-dd)	HCO3 (mg/L)	Br (mg/L)	Ca (mg/L)	CO3 (mg/L)	Cl (mg/L)	F (mg/L)	K (mg/L)	Mg (mg/L)	Na (mg/L)	NH3T (mg/L)	NH3_Un (mg/L)	NO2 (mg/L)	NO3 (mg/L)	NOX (mg/L)	SO4 (mg/L)	TKN (mg/L)	TN (mg/L)	TOC (mg/L)	TP-L (mg/L)
19-06-18	—	—	—	—	—	—	—	—	—	—	—	<0.05	<0.05	<0.05	—	0.7	0.4	—	**0.032**
19-07-18	—	—	—	—	—	—	—	—	—	—	—	<0.05	0.060	0.060	—	—	—	—	**0.031**
19-08-20	—	—	—	—	—	—	—	—	—	—	—	<0.05	0.240	0.240	—	—	—	—	**0.053**
19-09-17	—	—	—	—	—	—	—	—	—	—	—	<0.25	<0.25	<0.25	—	—	—	—	**0.027**

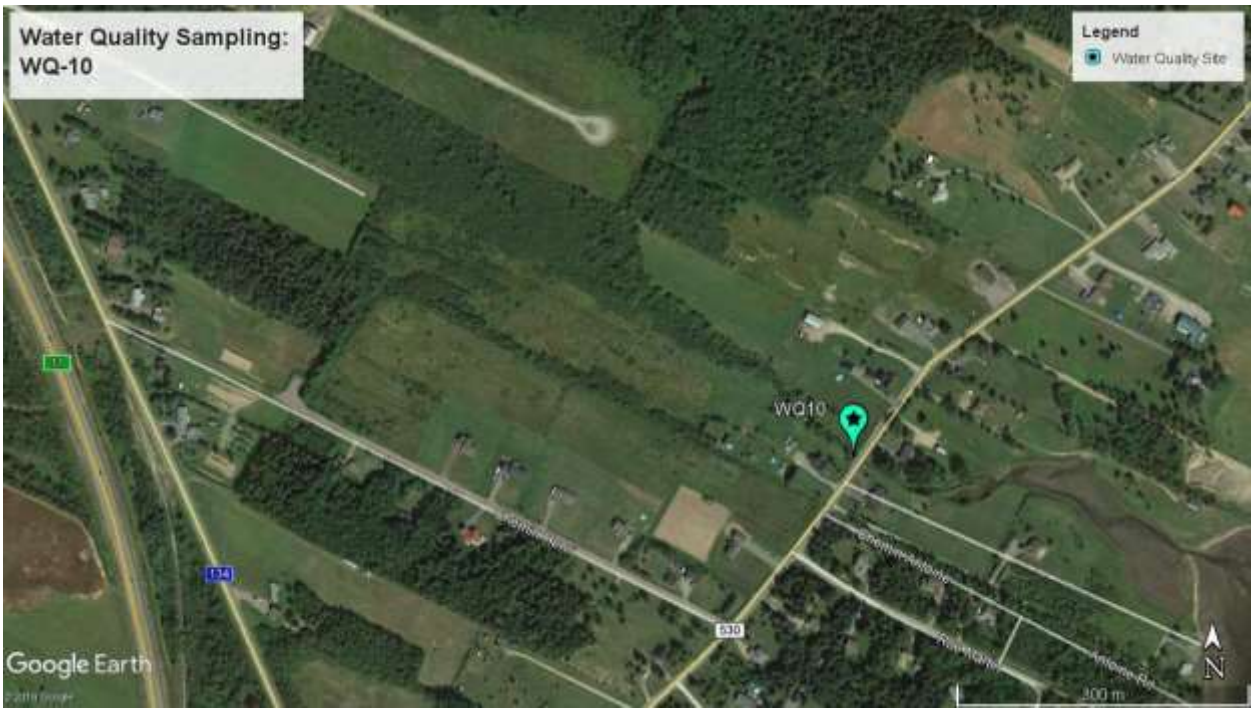


Figure 21: WQ-10 site location and surrounding land uses

Figure 22: Site photos for the water quality monitoring station WQ-10

4.11 WQ-11

This water quality sampling site is located off Route 530 (Grande-Digue Rd.), just before the Chemin des Soeurs. The samples are taken upstream of the culvert. The sample site is located approximately 80 m from the tidal zone. The surrounding land uses is mainly residential and agricultural farms. The farm lands are made up of various parcels of land, spanning over 58 Hectares of land leading up to the watershed boundary. There is very little evidence of any tree buffer over this area from aerial imagery, except for one forested parcel and a few thin lines of trees along property lines.

