Water Quality Monitoring in the Cape Tormentine Watershed

2019 Water Quality Report

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Kelli-Nicole Croucher, Watershed Coordinator
Eric Arbeau, Student Assistant

EOS Eco-Energy Inc.
P.O. Box 6001, 131D Main Street
Sackville, NB E4L 1G6
www.eosecoenergy.com

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- Mount Allison University for loaning sampling equipment to assist in our long-term water quality monitoring program
- And countless others for supporting EOS in establishing the Chignecto Watersheds Committee and starting up a long-term water quality monitoring program

Executive Summary

During 2019, water samples were collected from 12 sites across the Cape Tormentine Peninsula Watershed from June to September and sent to the RPC Laboratory in Moncton for analysis. In addition, in-situ measurements were taken (pH, temperature, conductivity, dissolved oxygen, total dissolved solids, salinity) from the 12 sites from May to October using a Hanna Multiparameter Meter. This water quality report compiles and summarizes these results which will be used as a baseline of water quality moving forward.

The objective of this report is to establish a baseline of water quality in the Cape Tormentine Watersheds, with the intention to continue with a long-term water quality monitoring program. This data will help us gain a better understanding of our watersheds and could lead to the undertaking of any necessary restoration or protection activities, ultimately ensuring healthy watersheds, sustainable ecosystems and resilient communities. This knowledge could also be used to educate the public on local watershed issues and how they connect to climate change in our region.

The water quality results were compared to provincial water quality guidelines, CCME water quality guidelines for the protection of aquatic health, and Health Canada Guidelines for Recreational Activities. While we could speculate on some of the potential causes for variations between sites and fluctuation in parameter concentrations, this is just the first year of data collection in our monitoring program. More years of data are required to look at trends and relationships within the water quality data.

Water temperature at all sites experienced typical seasonal variation, with an increase in temperature during the warmer summer months and a cooler temperatures in the fall and spring. Water temperature remained below the recommended CCME guideline of 20°C across all sites in May, June, September and October. In July, 6 sites exceeded the recommended temperature of 20°C, and 2 sites exceeded the guideline in August. The highest number of samples sites having dissolved oxygen concentrations below the New Brunswick guideline (6.5 mg/L) occurred in July and August, corresponding with the two hottest months according to our temperature data as dissolved oxygen decreases with increased temperature. In-situ water pH was within CCME guidelines (6.5 – 9) for the most part, with the exception of Blacklock Brook off Murray Road and Scott Brook off Noonan Road which were slightly below the CCME guideline in June, September, and October. Trout Brook off Murray Road was also slightly below the CCME guideline in October. Despite being sampled at low tide from June to October, our tidally influenced sites still had brackish water when they were sampled. This resulted in these sites displaying high levels of specific conductivity, TDS, and salinity.

E. coli levels only surpassed the Health Canada Recreational Guidelines at 4 sites in July and 6 sites in August. Most of our samples exceeded the NB total phosphorus guideline for the protection or aquatic life and were in eutrophic (0.035 – 0.100 mg/L) states, with

Trout Brook off Murray Road even being in a hyper-eutrophic state (> 0.100 mg/L) from July to September.

Surface water metals were mostly well below the detection limits, aside from iron and aluminum which were both above the CCME guidelines for all but one site. A number of samples were diluted prior to analysis due to their high ionic content, leading to results that were below the reporting limit and not quantified.

Overall, EOS had a very successful year of water quality monitoring that provided us with valuable baseline data that can be used to ensure the health of the Cape Tormentine Peninsula Watershed. Alongside this it has given us the opportunity to better understand our watershed and the opportunity to have it documented. This project was a great first step towards building a long-term water quality monitoring program within the watershed. As we continue to collect more data we will be able to see trends in the water quality and develop a better understanding of what the “normal” water quality is in our waterways as well as how climate change may impact them.

EOS Eco-Energy recommends that the knowledge gaps in our watersheds continue to be addressed through our long-term water quality monitoring plan. We would also like to expand our knowledge of our watersheds through the collection of CABIN data, hydrological data, riparian health data, and fish & habitat data. EOS believes that this program should extend to the Maringouin Peninsula & Dorchester area in 2020-21 to obtain information about the current state of water quality within the watershed. This is our next step in building a long-term water quality monitoring program within the Inner Bay of Fundy and Northumberland Strait Watersheds.

Introduction

EOS Eco-Energy is an environmental not-for-profit organization based out of Sackville, New Brunswick. EOS Eco-Energy is dedicated to community-based solutions to reducing and adapting to climate change in the Tantramar region of southeast New Brunswick. In 2017 EOS formed the Chignecto Watersheds Committee, a committee dedicated to the long-term sustainability and resiliency of our local environment and preparing our communities for the combined impacts of climate and land use change by promoting watershed awareness through public education, conducting long-term inland water monitoring, and performing subsequent restoration and protection activities. Members include representatives of Ducks Unlimited Canada, NatureNB, professors & research groups from Mount Allison University, the local planning commission, Fort Folly Habitat Recovery, Petitcodiac Watershed Alliance, and Chignecto Soil & Crop Association. This wide range of expertise provides the capacity, mentorships, partnerships, networks, and volunteer bases to be successful in establishing a long-term monitoring program. Having a long-term monitoring program will help us maintain healthy, productive aquatic environments that will continue to ensure dependable, safe, high quality water to recreational, agricultural, municipal, and industrial users. Thus, this project will ultimately contribute to the overall health of the environment and quality of life of New Brunswickers.

This year EOS' long-term water quality monitoring program extended to the Cape Tormentine Watershed. Water samples were collected from 12 sites across the watershed from June to September and sent to the RPC Laboratory in Moncton for analysis. In addition, in-situ measurements were taken (pH, temperature, conductivity, dissolved oxygen, total dissolved solids, salinity) from the 12 sites from May to October using a Hanna Multiparameter Meter. This water quality report compiles and summarizes these results which will be used as a baseline of water quality moving forward.

Objective

The objective of this report is to establish a baseline of water quality in the Cape Tormentine Peninsula Watershed, with the intention to continue with a long-term water quality monitoring program. This data will help us gain a better understanding of our watersheds and could lead to the undertaking of any necessary restoration or protection activities, ultimately ensuring healthy watersheds, sustainable ecosystems and resilient communities. This knowledge could also be used to educate the public on local watershed issues and how they connect to climate change in our region.

Methodology

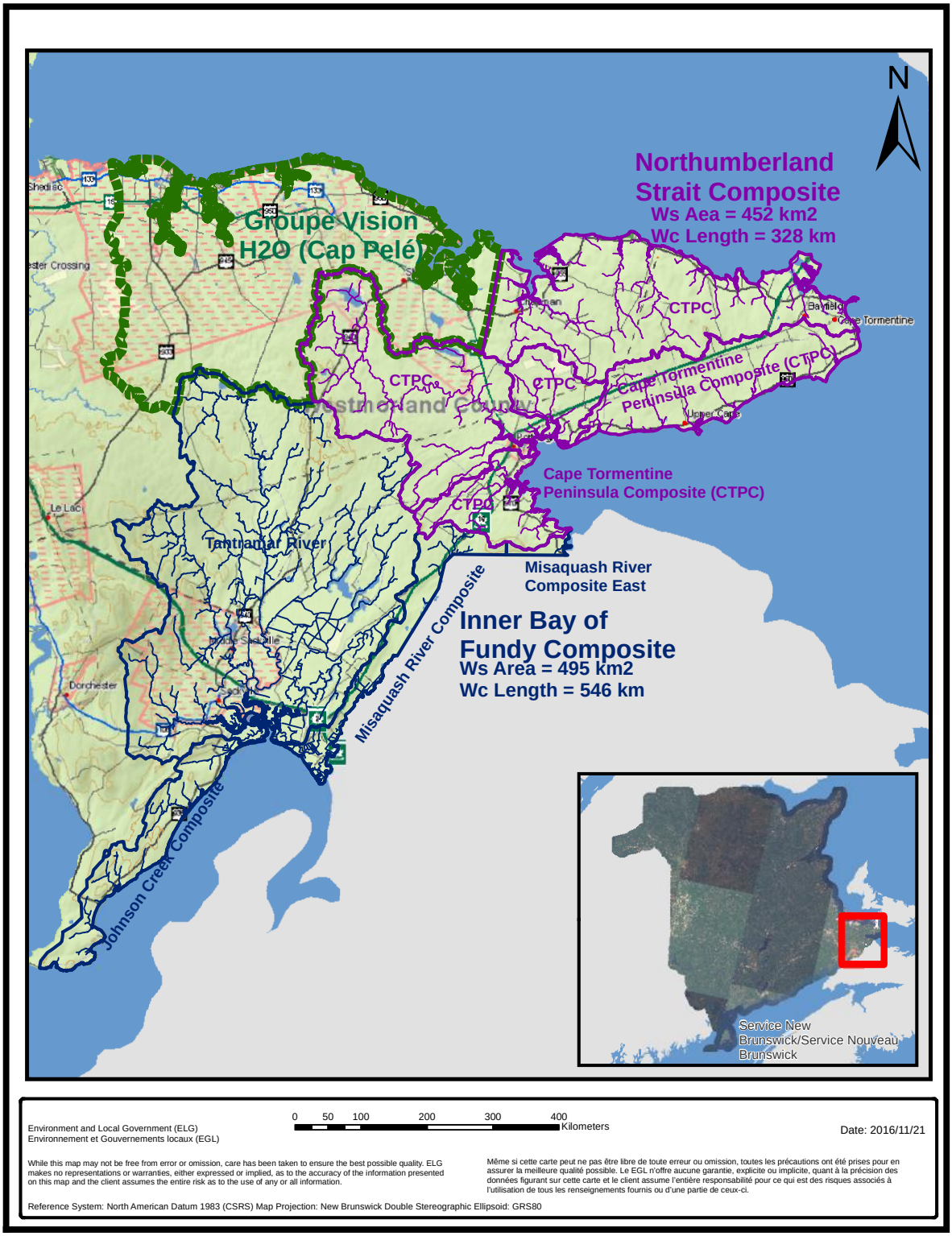
Water quality samples were collected from 12 sampling sites throughout the Cape Tormentine Peninsula Watershed once a month from June to September 2019. The water sampling was performed according to the New Brunswick Department of Environment and Local Government protocols. Water samples at tidally influenced sites were always sampled at low-tide to ensure that we were sampling freshwater that would be representative of what is happening further upstream in the watershed. Water samples were sent to RPC Laboratory Moncton for surface water quality parameters and *E. Coli* analysis. Sterile sample bottles were provided by RPC prior to sampling to ensure no sample contamination occurred. Collected samples were stored in a cooler at ~ 4^{o}C until they were transported to RPC at the end of the sampling day.

In-situ water quality parameters (pH, temperature, dissolved oxygen, conductivity, salinity, and total dissolved solids) were collected using a Hanna Multiparameter Meter from the 12 sampling sites from May to October 2019. The Hanna Meter was calibrated prior to each field outing.

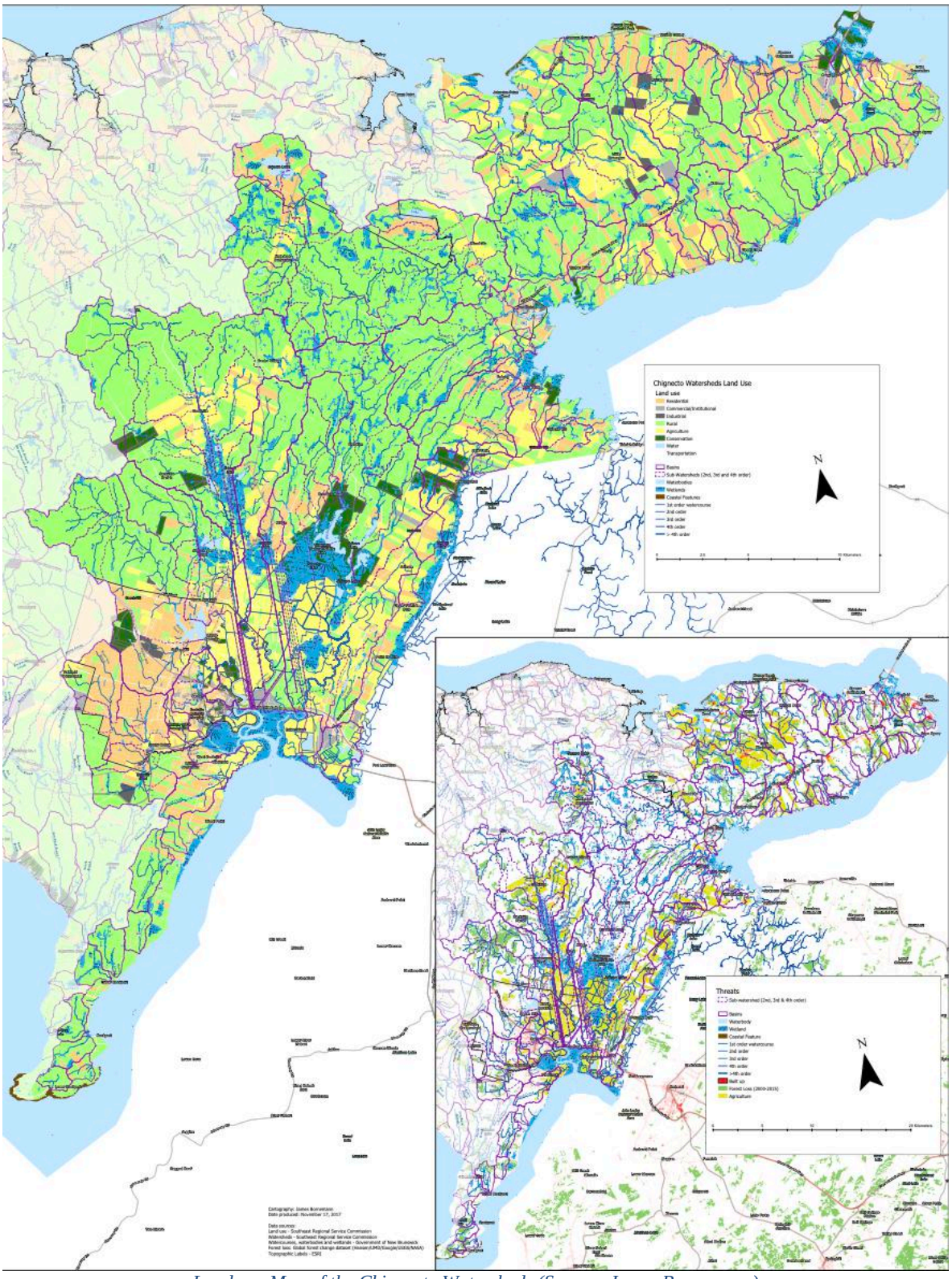
Study Area

The Cape Tormentine Peninsula Watershed covers 452 km^2 of land area and has a total watercourse length of 328 km. It is a part of the larger Northumberland Strait Watershed, where all the water ultimate flows into the Northumberland Strait. The watershed boundaries the watersheds covered by VisionH2O in Cap-Pele to the north, the Misaquash River Watershed to the south, and the Tantramar River Watershed to the southwest. The Gaspereau River is the only 4th order river within the watershed, with its headwaters starting at Square Lake, north of Anderson Settlement, and winds southeast to its outlet in Port Elgin. The rest of the watershed is made up of a series of brooks and creeks. According to the Canadian Rivers Institute New Brunswick Watershed map, this watershed is comprised of four level 3 sub-watersheds: the Baie Verte Creek Watershed, the Gaspereau River Watershed, the Oulton Creek Watershed, and the Kouchibouguac River Watershed which boundaries extend from Cape Tormentine over into the area covered by VisionH2O.

