# Integrated Watershed Management in the Shediac Bay Watershed



By:

**The Shediac Bay Watershed Association Inc.**

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# 1. INTRODUCTION

The primary mandate of the Shediac Bay Watershed Association (SBWA) is the protection and enhancement of water quality as well as increasing public awareness of environmental issues. Since the implementation of the water classification program in 1999, the SBWA has conducted a water quality monitoring program for surface water in the Shediac and Scoudouc rivers. The program has evolved and improved over the past 20 plus years. To better understand the suitability for fish habitat and collect data on changing temperature trends, water temperature loggers have been installed in different areas of the watershed since 2016.

A long-term water monitoring program allows the SBWA and government agencies to detect changes or trends in water quality data. This information is used to prioritize areas that require restoration work or more in-depth investigations. Stream surveys are undertaken to determine specific restoration projects when needed.

Each year, actions are done to help improve riparian habitat based on the information gathered from monitoring and stream surveys. Stream banks are stabilized and reforested to help improve water quality. In 2022, we worked to reduce stream bank erosion in two areas of the watershed. Stream clean-ups are also regularly undertaken with the help of the summer students.

The publication of a new Integrated Watershed Management Plan (IWMP) for the Shediac Bay watershed by the NB Department of Environment and Local Government (NB DELG) in 2021 is helping the SBWA to better plan and strategize our activities. An implementation committee was formed to help target the action items outlined in the plan.

The SBWA continues to develop public educational materials such as signage, interpretation panels, videos, handouts and social media postings. The Association has expanded its digital outreach on several social media platforms.

## 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 (Figure 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 their dendritic patterns of small tributaries covering a watershed of 201.8 and 143.3 km$^2$, respectively. Water velocity in both rivers is generally weak due to the gentle regional elevation. The watershed boundaries stretch into both Kent and Westmorland counties and cross into both the Town of Shediac and City of Moncton.

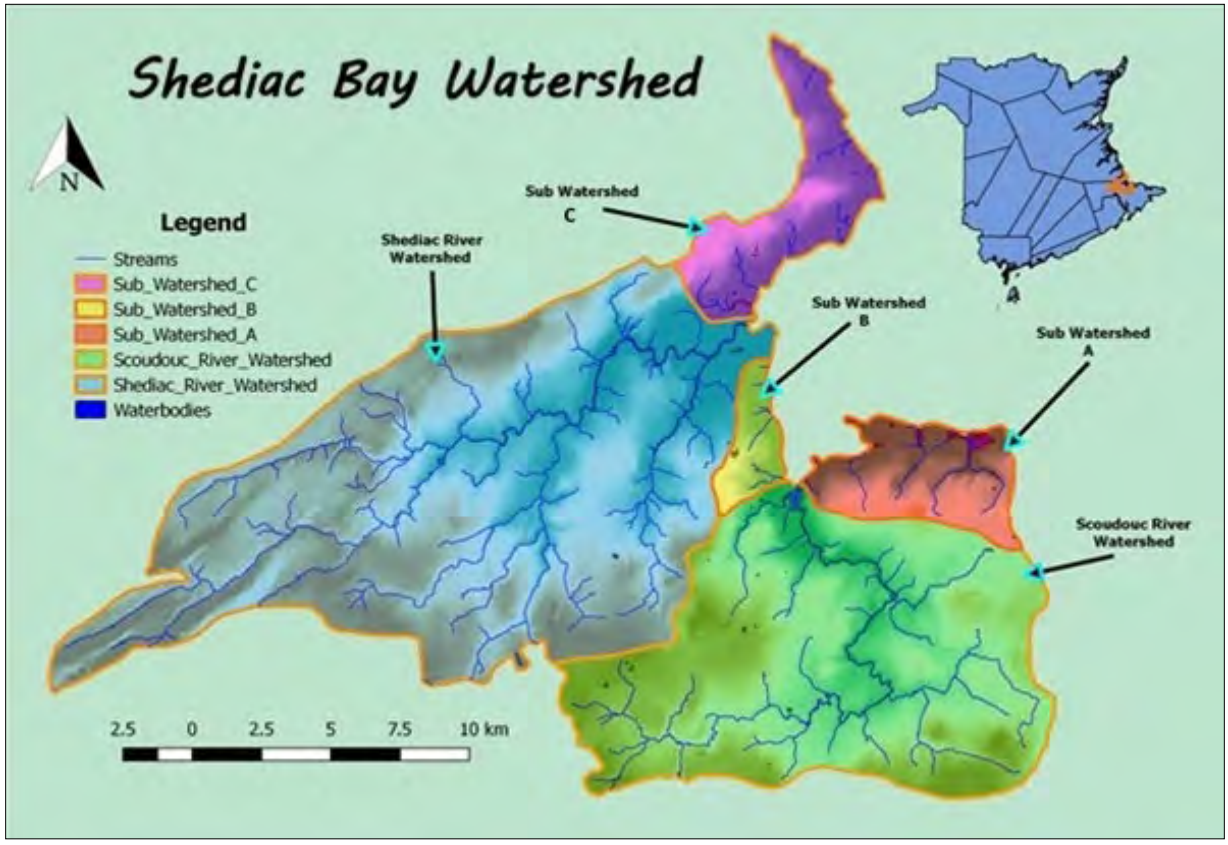



**Figure 1: Map of Shediac Bay watershed boundaries and sub-watersheds.**

# 2. METHODOLOGY

## 2.1 Water Quality Sampling Protocol

Water quality monitoring was conducted once a month from June to September, at 21 sampling stations in the major rivers and small tributaries of the Shediac Bay watershed. Water quality sampling was performed using the protocol developed by the NB DELG.

Regular water samples are collected during a period of dry weather, without the influence of non-point source pollution discharged in stormwater runoff. Ambient water quality data is used to determine the general health and water quality trends of a waterbody. A storm sampling event is the collection of water samples during or following a significant rainfall event. The result of a storm sampling event is an estimate of the pollution load leaving an area of land. It helps to better characterize concentrations of diffused contaminants entering a watercourse under a range of flow conditions.

Basic water quality parameters (DO, temperature, pH, conductivity and salinity) were measured using a YSI Professional Plus Multiparameter Meter. Water samples were sent to the Research and Productivity Council (RPC) Laboratory for analysis of *E. coli* and inorganic elements.

The equipment needed to conduct the sampling and collect habitat data includes; laboratory issued sample bottles, labels, latex or nitrile gloves, clipboards, waterproof paper for field sheets, pencils, waders or rubber boots, orange reflective vests for safety, GPS, a digital camera, YSI Meter, metre stick, survey measuring tape, and a cooler with ice for the water samples.

## 2.2 Site Information

### 2.2.1 Shediac and Scoudouc River Sampling

The Shediac River is divided in two major water arms. The northern water arm is created by the convergence of the McQuade, Weisner and Calhoun Brooks. The southern water arm consists of the Batemans Brook. The Shediac River tributaries stretch as far as the Irishtown area, crossing both the Shediac and Moncton parishes, and meanders through many agricultural, forested and residential areas. Both arms of the Shediac River join and empty into Shediac Bay near the Shediac Bridge area.

The mouth of the Scoudouc River system is located in the Town of Shediac and stretches into the Scoudouc area. The various tributaries of the river branch towards the Malakoff area and near Ohio Road. Only two tributaries of this river are officially named; the Cornwall Brook and the Dionne Brook. The rivers tributaries run through wetlands, residential and forested areas, and near an industrial park.

The following section describes the 10 sample sites for the water classification monitoring established in 1999. Figure 2 shows an aerial view of the location of each site within the watershed. Photographs and coordinates of each sampling station can be found in Appendix B.


**Figure 2: Shediac and Scoudouc river sampling locations.**

## Shediac A (ShdA)

This water quality sampling site is located on the main branch of the Shediac River, off of Route 115 in Irishtown. The sample is taken upstream of a culvert that crosses Route 115. The surrounding land use includes residences, farmlands, a subdivision and a golf course (Figure 3).

Fields on both sides of the river are used for the cultivation of hay and for grazing cattle. There is a cattle fence along the river, with an access point upstream of the sampling site for cows to cross. A section of the river near this crossing area has a thin buffer zone (> 10 m) or none in some areas.

An apple orchard was established in 2016-2017 approximately 200 m south of the sampling site. A large area of vegetation was cleared for the apple trees, with no tree buffer to help prevent drainage from the fields from reaching the river.

Next to the orchard is another plot of land (20 ha) that was previously used for agriculture. Records show this land is currently being developed into a subdivision with up to 185 individual lots.


**Figure 3: ShdA site location and surrounding land uses.**

The golf course is located just north of the river, approximately 500 m from the sample site. The sampling parameters used in this report may not include the detection of certain chemicals present in pesticides that are commonly used in golf courses. It is unknown whether or not the golf course uses pesticides and/or fertilizers on their greens.

## Shediac B (ShdB)

This water quality sampling site is located on the McQuade Brook, off of Scotch Settlement Road in Scotch Settlement. The sample is taken upstream of a culvert that crosses Scotch Settlement Road. The surrounding land use includes individual residences, farmlands, and a mineral extraction pit (Figure 4).

Most of the runoff from agricultural fields in the area would flow into other small tributaries of the McQuade Brook, converging at a lower point in the system. The gravel/mineral pit is approximately 3 km upstream of the sampling site. The buffer zone in the area of the pit ranges from 20 – 200 m or more in width. The McQuade Brook is made up of lots of small tributaries from around McQuade and Scotch Settlement, which are areas with farms and clear-cuts from past logging activity.


**Figure 4: ShdB site location and surrounding land uses.**

## Shediac C (ShdC)

This water quality site is located on the main branch of the Shediac River at the bridge on MacLean Crossing Road (at the junction of Shediac River Road and Cape Breton Road). The sample is taken upstream of the bridge. The surrounding land use is mainly residences and forested land (Figure 5). This site is located 5.3 km downstream of site ShdA; there is little more than houses and cabins between the two sites. From aerial imagery, there is evidence of an ATV crossing approximately 1.6 km downstream of the site.


**Figure 5: ShdC site location and surrounding land uses.**

## Shediac E (ShdE)

This water quality sampling site is located on the main branch of the Shediac River, at the Joshua Gallant Covered Bridge. The sample is taken upstream of the bridge. The surrounding land use is mainly residences, forested land and ATV trails (Figure 6). A set of transmission lines cross overhead of the site. There are some clear-cut lots further upstream along the river. This location is popular with individuals; remnants of camp fires are often found and there is usually some trash around the site.