The water sampling results for the site WQ-11, for 2019, meet the recommendations for the survival of freshwater aquatic life based on pH. However, the levels of dissolved oxygen levels fell below the recommendation (6.5 mg/L) for general cold water organisms in June, July and August (6.26 mg/L, 4.33 mg/L and 6.18 mg/L respectively).

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 all sampling months.

Concentration results for the nitrate ion (NO_3) are below the short term (550 mg/L) and long-term (13 mg/L) CCME recommendations for direct toxicity to sensitive freshwater life (these guidelines do not consider indirect effects due to eutrophication, nor does this interpret results for assessment of eutrophic conditions).

Bacterial levels exceed the maximum concentration of *E. coli* from Health Canada recreational guideline (≥ 400 MPN/100 mL) in July (487.0 MPN/100 mL) and August (1989.0 MPN/100 mL).

Table 29: Water chemistry data and *E. coli* results for WQ-11, 2019

SITE WQ-11: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES																		
Date (yy-mm-dd)	Temp (°C)		SAL	DO	E. coli (MPN /100mL)	ALK_T (mg/L)	CLRA (TCU)	COND (µS/cm)		HARD (mg/L)	Lang_Ind (20°C)	pH (pH)			TDS (mg/L)		TURB (NTU)
	Air	Water	(ppt)	(mg/L)				Field	Lab			Field	Lab	Sat (20°C)	Field	Lab	
19-06-18	22.0	19.9	21.92	6.26	85.0	—	—	32.180	—	—	—	6.88	—	—	22886.50	—	—
19-07-18	22.0	19.9	20.41	4.33	487.0	—	—	29.130	—	—	—	6.71	—	—	21060.50	—	—
19-08-20	25.0	22.0	18.91	6.18	1989.0	—	—	28.450	—	—	—	6.66	—	—	19708.00	—	—
19-09-17	11.0	12.7	0.08	9.37	214.2	—	—	0.124	—	—	—	7.36	—	—	105.30	—	—

Table 30: Nutrient results for WQ-11, 2019

SITE WQ-11: NUTRIENT DATA																			
Date (yy-mm-dd)	HCO3 (mg/L)	Br (mg/L)	Ca (mg/L)	CO3 (mg/L)	Cl (mg/L)	F (mg/L)	K (mg/L)	Mg (mg/L)	Na (mg/L)	NH3T (mg/L)	NH3_Un (mg/L)	NO2 (mg/L)	NO3 (mg/L)	NOX (mg/L)	SO4 (mg/L)	TKN (mg/L)	TN (mg/L)	TOC (mg/L)	TP-L (mg/L)
19-06-18	—	—	—	—	—	—	—	—	—	—	—	<0.05	0.130	0.130	—	0.6	0.5	—	0.039
19-07-18	—	—	—	—	—	—	—	—	—	—	—	<0.05	0.1	0.1	—	—	—	—	0.051
19-08-20	—	—	—	—	—	—	—	—	—	—	—	<0.05	0.070	0.070	—	—	—	—	0.072
19-09-17	—	—	—	—	—	—	—	—	—	—	—	<0.05	0.1	0.1	—	—	—	—	0.039