Land-use in the Cape Tormentine Watershed include agricultural and forestry activities, residential and commercial developments, municipal sewage lagoons and private wells, and the Cape Jourimain National Wildlife Area.



Map of Chignecto Watersheds (Source: DELG)



Land-use Map of the Chignecto Watersheds (Source: James Bornemann)

Sampling Sites

Water quality samples were collected from 12 sampling sites throughout the Cape Tormentine Peninsula Watershed once a month from June to September 2019 (Table 1).

Table 1: Water Quality Sampling Sites

Station Name	Latitude	Longitude	Elevation (m)	Location Description
Timber River	46.0669	-64.0591	2	Approx. 3.5km NE of Port Elgin beside Route 16 overpass
Blacklock Brook off Murray Rd	46.1176	-64.0104	12	1km NE from Hardy Rd.
Trout Brook off Murray Rd	46.1293	-63.9853	18	NE on Murray Rd. between Hardy Rd. and Noonan Rd.
Scott Brook off Noonan Rd	46.1380	-63.9565	8	1.5km east on Noonan Rd. on south side of culvert
Scott Brook Route 955	46.1723	-63.9601	1	Under Route 955 overpass just west of Murray Rd. intersection
Trout Brook Route 955	46.1767	-63.9891	1	West on Route 955 before Lanchester Rd. on south side of overpass
Blacklock Brook Route 955	46.1391	-64.0650	0	East of Blacklock Rd. on Route 955 at the old fish passageway
Gaspereau River Roundabout	46.0537	-64.0947	1	West of Port Elgin roundabout across the field between Routes 15 & 16
Gaspereau River in Port Elgin	46.0495	-64.0883	0	SW of parking lot at Main St. and Shemogue Rd. intersection in Port Elgin
Rayworth Brook	46.0597	-63.931	6	Approx. 0.25 km east of Upper Cape Rd. on North side of culvert
Oulton Brook	46.0752	-63.8724	3	Between Upper Cape and Cape Spear on north side of Route 960 overpass
McKay Brook	46.099	-63.7957	4	Approx. 1 km NE of Cape Spear Crossing Rd. west of Route 960 culvert

Map of Cape Tormentine Peninsula Sampling Sites (Source: E. Arbeau)

Site Descriptions

Timber River at Route 16

Timber River runs south under Route 16, emptying into the Northumberland Strait. The river passes mostly through forested and agricultural land, with some residential land near the mouth. The riparian area was healthy with diverse vegetation of trees, shrubs, and grasses. There was some bare soil present, but it was likely due to the low water levels seen throughout the season. In June there was slight undercutting on the left-hand side of the river bank facing upstream. The stream bottom was silt and sand rich. Samples were collected upstream of the Route 16 Bridge from the east bank.

Looking Upstream Timber River at Route 16 in July 2019 (Photo: KN Croucher)

Blacklock Brook off Murray Road

Blacklock Brook runs southwest under Murray road through a culvert and drains into the Northumberland Strait further downstream. Samples were collected upstream of the Murray Road culvert from the south bank. This brook is surrounded by forest and agricultural land. The sample site is densely covered with overhanging vegetation of trees, grasses, and shrubs. This was a smaller, slow moving stream. There were lots of aquatic insects present throughout the sampling season as well as tadpoles. The water was quite cloudy and we were unable to see the bottom of the brook.

Looking Upstream Blacklock Brook off Murray Road in July 2019 (Photo: KN Croucher)

Trout Brook off Murray Road

Trout Brook meanders northwest before slowly turning north near the mouth. It passes through agricultural, forested and residential land, crossing directly through a cow pasture upstream of the location samples were collected from. The brook passes under Murray road via a culvert, and samples were taken downstream of this culvert from the southeast bank. The riparian area was diverse in vegetation (e.g. grasses, ferns, goldenrod, swamp milkweed, oxeye daisy, alder, trees, shrubs) and had overhanging vegetation shading the brook. The brook was slow moving and even appeared stagnant in the warmer months (e.g. July) with low water levels. The brook bottom was very silty.

Looking Upstream Timber River off Murray Road in May 2019 (Photo: KN Croucher)

Scott Brook off Noonan Road

Scott Brook meanders northeast from its point of origin where it runs under Noonan road before turning north. This site features a heavily blocked culvert under Noonan road which would disrupt fish passageway, as well as considerable bank erosion. The brook flows through dense forest near its origin, as well as agricultural and residential land downstream of this sampling site. Collected samples were taken upstream of the Noonan road culvert along the east bank.

Looking Upstream Scott Brook off Noonan Road in July 2019 (Photo: KN Croucher)

Scott Brook off Route 955

This site is downstream from the Noonan Road sample site. This site is near the mouth of the brook, where it flows into the Northumberland Strait at Murray Corner. Samples were collected upstream of the Route 955 bridge, along the east shore of the brook. This section of the brook runs primarily through agricultural land, passing a few residential buildings, and features a wide floodplain near the mouth with trees and shrubs upstream. The righthand side of the bank facing upstream is covered in grasses that are mowed to the shoreline. In July & August there was a strong sulphur smell at this site.

Looking Upstream Scott Brook off Route 955 in August 2019 (Photo: KN Croucher)

Trout Brook off Route 955

Where trout brook meets the Northumberland Strait, it flows north under a bridge on Route 955 near Murray Beach Provincial Park. This location features a wide, grassy flood plain with trees & shrubs on the far riparian reach, as the river exits dense forest and runs past residential land. There are vernal pools near the mouth of the river, as well as residential houses on both sides near the outlet. This site was a popular spot for waterfowl across all months. Fish, mussels & sea snails were also spotted at this site. After a storm in September there was a road washout on the bridge downstream from our sampling site. Samples were collected from the east bank of the brook upstream of Route 955. This site has a heavy tidal influence due to its proximity to the Strait.

Looking Upstream Trout Brook off Route 955 in July 2019 (Photo: KN Croucher)

Blacklock Brook off Route 955

This site, at the mouth of Blacklock Brook, sees the brook flow through a culvert under Route 955 into the Northumberland Strait. The concrete structure at this site is the remnants of a DUC fish passageway. Samples were collected upstream of Route 955 from the concrete wall in the middle of the brook. This section of the brook has a wide flood plain with a mixture of vegetation (grasses, shrubs & trees) and flows mostly through rural forest and agricultural land. This site had an abundance of minnows present in May – July.

Looking Upstream Blacklock Brook off Route 955 in July 2019 (Photo: KN Croucher)

Gaspereau River at the Route 16 Roundabout

The Gaspereau River flows south from its headwaters at Square Lake through deforested areas with coniferous plantations, as well as forested and agricultural land. It passes through residential land near the village of Port Elgin, and is a popular recreation site for boating and fishing. At this site on the river, the flood plain is wide and rich in coniferous trees along the perimeter. Samples were collected from the east bank, upstream of the Route 16 Bridge, near the roundabout.

Looking Upstream Gaspereau River at Roundabout in July 2019 (Photo: KN Croucher)

Gaspereau River in Port Elgin

The Gaspereau River site in Port Elgin is located upstream of the Route 970 Bridge. The site is located within the village on Main Street, near many residential and retail buildings. This site is also used frequently for swimming, boating and fishing. This location is tidally influenced as it is near the mouth of the river, where it empties into the Northumberland Strait. Samples were collected from the community dock where Route 970 meets Main street. This site also had a sulphur smell in July & August.

Dock Where Samples are Collected from Gaspereau River in Port Elgin, August 2019 (Photo: KN Croucher)

Rayworth Brook

Rayworth Brook flows south through rural residential and agricultural land, crossing through a culvert under Route 960 before meeting the Northumberland Strait. The site is surrounded by dense vegetation of trees and shrubs. Brook trout were present at this sample site. This sample site is on Nature Conservancy of Canada (NCC) land making it a great “natural”, less impacted sample site. Access for sample collection was from the east bank, upstream of the culvert. The water was so clear at this site you could see the bottom of the brook.

Looking Upstream Rayworth Brook in July 2019 (Photo: KN Croucher)

Oulton Brook

Oulton Brook flows southwest through rural forested and agricultural land and passes some residential land before crossing under Route 960 and emptying into the Northumberland Strait. This brook is tidally influenced and has a wide, grassy flood plain with trees along the left-hand side of the stream facing upstream. This was a fairly channelized brook with some bank undercutting present. Downstream of the sample site there were vernal pools and saltmarsh near the mouth of the brook. Samples were collected upstream of the Route 960 bridge from the east bank.

Fall Colours Looking Upstream Oulton Brook in September 2019 (Photo: KN Croucher)

McKay Brook

McKay flows southeast from Jones Pond meandering slightly to the Northumberland Strait. It flows under Route 960, passing through rural, forested land along its course. This site is surrounded by dense forest upstream of Route 960, and features a wide, grassy flood plain downstream with grasses, shrubs, and trees. Samples were collected from the north bank upstream of the bridge.

Looking Upstream McKay Brook in July 2019 (Photo: KN Croucher)

Results & Discussion

Water samples were collected from 12 sites across the Cape Tormentine Peninsula Watershed from June to September which resulted in 52 samples being collected. Samples were analyzed at the RPC Laboratory in Moncton. The lab analyzed the samples for 58 parameters for each sample resulting in 3016 data points. In addition to water samples, in-situ measurements were collected using a Hanna Multiparameter Meter from the 12 sites from May to October resulting in 432 additional data points, for a total of 3448 data points collected over the course of the field season.

We compared our current baseline results to water quality guidelines used in New Brunswick (Table 2) and the CCME guidelines for the protection of aquatic life (http://st-ts.ccme.ca/en/index.html).

Table 2:Water quality guidelines used in New Brunswick

Parameter	Form	Guideline	Source
Ammonia	un-ionized	19 µg/L	1
Arsenic	total	5 µg/L	2
Chloride	total	120 mg/L	2
Copper	total	2 µg/L for hardness < 90 mg [$CaCO_3$]/L $0.2*e^{0.8545*ln[hardness]-1.465}$ µg/L for hardness > 90 mg [$CaCO_3$]/L	1
Iron	total	0.3 mg/L	1
Nitrate	total	2.9 mg N/L	1
Oxygen	dissolved	6.5 mg/L	2
pH	n/a	between 6.5 and 9	2
Phosphorus	total	0.03 mg/L	1
Turbidity	n/a	10 NTU (SSG[A])	2
Zinc	total	7.5 µg/L for hardness ≤ 90 mg [$CaCO_3$]/L 7.5 + 0.75*(hardness-90) for hardness > 90 mg [$CaCO_3$]/L	1

Note: n/a = not applicable.
[A] SSG denotes that different site-specific guidelines or formulas were used at sites. Specific site information is available upon request.

New Brunswick Water Quality Guideline Sources:

1 Government of Canada (2008) Technical Guidance Document for Water Quality Index Practitioners Reporting Under the Canadian Environmental Sustainability Indicators (CESI) Initiative 2008. Environment and Climate Change Canada and Statistics Canada. Retrieved on September 20, 2018.

2 Canadian Council of Ministers of the Environment (2016) Canadian Water Quality Guidelines for the Protection of Aquatic Life Summary Table. Retrieved on September 20, 2018.

In-Situ Water Quality Measurements

In-situ water quality measurements were collected using a Hanna Multiparameter Meter from the 12 sites for two additional months (May & October) than the RPC lab sampling due to funding constraints. For this reason, we have decided to present our in-situ water quality measurements as a monthly comparison across sites to capture seasonal variation of spring to fall.

Temperature

Water temperature is dependent on a number of factors including geographic location, season, time of day, velocity, width and depth of the waterbody, riparian vegetative cover, and anthropogenic impacts. Temperature is also a very important water quality parameter as it impacts a number of other chemical, biological, and physical processes in the aquatic environment. For example, higher temperature water means less oxygen can be dissolved.

Water temperature at all sites experienced typical seasonal variation, with an increase in temperature during the warmer, summer months (July-August), and a cooling in fall (September & October) (Table 3).

According to the CCME guidelines, water temperatures of salmonid species (e.g. trout found in our watershed) prefer cool water (< 20°C). Long-term exposure to temperatures greater than 24°C is lethal to salmonid species. There is also a CCME guideline that states that human activity should not induce temperature changes of +/- 1^{o}C from natural levels. Water temperature remained below the recommended CCME guideline of 20°C across all sites in May, June, September and October. In July, 6 sites (Trout Brook Rte. 955, Scott Brook Rte. 955, Blacklock Brook Rte. 955, both Gaspereau River sites, & Oulton Brook) exceeded the recommended temperature of 20°C, and 2 sites (both Gaspereau River sample sites) exceeded in August (Table 3). All of these sites are tidally influenced. The Northumberland Strait boasts the warmest waters north of the Carolinas, with shallow depths leading to warm water temperatures in summer months (particularly July & August) reaching as high as 25^{o}C in parts. Despite being sampled at low tide, these high temperatures could be due to warmer water remaining from the tidal influence. Additionally, it was discussed with RPC Moncton staff that water levels were so low this summer that tidally influenced sites tended to be saltier due to low water levels of the streams/rivers/brooks. Lower water levels and slower moving water tend to have high water temperatures which could also explain the higher temperatures observed at these sample sites. Most of these tidally influenced sample sites are also in areas with less riparian overhanging vegetation which also leads to high water temperatures.