**Figure 6: ShdE site location and surrounding land uses.**

## Shediac G (ShdG)

This site is located on the Weisner Brook, at the small bridge on St Phillipe Road. The sample is taken upstream of the bridge. The surrounding land use include residences, farmlands, forested land and a mineral extraction pit (Figure 7).

The Weisner Brook is a major tributary of the Shediac River; a combination of many small streams and the Calhoun Brook. A defining characteristic of this brook is its cold-water temperatures. This is due to long stretches of forested riparian area and cold spring inputs into its tributaries. The Weisner Brook is recognized by the Department of Natural Resources as a "summer resting refuge for mature trout" due to the cooler temperatures.

In addition, the Department of Fisheries and Oceans Canada has placed a variation order (GVO-2004-004) on this watercourse that prohibits any retention of brook trout after June 14$^{th}$ within the Weisner Brook, "from its confluence with the Shediac River upstream to its source, including all tributaries."


**Figure 7: ShdG site location and surrounding land uses.**

Several areas along the brook have thin buffer zones (> 10 m) made up of shrubs. To the left of the sampling site (looking upstream) just above the bridge, is an area that was recently transformed into an agricultural field. In 2017-2018, the buffer zone was cut and the field was tilled in preparation for planting. The clearing reached the riverbank, leaving little vegetation along the 175 m stretch. Alders and shrubs have since recolonized the riverbank area. The SBWA took steps in 2022 to plant trees and create a sediment trap and waddle fence in this area to reduce the amount of sediment and runoff entering the brook.

A gravel/mineral pit is located in the upper reaches of the Weisner Brook, over 3.3 km upstream. There is a forested buffer between the pit and brook of about 160 m. Further upstream from the pit are several farm fields and clear-cut areas, with good buffer strips separating the fields from the brook.

## Shediac H (ShdH)

This water quality site is located on the Batemans Brook, at the culvert on Bateman Mill Road. The sample is taken upstream from the culvert. The surrounding land use includes individual residences and farm fields for both the cultivation of hay and the grazing of cattle (Figure 8). A small pig farm is evident on aerial imagery just upstream of the site, but it is unknown whether there is still any activity. Further upstream are several active and/or recently active logging sites with small buffer zones between the cut area and brook, ranging from 10 – 20 m in width.


**Figure 8: ShdH site location and surrounding land uses.**

## Scoudouc B (ScdB)

This site is located on the main branch of the Scoudouc River, at the bridge on Route 132 next to the Waggin' Tale Inn. The sample is taken downstream of the bridge. The surrounding land use includes residences, the Greater Shediac Sewage Commission's aeration lagoons, the Scoudouc Industrial Park, Highway 15 and some forested land (Figure 9).


**Figure 9: ScdB site location and surrounding land uses.**

The sample site is upstream from the sewage commission's treated wastewater discharge pipe. The property to the left of the sampling site mows the lawn up to the riverbank, leaving only a few shrubs and grasses near the bank. Another property upstream of the bridge has similar mowing trends. Erosion is evident on the left bank. The industrial park has approximately 1 km of forested land between the edge of the property and the wetlands and drainage system.

## Scoudouc E-2 (ScdE-2)

This site is located on the main branch of the Scoudouc River, accessed through private property with landowner permission. Off Scoudouc River Road, there is a large field that staff uses to access a trail in the far-right corner. The path is marked down to the river. The site is approximately 11 km downstream from the sewage commission's aeration lagoons. The surrounding land use consists of residences, forested land, wetlands, ATV trails, and a mineral extraction pit (Figure 10). The pit has a wide buffer (> 350 m) between the outer limit and the beginning of the wetlands surrounding the river.

It was discovered that from 1999-2003 the sample for this site was taken approximately 1 km downstream of the current location. The original ScdE was located under the transmission lines crossing the Scoudouc River, and was most likely reached using an ATV. In 2005-2006, it is believed that staff found a different way of getting close to the area by contacting landowners and gaining permission to access the river. Since it is not in the exact location, the site code was changed to ScdE-2.


**Figure 10: ScdE-2 site location and surrounding land uses.**

## Scoudouc F (ScdF)

This water quality sampling site is located on an unnamed tributary of the Scoudouc River, accessed from Pellerin Road, located off Lino Road. The sample is taken downstream of the culvert crossing Lino Road. The surrounding land use includes cottages, forests, wetland, ATV trails, and at the headwaters, a bog being used to harvest peat moss (Figure 11). The peat moss extraction site spans over 200 ha as measured on aerial imagery from 2017.


**Figure 11: ScdF site location and surrounding land uses.**

## Scoudouc H (ScdH)

This site is located on the Cornwall Brook, and is accessed through a private road with landowner permission. The small road is located past the end of Harbour View Drive, behind the Seaside Chevrolet Dealership. The surrounding land use includes residences, agricultural and cattle fields, Highway 15, a mineral extraction pit, transmission lines and the Scoudouc Industrial Park (Figure 12).

The farm fields on either side of the sampling site have buffer zones ranging from 10 – 30 m in width. There is a beaver dam upstream of the site, and beaver activity has reduced the density of trees in the area. Clear-cut areas upstream now serve as cattle pastures, and seem to have buffer zones of 25 m or more. The gravel pit upstream has a forested buffer over 400 m, however it does seem there is a drainage near the pit that flows towards the brook. The headwaters of the Cornwall Brook are located near the Scoudouc Industrial Park. There is forested land between the industrial zone and the wetlands, and based on approximate land elevations, there does not appear to be drainage leading toward the brook.


**Figure 12: ScdH site location and surrounding land uses.**

It was discovered that during the water classification sampling years 1999-2003, the site ScdG was actually located in the higher reaches of the Scoudouc River, just above the Trans-Canada Highway. When the sampling program was restarted in 2005-2006, it is unknown why the station was changed to the Cornwall Brook, but the site code remained the same. Therefore, the station ID was changed to ScdH, and all data taken since 2006 under the site ID ScdG will now be compared to the data under the site name ScdH.

### 2.2.2 Shediac Bay Small Stream Sampling

The following describes the sample site information for the 11 small stream water quality monitoring stations established in 2017. Figure 13 shows an aerial view of the location of each site within the watershed. Photographs and coordinates of each sampling station can be found in Appendix C.

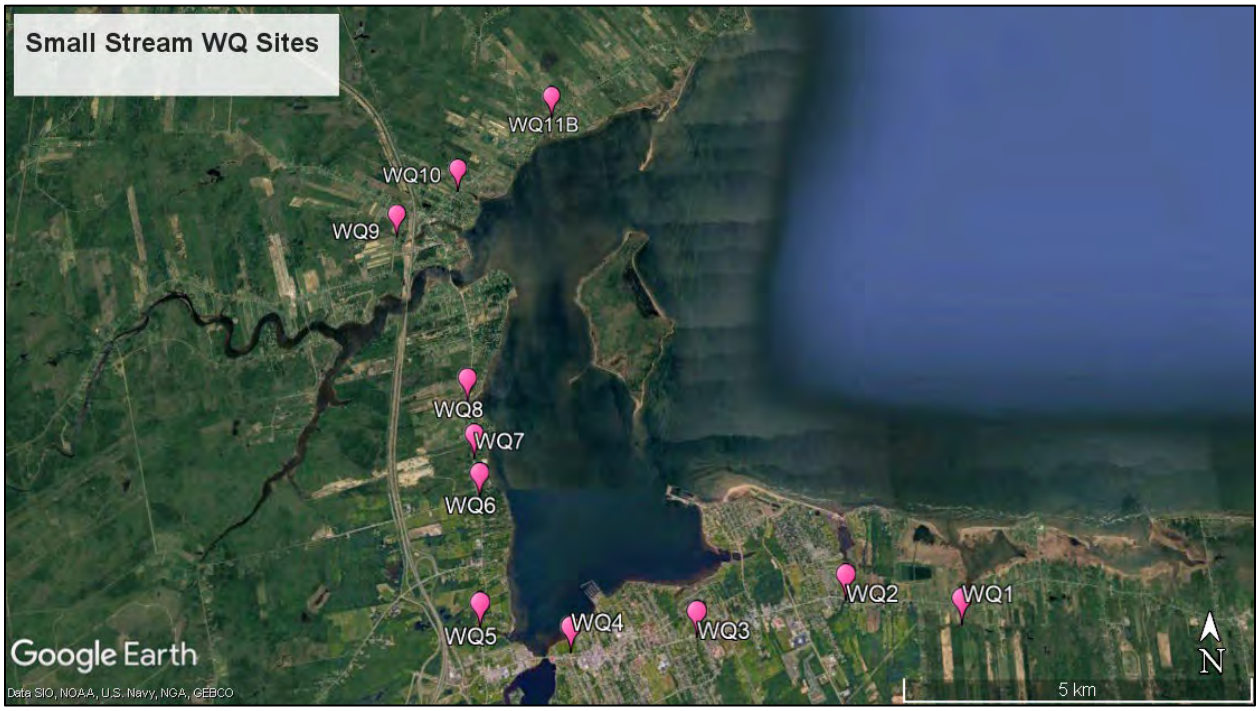



**Figure 13: Small stream sampling locations.**

## Water Quality 1 (WQ-1)

This site is located in a residential area in Boudreau-West, and is accessed from a private road with landowner permission off of Route 133. The samples are taken upstream of the culvert that crosses the dirt road. The surrounding land use includes agricultural fields, gravel pits, and Highway 15 (Figure 14). The buffer zone dividing the stream and the farm fields ranges between 15 and 50 m in width. 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.

This stream joins the Shediac Bay approximately 1 km downstream of the sampling site. The 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. This water quality station is located higher than the highest tidal zone.


**Figure 14: WQ-1 site location and surrounding land uses.**

## Water Quality 2 (WQ-2)

This water quality sampling site is also located in a residential area in Boudreau-West on Route 133. The samples are taken upstream of the culvert crossing Route 133. The surrounding land use is mainly residences, roads, and a drive-in movie theatre upstream of the site (Figure 15). Below the culvert of Route 133, directly below the sampling site, is the beginning of a provincially regulated freshwater wetland. The wetland is approximately 170 m in length. It transitions to a coastal salt marsh at the highest tidal point.