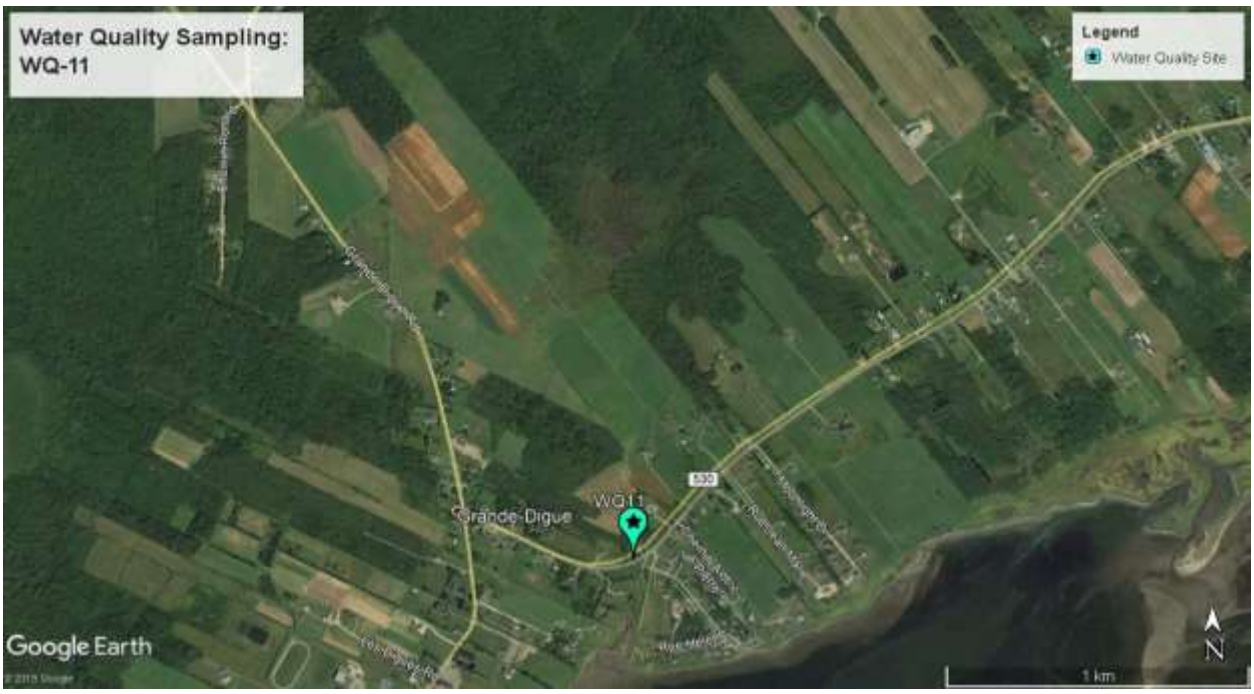


Figure 23: WQ-11 site location and surrounding land uses

Figure 24: Site photos for the water quality monitoring station WQ-11

4.12 Bacterial Sampling Summary

The bacterial levels in some of the small streams sites shows the need for more investigation around land uses. Valuable data has been collected since 2017 and will be used in the planning of future studies and remediation action plans.

The sites that did not have an instance of bacterial spike are; WQ-5, WQ-6, WQ-7. The sites WQ 1 and WQ-9 had some moderate levels of bacteria present. Based on the bacterial levels alone, the stations that merit further investigations for sources of fecal coliforms are; WQ-2, WQ-3, WQ-4, WQ-8, WQ-10 and WQ-11.