Table 3: Monthly Water Temperature Measured In-Situ Using Hanna Multiparameter Meter

Sample Site	May	June	July	August	September	October
Timber River	9.9	14.04	16.64	16.21	14.77	7.12
Blacklock Brook off Murray Rd	15.24	12.05	16.74	16.92	12.49	6.36
Trout Brook off Murray Rd	15.58	14.61	18.24	14.5	13.34	6.94
Scott Brook off Noonan Rd	13.53	13.64	17.94	15.97	15.02	6.54
Scott Brook Rte. 955	11.15	16.56	20.9	19.16	17.13	10.75
Trout Brook Rte. 955	11.5	18.9	21.91	18.74	17.62	10.44
Blacklock Brook Rte. 955	16.3	18.43	20.94	19.25	18.9	9.11
Gaspereau River @ Roundabout	11.59	17.6	23.82	21.66	17.42	11.24
Gaspereau River in Port Elgin	11.43	17.26	22.68	21.25	17.28	9.2
Rayworth Brook	10.2	12.97	16.07	13.53	14.21	8.56
Oulton Brook	10.15	18.87	24.02	18.81	16.08	10.4
McKay Brook	N/A	16.03	19.05	17.29	13.5	8.75

pH

pH is a measure of acidity or alkalinity of the water. It is a logarithmic measurement of free hydrogen ions in solution. The pH scale is from 0 to 14, with a pH of 7 being neutral, < 7 acidic, and > 7 basic. According to the CCME guidelines, the ideal pH for surface water to support aquatic life is between 6.5 and 9.0. According to Health Canada's Recreational Guidelines, the recommended pH is 5.0 to 9.0. pH of surface water can be influenced by a number of factors including surficial geology, acid rain, wastewater effluent, sewer overflows from septic tanks, and agricultural runoff.

In June, Blacklock Brook off Murray Road (6.24) and Scott Brook off Noonan Road (6.4) had pH values below the CCME guidelines (Table 4). Blacklock Brook off Murray Road (6.2) and Scott Brook off Noonan Road (6.46) had pH values below the CCME guidelines again in September; as well as in October (6.19 and 6.18 respectively) in addition to Trout Brook off Murray Road (6.08) (Table 4). It should also be noted that the Gaspereau River was within the Health Canada Recreational Guidelines across all months, indicating that it was safe for swimming, boating, etc.

Table 4: Monthly Water pH Measured In-Situ Using Hanna Multiparameter Meter

Sample Site	May	June	July	August	September	October
Timber River	8	6.58	7.13	7.02	6.61	6.27
Blacklock Brook off Murray Rd	7.3	6.24	6.9	7.38	6.2	6.19
Trout Brook off Murray Rd	7.55	5.84	6.58	6.85	5.99	6.08
Scott Brook off Noonan Rd	8.5	6.4	7	7.17	6.46	6.18
Scott Brook Rte. 955	7.9	6.8	6.8	7.04	6.9	6.85
Trout Brook Rte. 955	7.9	7.14	7.32	7.8	7.38	6.6
Blacklock Brook Rte. 955	7.35	6.6	7.6	8.66	8.11	6.84
Gaspereau River @ Roundabout	6.8	6.61	7.61	7.89	7.52	7.19
Gaspereau River in Port Elgin	7.92	6.62	7.79	7.81	6.5	6.81
Rayworth Brook	7.86	7.32	8.15	8.52	7.78	7.22
Oulton Brook	7.27	7.14	8.01	7.68	7.28	6.97
McKay Brook	N/A	7.12	7.1	6.98	7.8	7.5

Dissolved Oxygen (DO)

Dissolved oxygen (DO) is the amount of oxygen dissolved in the water that is available for aquatic life. New Brunswick has a water quality guideline of 6.5 mg/L DO for the protection of aquatic life (Table 2). As the temperature of a waterbody increases, the amount of dissolved oxygen in the water decreases. This is evident in our results as the highest number of sites with DO concentrations below the water quality guidelines occurs in July and August, the two hottest months according to our temperature data (Table 5). Trout Brook off Murray Rd. had DO levels below the recommended level across all months ranging from 0 to 6 mg/L (Table 5). Further downstream, Trout Brook Rte. 955 had DO level below the guideline from July to October (3.98-6.21 mg/L). Blacklock Brook off Murray Rd. is below the DO guideline every month (1.1-6.28 mg/L), except June (7.66 mg/L); while downstream at Route 955 it was only below the guideline in July (2.74 mg/L). Scott Brook had DO below the guideline in the two hottest months, July and August, at both the Noonan Road (4.6 mg/L, 4.12 mg/L) and Route 955 (1.08 mg/L, 1.22 mg/L) sites. McKay Brook had DO concentrations below the guideline from July to September ranging from 1.18 to 4.45 mg/L (Table 5). Low DO concentrations can also be due to slow moving or stagnant water, which can explain why these particular waterbodies have low DO as they are all slow-moving brooks, especially at the upstream sites.

Concentrations of DO below 3 mg/L are considered hypoxic conditions, while water with DO < 0.5 mg/L is considered anoxic. Anoxic conditions can lead to an increase in release of phosphorus from sediments, resulting in algae blooms. Trout Brook off Murray Road experienced anoxic conditions in July (0 mg/L DO). This sample site also experienced the highest turbidity and phosphorus levels for July (82.7 NTU and 0.23 mg/L total Phosphorus; (Table 5). Trout Brook off Murray Road was also hypoxic in September (2.1 mg/L DO). In addition, Blacklock Brook off Murray Road was hypoxic in July (2.24 mg/L DO) and September (1.1 mg/L DO); as well as hypoxic at the Route 955 sample site in

July (2.74 mg/L). Scott Brook at Route 955 was hypoxic in July (1.08 mg/L DO) and August (1.22 mg/L DO). Finally, McKay Brook was hypoxic in August (1.18 mg/L) and September (2.5 mg/L).

The Gaspereau River at the roundabout site had concentrations of DO slightly below the guideline in May (6.4 mg/L), July (6.19 mg/L), and August (6.3 mg/L); while the Port Elgin site was only below the DO guideline in August (6.15 mg/L) (Table 5). Oulton Brook was also slightly below the DO guideline for August (6.2 mg/L) and September (6.36 mg/L). Rayworth Brook, our most natural brook, had healthy dissolved oxygen levels throughout all months (Table 5).

Table 5:Monthly Dissolved Oxygen (mg/L) Measured In-Situ Using Hanna Multiparameter Meter

Sample Site	May	June	July	August	September	October
Timber River	8.46	9.14	8.34	7.62	8.72	10.72
Blacklock Brook off Murray Rd	6.28	7.66	2.24	4.46	1.1	5.99
Trout Brook off Murray Rd	6	3.98	0	3.25	2.1	5.65
Scott Brook off Noonan Rd	7.4	8.63	4.6	4.12	8.69	8.22
Scott Brook Rte. 955	7.71	7.26	1.08	1.22	7.32	7.12
Trout Brook Rte. 955	7.82	6.65	3.96	6.21	5.48	5.56
Blacklock Brook Rte. 955	8.61	6.61	2.74	8.89	9.85	8.81
Gaspereau River roundabout	6.4	7.55	6.19	6.3	6.92	10.45
Gaspereau River in Port Elgin	7.38	7.32	7.84	6.15	6.5	8.86
Rayworth Brook	11.28	9.8	9.62	10.83	9.1	10.37
Oulton Brook	8.4	8.67	7.52	6.2	6.36	9.12
McKay Brook	N/A	7.39	4.45	1.18	2.5	8.5

Specific Conductivity, Total Dissolved Solids & Salinity

Specific conductivity (µS/cm) is a measure of the ability of water to carry an electrical current. Conductivity is dependent on the quantity of dissolved inorganic solids (ions, e.g. sodium, chloride, nitrate, phosphate, etc.) and temperature. Conductivity in streams is typically based off of the surficial geology. Intertidal plains and salt marshes have clay, silt, some fine sand, minor peat and organic sediments; all of which can increase conductivity, total dissolved solids, and salinity in our watershed. Specific conductivity means that the conductivity is adjusted as if the sample had been taken at a reference temperature (usually 25^{o}C) so that conductivity can be compared across samples taken at different water temperatures. There is no water quality guideline for conductivity.

Table 6: Monthly In-Situ Specific Conductivity (µS/cm)

Sample Site	May	June	July	August	September	October
Timber River	82	60	4050	15820	253	91
Blacklock Brook off Murray Rd	84	73	170	298	147	121
Trout Brook off Murray Rd	78	62	160	219	124	99
Scott Brook off Noonan Rd	95	60	135	209	141	122
Scott Brook Rte. 955	41350	14130	30110	42660	32630	14350
Trout Brook Rte. 955	41960	17170	38840	42180	31480	6779
Blacklock Brook Rte. 955	1400	466	37480	43050	18240	5847
Gaspereau River roundabout	29000	3400	30540	41660	20560	2189
Gaspereau River in Port Elgin	37520	6974	33990	42270	24130	7520
Rayworth Brook	168	182	247	261	187	190
Oulton Brook	24	3765	42340	32950	21560	4900
McKay Brook	N/A	71	107	180	146	126

Total dissolved solids (TDS) is a measure of the quantity of dissolved solids within the water. TDS occurs naturally in water from sources such as algae, dead organic matter, and particulates from rock or soil. Since the dissolved solids are typically ions, TDS is directly related to conductivity. New Brunswick does not have a TDS guideline for water quality and CCME also does not have a recommended guideline for the protection of aquatic life. However, high levels of TDS can impact turbidity, clarity and colour of water, which when increased can lead to low DO levels (sometimes even anoxic conditions) due to the turbidity preventing sunlight from reaching aquatic plants.

Table 7: Monthly In-Situ Total Dissolved Solids (ppm)

Sample Site	May	June	July	August	September	October
Timber River	82	30	2061	5211	125	46
Blacklock Brook off Murray Rd	42	37	85	148	73	60
Trout Brook off Murray Rd	39	31	80	109	62	50
Scott Brook off Noonan Rd	43	30	67	104	70	61
Scott Brook Rte. 955	20680	7094	19060	21330	16300	7130
Trout Brook Rte. 955	20990	8590	19420	21070	15760	3375
Blacklock Brook Rte. 955	14370	233	18740	21520	1912	2923
Gaspereau River roundabout	14530	1698	15310	20830	10280	1115
Gaspereau River in Port Elgin	18770	3464	17000	21140	12050	3765
Rayworth Brook	84	91	123	131	113	94
Oulton Brook	18150	1885	21160	16470	10660	2000
McKay Brook	N/A	33	53	90	73	63

Salinity is the concentration of dissolved salt ions (e.g. salt, NaCl, dissolved into a sodium ion (Na^+) and chloride ion (Cl^-)). As it is related to conductivity and TDS, there are no water quality guidelines to compare our results too and the potential sources of salinity are the same as TDS and conductivity.

Table 6: Monthly In-Situ Salinity (ppm)

Sample Site	May	June	July	August	September	October
Timber River	0.04	0.03	0.08	5.28	0.12	0.04
Blacklock Brook off Murray Rd	0.04	0.03	0.08	0.14	0.07	0.06
Trout Brook off Murray Rd	0.04	0.03	0.06	0.11	0.06	0.05
Scott Brook off Noonan Rd	0.04	0.03	0.06	0.1	0.07	0.06
Scott Brook Rte. 955	26.48	8.45	24.28	27.52	20.46	8
Trout Brook Rte. 955	26.93	10.16	24.75	27.15	19.72	3.74
Blacklock Brook Rte. 955	17.89	0.22	23.82	27.79	10.81	3.2
Gaspereau River roundabout	18.01	1.79	18.95	26.79	12.33	1.15
Gaspereau River in Port Elgin	23.8	3.82	21.35	27.21	14.65	4.14
Rayworth Brook	0.08	0.09	0.12	0.13	0.06	0.09
Oulton Brook	22.91	2	27.22	20.72	12.8	2.09
McKay Brook	N/A	0.03	0.05	0.09	0.07	0.06

Despite being sampled at low tide from June to October, our tidally influenced sites (Trout Brook, Scott Brook, and Blacklock Brook at Route 955; both Gaspereau River sites, and Oulton Brook) still had brackish water when they were sampled. This resulted in these sites displaying high levels of specific conductivity (Table 6), total dissolved solids (Table 7), and salinity (Table 8). This was particularly evident in July & August when temperatures were higher and water levels were lower. It was discussed with RPC Moncton staff that water levels were so low this summer that tidally influenced sites tended to be saltier due to low water levels of the outflowing watercourses. Alternatively, saltwater intrusion due to sea level rise could be occurring resulting in groundwater fed streams to be fed with brackish water. Further investigation is required. Otherwise, generally the conductivity, TDS, and salinity results also appear to be lowest in May and June, then higher from July to September before decreasing again in October for all the non-brackish sample sites (Table 6, 7, & 8).

One site of interest is Timber River, as it displayed very high conductivity in July (4050 µS/cm) and August (15820 µS/cm) (Table 6). Total dissolved solids concentrations were also high at this site for July (2061 ppm) and August (5211 ppm) (Table 7). This site could be supporting the salt water intrusion theory as these two months would have had the lowest water levels.

RPC Surface Water Chemistry Results

In addition to our in-situ measurements, water quality grab samples were taken to be analyzed at RPC Moncton. This section of the results provides a by site description of the surface water quality results from RPC. We have chosen to also highlight *E. Coli* and Total Phosphorous as they are particularly a concern in our watershed.