**Figure 15: WQ-2 site location and surrounding land uses.**

Within the salt marsh area is Ocean Surf RV Park-Camping. There are no trees between the campground and the wetland and brook area; the buffer zone is only comprised of wild grasses and some shrubs. The SBWA has been working with Ocean Surf to improve this area. A living shoreline workshop held in 2020 concentrated on restoring 225 m of coastline around the campground. Improvements were made to the site in 2021.

## Water Quality 3 (WQ-3)

This water quality sampling site is located in a residential and commercial area within the Town of Shediac, directly off Main Street, next to the Shediac Bakery. The samples are taken upstream of the culvert. The surrounding land use upstream includes a large residential sector up to the headwaters below Highway 15 (Figure 16). It is important to note that most of the riparian zone along this brook has inadequate buffer zones of less than 15 m in width. This unnamed brook reaches the tidal zone approximately 400 m downstream of the sampling site. A new fast food restaurant and large apartment complex have been built on the opposite side of the brook from the bakery within the past year.


**Figure 16: WQ-3 site location and surrounding land uses.**

## Water Quality 4 (WQ-4)

This site is located behind the Shediac Town Hall building. There is a culvert where the brook exits an underground canal along the edge of the parking lots for the Town Hall building and Auberge Gabriele's Inn & Restaurant. The sample is taken directly below this culvert. The surrounding land use is mainly residential, with some roads and business parking lots (Figure 17).

A part of this brook is channelled in an underground pipe somewhere along Chesley Street, before reaching Main Street. There is also a dog park upstream 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 surrounding area. The brook flows into the Shediac Bay approximately 200 m downstream from the sampling site.

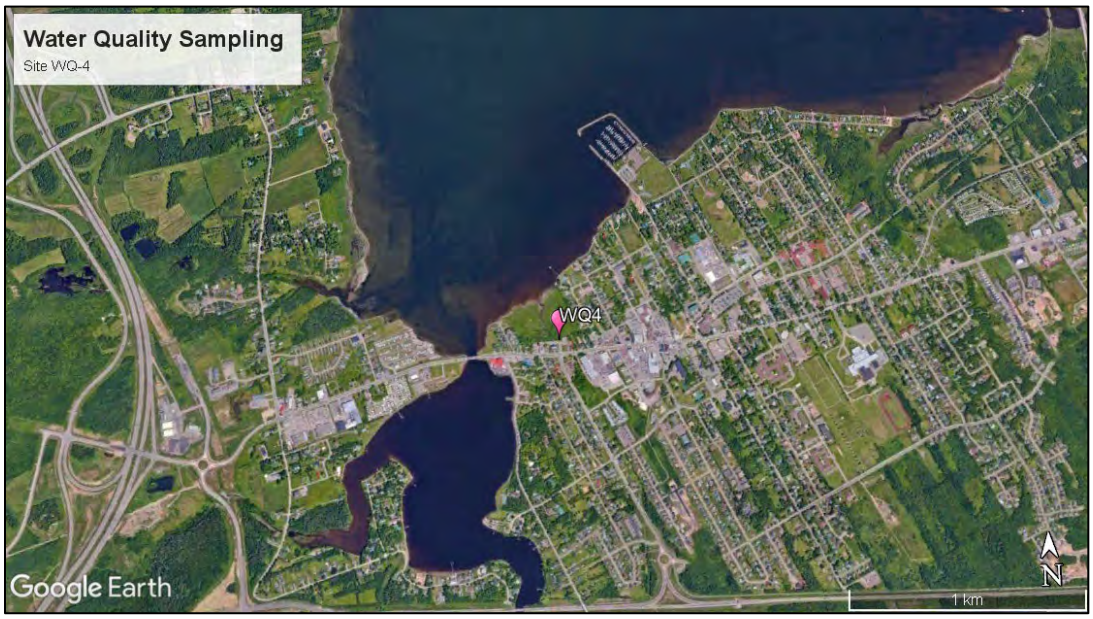



**Figure 17: WQ-4 site location and surrounding land uses.**

## Water Quality 5 (WQ-5)

This water quality sampling site is 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 this culvert. The site is located approximately 90 m from the tidal zone and the beginning of a salt marsh.

The surrounding land use is mostly residential, with some forested land and farm fields (Figure 18). The riparian area around the residential properties has a thin buffer (< 15 m), but this constitutes only small sections of the brook. There are adequate buffer zones between the farmlands and the head pond of this brook; 25 – 50 m in width. 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 visible buffer zone.


**Figure 18: WQ-5 site location and surrounding land uses.**

## Water Quality 6 (WQ-6)

This water quality site is located off Route 134, past Shediac Cape School next to Old Mill Road. The samples are taken downstream of the culvert crossing Route 134 to capture water coming from both Old Mill Road and along Route 134. The sample site is located approximately 175 m from the tidal zone.


**Figure 19: WQ-6 site location and surrounding land uses.**

The surrounding land use includes residences, farm fields for hay and cattle grazing, and a gravel pit (Figure 19). There is very little 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 visible tracks that cross the brook in one particular area and animals are visible in aerial views from several years. There does not appear to be any buffer between the gravel pit and the brook. Heading further upstream is a forested lot with a healthier looking riparian zone. The next parcel leading up to the end of the brook hear Highway 11 consists of cow pastures; cow tracks and cattle fencing an be seen on serial imagery. There is more vegetation in the buffer zones in this field, ranging from 5 – 30 m in width.

## Water Quality 7 (WQ-7)

This site is located off of Route 134, on the property of Bay Vista Lodge & Cottages. The samples are taken upstream of the culvert crossing Route 134. The site is located approximately 160 m from the tidal zone and the beginning of a salt marsh. This brook is very short; the only obvious source of water is a pond (1,700m$^2$) approximately 200 m upstream behind the cottages. The surrounding land use is mainly residential, however, there appears to be a large gravel pit west of the sampling site (Figure 20).

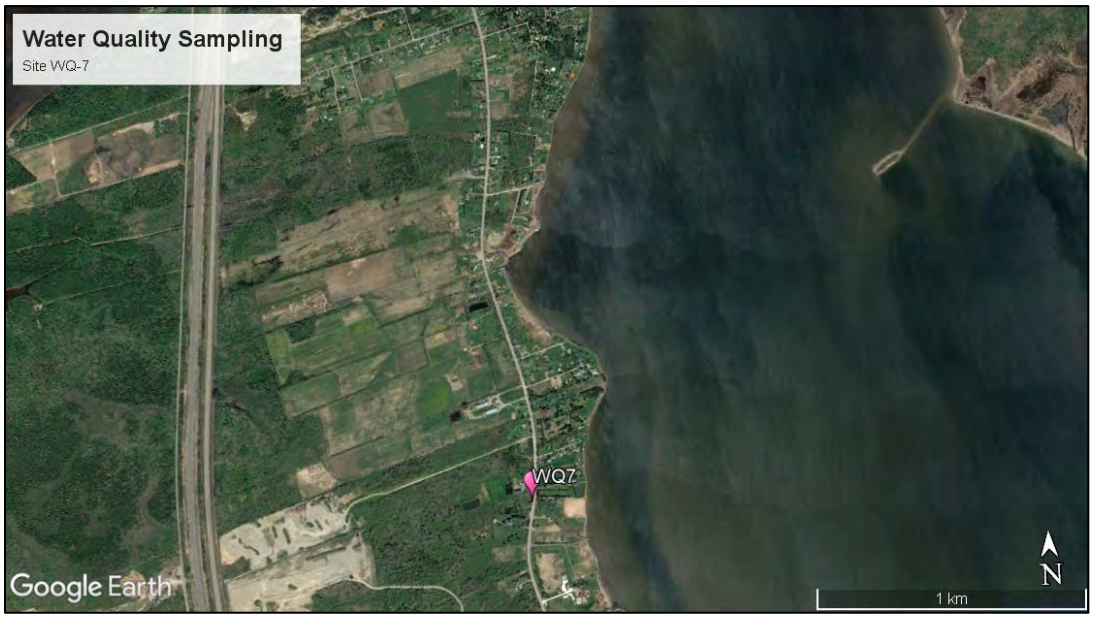



**Figure 20: WQ-7 site location and surrounding land uses.**

## Water Quality 8 (WQ-8)

This water quality site is located along Route 134 in Shediac Cape. The site is within the tidal zone approximately 75 m from the outlet into the Shediac Bay. The samples are taken upstream of the culvert.

The surrounding land use includes residences and farmlands, including a chicken farm (Figure 21). The farm fields possess little to no buffer zone or riparian area. Observations taken during the sampling include dark colouration and bad odours in the water.


**Figure 21: WQ-8 site location and surrounding land uses.**

## Water Quality 9 (WQ-9)

This site is located on the Albert-Gallant Brook, off Babineau Access Road, 320 m after turning to the left off Viaduc Road in the Shediac Bridge area. The samples are taken downstream of the culvert, due to flooding on the opposite side caused by a beaver dam. The sample site is located approximately 300 m from the tidal zone.

The surrounding land use is mainly residential with several large agricultural fields (Figure 22). There is farmland along the right side of the brook (looking upstream) with no buffer zone along the length of its riverbank (100 m). On the left side is a much larger cultivated field that is 14.6 ha and a small lot that is 5.3 ha. The drainage from these fields flows down to a ditch along Babineau Access Road, and may flow into the brook. There are no trees around any of these farm fields. Bastarache's Auto Salvage is located upstream, but there is approximately 1 km of forested buffer between the salvage lot and the head pond of the brook.


**Figure 22: WQ-9 site location and surrounding land uses.**

## Water Quality 10 (WQ-10)

This water quality sampling site is located off Route 530 (Grande-Digue Road), 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 use is mainly residential and small farm fields (Figure 23). There is a buffer zone that separates the fields and the brook that ranges from 5 – 15 m in width.


**Figure 23: WQ-10 site location and surrounding land uses.**

### Water Quality 11B (WQ-11B)

This site is also located off Route 530, just before Chemin des Soeurs. The samples are taken upstream of the culvert. The site is located approximately 80 m from the tidal zone.

The surrounding land use is mainly residential and agricultural (Figure 24). The farm lands are made up of many parcels, spanning over 58 ha leading up to the watershed boundary. There is little evidence of any tree buffer in this area from aerial imagery, except for one forested parcel and a few thin lines of trees along property lines.


**Figure 24: WQ-11B site location and surrounding land uses.**

## 2.3 Water Quality Parameters

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

### 2.3.1 Water Temperature

Water temperature can fluctuate depending on time of day and seasonal changes. Values are influenced by numerous factors like tree canopies providing shade, water velocity and depths, presence of cold springs, etc. It is considered that water above 25°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 22.5 °C are said to cause thermal stress to salmonid populations, causing them to stop feeding and search for thermal refugia (Crisp, 1993).