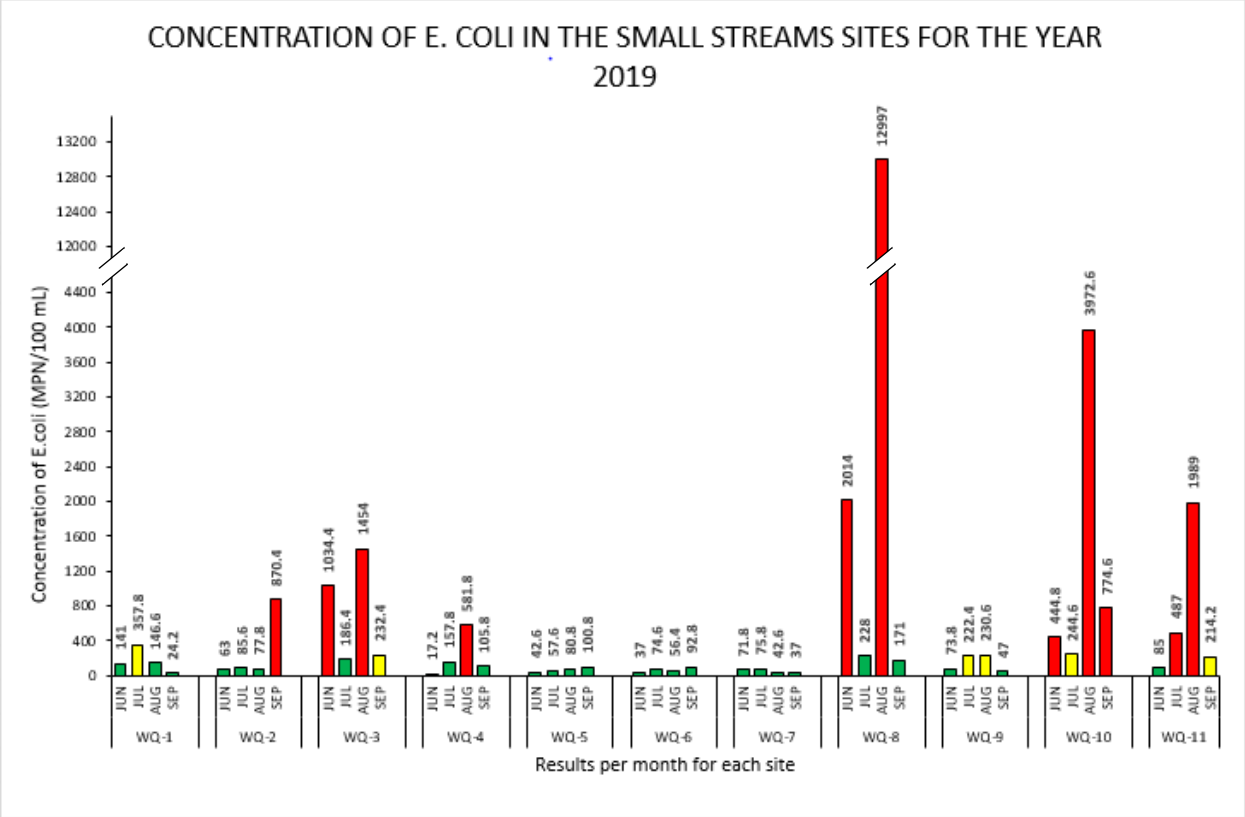


Figure 25: Summary of water quality results for *E. coli*, small streams sampling 2019

4.13 Discussion

The first disclaimer is that 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. We can point out trends from our limited sampling results, but changes occur so quickly that general patterns are not always evident. Our sampling is simply a snapshot of the results on that collection day. It would be very expensive to monitor water quality changes on a daily or even weekly basis. As a non-profit environmental organization, we do not have the resources or capacity for this. Our goal is to look for gross abnormalities in general patterns and hope to identify possible causes.

Many of the flagged parameters above 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.

Regarding bacterial analysis of these 11 water quality monitoring sites, 5 sites remained below the limits for *E. coli* based on Health Canada Recreational Guidelines (WQ-1, WQ-5, WQ-6, WQ-7 and WQ-9). Sampling stations that did have bacterial samples that surpassed the recommended guideline are: WQ-2, WQ-3, WQ-4, WQ-8, WQ-10 and WQ-11. These six sites merit further investigations for sources of fecal coliforms. However, the highest levels of bacterial contamination was detected at the station WQ-8, where levels reached 12,997 MPN/100 mL. This site will be a priority for further investigation and remediation projects.

All pH levels were found to be within the guidelines; between 6.5 and 9. However, dissolved oxygen was very poor in certain areas during the summer months. With very warm temperature in the summer 2019, and with several small streams lacking in shade from vegetative buffer zones, the water in some of those sampling sites became very warm and depleted of its dissolved oxygen. The presence of bacteria and algae can further decrease the levels of dissolved oxygen available for aquatic life due to biological oxygen demand (BOD).

Looking at total phosphorous levels, 4 of our site falls into mesotrophic (0.010 - 0.020 mg/L) to meso-eutrophic ranges (0.020 - 0.035 mg/L): WQ-1, WQ-2, WQ-4 and WQ-6. Four other sites have sample levels within the meso-eutrophic to eutrophic ranges (0.035 - 0.100 mg/L): WQ-3, WQ-5, WQ-7, WQ-9, WQ-10 and WQ-11. One of our sites have samples that reach the hyper-eutrophic ranges (> 0.100mg/L): WQ-8. The highest level of total phosphorous measured in 2019 was 0.183 mg/L at WQ-8 in August.

5 Eelgrass Monitoring in the Shediac Bay

The SeagrassNet program is a global seagrass monitoring network that monitors the status of seagrass and the threats to these ecosystems. The program started in 2001, and now includes more than 126 sites in 33 countries.

The Southern Gulf of Saint Lawrence Coalition on Sustainability (Coalition-SGSL) has implemented the SeagrassNet program in Atlantic Canada since 2015. They have provided equipment and training to the SBWA for the monitoring program to begin in the Shediac Bay. The first monitoring site was established in the estuary of the Scoudouc River in 2016, and a second site was established in the Shediac River estuary in 2017. In 2018, a third monitoring site was added in the Shediac Bay, near the mouth of the South Cove Estuary (near Pointe-du-Chêne). The final site was established in 2019 on the north shore of the bay in Grande-Digue.

The data collected from these annual surveys will serve to measure changes in eelgrass density in these sensitive habitats. Since the first appearance of the invasive green crab in the Shediac Bay in 2010, Green crab population monitoring has shown a trend of increase in their numbers. The green crab is an invader is capable of devastating eelgrass habitats. The SeagrassNet program provides a protocol to measure the impacts of the green crab in the Shediac Bay. The protocol for the sampling can be found at www.seagrassnet.org.