E. Coli

Escherichia coli (E. coli) is the most appropriate indicator of faecal contamination in fresh recreational waters. The presence of these fecal indicators could mean there are other disease-causing pathogens present, such as bacteria, viruses, and parasites. Although many strains of coliform bacteria are harmless, certain strains (e.g. *E. coli* 0157:H7) may cause illness. The results were then compared to the Guidelines for Canadian Recreational Water Quality. Water is safe for swimming when bacteria levels are below the guidelines, which Health Canada based off of risk management decisions which evaluated the potential health risks and the benefits of recreational water use for physical activity and enjoyment. For the case of our sampling, a single-sample was taken at each location from June to September, so we compared samples to the single-sample maximum guidelines of less than or equal to 400 E. coli/100mL (Table 9). Every time you take a water sample it is just a snapshot of the water quality at that location at that point in time. This is why an average of multiple samples taken from different locations along a beach is typically used for evaluating water quality. This is also why long-term monitoring is valuable as you can look at the natural variations in water quality and see the trends over time to get an idea of what is expected.

Table 7: Canadian Recreational Water Quality Guidelines

Enterococci	***E. coli***
A geometric mean of most recent five samples equal to or less than 35 enterococci/100 ml	A geometric mean of most recent five samples equal to or less than 200 E. coli/100 ml
A single-sample maximum equal to or less than 70 enterococci/100 ml	A single-sample maximum equal to or less than 400 E. coli/100 ml

The highest number of samples exceeding the guidelines for E. Coli based on the single-sample maximum according to the Canadian Recreational Water Quality Guidelines occurred in July and August (Table 10), with 4 sites exceeding the guideline in July and 6 sites exceeding the guideline in August. These were the two hottest months and the water levels were noted to be quite low which could lead to these higher results.

Blacklock Brook off Murray Road was above the Health Canada water quality guideline for recreational (400 E. coli/100mL) in both June (651 E. coli/100mL) and July (657 E. coli/mL) (Table 10). The other 3 sites above the Health Canada guideline in July included Trout Brook off Murray Road (24196 E. coli/100mL, which is essentially such a high reading it is above the detection limit), Trout Brook again further downstream at Route 955 (591 E. coli/100mL), and McKay Brook (909 E. coli/100mL) (Table 10). All of the Route 955 sites were significantly above (ranging from 3x to over 12x the guideline) the guideline in August (Scott Brook 1222 E. coli/100mL, Trout Brook 3076 E. coli/100mL, and Blacklock Brook at Route 955 4884 E. coli/100mL) (Table 10). All of these brooks run through agricultural land-use. The upstream sample sites of these brooks had low *E. coli*

results, indicating that the source is downstream from these sample sites. In addition, it should also be noted that although samples were taken at low-tide to capture freshwater when sampling, all 3 of these sites were brackish in nature. Typically, when you test brackish or saltwater for microbial water quality indicators, you analyze them for *Enterococcus* as it is the most appropriate indicator of fecal contamination in brackish waters since *E. coli* does not survive well in salt water. The *E. coli* numbers still being over the guideline at these sites could indicate the source is nearby.

The Gaspereau River was also above the Health Canada water quality guideline for recreation at both the roundabout (675 E. coli/100mL) and Port Elgin site (561 E. coli/100mL) in August (table 10). Oulton Brook (884 E. coli/100mL) was also over the guideline in August. Finally, Trout Brook off Murray Road was also over the guideline in September (6488 E. coli/mL).

Table 8: Monthly E. Coli (MPN/100mL)

Sample Site	June	July	August	September
Timber River	26.8	187	30.4	20
Blacklock Brook off Murray Rd	651	657	39.8	20
Trout Brook off Murray Rd	191.8	24196	59	6488
Scott Brook off Noonan Rd	164.6	253	59.8	63
Scott Brook Rte. 955	173	130	1222	95
Trout Brook Rte. 955	31	591	3076	195
Blacklock Brook Rte. 955	58.4	400	4884	84
Gaspereau River roundabout	135	73	675	30
Gaspereau River in Port Elgin	52	132	561	74
Rayworth Brook	37.4	85	64.6	< 10
Oulton Brook	146	98	884	279
McKay Brook	176.8	909	55	52

Total Phosphorus (TP)

The New Brunswick total phosphorus limit for protection of aquatic life is < 0.03 mg/L (Table 2). Phosphorus is a component of many important nutrient compounds used by plants, such as phosphates. Phosphorus is also the limiting nutrient for algal growth which can lead to eutrophication. Total phosphorus can range to ultra-oligotrophic (very low, < 0.004 mg/L TP) to hyper-eutrophic very high, (> 0.1 mg/L TP) (Table 11). Total phosphorus measures both organic and inorganic phosphates in the surface water. Phosphorus can be present naturally due to geological formations or decomposing organic matter. It is usually adsorbed by sediments. Phosphorus can also enter waterways from runoff from fertilizer, manure storage, wastewater treatment effluent, and septic systems leaching.

Table 9: Total phosphorus trigger ranges for Canadian lakes and rivers (Source: CCME)

Trophic Status	Canadian Trigger Ranges Total phosphorus ($\mu g \cdot L^{-1}$)
Ultra-oligotrophic	< 4
Oligotrophic	4-10
Mesotrophic	10-20
Meso-eutrophic	20-35
Eutrophic	35-100
Hyper-eutrophic	> 100

Most of our samples exceeded the NB total phosphorus guideline (0.03 mg/L) for the protection or aquatic life and were in eutrophic (0.035 – 0.100 mg/L) states, with Trout Brook off Murray Road even being in a hyper-eutrophic state (> 0.100 mg/L) from July to September according to the CCME Canadian Trigger Ranges for Total Phosphorous (Table 12).

August had the greatest number of samples exceeding the guideline, with all sample sites except Rayworth Brook exceeding the provincial total phosphorus guideline. Rayworth Brook was actually the only site that stayed consistently below the guideline ranging 0.011 – 0.022 mg/L (mesotrophic to meso-eutrophic). Timber River only exceeded the guideline slightly once in August (0.031 mg/L, meso-eutrophic); and was the only other sample site to not reach a eutrophic state (Table 12).

Blacklock Brook off Murray Road, Trout Brook off Murray Road, Trout Brook @ Route 955, Gaspereau River @ Roundabout, Oulton Brook, and McKay Brook all exceeded the total phosphorous guideline from June to September. Trout Brook off Murray Road had the highest total phosphorus sample in August with 0.438 mg/L (Table 12).

Gaspereau River in Port Elgin exceeded the guideline in July (0.033 mg/L, meso-eutrophic) and August (0.048, eutrophic). Similarly, Scott Brook off Noonan Rd. exceeded the guideline in July (0.036 mg/L) and August (0.046), both of which are considered eutrophic states. Downstream, Scott Brook Route 955 exceeded the guideline in June (0.031 mg/L, meso-eutrophic), August (0.056 mg/L, eutrophic), and September (0.054 mg/L, eutrophic).

Table 12: Monthly Total Phosphorous (P-Total) (mg/L)

Sample Site	June	July	August	September
Timber River	0.021	0.026	0.031	0.014
Blacklock Brook off Murray Rd	0.042	0.1	0.09	0.046
Trout Brook off Murray Rd	0.038	0.23	0.438	0.393
Scott Brook off Noonan Rd	0.023	0.036	0.046	0.019
Scott Brook Rte. 955	0.031	0.025	0.056	0.054
Trout Brook Rte. 955	0.033	0.039	0.039	0.043
Blacklock Brook Rte. 955	0.055	0.05	0.09	0.02
Gaspereau River @ Roundabout	0.031	0.031	0.042	0.031
Gaspereau River in Port Elgin	0.025	0.033	0.048	0.025
Rayworth Brook	0.02	0.017	0.022	0.011
Oulton Brook	0.033	0.067	0.053	0.045
McKay Brook	0.043	0.036	0.067	0.032

Surface Water Quality by Sample Site

Timber River

Timber River displayed very high conductivity in July (3890 µS/cm) and August (10800 µS/cm) (Table 13). Total dissolved solids concentrations were also higher at this site for July (2060 ppm) and August (5350 ppm). Looking at the sodium (Na) and chloride (Cl) concentrations for those months, the sodium was higher (626 ppm & 1680 ppm) and the chloride concentrations (1110 ppm & 2870 ppm) were actually above the CCME freshwater guideline for protection of aquatic life (short-term 640 ppm and long-term 120 ppm). The potassium (K), calcium (Ca), sulfate (SO_4), and bromine (Br) concentrations were also significantly higher in July & August compared to June & September (Table 13).

Table 13: Timber River Surface Water Chemistry

TIMBER RIVER: SURFACE WATER CHEMISTRY																									
Date (yyyy-mm-dd)	Na (mg/L)	K (mg/L)	Ca (mg/L)	Mg (mg/L)	Alkalinity (as CaCO3) (mg/L)	Cl (mg/L)	F (mg/L)	SO_4 (mg/L)	Br (mg/L)	Ammonia (as N) (mg/L)	Un-ionized @ 20°C (mg/L)	Nitrate and Nitrite (as N) (mg/L)	NO2 (as N) (mg/L)	NO3 (as N) (mg/L)	N-Total (mg/L)	DOC (mg/L)	Colour (TCU)	Conductivity (µS/cm)	pH	Turbitity (NTU)	Bicarbonate (as $CaCO_3$) (mg/L)	Carbonate (as $CaCO_3$) (mg/L)	Hardness (as $CaCO_3$) (mg/L)	TDS (calc) (mg/L)	Saturation pH (20°C)	Langelier Index (20°C)
2019-06-25	3.65	0.21	4.6	0.78	10	7	0.22	1	0.03	< 0.25	< 0.001	< 0.25	< 0.25	< 0.25	0.7	23	180	43	7.3	1.6	10	0.019	14.7	24	9.6	-2.33
2019-07-22	626	23.4	35.4	72.7	47	1110	0.35	151	3.87	< 0.05	< 0.001	0.22	< 0.05	0.22	0.7	11	68	3890	7.5	1.8	46.8	0.139	388	2060	8.4	-0.88
2019-08-26	1680	72.3	67.1	208	76	2870	0.64	400	10.7	< 0.05	< 0.001	< 0.05	< 0.05	< 0.05	0.7	4.6	19	10800	7.7	1.5	75.6	0.356	1020	5350	8	-0.29
2019-09-23	25.2	1.09	10.4	3.42	29	44.9	0.22	< 1	0.14	< 0.05	< 0.001	0.1	< 0.05	0.1	0.4	14.8	110	218	7.2	1	28.9	0.043	40.1	119	8.9	-1.67

The concentration of Aluminum (Al) exceeded the CCME guideline for the protection of aquatic life of 100 µg/L for surface water with a pH ≥ 6.5 in June (240 µg/L) and July (690 µg/L) (Table 14). The province of New Brunswick is known to have higher levels of naturally occurring Al. Therefore, with runoff, rain events, or snow melt can cause Al to leach into the waterways from the soils. This site also exceeded the New Brunswick guideline for iron (Fe) 300 µg/L for the protection of aquatic life in June (620 µg/L), July (500 µg/L), and September (320 µg/L) (Table 14). Similar to Al, Fe would enter the river through runoff from naturally occurring Fe in the watershed rocks or soils. Iron can also enter waterbodies through anthropogenic sources such as urban runoff or wastewater effluent.

In July and August, the copper (Cu) and selenium (Se) concentrations were above the CCME guidelines of 4 µg/L Cu for samples with a hardness > 180 mg/L and 1 µg/L Se (Table 14). The arsenic (As) concentration was also highlighted in red as being above the CCME guideline of 5 µg/L in August (Table 14). It should be noted that these samples were diluted prior to analysis, resulting in concentrations that were below the reporting limit, therefore these results are likely closer to the June & September results that were below the CCME guidelines for each respective analyte. Further sampling is required.

Table 14: Timber River Surface Water Metals

TIMBER RIVER: SURFACE WATER METALS																											
Date (yyyy-mm-dd)	Al (µg/L)	Sb (µg/L)	As (µg/L)	Ba (µg/L)	Be (µg/L)	Bi (µg/L)	B (µg/L)	Cd (µg/L)	Cr (µg/L)	Co (µg/L)	Cu (µg/L)	Fe (µg/L)	Pb (µg/L)	Li (µg/L)	Mn (µg/L)	Mo (µg/L)	Ni (µg/L)	Rb (µg/L)	Se (µg/L)	Ag (µg/L)	Sr (µg/L)	Te (µg/L)	Tl (µg/L)	Sn (µg/L)	U (µg/L)	V (µg/L)	Zn (µg/L)
2019-06-25	240	< 0.1	< 1	41	< 0.1	< 1	5	0.01	< 1	0.1	< 1	620	0.2	0.7	53	< 0.1	< 1	0.3	< 1	< 0.1	26	< 0.1	< 0.1	< 0.1	0.1	< 1	2
2019-07-22	690	< 0.5	< 5	105	< 0.5	< 5	277	< 0.05	< 5	< 0.5	< 5	500	< 0.5	12	242	0.9	< 5	7.5	< 5	< 0.5	551	< 0.5	< 0.5	< 0.5	< 0.5	< 5	< 5
2019-08-26	10	< 1	< 10	70	< 1	< 10	790	< 0.1	< 10	< 1	< 10	< 200	< 1	28	70	3	< 10	20	< 10	< 1	930	< 1	< 1	< 1	< 1	< 10	< 10
2019-09-23	88	< 0.1	< 1	83	< 0.1	< 1	18	< 0.01	< 1	< 0.1	< 1	320	0.1	1.9	40	0.2	< 1	1	< 1	< 0.1	81	< 0.1	< 0.1	< 0.1	0.2	< 1	< 1

Blacklock Brook off Murray Road

Blacklock Brook exceeded the New Brunswick water quality guideline of 10 NTU for turbidity in August (11.4 NTU) (Table 15).