### 2.3.2 Potential Hydrogen (pH)

The potential hydrogen (pH) level indicates if the water is acidic or basic. It can affect how other substances, such as chemicals and heavy metals, dissolve in the water. Many aquatic organisms are sensitive to changes in pH and may be adversely affected by pH values that are either too high or too low. pH varies naturally depending on bedrock, climate and vegetation cover, but may also be affected by industrial or other effluents, the exposure of some types of rock, or drainage from mining operations. According to the *CCME Recommended Guidelines for the Protection of Aquatic Life*, pH should be between 6.5 and 9 (CCME, 2022). As pH levels move away from this range it can stress animal systems and reduce hatching and survival rates in the stream.

### 2.3.3 Dissolved Oxygen

Dissolved oxygen (DO) represents the concentration of oxygen in the water that is available to aquatic living organisms. Most of the oxygen in the water comes from the atmosphere and is mixed into the water through turbulence and current. The measurement of the concentration of dissolved oxygen in surface water is essential for measuring changes in water condition and evaluating water quality. Dissolved oxygen is essential for the survival of fish and many other forms of aquatic life. Dissolved oxygen varies with temperature and tends to be lower when the water temperature is high. According to the *CCME Recommended Guidelines for the Protection of Aquatic Life*, 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 (CCME, 1999).

### 2.3.4 Conductivity

Conductivity is the measurement of the ability of water to pass an electrical current. It is influenced by the amount of inorganic dissolved solids (nitrate, chloride, sulfate, sodium, etc.) found in the water. Conductivity levels 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 support a good mixed fishery (EPA, 2012). Consequently, a higher conductivity level may indicate a higher amount of dissolved material in the water and the presence of contaminants.

### 2.3.5 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 the 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 *CCME Recommended Guidelines for the Protection of Aquatic Life* for Nitrate-nitrogen is 3.0 mg/l (NO3) (CCME, 2012). Values above this number could lead to an impact on aquatic life.

### 2.3.6 Phosphates

Phosphates exist in different forms: orthophosphate, metaphosphate and organic compounds contain phosphorus. These forms of phosphate occur in living and decomposing plants and animals as free ions, chemically bonded in aqueous systems or mineralized compounds in sediments, soils and rocks. Large amounts of phosphate coming from cleaning products (detergents), run off from agriculture and residential fertilizer, can lead to eutrophication. Soil erosion is a major contributor of phosphorus in streams. It is recommended by Environment and Climate Change Canada to apply the Canadian Framework for Total Phosphorus (CCME, 2004). 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.

### 2.3.7 Escherichia coli

Escherichia coli (*E. coli*) is one of many species of bacteria living in the lower intestines of mammals. The presence of *E. coli* in water is a common indicator of fecal contamination. The acceptable count of *E. coli* in water for recreational purposes is set at 235 MPN/100 ml through the *Guidelines for Canadian Recreational Water Quality* (Health Canada, 2023).

### 2.3.8 Aluminum

A high concentration of aluminum due to non-point sources such as rain and snowmelt leaching can pose a risk to fish in freshwater habitats. Ionoregulatory and osmoregulatory complications can develop in fish where aluminum concentrations exceed the CCME guideline of 5 μg/L when the pH is less than 6.5, and 100 μg/L when the pH is greater than or equal to 6.5 (CCME, 2022). Furthermore, respiratory problems can occur due to the precipitation of aluminum on the gills, as the positively charged aluminum ion binds with the negatively charged epithelium of the gill.

Many of Atlantic Canada's freshwater habitats naturally contain aluminum concentrations that often exceed the *CCME Recommended Guidelines for the Protection of Aquatic Life*, however, many fish species are abundant in New Brunswick's rivers. This increased amount of aluminum and other metals is often accompanied by runoff of organic carbon due to Atlantic Canada's relatively flat topography and impermeability (Dennis & Clair, 2012). The organic carbon possesses a negatively charged carboxylic functional group, which attracts and binds with the positively charged dissolved aluminum ion. This neutralizes the aluminum ion, rendering it inert and therefore unable to bind with the negatively charged epithelium of the fish gill. Despite this, aluminum ion levels in Atlantic Canada can still reach levels dangerous to fish (Dennis & Clair, 2012).

### 2.3.9 Iron

Iron enters freshwater habitats in a similar manner to aluminum. Rain and snowmelt leach iron from rocks and watershed soils, and the runoff enters rivers and streams. Anthropogenic sources, such as wastewater and storm water discharges, are also non-point sources of iron in freshwater habitats. The CCME guideline for iron is 0.3 mg/L (CCME, 2022). A high concentration of iron may cause physiological and/or morphological changes in aquatic plant species (Xing & Liu, 2011).

### 2.3.10 Copper

Because copper is an essential metal, aquatic organisms have developed methods of copper regulation in the body. Despite this, however, copper toxicity is still possible at high concentrations (Brix, Deforest, & Adams, 2001). The CCME guideline for copper can be determined through an equation based on hardness (CCME, 2022).

### 2.3.11 Lead

In the case of lead, the *CCME Recommended Guidelines for the Protection of Aquatic Life* are as follows: when the hardness ($CaCO_3$) ranges from 0-60 mg/L, the limit is set at 1 μg/L; from 60-120 mg/L the limit is 2 μg/L; from 120-180 mg/L the limit is 4 μg/L; and when the hardness is higher than 180 mg/L the limit is 7 μg/L (CCME, 2022). The combination of low dissolved oxygen and toxic chemicals may lead to stress responses in aquatic organisms. The toxicity of zinc, lead, copper, and ammonia are enhanced by low dissolved oxygen levels. Dissolved metals may be removed from the water column by adsorption, precipitation, and co-precipitation processes. Lead, for example, is strongly adsorbed to particles and can be removed from the water column and concentrated in sediments (Canadian Council of Ministers of the Environment, 2008).

## 2.4 Health Canada - Guidelines for Canadian Recreational Water Quality

**Table 1: Guidelines for Canadian Recreational Water Quality.**

| GUIDELINES FOR HEALTH CANADA RECREATIONAL WATER QUALITY | | |
|---|---|---|
| **Parameter** | **Considerations** | **Guideline** |
| *Escherichia coli* (Primary Contact Recreation) * | Single sample maximum concentration | ≤ 235 *E. coli*/100mL |
| Enterococci (Primary Contact Recreation) * | Single sample maximum concentration | ≤ 70 Enterococci/100mL |
| *Advice regarding waters intended for secondary-contact recreational activities is provided in Section 7.0 of the *Guidelines for Canadian Recreational Water Quality Guideline Technical Document.* | | |
| https://www.canada.ca/content/dam/hc-sc/documents/services/publications/healthy-living/recreational-water-quality-guidelines-indicators-fecal-contamination/recreational-water-quality-guidelines-indicators-fecal-contamination.pdf | | |

## 2.5 CCME – Water Quality Guidelines for the Protection of Aquatic Life (Freshwater)

**Table 2: Summary of the WQ Guidelines for the Protection of Aquatic Life.**

| 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: ALK_T, Ba, Be, HCO3, Bi, BR, Ca, CO3, Co, COND, Cr, F, HARD, K, Land_Ind (20˚C), Li, Mg, Mn, Na, NOX, Rb, pH (Sat), Sb, Sn, SO4, Sr, TDS, Te, TKN, TOC, TP-L, TURB, V.<br><br>† 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.<br>‡ There is no limit for the protection of aquatic wildlife. The limit of 235MPN/100mL for the protection of environmental and human health is used instead. |
| 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 | **235 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 (as N) | — | — | Upper | **0.06** | — | |
| NO3 (as N) | Short-Term | **124** | Long-Term | **3** | — | |
| Pb | HARD≤60 | **0.001** | HARD>180 | **0.007** | EXP(1.273*LN(HARD)-4.705) | |
| pH | Lower L-T | **0.0065** | Upper L-T | **0.01** | — | |
| Se | — | — | Upper | **0.001** | — | |
| Tl | — | — | Upper | **0.0008** | — | |
| U | Short-Term | **0.033** | Long-Term | **0.015** | — | |
| Zn | — | | Upper | **0.03** | — | |

**Table 3: Summary of the WQ Guidelines for the Protection of Aquatic Life (other).**

| CCME RECOMMENDED GUIDELINES FOR THE PROTECTION OF AQUATIC LIFE (FRESHWATER) SUMMARY OF OTHER PARAMETERS | | | | | |
|---|---|---|---|---|---|
| **Parameter** | **Description** | **Value** | **Units** | | **Notes** |
| Dissolved Oxygen † | 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 235 MPN/10mL is for the protection of environmental and human health is used instead. |
| | Upper long-term limit | **9** | — | | |
| *E. coli* ‡ | Upper limit | **235** | MPN/100mL | | |

**Table 4: CCME Guidance Framework for Total 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 life (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 |

**Table 5: CCME WQ Guidelines for the Protection of Aquatic Life for Nitrates.**

| CCME RECOMMENDED GUIDELINES FOR THE PROTECTION OF AQUATIC LIFE (FRESHWATER) SUMMARY | | | | |
|---|---|---|---|---|
| **Parameter** | **Condition** | **Value (mg/L)** | **Condition** | **Value (mg/L)** |
| NO3 | Short-term | **124** | Long-term | **3** |

## 2.6 Terms and Definitions

All data collected during the sampling season has been organized in three 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** |
| Temperature | ˚C | Air and water temperature measured in degrees Celsius. |
| SAL | Ppt | Salinity measures in parts per thousand. |
| Dissolved Oxygen | 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 milliliters. |
| 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. |
| Land 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** |
| HCO3 | mg/L | Bicarbonate measured in milligrams per litre. | NH3_Un | µg/L | Ammonia unionized at 20˚C measured in micrograms per litre. |
| Br | µg/L | Bromine measured in micrograms per litre. | NO2 | µg/L | Nitrite measured in micrograms per litre. |
| Ca | mg/L | Calcium measured in milligrams per litre. | NO3 | µg/L | Nitrate measured in micrograms per litre. |
| CO3 | µg/L | Carbonate measured in micrograms per litre. | NOX | µg/L | Nitrite + Nitrate measured in micrograms per litre. |
| Cl | mg/L | Chloride measured in milligrams per litre. | SO4 | 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 | mg/L | Total phosphorus measured in milligrams per litre. |
| NH3 | µg/L | Total ammonia measured in micrograms per litre. | — | — | — |

**Table 8: Terms and definitions for inorganics 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. |

## 2.7 Water Quality Index

The CCME Water Quality Index (WQI) is a tool that can be used to summarize complex water quality data and help communicate it to a general audience. The WQI incorporates three elements: scope – the number of parameters not meeting water quality guidelines; frequency – the number of times these guidelines are not met; and amplitude – the amount by which the guidelines are not met. The Index provides a number between 0 and 100 that describes water quality. These numbers are divided into four categories:

- Excellent (WQI 95-100) – water quality is protected with a virtual absence of threat or impairment; conditions very close to natural or pristine levels.
- Good (WQI 80-94) – water quality is protected with only a minor degree of threat of impairment; conditions rarely depart from natural or desirable levels.
- Fair (WQI 65-79) – water quality is usually protected but occasionally threatened or impaired; conditions sometimes depart from natural or desirable levels.
- Marginal (WQI 45-64) – water quality is frequently threatened or impaired; conditions often depart from natural or desirable levels.
- Poor (WQI 0-44) – water quality is almost always threatened or impaired; conditions usually depart from natural or desirable levels.