Reports on eelgrass and green crab monitoring are included in Annexes of this report and will be available on the SBWA website. The reports will give an update on data recorded and restoration efforts.

Figure 27: Sampling quadrant

Figure 26: Green crabs in sampling trap

6 Buffer Zone Enhancement in Boudreau-Ouest

This marsh is located at a small estuary of an unnamed brook that crosses route 133. The Boudreau-Ouest marsh was identified to have a lack of buffer zone and also there was evidence of erosion in 2017. In 2018, 417 native trees were planted on both sides of the stream to help create a healthy buffer zone, as well as to stabilize the soil to protect against erosion. A WAWA permit and two land owner permissions were acquired. Unfortunately, there was a miscommunication between the landowner that owns the eastern side of the marsh and the person that mows the field. During the summer of 2018, a large portion of the young trees that were planted in the spring got mowed over and did not survive.

A renewal of the WAWA permit was acquired to plant additional native trees on the eastern side of Boudreau-Ouest marsh to replace the ones that did not survive in 2018. On May 24th and May 27th, 68 native trees and one shrub were planted. The diversity of these trees included: 19 White Spruces, 18 Red Maples, 8 Grey Birches, 23 Yellow Birches and one Meadow sweet shrub. Along with the tree planting sign that was installed in the fall of 2018, stakes panted in a bright red colour were installed along the easternmost tree planting area for extra precaution.

The trees and shrub were taken from the ``Vert l'Avenir`` farm woodlot and from two of SBWA`s tree nurseries (Shediac Cape and Grande-Digue).

Figure 28: Map of the tree planting site at the Boudreau-Ouest saltmarsh

Figure 29: Photos of tree planting site in the Boudreau-Ouest saltmarsh

7 Public Education, Outreach and Involvement

7.1 Boater Awareness Program

A criteria of the Blue Flag certification the Shediac Bay Yacht Club is to display information on sensitive habitats. An interpretation panel on eelgrass was produced and printed for this purpose. Educational materials for boaters developed in 2019 focused on eelgrass was distributed to local marinas during the summer. A pamphlet and poster that lists pump-out stations locations that are available in Southeast New Brunswick is still displayed locally.

The Shediac Bay Watershed Association is a member of the environmental committee for the Blue Flag designation of the Shediac Bay Yatch Club and Parlee Beach Provincial Park. The committee will encourage more partnerships with other organisations around Shediac Bay especially regarding educational activities.

The Pointe-du-Chêne Harbour Autority has an advisory committee to oversee recommendations for future maintenance and development of the wharf. The SBWA is participating in this committee to provide recommendations regarding the environmental impacts and opportunities for environmental education or restoration.

Figure 30: Boater Awareness poster and interpretation panel

7.2 Beach Sweep

In celebration of World's Oceans Day, a public beach sweep event is organized every year by the SBWA, in partnership with the Town of Shediac. This activity aims to combat marine litter, to raise awareness, and contribute to the protection and conservation of our marine environment in the Shediac Bay. The event was advertised to begin at the Shediac Bay Yacht Club on Saturday, June 8, 2019.

It was a beautiful warm sunny day, and 19 volunteers showed up to pick up trash along the coastline of the Town of Shediac. SBWA staff greeted volunteers and provided them with gloves, garbage bags and small handout gifts.

People were directed to different parts of the coastline in order to cover as much ground as possible. There were designated drop-off points for their garbage bags, which would then be picked up by staff of the Town of Shediac. Our volunteers were then invited to a lunch of hot dogs on the BBQ, donated by the *Shediac Coop IGA*. Special thanks go out to the local businesses who donated gift certificates as prize draws for the volunteers; Oceanside Fitness Gym for two 1 month free memberships at the gym, Shediac Kent Store for a 25$ gift card, and Shediac Dixie Lee for two 10$ gift cards. Other toy prizes were drawn for the children participating in the event.

In total, 16 extra-large garbage bags of litter was collected in addition to larger debris items. Based on volunteer feedback, an estimate of 4.4 km of coastline was cleaned that day.