Table 15: Blacklock Brook off Murray Road Surface Water Chemistry

BLACKLOOK BROOK OFF MURRAY ROAD: SURFACE WATER CHEMISTRY																										
Date (yyyy-mm-dd)	Na (mg/L)	K (mg/L)	Ca (mg/L)	Mg (mg/L)	Alkalinity (as CaCO3) (mg/L)	Cl (mg/L)	F (mg/L)	SO_4 (mg/L)	Br (mg/L)	Ammonia (as N) (mg/L)	Un-ionized @ 20ºC (mg/L)	Nitrate and Nitrite (as N) (mg/L)	NO2 (as N) (mg/L)	NO3 (as N) (mg/L)	N-Total (mg/L)	DOC (mg/L)	Colour (TCU)	Conductivity (µS/cm)	pH	Turbitity (NTU)	Bicarbonate (as $CaCO_3$) (mg/L)	Carbonate (as $CaCO_3$) (mg/L)	Hardness (as $CaCO_3$) (mg/L)	TDS (calc) (mg/L)	Saturation pH (20°C)	Langelier Index (20°C)
2019-06-25	3.64	0.28	7.5	0.85	20	6	0.32	2	0.04	<0.25	<0.001	<0.25	<0.25	<0.25	0.8	26	200	58	7.1	1.9	20	0.024	22.2	34	9.1	,2.03
2019-07-22	5.98	0.95	17.2	1.72	55	8.7	0.2	<1	0.05	0.34	0.002	0.14	<0.05	0.14	0.9	11.8	79	145	7.2	7.7	54.9	0.082	50	90	8.4	-1.16
2019-08-26	7.68	2.06	23.9	2.55	80	13	0.3	< 5	0.08	0.5	0.003	< 0.25	< 0.25	< 0.25	1.7	17	180	213	7.2	11.4	79.9	0.119	70.2	130	8.1	-0.87
2019-09-23	6.91	0.91	13	1.63	33	15.9	0.23	2	0.06	0.11	< 0.001	< 0.05	< 0.05	< 0.05	0.6	19	118	122	6.9	3.2	33	0.025	39.2	83	8.7	-1.79

Again, the concentrations of Al exceeded the CCME guideline for the protection of aquatic life (100 µg/L Al for surface water with a pH ≥ 6.5) in June (299 µg/L), July (690 µg/L), and September (118 µg/L) (Table 16). This site also exceeded the New Brunswick guideline for Fe (300 µg/L) across all months (1020 - 6390 µg/L) (Table 16).

Table 16: Blacklock Brook off Murray Road Surface Water Metals

BLACKLOCK BROOK OFF MURRAY ROAD: SURFACE WATER METALS																											
Date (yyyy-mm-dd)	Al (µg/L)	Sb (µg/L)	As (µg/L)	Ba (µg/L)	Be (µg/L)	Bi (µg/L)	B (µg/L)	Cd (µg/L)	Cr (µg/L)	Co (µg/L)	Cu (µg/L)	Fe (µg/L)	Pb (µg/L)	Li (µg/L)	Mn (µg/L)	Mo (µg/L)	Ni (µg/L)	Rb (µg/L)	Se (µg/L)	Ag (µg/L)	Sr (µg/L)	Te (µg/L)	Tl (µg/L)	Sn (µg/L)	U (µg/L)	V (µg/L)	Zn (µg/L)
2019-06-25	299	< 0.1	< 1	34	< 0.1	< 1	5	0.02	< 1	0.3	< 1	1020	0.2	0.4	337	0.1	< 1	0.5	< 1	< 0.1	26	< 0.1	< 0.1	< 0.1	0.2	< 1	2
2019-07-22	101	< 0.1	2	96	< 0.1	< 1	5	0.02	< 1	2.4	< 1	3250	0.3	0.3	5950	0.6	< 1	2.3	< 1	< 0.1	67	< 0.1	< 0.1	< 0.1	1	1	2
2019-08-26	56	< 0.1	3	117	< 0.1	< 1	8	0.01	< 1	2.4	< 1	6390	0.3	0.2	7690	1.1	< 1	5.1	< 1	< 0.1	95	< 0.1	< 0.1	< 0.1	0.2	1	< 1
2019-09-23	118	< 0.1	1	61	< 0.1	< 1	7	0.02	< 1	0.9	< 1	1480	0.1	0.4	1850	0.2	< 1	1.7	< 1	< 0.1	50	< 0.1	< 0.1	< 0.1	0.1	1	2

Trout Brook off Murray Road

Trout Brook exceeded the New Brunswick water quality guideline of 10 NTU for turbidity in July (82.7 NTU), August (40.9 NTU), and September (71.8 NTU) (Table 17).

Table 17: Trout Brook off Murray Road Surface Water Chemistry

TROUT BROOK OFF MURRAY ROAD: SURFACE WATER CHEMICALS																									
Date (yyyy-mm-dd)	Na (mg/L)	K (mg/L)	Ca (mg/L)	Mg (mg/L)	Alkalinity (as CaCO3) (mg/L)	Cl (mg/L)	F (mg/L)	SO_4 (mg/L)	Br (mg/L)	Ammonia (as N) (mg/L)	Un-ionized @ 20ºC (mg/L)	Nitrate and Nitrite (as N) (mg/L)	NO2 (as N) (mg/L)	NO3 (as N) (mg/L)	N-Total (mg/L)	DOC (mg/L)	Colour (TCU)	Conductivity (µS/cm)	pH	Turbitity (NTU)	Bicarbonate (as $CaCO_3$) (mg/L)	Carbonate (as $CaCO_3$) (mg/L)	Hardness (as $CaCO_3$) (mg/L)	TDS (calc) (mg/L)	Saturation pH (20°C)	Langelier Index (20°C)
2019-06-25	3.41	0.2	5.66	0.77	20	5	0.25	<5	0.04	<0.25	<0.001	<0.25	<0.25	<0.25	0.8	26	160	47	6.8	2.4	20	0.012	17.3	29	9.2	-2.34
2019-07-22	7.17	1.9	14.6	2.01	55	9.8	0.22	<1	0.08	0.9	0.003	<0.05	<0.05	<0.05	1.9	25	266	144	6.9	82.7	55	0.041	44.7	111	8.4	-1.53
2019-08-26	14.2	3	19	2.43	60	25	0.31	< 5	0.12	<0.25	<0.001	<0.25	< 0.25	< 0.25	2.2	31	380	198	7.1	40.9	59.9	0.071	57.4	147	8.3	-1.19
2019-09-23	7.94	0.94	9.13	1.56	19	20.3	0.16	1	0.07	< 0.05	< 0.001	< 0.05	< 0.05	< 0.05	0.8	18.4	71	106	6.6	71.8	19	0.007	29.2	73	9.1	-2.48

The concentrations of Al exceeded the CCME guideline for the protection of aquatic life (100 µg/L Al for surface water with a pH ≥ 6.5) across all months ranging from 345 to 614 µg/L (Table 18). This site also exceeded the New Brunswick guideline for Fe (300 µg/L) across all months ranging 1010 to 12900 µg/L (Table 18). In July, the Cu (2 µg/L) was at the NB water quality guideline of 2 µg/L for water with a hardness < 90 mg/L (Table 18). Zinc (Zn) (9 µg/L) was also higher than the NB water quality guideline of 7.5 µg/L for water with a hardness < 90 mg/L (Table 18). Finally, the lead (Pb) concentrations were above the CCME guideline of 1 µg/L for water with a hardness less than or equal to 60 mg/L for July (4.2 µg/L), August (3 µg/L), and September (3.1 µg/L) (Table 18).

Table 18: Trout Brook off Murray Road Surface Water Metals

TROUT BROOK OFF MURRAY ROAD: SURFACE WATER METALS																											
Date (yyyy-mm-dd)	Al (µg/L)	Sb (µg/L)	As (µg/L)	Ba (µg/L)	Be (µg/L)	Bi (µg/L)	B (µg/L)	Cd (µg/L)	Cr (µg/L)	Co (µg/L)	Cu (µg/L)	Fe (µg/L)	Pb (µg/L)	Li (µg/L)	Mn (µg/L)	Mo (µg/L)	Ni (µg/L)	Rb (µg/L)	Se (µg/L)	Ag (µg/L)	Sr (µg/L)	Te (µg/L)	Tl (µg/L)	Sn (µg/L)	U (µg/L)	V (µg/L)	Zn (µg/L)
2019-06-25	345	< 0.1	< 1	26	< 0.1	< 1	5	0.01	< 1	0.2	< 1	1010	0.2	0.4	131	0.1	< 1	0.4	< 1	< 0.1	22	< 0.1	< 0.1	< 0.1	0.2	< 1	5
2019-07-22	603	< 0.1	3	117	< 0.1	< 1	6	0.04	1	2.4	2	10300	4.2	0.4	4990	0.5	1	4.9	< 1	< 0.1	60	< 0.1	< 0.1	< 0.1	0.4	4	9
2019-08-26	478	< 0.1	3	123	< 0.1	< 1	9	0.04	< 1	1.6	1	12900	3	0.4	2100	0.4	1	6.7	< 1	< 0.1	71	< 0.1	< 0.1	< 0.1	0.4	4	6
2019-09-23	614	< 0.1	1	71	< 0.1	< 1	7	0.04	< 1	0.8	1	1560	3.1	0.6	561	< 0.1	1	2.2	< 1	< 0.1	38	< 0.1	< 0.1	< 0.1	0.3	3	7

Scott Brook off Noonan Road

Scott Brook off Noonan Road is one of our less impacted sites, so it is nice to see no guidelines exceeded in the surface water chemistry (Table 19). The iron (Fe) concentrations exceeded the New Brunswick water quality guideline (300 µg/L) across all months ranging 690 to 1760 µg/L (Table 20). Aluminum (Al) also exceeded the CCME guideline for the protection of aquatic life (100 µg/L Al for surface water with a pH ≥ 6.5) in June (329 µg/L) and September (84 µg/L) (Table 20).

Table 19: Scott Brook off Noonan Road Surface Water Chemistry

SCOTT BROOK OFF NOONAN ROAD: SURFACE WATER CHEMICALS																										
Date (yyyy-mm-dd)	Na (mg/L)	K (mg/L)	Ca (mg/L)	Mg (mg/L)	Alkalinity (as CaCO3) (mg/L)	Cl (mg/L)	F (mg/L)	SO_4 (mg/L)	Br (mg/L)	Ammonia (as N) (mg/L)	Un-ionized @ 20ºC (mg/L)	Nitrate and Nitrite (as N) (mg/L)	NO2 (as N) (mg/L)	NO3 (as N) (mg/L)	N-Total (mg/L)	DOC (mg/L)	Colour (TCU)	Conductivity (µS/cm)	pH	Turbitity (NTU)	Bicarbonate (as $CaCO_3$) (mg/L)	Carbonate (as $CaCO_3$) (mg/L)	Hardness (as $CaCO_3$) (mg/L)	TDS (calc) (mg/L)	Saturation pH (20°C)	Langelier Index (20°C)
2019-06-25	3.6	0.19	5.67	0.71	20	5	0.3	<5	0.04	<0.25	<0.001	<0.25	<0.25	<0.25	0.7	25	190	45	6.9	1.9	20	0.015	17.1	28	9.2	-2.34
2019-07-22	6.98	0.68	14.7	1.61	45	6.7	0.22	<1	0.07	0.13	0.001	0.07	<0.05	0.07	0.8	17.7	110	117	7.3	5.1	44.9	0.084	43.3	78	8.5	-1.21
2019-08-26	8.46	1.01	24.6	2.45	74	8.3	0.21	< 1	0.09	< 0.05	< 0.001	< 0.05	< 0.05	< 0.05	0.8	15.6	61	190	7.4	6.6	73.8	0.174	71.5	108	8.1	-0.69
2019-09-23	7.56	0.68	12.3	1.58	29	18.7	0.19	3	0.06	< 0.05	< 0.001	< 0.05	< 0.05	< 0.05	0.4	14.8	84	120	7.1	3.1	29	0.034	37.2	78	8.8	-1.67

Table 20: Scott Brook off Noonan Road Surface Water Metals

SCOTT BROOK OFF NOONAN ROAD: SURFACE WATER METALS																											
Date (yyyy-mm-dd)	Al (µg/L)	Sb (µg/L)	As (µg/L)	Ba (µg/L)	Be (µg/L)	Bi (µg/L)	B (µg/L)	Cd (µg/L)	Cr (µg/L)	Co (µg/L)	Cu (µg/L)	Fe (µg/L)	Pb (µg/L)	Li (µg/L)	Mn (µg/L)	Mo (µg/L)	Ni (µg/L)	Rb (µg/L)	Se (µg/L)	Ag (µg/L)	Sr (µg/L)	Te (µg/L)	Tl (µg/L)	Sn (µg/L)	U (µg/L)	V (µg/L)	Zn (µg/L)
2019-06-25	329	< 0.1	< 1	39	< 0.1	< 1	6	0.01	< 1	0.2	< 1	690	0.3	0.4	79	0.1	< 1	0.4	< 1	< 0.1	22	< 0.1	< 0.1	< 0.1	0.2	< 1	2
2019-07-22	94	< 0.1	< 1	71	< 0.1	< 1	1006	0.02	< 1	0.4	< 1	1760	0.4	0.4	698	0.6	< 1	2.1	< 1	< 0.1	64	< 0.1	< 0.1	< 0.1	0.3	1	1
2019-08-26	53	< 0.1	1	102	< 0.1	< 1	9	< 0.01	< 1	0.5	< 1	1580	0.3	0.3	844	0.6	< 1	2.3	< 1	< 0.1	100	< 0.1	< 0.1	< 0.1	0.4	< 1	< 1
2019-09-23	84	< 0.1	< 1	69	< 0.1	< 1	8	< 0.01	< 1	0.3	< 1	890	0.2	0.6	295	0.2	< 1	1.5	< 1	< 0.1	51	< 0.1	< 0.1	< 0.1	0.2	< 1	1

Scott Brook off Route 955

Moving downstream, Scott Brook off Route 955 exceeded the CCME freshwater guideline for protection of aquatic life (short-term 640 ppm and long-term 120 ppm) across all months ranging from 3500 ppm to 150000 ppm, despite being sampled at low-tide (Table 21). This was one of our tidally influenced sites.