The specific parameters, guidelines and time periods used in the calculation of the WQI are not specified, and can vary from region to region depending on local conditions, purpose of the use of the index, and water quality issues. It is recommended that at a minimum, four parameters sampled at least four times per year be used in the calculation of the WQI. Sites should only be compared when the same parameters, guidelines, time periods and a number of samples are used.

The SBWA have chosen 11 parameters to use in the calculation of the WQI for each of the Shediac and Scoudouc river sites, and 10 parameters for each of the small stream sites. (Table 9). These parameters are the same ones that are used in the IWMP for the Shediac Bay Watershed (see Section 8 for more information). Guidelines for each of the parameters reflect those of the *CCME Recommended Guidelines for the Protection of Aquatic Life*. For total phosphorus, Ontario's total phosphorus guideline of 0.03 mg/L is used (OMOEE, 1994). For more information on each of these parameters and their associated guidelines, refer to Table 4.

Chloride is a major component of salt water, and therefore is recorded in extremely high numbers at several of the small stream sites, due to their proximity to the Shediac Bay and that certain sites are influenced by the tide. Because of this, chloride was excluded from the WQI calculation at the small stream sites due to its impact on the overall score for each site.

**Table 9: Parameters used in the calculation of the WQI.**

| Metals/Metalloids | Nutrients | Major Ions | General Chemistry |
|---|---|---|---|
| Arsenic | Total Ammonia | Chloride* | Dissolved Oxygen |
| Copper | Nitrate | | pH |
| Iron | Total Phosphorus | | Turbidity |
| Zinc | | | |
| *Chloride was not included in the WQI calculation of the small stream sites due to tidal influence at certain sites. | | | |

# 3. RESULTS

## 3.1 Shediac and Scoudouc River Sampling

The following section contains the results on the data collected during water quality monitoring in 2022. All water samples were assigned with a designated field number so that they can be logged into the NB DELG database.

The purpose of a long-term monitoring program is to evaluate a waterbody under various conditions, such as changes in surrounding land uses and changes in climate patterns. A long-term monitoring program establishes baseline trends in water quality and can detect abnormalities and significant changes over time.

In 2022, all Shediac and Scoudouc river samples were collected under ambient conditions. No planned rain sampling was done in 2022.

### 3.1.1 ShdA

The water sampling results for site ShdA in 2022 met or exceeded the *CCME Recommended Guidelines for the Protection of Aquatic Life* based on pH and dissolved oxygen. Water temperature exceeded the 22.5˚C limit for thermal stress in salmonids in July (Table 10).

Bacterial levels did not exceed the maximum concentration of *E. coli* from the *Guidelines for Canadian Recreational Water Quality* (≤ 235 MPN/100 mL) (Table 10).

Total phosphorus levels for long-term eutrophic conditions, according to the *CCME Guidance Framework for Total Phosphorus*, were in the mesotrophic range (0.010–0.020 mg/L) from June to August and in the meso-eutrophic range (0.020–0.035 mg/L) in September (Table 11).

Concentrations of aluminum exceeded the *CCME Recommended Guidelines for the Protection of Aquatic Life* (0.100 mg/L, pH ≥ 6.5) in September. The concentration of iron exceeded the guideline of 0.3 mg/L in July and September (Table 12).

Due to severe weather conditions causing safety concerns (thunderstorm), sample collection from this site did not occur in June.

**Table 10: Water chemistry data and *E. coli* results for ShdA, 2022.**

| SITE ShdA: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Date (yy-mm-dd) | Temp (˚C) | | SAL (ppt) | DO (mg/L) | *E. coli* (MPN/100 mL) | ALK_T (mg/L) | CLRA (TCU) | COND (mS/cm) | |
| | Air | Water | | | | | | Field | Lab |
| 22-07-26 | 27 | 22.9 | 0.12 | 7.69 | 41 | 91 | 18 | 0.235 | 0.231 |
| 22-08-29 | 26 | 19.0 | 0.11 | 9.75 | 41 | 79 | 21 | 0.209 | 0.225 |
| 22-09-28 | 19 | 14.2 | 0.06 | 10.55 | 63 | 44 | 53 | 0.107 | 0.133 |
| Date (yy-mm-dd) | HARD (mg/L) | Lang_Ind (20˚C) | pH | | | TDS (mg/L) | | TURB (NTU) | — |
| | | | Field | Lab | Sat (20˚C) | Field | Lab | | |
| 22-07-26 | 106.0 | 0.31 | 8.36 | 8.2 | 7.9 | 159.25 | 141 | 1.8 | — |
| 22-08-29 | 96.3 | 0.21 | 8.50 | 8.2 | 8.0 | 154.05 | 135 | 1.6 | — |
| 22-09-28 | 47.4 | -0.83 | 7.51 | 7.7 | 8.5 | 87.95 | 83 | 5.0 | — |

**Table 11: Nutrient results for ShdA, 2022.**

| SITE ShdA: 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) |
| 22-07-26 | 89.6 | 0.02 | 33.9 | 1.330 | 14.0 | 0.15 | 0.79 | 5.23 | 7.6 | <0.05 |
| 22-08-29 | 77.8 | 0.02 | 30.5 | 1.160 | 13.5 | 0.16 | 0.85 | 4.90 | 8.32 | <0.05 |
| 22-09-28 | 43.8 | 0.02 | 14.4 | 0.206 | 10.7 | 0.20 | 0.82 | 2.79 | 6.9 | <0.05 |
| Date (yy-mm-dd) | NH3T_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) | — |
| 22-07-26 | <0.001 | <0.05 | 1.02 | 1.02 | 19 | — | 1.0 | 2.9 | 0.012 | — |
| 22-08-29 | <0.001 | <0.05 | 1.22 | 1.22 | 18 | — | 1.2 | 4.7 | 0.011 | — |
| 22-09-28 | <0.001 | <0.05 | 0.56 | 0.56 | 9 | — | 0.8 | 8.4 | 0.026 | — |

**Table 12: Inorganics results for ShdA, 2022.**

| SITE ShdA: HEAVY METALS AND OTHER ELEMENTS | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Date (yy-mm-dd) | Al (mg/L) | As (mg/L) | B (mg/L) | Ba (mg/L) | Cd (mg/L) | Co (mg/L) | Cr (mg/L) | Cu (mg/L) | Fe (mg/L) | Li (mg/L) |
| 22-07-26 | 0.067 | <0.001 | 0.052 | 0.052 | <0.00001 | <0.0001 | <0.001 | <0.001 | 0.42 | 0.0025 |
| 22-08-29 | 0.050 | <0.001 | 0.045 | 0.045 | <0.00001 | <0.0001 | <0.001 | <0.001 | 0.29 | 0.0024 |
| 22-09-28 | 0.141 | <0.001 | 0.034 | 0.034 | <0.00001 | 0.0001 | <0.001 | 0.001 | 0.36 | 0.0012 |
| Date (yy-mm-dd) | Mn (mg/L) | Mo (mg/L) | Ni (mg/L) | Pb (mg/L) | Rb (mg/L) | Sb (mg/L) | Sr (mg/L) | U (mg/L) | V (mg/L) | Zn (mg/L) |
| 22-07-26 | 0.003 | 0.0025 | <0.001 | 0.0003 | 0.0012 | 0.0001 | 0.406 | 0.0021 | <0.001 | 0.005 |
| 22-08-29 | 0.002 | 0.0024 | <0.001 | <0.0001 | 0.0010 | 0.0001 | 0.356 | 0.0021 | <0.001 | 0.001 |
| 22-09-28 | 0.001 | 0.0012 | <0.001 | 0.0003 | 0.0008 | <0.0001 | 0.167 | 0.0005 | <0.001 | 0.002 |

### 3.1.2 ShdB

The water sampling results for site ShdB in 2022 met or exceeded the *CCME Recommended Guidelines for the Protection of Aquatic Life* based on pH. Levels of dissolved oxygen dropped below the guideline of 6.5 mg/L for general cold-water organisms in July. Water temperature exceeded the 22.5 ˚C limit for thermal stress in salmonids in July (Table 13).

Bacterial levels did not exceed the maximum concentration of *E. coli* from the *Guidelines for Canadian Recreational Water Quality* (≤ 235 MPN/100 mL) (Table 13).

Total phosphorus levels for long-term eutrophic conditions, according to the *CCME Guidance Framework for Total Phosphorus*, were in the mesotrophic range (0.010 – 0.020 mg/L) in July; in the oligotrophic range (0.004–0.010 mg/L) in August; and meso-eutrophic range (0.020–0.035 mg/L) in September (Table 14).

Concentrations of aluminum exceeded the *CCME Recommended Guidelines for the Protection of Aquatic Life* (0.100 mg/L, pH ≥ 6.5) in September. Iron levels exceeded the guideline of 0.3 mg/L in July, August and September (Table 15).

Due to severe weather conditions causing safety concerns (thunderstorm), sample collection from this site did not occur in June.