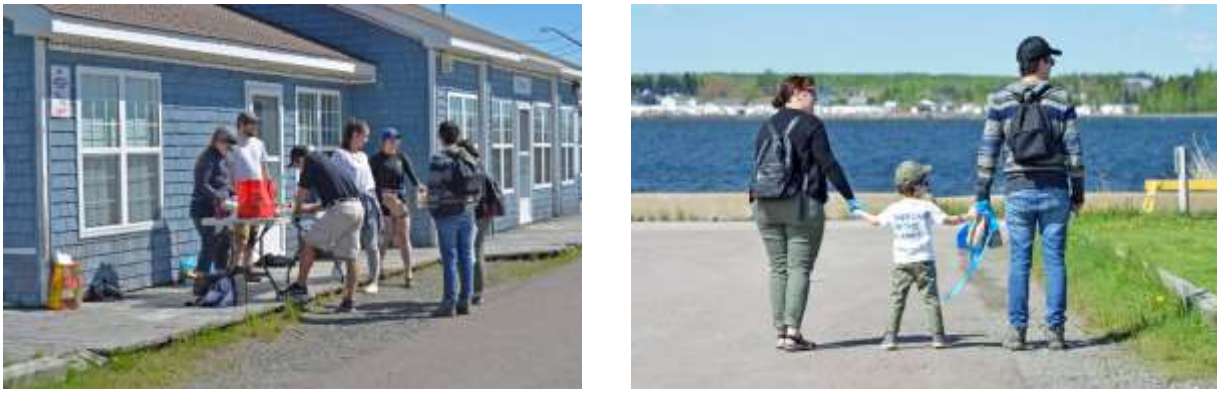


Figure 31: Annual Beach Sweep June 8, 2019

7.3 Salt marsh educational park in Pointe-du-Chêne

A partnership is forming between the Anglican Parish of Shediac and the Shediac Bay Watershed Association to develop an educational park on a parcel of land in Pointe-du-Chêne. Permission was granted to bring school groups to the site.

The SBWA has contacted Ducks Unlimited to assess the possibility of launching a Wetland Center of Excellence program at this site (https://www.ducks.ca/initiatives/wetland-centres-of-excellence/). The site is eligible and first steps are being undertaken to implement this program.

A field trip was organized with the grade 10 science classes from Louis-J.-Robichaud high school. On October 11th, both classes took the bus and went to visit the salt marsh, one group in the morning and one in the afternoon. A presentation was given on general wetlands, plants tolerant to salt, biotic and abiotic factors of that specific ecosystem, the ecosystem services provided by the salt-marsh, etc. A bated minnow trap was placed in the water and managed to catch a few dozen mummichogs. The group explored a saltpan with a critter dipping activity, where they were able to find invertebrates using a dip net.

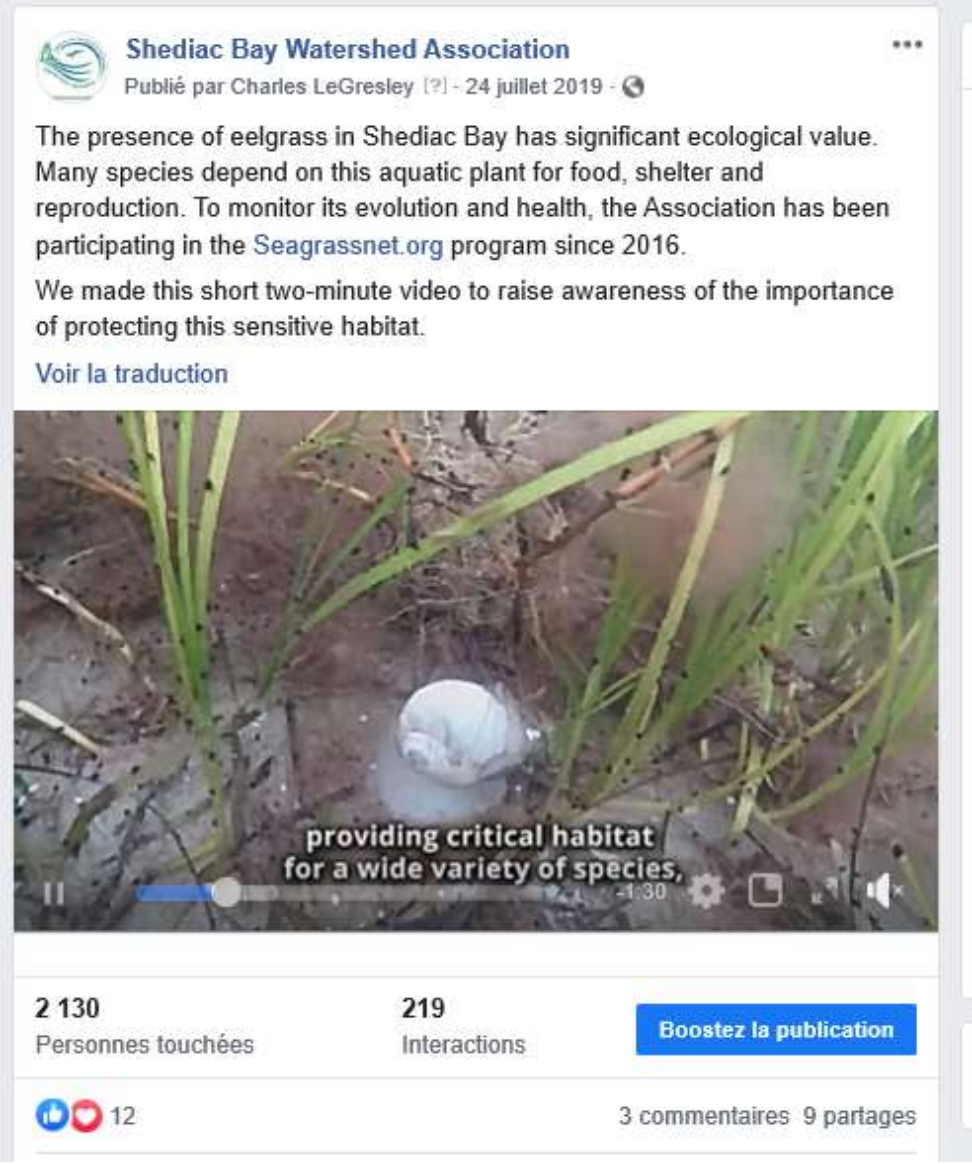
The field trip was later followed up by another classroom presentation on ecosystems in general, biodiversity, food chains (terrestrial and aquatic), energy transfer and bioaccumulation, interactions and relations, threats to biodiversity and better management practices. The teachers really enjoyed the level of education that was involved in this series of activities, and they look forward to repeating this on a yearly basis.