Table 21: Scott Brook off Route 955 Surface Water Chemistry

SCOTT BROOK OFF ROUTE 955: SURFACE WATER CHEMICALS																											
Date (yyyy-mm-dd)	Na (mg/L)	K (mg/L)	Ca (mg/L)	Mg (mg/L)	Alkalinity (as CaCO3) (mg/L)	Cl (mg/L)	F (mg/L)	SO_4 (mg/L)	Br (mg/L)	Ammonia (as N) (mg/L)	Un-ionized @ 20ºC (mg/L)	Nitrate and Nitrite (as N) (mg/L)	NO2 (as N) (mg/L)	NO3 (as N) (mg/L)	N-Total (mg/L)	DOC (mg/L)	Colour (TCU)	Conductivity (µS/cm)	pH	Turbitity (NTU)	Bicarbonate (as $CaCO_3$) (mg/L)	Carbonate (as $CaCO_3$) (mg/L)	Hardness (as $CaCO_3$) (mg/L)	TDS (calc) (mg/L)	Saturation pH (20°C)	Langelier Index (20°C)
2019-06-25	1960	73.6	77	228	50	3500	0.7	490	12.2	<0.25	<0.001	<0.25	<0.25	<0.25	<1	20	130	12800	6.8	2.2	50	0.03	1130	6360	8.1	-1.32
2019-07-22	8100	293	304	935	80	11900	1.43	1910	50.5	0.12	0.001	<0.05	<0.05	<0.05	<5	<12.5	<5	47600	7.4	1.1	79.8	0.188	4610	23500	7.2	0.24
2019-08-26	8860	358	315	1170	97	15000	1.61	2100	55.3	0.28	0.002	< 0.05	<0.05	<0.05	0.7	4.2	9	49800	7.3	2.2	96.8	0.182	5600	27900	7	0.32
2019-09-23	5900	263	271	817	92	10400	1.35	1640	44.5	< 0.05	< 0.001	< 0.25	< 0.05	< 0.25	0.3	7.2	25	40400	7.3	1.4	91.8	0.172	4040	19400	7.2	0.08

The iron (Fe) concentrations exceeded the New Brunswick water quality guideline (300 µg/L) across all months ranging 600 to 1000 µg/L (Table 22). Aluminum (Al) exceeded the CCME guideline for the protection of aquatic life (100 µg/L Al for surface water with a pH ≥ 6.5) in June (260 µg/L) (Table 22). Boron (B) also exceeded the CCME long-term guideline of 1500 µg/L from July to September (3230 – 3800 µg/L) (Table 22). The remaining highlighted results in table 22 require further sampling (arsenic (As), cadmium (Cd), copper (Cu), selenium (Se), thallium (Tl), and zinc (Zn). The samples were diluted prior to analysis due to their high ionic content, leading to results that were below the reporting limit and not quantified.

Table 22: Scott Brook off Route 955 Surface Water Metals

SCOTT BROOK OFF ROUTE 955: SURFACE WATER METALS																												
Date (yyyy-mm-dd)	Al (µg/L)	Sb (µg/L)	As (µg/L)	Ba (µg/L)	Be (µg/L)	Bi (µg/L)	B (µg/L)	Cd (µg/L)	Cr (µg/L)	Co (µg/L)	Cu (µg/L)	Fe (µg/L)	Pb (µg/L)	Li (µg/L)	Mn (µg/L)	Mo (µg/L)	Ni (µg/L)	Rb (µg/L)	Se (µg/L)	Ag (µg/L)	Sr (µg/L)	Te (µg/L)	Tl (µg/L)	Sn (µg/L)	U (µg/L)	V (µg/L)	Zn (µg/L)
2019-06-25	260	< 2	< 20	40	< 2	< 20	860	< 0.2	< 20	< 2	< 20	600	< 2	32	120	2	< 20	21	< 20	< 2	1450	< 2	< 2	< 2	< 2	20	< 20
2019-07-22	< 50	< 5	< 50	60	< 5	< 50	3480	< 0.5	< 50	< 5	< 50	1000	< 5	130	160	7	< 50	86	< 50	< 5	6040	< 5	< 5	< 5	< 5	50	< 50
2019-08-26	< 50	< 5	< 50	50	< 5	< 50	3800	< 0.5	< 50	< 5	< 50	< 1000	< 5	145	170	11	< 50	95	< 50	< 5	5030	< 5	< 5	< 5	< 5	< 50	< 50
2019-09-23	< 50	< 5	< 50	60	0	< 50	3230	< 0.5	< 50	< 5	< 50	1000	< 5	116	350	6	< 50	77	0	0	5330	0	< 5	< 5	< 5	< 50	0

Trout Brook off Route 955

Trout Brook off Route 955 was less turbid than upstream at the Murray Road sample site. This is another one of our tidally influenced sites. Chloride exceeded the CCME freshwater guideline for protection of aquatic life (short-term 640 ppm and long-term 120 ppm) across all months ranging from 5600 ppm to 149000 ppm, despite being sampled at low-tide (Table 23).

Table 23: Trout Brook off Route 955 Surface Water Chemistry

TROUT BROOK OFF ROUTE 955: SUFACE WATER CHEMICALS																									
Date (yyyy-mm-dd)	Na (mg/L)	K (mg/L)	Ca (mg/L)	Mg (mg/L)	Alkalinity (as CaCO3) (mg/L)	Cl (mg/L)	F (mg/L)	SO_4 (mg/L)	Br (mg/L)	Ammonia (as N) (mg/L)	Un-ionized @ 20ºC (mg/L)	Nitrate and Nitrite (as N) (mg/L)	NO2 (as N) (mg/L)	NO3 (as N) (mg/L)	N-Total (mg/L)	DOC (mg/L)	Colour (TCU)	Conductivity (µS/cm)	pH	Turbitity (NTU)	Bicarbonate (as $CaCO_3$) (mg/L)	Carbonate (as $CaCO_3$) (mg/L)	Hardness (as $CaCO_3$) (mg/L)	TDS (calc) (mg/L)	Saturation pH (20°C)	Langelier Index (20°C)
2019-06-25	3150	114	117	356	70	5600	0.88	760	19.6	<0.25	<0.001	<0.25	<0.25	<0.25	<2	17	80	19600	7.2	3.3	69.9	0.104	1760	10100	7.8	-0.6
2019-07-22	8480	307	316	974	92	13500	1.52	2000	52.6	0.06	<0.001	<0.05	<0.05	<0.05	<5	<12.5	<5	47400	7.5	1.1	91.7	0.273	4800	25600	7.1	0.45
2019-08-26	8660	367	322	1130	92	14900	1.63	1980	53.4	<0.05	<0.001	<0.05	<0.05	<0.05	0.6	4.2	9	49400	7.7	2.2	91.5	0.431	5460	27400	7	0.69
2019-09-23	5800	237	245	748	89	9710	1.33	1590	40.8	< 0.05	< 0.001	< 0.25	< 0.05	< 0.25	0.4	6.1	16	38700	7.5	2.7	88.7	0.264	3690	18400	7.3	0.21

In June, the aluminum concentration (180 µg/L) exceeded the CCME guideline for the protection of aquatic life (100 µg/L Al for surface water with a pH ≥ 6.5) (Table 24). The iron (Fe) concentrations exceeded the New Brunswick water quality guideline (300 µg/L) across all months ranging 600 to 1000 µg/L (Table 24). Boron (B) also exceeded the CCME long-term guideline of 1500 µg/L from July to September ranging from 2950 to 3630 µg/L (Table 24). The remaining highlighted results in table 24 require further sampling (arsenic (As), cadmium (Cd), copper (Cu), selenium (Se), thallium (Tl), and zinc (Zn). The samples were diluted prior to analysis due to their high ionic content, leading to results that were below the reporting limit and not quantified.

Table 24: Trout Brook off Route 955 Surface Water Metals

TROUT BROOK OFF ROUTE 955: SURFACE WATER METALS																												
Date (yyyy-mm-dd)	Al (µg/L)	Sb (µg/L)	As (µg/L)	Ba (µg/L)	Be (µg/L)	Bi (µg/L)	B (µg/L)	Cd (µg/L)	Cr (µg/L)	Co (µg/L)	Cu (µg/L)	Fe (µg/L)	Pb (µg/L)	Li (µg/L)	Mn (µg/L)	Mo (µg/L)	Ni (µg/L)	Rb (µg/L)	Se (µg/L)	Ag (µg/L)	Sr (µg/L)	Te (µg/L)	Tl (µg/L)	Sn (µg/L)	U (µg/L)	V (µg/L)	Zn (µg/L)
2018-06-12	180	< 2	< 20	30	< 2	< 20	1340	< 0.2	< 20	< 2	< 20	600	< 2	50	120	3	< 20	33	< 20	< 2	2290	< 2	< 2	< 2	< 2	30	< 20
2018-07-16	< 50	< 5	< 50	< 50	< 5	< 50	3590	< 0.5	< 50	< 5	< 50	1000	< 5	138	70	7	< 50	90	< 50	< 5	6280	< 5	< 5	< 5	< 5	60	< 50
2018-08-15	50	< 5	< 50	< 50	< 5	< 50	3630	< 0.5	< 50	< 5	< 50	< 1000	< 5	142	70	12	< 50	93	< 50	< 5	5050	< 5	< 5	< 5	< 5	< 50	< 50
2018-09-04	70	< 5	< 50	< 50	< 5	< 50	2950	< 0.5	< 50	< 5	< 50	< 1000	< 5	106	190	6	< 50	70	50	< 5	4890	< 5	< 5	< 5	< 5	< 50	< 50

Blacklock Brook off Route 955

Blacklock off Route 955 was less turbid than the upstream site. This is another one of our tidally influenced sites. Chloride exceeded the CCME freshwater guideline for protection of aquatic life (short-term 640 ppm and long-term 120 ppm) from July to September ranging from 2840 ppm to 152000 ppm, despite being sampled at low-tide (Table 25).

Table 25: Blacklock Brook off Route 955 Surface Water Chemistry

BLACKLOCK BROOK OFF ROUTE 955: SURFACE WATER CHEMICALS																									
Date (yyyy-mm-dd)	Na (mg/L)	K (mg/L)	Ca (mg/L)	Mg (mg/L)	Alkalinity (as CaCO3) (mg/L)	Cl (mg/L)	F (mg/L)	SO_4 (mg/L)	Br (mg/L)	Ammonia (as N) (mg/L)	Un-ionized @ 20ºC (mg/L)	Nitrate and Nitrite (as N) (mg/L)	NO2 (as N) (mg/L)	NO3 (as N) (mg/L)	N-Total (mg/L)	DOC (mg/L)	Colour (TCU)	Conductivity (µS/cm)	pH	Turbitity (NTU)	Bicarbonate (as $CaCO_3$) (mg/L)	Carbonate (as $CaCO_3$) (mg/L)	Hardness (as $CaCO_3$) (mg/L)	TDS (calc) (mg/L)	Saturation pH (20°C)	Langelier Index (20°C)
2019-06-25	60.5	3.05	7.92	7.1	30	116	80	<5	0.41	<0.25	<0.001	<0.25	<0.25	<0.25	1	30	220	442	7	2.6	30	0.028	49	214	9	-2.01
2019-07-22	8290	303	311	962	93	13000	1.49	1750	51.7	<0.05	<0.001	<0.05	<0.05	<0.05	<5	<12.5	<5	47200	7.7	1.1	92.5	0.436	4740	24700	7.1	0.63
2019-08-26	8240	348	303	1070	91	15200	1.66	2000	54.6	<0.05	<0.001	<0.05	<0.05	<0.05	0.9	11	34	49500	8.6	1.3	87.5	3.27	5160	27200	7.1	1.53
2019-09-23	1620	64	74.9	201	37	2840	0.65	380	10.8	< 0.05	< 0.001	< 0.05	< 0.05	< 0.05	0.5	15.5	69	10300	7.5	1	36.9	0.11	1010	5220	8.3	-0.75

In June the aluminum concentration (350 µg/L) exceeded the CCME guideline for the protection of aquatic life (100 µg/L) for surface water with a pH ≥ 6.5 (Table 26). This site also exceeded the New Brunswick guideline for Fe (300 µg/L) across all months ranging from 400 - 1000 µg/L (Table 26). Boron (B) also exceeded the CCME long-term guideline of 1500 µg/L in July (3580 µg/L) and August (3580 µg/L) (Table 24). The remaining highlighted results in table 26 require further sampling (arsenic (As), cadmium (Cd), copper (Cu), selenium (Se), thallium (Tl), and zinc (Zn). The samples were diluted prior to analysis due to their high ionic content, leading to results that were below the reporting limit and not quantified.

Table 26: Blacklock Brook off Route 955 Surface Water Metals

BLACKLOCK BROOK OFF ROUTE 955: SURFACE WATER METALS																											
Date (yyyy-mm-dd)	Al (µg/L)	Sb (µg/L)	As (µg/L)	Ba (µg/L)	Be (µg/L)	Bi (µg/L)	B (µg/L)	Cd (µg/L)	Cr (µg/L)	Co (µg/L)	Cu (µg/L)	Fe (µg/L)	Pb (µg/L)	Li (µg/L)	Mn (µg/L)	Mo (µg/L)	Ni (µg/L)	Rb (µg/L)	Se (µg/L)	Ag (µg/L)	Sr (µg/L)	Te (µg/L)	Tl (µg/L)	Sn (µg/L)	U (µg/L)	V (µg/L)	Zn (µg/L)
2019-06-25	350	< 0.1	< 1	21	< 0.1	< 1	48	0.01	< 1	0.1	< 1	970	0.4	2.4	50	0.3	< 1	1.3	< 1	< 0.1	61	< 0.1	< 0.1	< 0.1	0.2	2	2
2019-07-22	< 50	< 5	< 50	< 50	< 5	< 50	3580	< 0.5	< 50	< 5	< 50	1000	< 5	136	70	8	< 50	89	< 50	< 5	6210	< 5	< 5	< 5	< 5	60	< 50
2019-08-26	< 50	< 5	< 50	60	< 5	< 50	3580	< 0.5	< 50	< 5	< 50	< 1000	< 5	130	< 50	9	< 50	95	< 50	< 5	4880	< 5	< 5	< 5	< 5	< 50	< 50
2019-09-23	70	< 1	< 10	40	< 1	< 10	790	< 0.1	< 10	< 1	< 10	400	< 1	31	80	2	< 10	19	20	< 1	1310	< 1	< 1	< 1	< 1	10	< 10

Gaspereau River @ Roundabout

Chloride exceeded the CCME freshwater guideline for protection of aquatic life (short-term 640 ppm and long-term 120 ppm) across all months ranging from 880 ppm to 147000 ppm, despite being sampled at low-tide (Table 27).