**Table 13: Water chemistry data and *E. coli* results for ShdB, 2022.**

| SITE ShdB: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Date (yy-mm-dd) | Temp (˚C) | | SAL (ppt) | DO (mg/L) | *E. coli* (MPN/100 mL) | ALK_T (mg/L) | CLRA (TCU) | COND (mS/cm) | |
| | Air | Water | | | | | | Field | Lab |
| 22-07-26 | 28 | **25.4** | 0.09 | **5.45** | 108 | 83 | 24 | 0.201 | 0.185 |
| 22-08-29 | 26 | 18.4 | 0.08 | 9.37 | 173 | 65 | 70 | 0.151 | 0.169 |
| 22-09-28 | 21 | 14.4 | 0.04 | 10.25 | 109 | 31 | 99 | 0.065 | 0.082 |
| Date (yy-mm-dd) | HARD (mg/L) | Lang_Ind (20˚C) | pH | | | TDS (mg/L) | | TURB (NTU) | — |
| | | | Field | Lab | Sat (20˚C) | Field | Lab | | |
| 22-07-26 | 70.8 | -0.31 | 7.96 | 7.8 | 8.1 | 129.35 | 111 | 1.4 | — |
| 22-08-29 | 63.2 | -0.46 | 8.23 | 7.8 | 8.3 | 112.45 | 96 | 1.1 | — |
| 22-09-28 | 29.7 | -1.48 | 7.33 | 7.4 | 8.9 | 52.65 | 56 | 3.1 | — |

**Table 14: Nutrient results for ShdB, 2022.**

| SITE ShdB: 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) |
| 22-07-26 | 82.5 | 0.05 | 21.5 | 0.489 | 14.8 | 0.18 | 0.98 | 0.98 | 12.6 | <0.05 |
| 22-08-29 | 64.6 | 0.04 | 18.9 | 0.383 | 12.0 | 0.18 | 0.89 | 0.89 | 10.9 | <0.05 |
| 22-09-28 | 30.9 | 0.02 | 8.8 | 0.073 | 6.8 | 0.32 | 0.56 | 0.56 | 5.4 | <0.05 |
| Date (yy-mm-dd) | NH3T_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) | — |
| 22-07-26 | <0.001 | <0.05 | <0.05 | <0.05 | 5 | — | 0.3 | 5.0 | **0.011** | — |
| 22-08-29 | <0.001 | <0.05 | <0.05 | <0.05 | 1 | — | 0.3 | 7.8 | **0.009** | — |
| 22-09-28 | <0.001 | <0.05 | <0.05 | <0.05 | <5 | — | 0.4 | 13.0 | **0.024** | — |

**Table 15: Inorganics results for ShdB, 2022.**

| SITE ShdB: HEAVY METALS AND OTHER ELEMENTS | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Date (yy-mm-dd) | Al (mg/L) | As (mg/L) | B (mg/L) | Ba (mg/L) | Cd (mg/L) | Co (mg/L) | Cr (mg/L) | Cu (mg/L) | Fe (mg/L) | Li (mg/L) |
| 22-07-26 | 0.033 | 0.001 | 0.014 | 0.085 | <0.00001 | 0.0001 | <0.001 | <0.001 | **0.56** | 0.0010 |
| 22-08-29 | 0.041 | <0.001 | 0.012 | 0.070 | <0.00001 | 0.0001 | <0.001 | <0.001 | **0.38** | 0.0009 |
| 22-09-28 | **0.214** | <0.001 | 0.007 | 0.037 | 0.00001 | 0.0001 | <0.001 | <0.001 | **0.35** | 0.0006 |
| Date (yy-mm-dd) | Mn (mg/L) | Mo (mg/L) | Ni (mg/L) | Pb (mg/L) | Rb (mg/L) | Sb (mg/L) | Sr (mg/L) | U (mg/L) | V (mg/L) | Zn (mg/L) |
| 22-07-26 | 0.294 | 0.0010 | <0.001 | <0.0001 | 0.0013 | <0.0001 | 0.123 | 0.0002 | <0.001 | <0.001 |
| 22-08-29 | 0.132 | 0.0009 | <0.001 | 0.0001 | 0.0011 | <0.0001 | 0.109 | 0.0002 | <0.001 | 0.002 |
| 22-09-28 | 0.047 | 0.0004 | <0.001 | 0.0002 | 0.0006 | <0.0001 | 0.046 | <0.0001 | <0.001 | <0.001 |

### 3.1.3 ShdC

The water sampling results for site ShdC in 2022 met or exceeded the *CCME Recommended Guidelines for the Protection of Aquatic Life* based on pH and dissolved oxygen. Water temperature exceeded the 22.5˚C limit for thermal stress in salmonids in July (Table 16).

Bacterial levels exceeded the maximum concentration of *E. coli* from the *Guidelines for Canadian Recreational Water Quality* (≤ 235 MPN/100 mL) in August (Table 16).

Total phosphorus levels for long-term eutrophic conditions, according to the CCME *Guidance Framework for Total Phosphorus*, were in the oligotrophic range (0.010 – 0.020 mg/L) for July and August, and in the meso-eutrophic range (0.020 – 0.035 mg/L) in September (Table 17).

Concentrations of aluminum exceeded the *CCME Recommended Guidelines for the Protection of Aquatic Life* (0.100 mg/L, pH ≥ 6.5) in September. Iron levels exceeded the guideline of 0.3 mg/L in September as well (Table 18).

Due to severe weather conditions causing safety concerns (thunderstorm), sample collection from this site did not occur in June.

**Table 16: Water chemistry data and *E. coli* results for ShdC, 2022.**

| SITE ShdC: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Date (yy-mm-dd) | Temp (˚C) | | SAL (ppt) | DO (mg/L) | *E. coli* (MPN/100 mL) | ALK_T (mg/L) | CLRA (TCU) | COND (mS/cm) | |
| | Air | Water | | | | | | Field | Lab |
| 22-07-26 | 27 | 24.1 | 0.11 | 8.24 | 41 | 91 | 12 | 0.238 | 0.228 |
| 22-08-29 | 26 | 19.1 | 0.11 | 12.80 | 437 | 72 | 16 | 0.202 | 0.226 |
| 22-09-28 | 21 | 14.3 | 0.05 | 10.16 | 74 | 40 | 73 | 0.085 | 0.124 |
| Date (yy-mm-dd) | HARD (mg/L) | Lang_Ind (20˚C) | pH | | | TDS (mg/L) | | TURB (NTU) | — |
| | | | Field | Lab | Sat (20˚C) | Field | Lab | | |
| 22-07-26 | 99.4 | 0.47 | 8.55 | 8.4 | 7.9 | 157.30 | 137 | 0.7 | — |
| 22-08-29 | 86.8 | 0.70 | 8.95 | 8.8 | 8.1 | 148.20 | 126 | 0.7 | — |
| 22-09-28 | 42.6 | -1.01 | 7.22 | 7.6 | 8.6 | 68.25 | 80 | 4.5 | — |

**Table 17: Nutrient results for ShdC, 2022.**

| SITE ShdC: 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) |
| 22-07-26 | 88.8 | 0.03 | 31.1 | 2.100 | 15.4 | 0.16 | 1.21 | 5.28 | 9.9 | <0.05 |
| 22-08-29 | 67.7 | 0.03 | 27.0 | 4.020 | 16.8 | 0.18 | 1.13 | 4.71 | 10.9 | <0.05 |
| 22-09-28 | 39.8 | 0.02 | 13.1 | 0.149 | 11.8 | 0.26 | 0.97 | 2.40 | 7.9 | 0.06 |
| Date (yy-mm-dd) | NH3T_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) | — |
| 22-07-26 | <0.001 | <0.05 | 0.37 | 0.37 | 17 | — | 0.5 | 2.7 | 0.007 | — |
| 22-08-29 | <0.001 | <0.05 | 0.49 | 0.49 | 15 | — | 0.6 | 4.4 | 0.009 | — |
| 22-09-28 | <0.001 | <0.05 | 0.24 | 0.24 | 7 | — | 0.6 | 10.8 | 0.030 | — |

**Table 18: Inorganics results for ShdC, 2022.**

| SITE ShdC: HEAVY METALS AND OTHER ELEMENTS | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Date (yy-mm-dd) | Al (mg/L) | As (mg/L) | B (mg/L) | Ba (mg/L) | Cd (mg/L) | Co (mg/L) | Cr (mg/L) | Cu (mg/L) | Fe (mg/L) | Li (mg/L) |
| 22-07-26 | 0.021 | <0.001 | 0.068 | 0.068 | <0.00001 | <0.0001 | <0.001 | <0.001 | 0.05 | 0.0014 |
| 22-08-29 | 0.031 | <0.001 | 0.057 | 0.057 | <0.00001 | <0.0001 | <0.001 | <0.001 | 0.10 | 0.0013 |
| 22-09-28 | 0.178 | <0.001 | 0.038 | 0.038 | <0.00001 | 0.0001 | <0.001 | 0.001 | 0.33 | 0.0009 |
| Date (yy-mm-dd) | Mn (mg/L) | Mo (mg/L) | Ni (mg/L) | Pb (mg/L) | Rb (mg/L) | Sb (mg/L) | Sr (mg/L) | U (mg/L) | V (mg/L) | Zn (mg/L) |
| 22-07-26 | 0.022 | 0.0016 | <0.001 | <0.0001 | 0.0012 | <0.0001 | 0.302 | 0.0010 | <0.001 | <0.001 |
| 22-08-29 | 0.020 | 0.0015 | <0.001 | <0.0001 | 0.0010 | <0.0001 | 0.281 | 0.0010 | <0.001 | <0.001 |
| 22-09-28 | 0.023 | 0.0006 | <0.001 | 0.0002 | 0.0008 | <0.0001 | 0.117 | 0.0003 | <0.001 | <0.001 |

### 3.1.4 ShdE

The water sampling results for ShdE met or exceeded the *CCME Recommended Guidelines for the Protection of Aquatic Life* based on pH and dissolved oxygen. Water temperature exceeded the 22.5˚C limit for thermal stress in salmonids in July (Table 19).

Bacterial levels did not exceed the maximum concentration of *E. coli* from the *Guidelines for Canadian Recreational Water Quality* (≤ 235 MPN/100 mL) (Table 19).

Total phosphorus levels for long-term eutrophic conditions, according to the *CCME Guidance Framework for Total Phosphorus*, were in the oligotrophic range (0.004 – 0.010 mg/L) for June and July, the mesotrophic range (0.010 – 0.020 mg/L) in August and meso-eutrophic range (0.020 – 0.035) in September (Table 20).