Figure 32: Photos of the Pointe-du-Chêne saltmarsh field trip, October 2019

7.4 Video

A video on the importance of eelgrass in the Shediac Bay was produced in 2019. The video is posted on YouTube and was posted on our Facebook page and Website. The video gives information on eelgrass and its threats to protect this important habitat.

The video has been seen on Facebook by 2130 people for the English version and 580 people for the French version.



The video can be viewed on our Youtube site:
https://www.youtube.com/watch?v=ONujRwISg88

Or http://www.shediacbayassociation.org/eelgrass-video/

7.5 Media Outreach

7.5.1 Newsletter

A bilingual newsletter was produced during the 2019-2020 fiscal year. The newsletter display information and photos on the various projects that the SBWA has been doing in the year. The newsletter is now distributed electronically by email list and is available on our website and Facebook page.

Socials Medias and Website

The SBWA is working to keep its website and social media up to date, posting photos and short description of activities and projects. The SBWA now has a dedicated employee who focuses on outreach and communications, and the design and production of educational materials. See Table 45 for details.

www.shediacbayassociation.org www.facebook.com/#!/shediacbaywatershedassociation

Table 31: SBWA Social Media Outreach 2018

Posted	Type	Lifetime Post Total Reach
4-02-19	Photo	426
4-22-19	Status	418
5-06-19	Photo	509
5-06-19	Link	544
5-09-19	Link	90
5-15-19	Photo	3113
5-16-19	Link	170
5-21-19	Photo	3515
5-31-19	Photo	182
6-06-19	Link	82
6-08-19	Link	71
6-12-19	Photo	485
6-24-19	Photo	273
7-08-19	Photo	1127
7-24-19	Video	588
7-24-19	Video	2130
9-12-19		3595
9-23-19	Photo	279
10-10-19	Photo	162
10-21-19	Photo	527
11-05-19	Link	186
2-07-20	Link	412
2-07-20	Link	78
	Total Reach	**18962**

8 Closing Comments

The evaluation of the Health of Shediac Bay program has terminated its fourth year. The aim of the program is to identify areas and ecosystems that can benefit from restoration activities and gather data on the health of the Shediac Bay.

The water quality monitoring is showing some areas that have samples with high bacterial counts in small streams. Land use around these areas will be examined to determine if the cause of the contamination can be found. Landowners will be invited to participate in restoration efforts and stewardship programs to reforest the streams.

The Shediac Bay Watershed Association will also be working more closely with the Town of Shediac to develop storm water management projects and stewardship activities near small streams within the municipality. Activities will take place to increase awareness on the importance of small streams.