Table 27: Gaspereau River @ Roundabout Surface Water Chemistry

GASPEREAU RIVER AT ROUNDABOUT: SURFACE WATER CHEMCALS																										
Date (yyyy-mm-dd)	Na (mg/L)	K (mg/L)	Ca (mg/L)	Mg (mg/L)	Alkalinity (as CaCO3) (mg/L)	Cl (mg/L)	F (mg/L)	SO_4 (mg/L)	Br (mg/L)	Ammonia (as N) (mg/L)	Un-ionized @ 20ºC (mg/L)	Nitrate and Nitrite (as N) (mg/L)	NO2 (as N) (mg/L)	NO3 (as N) (mg/L)	N-Total (mg/L)	DOC (mg/L)	Colour (TCU)	Conductivity (µS/cm)	pH	Turbitity (NTU)	Bicarbonate (as $CaCO_3$) (mg/L)	Carbonate (as $CaCO_3$) (mg/L)	Hardness (as $CaCO_3$) (mg/L)	TDS (calc) (mg/L)	Saturation pH (20°C)	Langelier Index (20°C)
2019-06-25	484	18.4	21.1	56.9	20	880	0.39	127	3.18	<0.25	<0.001	<025	<0.25	<0.25	0.8	23	170	3120	6.7	2.3	20	0.009	287	1600	8.9	-2.24
2019-07-22	6560	241	235	774	70	9480	1.32	1500	40.5	<0.05	<0.001	<0.05	<0.05	<0.05	<4	<10	42	37800	7.6	1.2	69.7	0.261	3770	18800	7.4	0.19
2019-08-26	8210	342	299	1060	87	14700	1.64	2000	52.8	< 0.05	< 0.001	< 0.05	< 0.05	< 0.05	0.6	6.1	18	49200	7.9	1.6	86.3	0.644	5110	26700	7.1	0.81
2019-09-23	4030	148	160	468	53	6750	1.06	940	26	< 0.05	< 0.001	< 0.05	< 0.05	< 0.05	0.4	12.4	73	25300	7.4	1.9	52.9	0.125	2330	12500	7.8	-0.37

The aluminum concentration exceeded the CCME guideline for the protection of aquatic life of for surface water with a pH ≥ 6.5 (100 µg/L) in June (269 µg/L) and September (100 µg/L) (Table 28). This site also exceeded the New Brunswick guideline for Fe (300 µg/L) across all months ranging from 600 to 1000 µg/L (Table 28). Boron (B) also exceeded the CCME long-term guideline of 1500 µg/L in July (2790 µg/L), August (3390 µg/L), and September (1820 µg/L). The remaining highlighted results in table 28 require further sampling (arsenic (As), cadmium (Cd), copper (Cu), selenium (Se), thallium (Tl), and zinc (Zn). The samples were diluted prior to analysis due to their high ionic content, leading to results that were below the reporting limit and not quantified.

Table 28: Gaspereau River @ Roundabout Surface Water Metals

GASPEREAU RIVER AT ROUNDABOUT: SURFACE WATER METALS																										
Date (yyyy-mm-dd)	Al (µg/L)	Sb (µg/L)	As (µg/L)	Ba (µg/L)	Be (µg/L)	Bi (µg/L)	B (µg/L)	Cd (µg/L)	Cr (µg/L)	Co (µg/L)	Cu (µg/L)	Fe (µg/L)	Pb (µg/L)	Li (µg/L)	Mn (µg/L)	Mo (µg/L)	Ni (µg/L)	Rb (µg/L)	Se (µg/L)	Ag (µg/L)	Sr (µg/L)	Te (µg/L)	Tl (µg/L)	Sn (µg/L)	U (µg/L)	V (µg/L)	Zn (µg/L)
2019-06-25	269	< 0.2	< 2	30	< 0.2	< 2	219	< 0.02	< 2	< 0.2	< 2	630	0.3	8.6	89	0.7	< 2	5.8	< 2	< 0.2	389	< 0.2	< 0.2	< 0.2	< 0.2	6	2
2019-07-22	< 50	< 5	< 50	50	< 5	< 50	2790	< 0.5	< 50	< 5	< 50	1000	< 5	108	140	6	< 50	70	< 50	< 5	4920	< 5	< 5	< 5	< 5	< 50	< 50
2019-08-26	< 50	< 5	< 50	< 50	< 5	< 50	3390	< 0.5	< 50	< 5	< 50	< 1000	< 5	134	60	12	< 50	91	< 50	< 5	4830	< 5	< 5	< 5	< 5	< 50	< 50
2019-09-23	100	< 2	< 20	50	< 2	< 20	1820	< 0.2	< 20	< 2	< 20	600	< 2	67	100	4	< 20	44	30	< 2	3080	< 2	< 2	< 2	< 2	20	< 20

Gaspereau River in Port Elgin

Further downstream the Gaspereau River, chloride concentrations continued to exceed the CCME freshwater guideline for protection of aquatic life (short-term 640 ppm and long-term 120 ppm) across all months ranging from 2020 ppm to 154000 ppm, despite being sampled at low-tide (Table 29).

Table 29: Gaspereau River in Port Elgin Surface Water Chemistry

GASPEREAU RIVER IN PORT ELGIN: SURFACE WATER CHEMICALS																										
Date (yyyy-mm-dd)	Na (mg/L)	K (mg/L)	Ca (mg/L)	Mg (mg/L)	Alkalinity (as CaCO3) (mg/L)	Cl (mg/L)	F (mg/L)	SO_4 (mg/L)	Br (mg/L)	Ammonia (as N) (mg/L)	Un-ionized @ 20ºC (mg/L)	Nitrate and Nitrite (as N) (mg/L)	NO2 (as N) (mg/L)	NO3 (as N) (mg/L)	N-Total (mg/L)	DOC (mg/L)	Colour (TCU)	Conductivity (µS/cm)	pH	Turbitity (NTU)	Bicarbonate (as $CaCO_3$) (mg/L)	Carbonate (as $CaCO_3$) (mg/L)	Hardness (as $CaCO_3$) (mg/L)	TDS (calc) (mg/L)	Saturation pH (20°C)	Langelier Index (20°C)
2019-06-25	1220	44.5	46.1	138	30	2020	0.69	290	7.61	<0.25	<0.001	<0.25	<0.25	<0.25	<1	23	160	7760	6.7	2.1	30	0.014	683	3780	8.5	-1.21
2019-07-22	7780	273	279	861	74	10900	1.41	1670	49.3	<0.05	<0.001	<0.05	<0.05	<0.05	<5	<12.5	32	43400	7.8	1.2	73.5	0.436	4240	21800	7.3	0.54
2019-08-26	9080	355	265	999	87	15400	1.63	2000	56.1	< 0.05	< 0.001	< 0.05	< 0.05	< 0.05	0.6	5.3	16	48000	7.8	0.8	86.5	0.513	4780	28200	7.1	0.68
2019-09-23	4430	179	192	562	56	7640	1.14	1200	31.5	0.06	< 0.001	< 0.25	< 0.05	< 0.25	0.4	11	64	29000	7.4	1.4	55.9	0.132	2790	14200	7.7	-0.25

Similar to upstream, the aluminum concentration exceeded the CCME guideline for the protection of aquatic life of for surface water with a pH ≥ 6.5 (100 µg/L) in June (244 µg/L) (Table 30). This site also exceeded the New Brunswick guideline for Fe (300 µg/L) in June (600 µg/L), July (1000 µg/L), and September (600 µg/L) (Table 28). Boron (B) also exceeded the CCME long-term guideline of 1500 µg/L in July (3170 µg/L), August (2800 µg/L), and September (2150 µg/L). In September, the selenium (Se) concentration (30 µg/L) was above the CCME guidelines of 1 µg/L for surface water with a hardness > 180 mg/L (Table 30). The remaining highlighted results in table 30 require further sampling (arsenic (As), cadmium (Cd), copper (Cu), selenium (Se), thallium (Tl), and zinc (Zn). The samples were diluted prior to analysis due to their high ionic content, leading to results that were below the reporting limit and not quantified.

Table 30: Gaspereau River in Port Elgin Surface Water Metals

GASPEREAU RIVER IN PORT ELGIN: SURFACE WATER METALS																											
Date (yyyy-mm-dd)	Al (µg/L)	Sb (µg/L)	As (µg/L)	Ba (µg/L)	Be (µg/L)	Bi (µg/L)	B (µg/L)	Cd (µg/L)	Cr (µg/L)	Co (µg/L)	Cu (µg/L)	Fe (µg/L)	Pb (µg/L)	Li (µg/L)	Mn (µg/L)	Mo (µg/L)	Ni (µg/L)	Rb (µg/L)	Se (µg/L)	Ag (µg/L)	Sr (µg/L)	Te (µg/L)	Tl (µg/L)	Sn (µg/L)	U (µg/L)	V (µg/L)	Zn (µg/L)
2019-06-25	244	< 0.5	< 5	30	< 0.5	< 5	517	< 0.05	< 5	< 0.5	< 5	600	< 0.5	19.7	99	1.3	< 5	13.3	< 5	< 0.5	915	< 0.5	< 0.5	< 0.5	< 0.5	20	< 5
2019-07-22	50	< 5	< 50	< 5	< 5	< 50	3170	< 0.5	< 50	< 5	< 50	1000	< 5	123	100	7	< 50	79	< 50	< 5	5560	< 5	< 5	< 5	< 5	50	< 50
2019-08-26	37	0.2	< 2	27	< 0.2	< 2	2800	0.05	< 2	0.3	< 2	70	< 0.2	135	39	9	< 2	113	< 2	< 0.2	3310	< 0.2	< 0.2	< 0.2	1.8	< 2	< 2
2019-09-23	80	< 2	< 20	50	< 2	< 20	2150	< 0.2	< 20	< 2	< 20	600	< 2	80	90	5	< 20	54	30	< 2	3700	< 2	< 2	< 2	< 2	30	< 20

Rayworth Brook

Rayworth Brook is our most pristine sample site. All water quality parameters were well below their respective guidelines (Table 31 & 32).

Table 31: Rayworth Brook Surface Water Chemistry

RAYWORTH BROOK: SURFACE WATER CHEMICALS																										
Date (yyyy-mm-dd)	Na (mg/L)	K (mg/L)	Ca (mg/L)	Mg (mg/L)	Alkalinity (as CaCO3) (mg/L)	Cl (mg/L)	F (mg/L)	SO_4 (mg/L)	Br (mg/L)	Ammonia (as N) (mg/L)	Un-ionized @ 20ºC (mg/L)	Nitrate and Nitrite (as N) (mg/L)	NO2 (as N) (mg/L)	NO3 (as N) (mg/L)	N-Total (mg/L)	DOC (mg/L)	Colour (TCU)	Conductivity (µS/cm)	pH	Turbitity (NTU)	Bicarbonate (as $CaCO_3$) (mg/L)	Carbonate (as $CaCO_3$) (mg/L)	Hardness (as $CaCO_3$) (mg/L)	TDS (calc) (mg/L)	Saturation pH (20°C)	Langelier Index (20°C)
2019-06-25	11.4	0.58	16.8	1.87	40	19	0.13	<5	0.04	<0.25	<0.001	0.9	<0.25	0.9	1	10	60	162	7.3	0.6	39.9	0.075	49.7	78	8.5	-1.21
2019-07-22	13.9	0.95	24.1	2.5	58	24.3	0.11	4	0.04	<0.05	<0.001	1.18	<0.05	1.18	1.2	3.6	23	226	7.9	0.5	57.5	0.429	70.5	114	8.2	-0.31
2019-08-26	12.7	1.01	25.9	2.82	70	22.9	0.14	6	0.04	< 0.05	< 0.001	1.32	< 0.05	1.32	1.4	1.5	10	242	8.1	0.7	69.1	0.818	76.3	122	8.1	-0.01
2019-09-23	13.6	1.03	23.4	2.6	60	25.5	0.16	5	0.04	< 0.05	< 0.001	1.11	< 0.05	1.11	1.1	4	26	223	7.9	0.3	59.5	0.444	69.1	117	8.2	-0.31

Table 32: Rayworth Brook Surface Water Metals

RAYWORTH BROOK: SURFACE WATER METALS																											
Date (yyyy-mm-dd)	Al (µg/L)	Sb (µg/L)	As (µg/L)	Ba (µg/L)	Be (µg/L)	Bi (µg/L)	B (µg/L)	Cd (µg/L)	Cr (µg/L)	Co (µg/L)	Cu (µg/L)	Fe (µg/L)	Pb (µg/L)	Li (µg/L)	Mn (µg/L)	Mo (µg/L)	Ni (µg/L)	Rb (µg/L)	Se (µg/L)	Ag (µg/L)	Sr (µg/L)	Te (µg/L)	Tl (µg/L)	Sn (µg/L)	U (µg/L)	V (µg/L)	Zn (µg/L)
2019-06-25	66	< 0.1	< 1	156	< 0.1	< 1	13	< 0.01	< 1	<0.1	< 1	230	<0.1	0.7	21	0.1	< 1	0.6	< 1	< 0.1	57	< 0.1	< 0.1	< 0.1	0.3	< 1	< 1
2019-07-22	16	< 0.1	< 1	253	< 0.1	< 1	15	< 0.01	< 1	<0.1	< 1	140	<0.1	1.1	20	0.2	< 1	1	< 1	< 0.1	84	< 0.1	< 0.1	< 0.1	0.5	< 1	4
2019-08-26	12	< 0.1	< 1	257	< 0.1	< 1	18	< 0.01	< 1	< 0.1	< 1	70	< 0.1	1.1	16	0.3	< 1	1	< 1	< 0.1	91	< 0.1	< 0.1	< 0.1	0.6	< 1	2
2019-09-23	16	< 0.1	< 1	227	< 0.1	< 1	18	< 0.01	< 1	< 0.1	< 1	60	< 0.1	1.1	10	0.2	< 1	1.1	< 1	< 0.1	83	< 0.1	< 0.1	< 0.1	0.5	< 1	< 1

Oulton Brook

The Oulton Brook chloride concentrations exceeded the CCME freshwater guideline for protection of aquatic life (short-term 640 ppm and long-term 120 ppm) across all months ranging from 1090 ppm to 144000 ppm (Table 33).