Concentrations of aluminum exceeded the *CCME Recommended Guidelines for the Protection of Aquatic Life* (0.100 mg/L, pH ≥ 6.5) in September. The concentration of iron exceeded the guideline of 0.3 mg/L in September as well (Table 21).

**Table 19: Water chemistry data and *E. coli* results for ShdE, 2022.**

| SITE ShdE: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Date (yy-mm-dd) | Temp (˚C) | | SAL (ppt) | DO (mg/L) | *E. coli* (MPN/100 mL) | ALK_T (mg/L) | CLRA (TCU) | COND (mS/cm) | |
| | Air | Water | | | | | | Field | Lab |
| 22-06-30 | 22 | 21.3 | 0.08 | 8.23 | 31 | 64 | 24 | 0.157 | 0.167 |
| 22-07-26 | 25 | **24.6** | 0.10 | 6.87 | 52 | 84 | 15 | 0.205 | 0.194 |
| 22-08-29 | 22 | 18.0 | 0.09 | 9.28 | 20 | 70 | 22 | 0.172 | 0.194 |
| 22-09-28 | 19 | 13.1 | 0.04 | 10.20 | 63 | 32 | 116 | 0.066 | 0.091 |
| Date (yy-mm-dd) | HARD (mg/L) | Lang_Ind (20˚C) | pH | | | TDS (mg/L) | | TURB (NTU) | — |
| | | | Field | Lab | Sat (20˚C) | Field | Lab | | |
| 22-06-30 | 64.1 | -0.44 | 8.01 | 7.8 | 8.2 | 109.85 | 92 | 0.7 | — |
| 22-07-26 | 81.8 | -0.03 | 7.87 | 8.0 | 8.0 | 134.55 | 115 | 0.7 | — |
| 22-08-29 | 73.0 | -0.06 | 8.06 | 8.1 | 8.2 | 129.35 | 111 | 0.8 | — |
| 22-09-28 | 31.5 | -1.43 | 7.03 | 7.4 | 8.8 | 55.25 | 66 | 3.6 | — |

**Table 20: Nutrient results for ShdE, 2022.**

| SITE ShdE: 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) |
| 22-06-30 | 63.6 | 0.03 | 20.0 | 0.377 | 13.3 | 0.13 | 0.91 | 3.43 | 8.03 | <0.05 |
| 22-07-26 | 83.2 | 0.03 | 26.0 | 0.782 | 13.0 | 0.15 | 1.17 | 4.11 | 9.6 | <0.05 |
| 22-08-29 | 69.1 | 0.03 | 22.8 | 0.818 | 15.1 | 0.20 | 1.06 | 3.90 | 10.3 | <0.05 |
| 22-09-28 | 31.9 | 0.02 | 9.7 | 0.075 | 8.3 | 0.35 | 0.81 | 1.78 | 5.8 | 0.07 |
| Date (yy-mm-dd) | NH3T_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) | — |
| 22-06-30 | <0.001 | <0.05 | 0.05 | 0.05 | 7.0 | — | 0.4 | 6.0 | **0.010** | — |
| 22-07-26 | <0.001 | <0.05 | 0.11 | 0.11 | 9.0 | — | 0.3 | 4.0 | **0.009** | — |
| 22-08-29 | <0.001 | <0.05 | 0.10 | 0.10 | 9.0 | — | 0.4 | 5.7 | **0.011** | — |
| 22-09-28 | <0.001 | <0.05 | 0.13 | 0.13 | 5.0 | — | 0.6 | 13.8 | **0.028** | — |

**Table 21: Inorganics results for ShdE, 2022.**

| SITE ShdE: HEAVY METALS AND OTHER ELEMENTS | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Date (yy-mm-dd) | Al (mg/L) | As (mg/L) | B (mg/L) | Ba (mg/L) | Cd (mg/L) | Co (mg/L) | Cr (mg/L) | Cu (mg/L) | Fe (mg/L) | Li (mg/L) |
| 22-06-30 | 0.037 | <0.001 | 0.067 | 0.067 | <0.00001 | <0.0001 | <0.001 | <0.001 | 0.21 | 0.0011 |
| 22-07-26 | 0.025 | <0.001 | 0.081 | 0.081 | <0.00001 | <0.0001 | <0.001 | <0.001 | 0.14 | 0.0014 |
| 22-08-29 | 0.033 | <0.001 | 0.074 | 0.074 | <0.00001 | <0.0001 | <0.001 | <0.001 | 0.18 | 0.0012 |
| 22-09-28 | **0.223** | <0.001 | 0.040 | 0.040 | <0.00001 | 0.0001 | <0.001 | <0.001 | **0.42** | 0.0007 |
| Date (yy-mm-dd) | Mn (mg/L) | Mo (mg/L) | Ni (mg/L) | Pb (mg/L) | Rb (mg/L) | Sb (mg/L) | Sr (mg/L) | U (mg/L) | V (mg/L) | Zn (mg/L) |
| 22-06-30 | 0.039 | 0.0006 | <0.001 | <0.0001 | 0.0010 | <0.0001 | 0.154 | 0.0003 | <0.001 | <0.001 |
| 22-07-26 | 0.065 | 0.0010 | <0.001 | <0.0001 | 0.0013 | <0.0001 | 0.199 | 0.0005 | <0.001 | <0.001 |
| 22-08-29 | 0.037 | 0.0008 | <0.001 | <0.0001 | 0.0010 | <0.0001 | 0.190 | 0.0004 | <0.001 | 0.001 |
| 22-09-28 | 0.040 | 0.0003 | <0.001 | 0.0003 | 0.0008 | <0.0001 | 0.066 | 0.0001 | <0.001 | 0.001 |

### 3.1.5 ShdG

The water sampling results for site ShdG in 2022 met or exceeded the *CCME Recommended Guidelines for the Protection of Aquatic Life* based on pH and dissolved oxygen. Water temperature did not exceed the 22.5˚C limit for thermal stress in salmonids (Table 22).

Bacterial levels exceed the maximum concentration of *E. coli* from the *Guidelines for Canadian Recreational Water Quality* (≤ 235 MPN/100 mL) in June and July (Table 22).

Total phosphorus levels for long-term eutrophic conditions, according to the *CCME Guidance Framework for Total Phosphorus*, were in the meso-eutrophic range (0.020 – 0.035 mg/L) in June and July, and in the eutrophic range (0.035 – 0.100 mg/L) in August and September (Table 23).

Concentrations of aluminum exceeded the *CCME Recommended Guidelines for the Protection of Aquatic Life* (0.100 mg/L, pH ≥6.5) in the samples taken in September. The concentration of iron exceeded the guideline of 0.3 mg/L in June, August and September (Table 24).

**Table 22: Water chemistry data and *E. coli* results for ShdG, 2022.**

| SITE ShdG: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Date (yy-mm-dd) | Temp (˚C) | | SAL (ppt) | DO (mg/L) | *E. coli* (MPN/100 mL) | ALK_T (mg/L) | CLRA (TCU) | COND (mS/cm) | |
| | Air | Water | | | | | | Field | Lab |
| 22-06-30 | 23 | 17.0 | 0.06 | 9.45 | 253 | 53 | 73 | 0.105 | 0.123 |
| 22-07-26 | 25 | 19.5 | 0.07 | 9.23 | 272 | 62 | 61 | 0.126 | 0.131 |
| 22-08-29 | 25 | 17.3 | 0.06 | 9.02 | 156 | 48 | 103 | 0.107 | 0.121 |
| 22-09-28 | 20 | 13.5 | 0.02 | 10.72 | 96 | 15 | 210 | 0.040 | 0.050 |
| Date (yy-mm-dd) | HARD (mg/L) | Lang_Ind (20˚C) | pH | | | TDS (mg/L) | | TURB (NTU) | — |
| | | | Field | Lab | Sat (20˚C) | Field | Lab | | |
| 22-06-30 | 49.1 | -0.9 | 7.65 | 7.6 | 8.5 | 80.60 | 64 | 0.9 | — |
| 22-07-26 | 57.9 | -0.56 | 7.71 | 7.8 | 8.4 | 91.65 | 73 | 0.8 | — |
| 22-08-29 | 47.9 | -0.84 | 8.09 | 7.7 | 8.5 | 81.90 | 78 | 0.9 | — |
| 22-09-28 | 18.5 | -2.42 | 6.83 | 7.0 | 9.4 | 33.15 | 54 | 1.2 | — |

**Table 23: Nutrient results for ShdG, 2022.**

| SITE ShdG: 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) |
| 22-06-30 | 52.8 | 0.02 | 12.9 | 0.198 | 7.0 | 0.19 | 0.56 | 4.09 | 5.82 | <0.05 |
| 22-07-26 | 61.6 | 0.02 | 15.4 | 0.365 | 6.8 | 0.18 | 0.69 | 4.73 | 6.1 | <0.05 |
| 22-08-29 | 47.8 | 0.03 | 12.9 | 0.225 | 8.7 | 0.27 | 0.78 | 3.80 | 6.75 | <0.05 |
| 22-09-28 | 15.0 | 0.02 | 5.0 | 0.014 | 6.0 | 0.46 | 0.52 | 1.45 | 3.5 | <0.05 |
| Date (yy-mm-dd) | NH3T_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) | — |
| 22-06-30 | <0.001 | <0.05 | 0.21 | 0.21 | <1 | — | 0.6 | 9.8 | 0.027 | — |
| 22-07-26 | <0.001 | <0.05 | 0.22 | 0.22 | <1 | — | 0.4 | 5.5 | 0.021 | — |
| 22-08-29 | <0.001 | <0.05 | 0.23 | 0.23 | <1 | — | 0.6 | 13.7 | 0.043 | — |
| 22-09-28 | <0.001 | <0.05 | <0.05 | <0.05 | 3 | — | 0.7 | 24.0 | 0.036 | — |