When dealing with non-point source pollution in a watershed, one cannot be expected to solve the issues of human activities overnight. Problems related with storm water runoff and faults in both private and municipal infrastructure can take several years and even decades to be detected and resolved. Collaborations between environmental groups, businesses, private citizens and government are crucial in the development and implementation of an action plan.

The Coalition for the Sustainability of the Southern Gulf of Saint Lawrence coordinates a working group on eelgrass monitoring and restoration. The working group brings, government agencies, academics, ENGO's and First Nations around the table to discuss different projects on eelgrass that is conducted in the region. The eelgrass beds of Shediac Bay have been surveyed by different methods to determine the present extent of the beds. The SeagrassNet protocol will help validate data that is collected remotely. A final eelgrass monitoring site has been added in Grande-Digue to have sites in all areas around the bay. It will take several years of monitoring to determine if the green crab has a negative impact on eelgrass and if restoration or protection measures are needed.

Salt marshes are an important part of the bay ecosystem. The SBWA will expand on its education program to include more activities around salt marshes. A project is underway for the marsh in Pointe-du-Chêne. The association will be able to develop trails to allow the SBWA to do marsh discovery activities with schools and the public.

The next phases of this project will develop more shoreline restoration solutions for landowners to reduce erosion and increase biodiversity. A workshop on living shorelines is planned for May 2020 targeted to local landowners. A local business has shown interest in exploring natural landscaping for the coastal zone.

A restoration priority for the association will be to continue reforesting buffer zones around marshes and small streams. By helping streams and marshes regain a more naturalized state their function to improve water quality will be enhanced. The reforestation will also help biodiversity by providing habitat for birds and other animals.

The Shediac Bay Watershed Association will continue the various educational campaigns around the health of the Shediac Bay. The association will continue to increase opportunities for stewardship activities with the public such as shoreline clean-ups and tree planting activities. Partnerships with the local marinas will help promote best practices for boaters that are regular users of Shediac Bay. Other partnerships such as the beach sweep with the town of Shediac will be developed to help increase awareness around the importance of a healthy environment.

Educational materials will continue to be produced by the SBWA for all its projects. There will be an increase of the presence in social media and at local events.

The Shediac Bay Health Evaluation project has gathered a wide range of information since 2016. The project will continue to expand in the coming years with increasing partnerships. There is still more that can be done to improve our knowledge about the Shediac Bay. As the project evolves the association will concentrate on more stewardship projects to help improve the environment around Shediac Bay.

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Appendix A – WATER CHEMISTRY METHODOLOGY

Table 46: RPC Laboratory Analytical Methods

RPC LABORATORY ANALYTICAL METHODS				
Analyte	Parameter	RPC SOP Number	Method Reference	Method Principle
Ammonia	NH_3T	4.M47	APHA 4500-NH3 G	Phenate Colourimetry
pH	pH	4.M03	APHA 4500-H+ B	pH Electrode - Electrometric
Alkalinity (as CaCO3)	ALK_T	4.M43	EPA 310.2	Methyl Orange Colourimetry
Chloride	Cl	4.M44	APHA 4500-CL E	Ferricyanide Colourimetry
Fluoride	F	4.M30	APHA 4500-F- D	SPADNS Colourimetry
Sulfate	SO_4	4.M45	APHA 4500-SO4 E	Turbidimetry
Nitrate + Nitrite (as N)	NO_X	4.M48	APHA 4500-NO3 H	Hydrazine Red., Derivitization, Colourimetry
Nitrite (as N)	NO_3	4.M49	APHA 4500-NO2- B	Ferrous Ammonium Sulfate Colourimetry
Phosphorus - Total	TP-L	4.M17	APHA 4500-P E	Digestion, Manual Colourimetry
Carbon - Dissolved Organic	TOC	4.M38	APHA 5310 C	UV-Persulfate Digestion, NDIR Detection
Turbidity	TURB	4.M06	APHA 2130 B	Nephelometry
Colour	CLRA	4.M55	APHA 2020 Color (A,C)	Single Wavelength Spectrophotometry
Conductivity	COND	4.M04	APHA 2510 B	Conductivity Meter, Pt Electrode
Trace Metals	—	4.M01/4.M29	EPA 200.8/EPA 200.7	ICP-MS/ICP-ES

Table 47: RPC Laboratory Analytical Methods for *E. coli*

RPC LAB ANALYTICAL METHODS FOR *E. COLI*		
Method	ID	Max Detection Limit
Membrane Filtration	FSA-01	10000 MPN/100 mL
Colilert	FSA-10	2419.6 MPN/100 mL