Table 33: Oulton Brook Surface Water Chemistry

OULTON BROOK: SURFACE WATER CHEMIALS																										
Date (yyyy-mm-dd)	Na (mg/L)	K (mg/L)	Ca (mg/L)	Mg (mg/L)	Alkalinity (as CaCO3) (mg/L)	Cl (mg/L)	F (mg/L)	SO_4 (mg/L)	Br (mg/L)	Ammonia (as N) (mg/L)	Un-ionized @ 20ºC (mg/L)	Nitrate and Nitrite (as N) (mg/L)	NO2 (as N) (mg/L)	NO3 (as N) (mg/L)	N-Total (mg/L)	DOC (mg/L)	Colour (TCU)	Conductivity (µS/cm)	pH	Turbitity (NTU)	Bicarbonate (as $CaCO_3$) (mg/L)	Carbonate (as $CaCO_3$) (mg/L)	Hardness (as $CaCO_3$) (mg/L)	TDS (calc) (mg/L)	Saturation pH (20°C)	Langelier Index (20°C)
2019-06-25	563	22.1	32.4	66	50	1090	0.39	147	3.75	<0.25	<0.001	<0.25	<0.25	<0.25	0.7	21	120	3700	7.1	2.3	49.9	0.059	353	1950	8.4	-1.28
2019-07-22	9270	342	348	1080	100	14400	1.6	2100	57.7	<0.05	<0.001	<0.05	<0.05	<0.05	<5	<12.5	<5	47000	8	8.6	99	0.931	5320	27600	6.9	1.06
2019-08-26	6150	269	246	876	97	10600	1.4	1590	41.9	< 0.05	< 0.001	< 0.05	< 0.05	< 0.05	0.4	3.3	11	39100	7.6	0.9	96.6	0.361	4220	19800	7.2	0.37
2019-09-23	3070	112	134	356	71	5050	0.87	700	19.4	< 0.05	< 0.001	< 0.05	< 0.05	< 0.05	0.4	8	34	19300	7.5	5.2	70.8	0.21	1800	9480	7.7	-0.24

The iron concentrations exceeded the New Brunswick guideline for Fe (300 µg/L) across all months ranging from 500 to 1000 µg/L (Table 34). The aluminum concentration exceeded the CCME guideline for the protection of aquatic life of for surface water with a pH ≥ 6.5 (100 µg/L) in June (270 µg/L), July (130 µg/L), and September (110 µg/L) (Table 34). Boron (B) also exceeded the CCME long-term guideline of 1500 µg/L in July (3990 µg/L), August (2670 µg/L), and September (1400 µg/L). In September, the selenium (Se) concentration (20 µg/L) was above the CCME guidelines of 1 µg/L for surface water with a hardness > 180 mg/L (Table 30). The remaining highlighted results in table 34 require further sampling (arsenic (As), cadmium (Cd), copper (Cu), selenium (Se), thallium (Tl), and zinc (Zn). The samples were diluted prior to analysis due to their high ionic content, leading to results that were below the reporting limit and not quantified.

Table 34: Oulton Brook Surface Water Metals

OULTON BROOK: SURFACE WATER METALS																										
Date (yyyy-mm-dd)	Al (µg/L)	Sb (µg/L)	As (µg/L)	Ba (µg/L)	Be (µg/L)	Bi (µg/L)	B (µg/L)	Cd (µg/L)	Cr (µg/L)	Co (µg/L)	Cu (µg/L)	Fe (µg/L)	Pb (µg/L)	Li (µg/L)	Mn (µg/L)	Mo (µg/L)	Ni (µg/L)	Rb (µg/L)	Se (µg/L)	Ag (µg/L)	Sr (µg/L)	Te (µg/L)	Tl (µg/L)	Sn (µg/L)	U (µg/L)	V (µg/L)	Zn (µg/L)
2019-06-25	170	< 0.2	< 2	91	< 0.2	< 2	266	< 0.02	< 2	< 0.2	< 2	510	0.3	9.9	178	0.6	< 2	7.3	< 2	< 0.2	479	< 0.2	< 0.2	< 0.2	0.5	7	2
2019-07-22	130	< 5	< 50	< 50	< 5	< 50	3990	< 0.5	< 50	< 5	< 50	1000	< 5	153	200	10	< 50	98	< 50	< 5	6980	< 5	< 5	< 5	< 5	60	< 50
2019-08-26	< 50	< 5	< 50	90	< 5	< 50	2670	< 0.5	< 50	< 5	< 50	< 1000	< 5	103	320	12	< 50	74	< 50	< 5	3920	< 5	< 5	< 5	< 5	< 50	< 50
2019-09-23	110	< 2	< 20	140	< 2	< 20	1400	< 0.2	< 20	< 2	< 20	500	< 2	50	290	3	< 20	34	20	< 2	2370	< 2	< 2	< 2	< 2	< 20	< 20

McKay Brook

All the surface water chemistry was well below the guidelines in Table 35 for McKay Brook. In June, the aluminum concentration (324 µg/L) exceeded the 100 µg/L CCME guideline (Table 36). Iron concentrations exceeded the CCME guideline across all months ranging from 1010 µg/L to 1980 µg/L (Table 36). In August, the lead (Pb) concentration (1.1 µg/L) exceeded the CCME guideline of 1 µg/L for water with a hardness less than or equal to 60 ppm (Table 36).

Table 35: McKay Brook Surface Water Chemistry

MCKAY BROOK: SURFACE WATER CHEMICALS																										
Date (yyyy-mm-dd)	Na (mg/L)	K (mg/L)	Ca (mg/L)	Mg (mg/L)	Alkalinity (as CaCO3) (mg/L)	Cl (mg/L)	F (mg/L)	SO_4 (mg/L)	Br (mg/L)	Ammonia (as N) (mg/L)	Un-ionized @ 20ºC (mg/L)	Nitrate and Nitrite (as N) (mg/L)	NO2 (as N) (mg/L)	NO3 (as N) (mg/L)	N-Total (mg/L)	DOC (mg/L)	Colour (TCU)	Conductivity (µS/cm)	pH	Turbitity (NTU)	Bicarbonate (as $CaCO_3$) (mg/L)	Carbonate (as $CaCO_3$) (mg/L)	Hardness (as $CaCO_3$) (mg/L)	TDS (calc) (mg/L)	Saturation pH (20°C)	Langelier Index (20°C)
2019-06-25	4.72	0.42	6.1	0.91	20	7	0.26	1	0.06	<0.25	<0.001	<0.25	<0.25	<0.25	0.8	24	200	57	7	3.3	20	0.019	19	34	9.2	-2.21
2019-07-22	4.59	0.73	8.11	1.04	26	6.4	0.14	<1	0.05	0.13	0.001	<0.05	<0.05	<0.05	0.7	13.2	94	76	7.3	7.6	25.9	0.049	24.5	53	9	-1.68
2019-08-26	9.22	1.02	16.2	1.86	55	11.5	0.19	1	0.09	< 0.05	< 0.01	< 0.05	< 0.05	< 0.05	0.7	12.9	61	155	7.4	6.6	54.9	0.13	48.1	87	8.4	-0.99
2019-09-23	8.4	1.11	11.2	1.55	27	18.3	0.18	2	0.08	< 0.05	< 0.01	< 0.05	< 0.05	< 0.05	0.6	17.1	105	120	7.4	6.7	26.9	0.064	34.3	78	8.8	-1.44

Table 36: McKay Brook Surface Water Metals

MCKAY BROOK: SURFACE WATER METALS																											
Date (yyyy-mm-dd)	Al (µg/L)	Sb (µg/L)	As (µg/L)	Ba (µg/L)	Be (µg/L)	Bi (µg/L)	B (µg/L)	Cd (µg/L)	Cr (µg/L)	Co (µg/L)	Cu (µg/L)	Fe (µg/L)	Pb (µg/L)	Li (µg/L)	Mn (µg/L)	Mo (µg/L)	Ni (µg/L)	Rb (µg/L)	Se (µg/L)	Ag (µg/L)	Sr (µg/L)	Te (µg/L)	Tl (µg/L)	Sn (µg/L)	U (µg/L)	V (µg/L)	Zn (µg/L)
2019-06-25	324	< 0.1	< 1	49	< 0.1	< 1	7	0.02	< 1	0.4	< 1	1010	0.4	0.5	483	< 0.1	< 1	0.9	< 1	< 0.1	28	< 0.1	< 0.1	< 0.1	0.2	1	3
2019-07-22	74	< 0.1	< 1	65	< 0.1	< 1	7	< 0.01	< 1	0.4	< 1	1590	0.2	0.5	800	0.1	< 1	1.9	< 1	< 0.1	37	< 0.1	< 0.1	< 0.1	0.1	< 1	5
2019-08-26	90	< 0.1	< 1	149	< 0.1	< 1	17	0.01	< 1	1.2	< 1	1980	1.1	0.8	3790	0.2	< 1	2	< 1	< 0.1	83	< 0.1	< 0.1	< 0.1	0.2	< 1	6
2019-09-23	85	< 0.1	< 1	86	< 0.1	< 1	10	0.01	< 1	0.5	< 1	1280	0.2	0.7	827	< 0.1	< 1	1.9	< 1	< 0.1	53	< 0.1	< 0.1	< 0.1	0.2	1	1

Conclusions and Recommendations

During the 2019 field season we were able to collect water quality data from 12 sites throughout the Cape Tormentine Peninsula Watershed. The water quality results were compared to provincial water quality guidelines, CCME water quality guidelines for the protection of aquatic health, and Health Canada Guidelines for Recreational Activities. While we could speculate on some of the potential causes for variations between sites and fluctuation in parameter concentrations, this is just the first year of data collection in our monitoring program for this watershed. More years of data are required to look at the natural variations in water quality and to see trends over time to get an idea of what is expected. As mentioned previously, every time you take a water sample it is just a snapshot of the water quality at that location at that point in time. This is also why long-term monitoring is so important.

Water temperature at all sites experienced typical seasonal variation, with an increase in temperature during the warmer summer months and a cooler temperatures in the fall and spring. Water temperature remained below the recommended CCME guideline of 20°C across all sites in May, June, September and October. In July, 6 sites (Trout Brook Rte. 955, Scott Brook Rte. 955, Blacklock Brook Rte. 955, both Gaspereau River sites, & Oulton Brook) exceeded the recommended temperature of 20°C, and 2 sites (both Gaspereau River sample sites) exceeded in August. These higher temperatures could be attributed to lower water levels, slower moving water, less overhanging riparian vegetation at the sample sites, or mixing with the warm waters of the Northumberland Strait.

In-situ water pH was within CCME guidelines (6.5 – 9) for the most part, with the exception of Blacklock Brook off Murray Road and Scott Brook off Noonan Road which were slightly below the CCME guideline in June, September, and October. Trout Brook off Murray Road was also slightly below the CCME guideline in October.

The highest number of samples sites having dissolved oxygen concentrations below the New Brunswick guideline (6.5 mg/L) occurred in July (7 sites below the guideline) and August (9 sites below the guideline), corresponding with the two hottest months according to our temperature data as dissolved oxygen decreases with increased temperature. Trout Brook off Murray Rd. had DO levels below the recommended level across all months ranging from 0 to 6 mg/L. Rayworth Brook and Timber River had healthy DO concentrations across all months.

There are no water quality guidelines for conductivity, TDS, and salinity. Despite being sampled at low tide from June to October, our tidally influenced sites (Trout Brook, Scott Brook, and Blacklock Brook at Route 955; both Gaspereau River sites, and Oulton Brook) still had brackish water when they were sampled. This resulted in these sites displaying high levels of specific conductivity, TDS, salinity, and chloride concentrations. This was particularly evident in July & August when temperatures were higher and water levels were lower.

The highest number of samples exceeding the guidelines for E. Coli based on the single-sample maximum according to the Canadian Recreational Water Quality Guidelines occurred in July

and August, with 4 sites (Blacklock Brook off Murray road, both Trout Brook sample sites, and McKay Brook) exceeding the guideline in July and 6 sites (all of the Route 955 sample sites (Trout, Scott, and Blacklock Brook), both Gaspereau River sites, and Oulton Brook) exceeding the guideline in August.

From June to September total phosphorus levels frequently exceeded the New Brunswick guideline ~ 73% of the time (35 samples exceeding the guideline and only 13 coming out below the guideline). August had the greatest number of samples exceeding the guideline, with all sample sites except Rayworth Brook exceeding the provincial total phosphorus guideline. Rayworth Brook was he only site that was below the guideline across all months ranging mesotrophic to meso-eutrophic. Timber River only exceeded the guideline slightly once in August (0.031 mg/L, meso-eutrophic); and was the only other sample site to not reach a eutrophic state. Otherwise most of our samples exceeded the NB total phosphorus guideline and were in eutrophic (0.035 – 0.100 mg/L) states, with Trout Brook off Murray Road even being in a hyper-eutrophic state (> 0.100 mg/L) from July to September. As a key nutrient that can lead to an increase in algae growth and decrease in DO in our waterways, this is a parameter that we would like to look into further.

Surface water metals were mostly well below the detection limits, aside from iron and aluminum which were both above the CCME guidelines for every sample site except Rayworth Brook. Rayworth Brook was our most pristine site and had no water quality results exceeding any water quality guidelines. A number of samples were diluted prior to analysis due to their high ionic content, leading to results that were below the reporting limit and not quantified.

Overall, EOS had a very successful year of water quality monitoring that provided us with valuable baseline data that can be used to ensure the health of the Cape Tormentine Peninsula Watershed. Alongside this it has given us the opportunity to better understand our watershed and the opportunity to have it documented. This project was a great first step towards building a long-term water quality monitoring program within the watershed. As we continue to collect more data we will be able to see trends in the water quality and develop a better understanding of what the “normal” water quality is in our waterways as well as how climate change may impact them.

EOS Eco-Energy recommends that the knowledge gaps in our watersheds continue to be addressed through our long-term water quality monitoring plan. We would also like to expand our knowledge of our watersheds through the collection of CABIN data, hydrological data, riparian health data, and fish & habitat data. EOS believes that this program should extend to the Maringouin Peninsula & Dorchester area in 2020-21 to obtain information about the current state of water quality within the watershed. This is our next step in building a long-term water quality monitoring program within the Inner Bay of Fundy and Northumberland Strait Watersheds.

References

Environment and Climate Change Canada (2019) Canadian Environmental Sustainability Indicators: Water quality in Canadian rivers. Available at: www.canada.ca/en/environment-climate-change/services/environmental- indicators/water-quality-canadian-rivers.html.

Canadian Council of Ministers of the Environment. 2007. Canadian water quality guidelines for the protection of aquatic life: Summary table. Updated September, 2007. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg.

Health Canada (2012). Guidelines for Canadian Recreational Water Quality, Third Edition. Water, Air and Climate Change Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, Ontario. (Catalogue No H129-15/2012E).