**Table 24: Inorganics results for ShdG, 2022.**

| SITE ShdG: HEAVY METALS AND OTHER ELEMENTS | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Date (yy-mm-dd)** | **Al (mg/L)** | **As (mg/L)** | **B (mg/L)** | **Ba (mg/L)** | **Cd (mg/L)** | **Co (mg/L)** | **Cr (mg/L)** | **Cu (mg/L)** | **Fe (mg/L)** | **Li (mg/L)** |
| 22-06-30 | 0.045 | <0.001 | 0.054 | 0.054 | <0.00001 | 0.0001 | <0.001 | <0.001 | **0.51** | 0.0013 |
| 22-07-26 | 0.021 | <0.001 | 0.063 | 0.063 | <0.00001 | <0.0001 | <0.001 | <0.001 | 0.22 | 0.0017 |
| 22-08-29 | 0.052 | <0.001 | 0.054 | 0.054 | <0.00001 | 0.0001 | <0.001 | <0.001 | **0.50** | 0.0014 |
| 22-09-28 | **0.259** | <0.001 | 0.037 | 0.037 | <0.00001 | 0.0001 | <0.001 | <0.001 | **0.55** | 0.0008 |
| **Date (yy-mm-dd)** | **Mn (mg/L)** | **Mo (mg/L)** | **Ni (mg/L)** | **Pb (mg/L)** | **Rb (mg/L)** | **Sb (mg/L)** | **Sr (mg/L)** | **U (mg/L)** | **V (mg/L)** | **Zn (mg/L)** |
| 22-06-30 | 0.066 | 0.0001 | <0.001 | 0.0001 | 0.0007 | <0.0001 | 0.071 | <0.0001 | <0.001 | 0.001 |
| 22-07-26 | 0.063 | 0.0001 | <0.001 | <0.0001 | 0.0008 | <0.0001 | 0.085 | <0.0001 | <0.001 | 0.003 |
| 22-08-29 | 0.053 | 0.0001 | <0.001 | 0.0001 | 0.0009 | <0.0001 | 0.076 | <0.0001 | <0.001 | 0.002 |
| 22-09-28 | 0.043 | <0.0001 | <0.001 | 0.0002 | 0.0006 | <0.0001 | 0.027 | <0.0001 | <0.001 | 0.002 |

### 3.1.6 ShdH

The water sampling results for site ShdH in 2022 met or exceeded the *CCME Recommended Guidelines for the Protection of Aquatic Life* based on pH and dissolved oxygen. Water temperature did not exceed the 22.5˚C limit for thermal stress in salmonids (Table 25).

Bacterial levels did not exceed the maximum concentration of *E. coli* from the *Guidelines for Canadian Recreational Water Quality* (≤ 235 MPN/100 mL) (Table 25).

Total phosphorus levels for long-term eutrophic conditions, according to the *CCME Guidance Framework for Total Phosphorus,* were in the meso-eutrophic (0.020 – 0.035 mg/L) range in June, the mesotrophic range (0.010 – 0.020 mg/L) in July and August, and the meso-eutrophic range again in September (Table 26).

Concentrations of aluminum exceed the *CCME Recommended Guidelines for the Protection of Aquatic Life* (0.100 mg/L, pH ≥ 6.5) in September. Iron levels exceeded the guideline of 0.3 mg/L in every sample taken in 2022 (Table 27).

**Table 25: Water chemistry data and *E. coli* results for ShdH, 2022.**

| SITE ShdH: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Date (yy-mm-dd)** | **Temp (˚C)** | | **SAL (ppt)** | **DO (mg/L)** | ***E. coli* (MPN/100 mL)** | **ALK_T (mg/L)** | **CLRA (TCU)** | **COND (mS/cm)** | |
| | **Air** | **Water** | | | | | | **Field** | **Lab** |
| 22-06-30 | 24 | 20.2 | 0.06 | 7.10 | 63 | 63 | 41 | 0.161 | 0.175 |
| 22-07-26 | 25 | 21.7 | 0.10 | 7.24 | 158 | 82 | 22 | 0.206 | 0.207 |
| 22-08-29 | 22 | 17.2 | 0.09 | 9.70 | 205 | 62 | 44 | 0.163 | 0.187 |
| 22-09-28 | 19 | 13.6 | 0.04 | 10.67 | 52 | 24 | 147 | 0.068 | 0.084 |
| **Date (yy-mm-dd)** | **HARD (mg/L)** | **Lang_Ind (20˚C)** | **pH** | | | **TDS (mg/L)** | | **TURB (NTU)** | **—** |
| | | | **Field** | **Lab** | **Sat (20˚C)** | **Field** | **Lab** | | |
| 22-06-30 | 60.1 | -0.67 | 7.47 | 7.6 | 8.3 | 115.70 | 95 | 1.2 | — |
| 22-07-26 | 75.7 | -0.27 | 7.67 | 7.8 | 8.1 | 143.00 | 119 | 2.0 | — |
| 22-08-29 | 63.5 | -0.46 | 7.57 | 7.8 | 8.3 | 124.15 | 104 | 2.2 | — |
| 22-09-28 | 24.9 | -1.84 | 6.79 | 7.2 | 9 | 55.25 | 65 | 2.7 | — |

**Table 26: Nutrient results for ShdH, 2022.**

| SITE ShdH: 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)** |
| 22-06-30 | 62.7 | 0.03 | 18.9 | 0.235 | 21.4 | 0.15 | 0.72 | 3.14 | 11.2 | <0.05 |
| 22-07-26 | 81.5 | 0.03 | 24.0 | 0.483 | 24.5 | 0.06 | 0.92 | 3.83 | 14.7 | <0.05 |
| 22-08-29 | 61.6 | 0.03 | 20.0 | 0.365 | 21.1 | 0.17 | 0.85 | 3.30 | 12.7 | <0.05 |
| 22-09-28 | 24.0 | 0.02 | 7.7 | 0.036 | 13.2 | 0.36 | 0.70 | 1.36 | 7.7 | 0.06 |
| **Date (yy-mm-dd)** | **NH3T_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)** | **—** |
| 22-06-30 | <0.001 | <0.05 | 0.10 | 0.10 | <1 | — | 0.4 | 6.7 | **0.022** | — |
| 22-07-26 | <0.001 | <0.05 | <0.05 | <0.05 | <1 | — | 0.3 | 3.7 | **0.015** | — |
| 22-08-29 | <0.001 | <0.05 | 0.07 | 0.07 | <1 | — | 0.4 | 7.4 | **0.017** | — |
| 22-09-28 | <0.001 | <0.05 | 0.06 | 0.06 | <5 | — | 0.6 | 18.0 | **0.032** | — |

**Table 27: Inorganics results for ShdH, 2022.**

| SITE ShdH: HEAVY METALS AND OTHER ELEMENTS | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Date (yy-mm-dd)** | **Al (mg/L)** | **As (mg/L)** | **B (mg/L)** | **Ba (mg/L)** | **Cd (mg/L)** | **Co (mg/L)** | **Cr (mg/L)** | **Cu (mg/L)** | **Fe (mg/L)** | **Li (mg/L)** |
| 22-06-30 | 0.046 | <0.001 | 0.103 | 0.103 | <0.00001 | 0.0001 | <0.001 | <0.001 | **0.50** | 0.0014 |
| 22-07-26 | 0.032 | <0.001 | 0.124 | 0.124 | <0.00001 | 0.0001 | <0.001 | <0.001 | **0.46** | 0.0018 |
| 22-08-29 | 0.039 | <0.001 | 0.106 | 0.106 | <0.00001 | 0.0001 | <0.001 | <0.001 | **0.46** | 0.0014 |
| 22-09-28 | **0.245** | <0.001 | 0.050 | 0.050 | 0.00001 | 0.0002 | <0.001 | <0.001 | **0.53** | 0.0007 |
| **Date (yy-mm-dd)** | **Mn (mg/L)** | **Mo (mg/L)** | **Ni (mg/L)** | **Pb (mg/L)** | **Rb (mg/L)** | **Sb (mg/L)** | **Sr (mg/L)** | **U (mg/L)** | **V (mg/L)** | **Zn (mg/L)** |
| 22-06-30 | 0.144 | 0.0001 | <0.001 | 0.0001 | 0.0011 | <0.0001 | 0.109 | 0.0002 | <0.001 | 0.001 |
| 22-07-26 | 0.123 | 0.0001 | <0.001 | <0.0001 | 0.0012 | <0.0001 | 0.138 | 0.0003 | <0.001 | 0.002 |
| 22-08-29 | 0.079 | 0.0001 | <0.001 | <0.0001 | 0.0011 | <0.0001 | 0.118 | 0.0002 | <0.001 | 0.001 |
| 22-09-28 | 0.054 | <0.0001 | <0.001 | 0.0003 | 0.0008 | <0.0001 | 0.041 | <0.0001 | <0.001 | 0.001 |

### 3.1.7 ScdB

The water sampling results for site ScdB in 2022 met or exceeded the *CCME Recommended Guidelines for the Protection of Aquatic Life* based on pH values collected in the field. pH results from the lab were just below the guideline of 6.5 in September. Levels of dissolved oxygen dropped below the guideline of 6.5 mg/L for general cold-water organisms in June and July. Water temperature did not exceed the 22.5˚C limit for thermal stress in salmonids (Table 28).

Bacterial levels exceed the maximum concentration of *E. coli* from the *Guidelines for Canadian Recreational Water Quality* (≤ 235 MPN/100 mL) in June, July and August (Table 28).

Total phosphorus levels for long-term eutrophic conditions, according to the *CCME Guidance Framework for Total Phosphorus,* were in the eutrophic range (0.035 – 0.100 mg/L) from June to August, and in the meso-eutrophic range (0.020 – 0.035 mg/L) in September (Table 29).

Concentrations of aluminum exceeded the *CCME Recommended Guidelines for the Protection of Aquatic Life* (0.100 mg/L, pH ≥ 6.5) in every sample taken in 2022. Iron levels also exceeded the guideline of 0.3 mg/L in every sample taken in 2022. (Table 30).

**Table 28: Water chemistry data and *E. coli* results for ScdB, 2022.**

| SITE ScdB: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Date (yy-mm-dd) | Temp (˚C) | | SAL (ppt) | DO (mg/L) | *E. coli* (MPN/100 mL) | ALK_T (mg/L) | CLRA (TCU) | COND (mS/cm) | |
| | Air | Water | | | | | | Field | Lab |
| 22-06-30 | 24 | 19.9 | 0.07 | **5.39** | **295** | 45 | 198 | 0.126 | 0.137 |
| 22-07-26 | 24 | 21.8 | 0.09 | **3.43** | **259** | 56 | 160 | 0.171 | 0.163 |
| 22-08-29 | 21 | 17.0 | 0.06 | 7.02 | **275** | 38 | 254 | 0.101 | 0.112 |
| 22-09-28 | 16 | 13.2 | 0.03 | 9.61 | 135 | 10 | 269 | 0.046 | 0.057 |
| Date (yy-mm-dd) | HARD (mg/L) | Lang_Ind (20˚C) | pH | | | TDS (mg/L) | | TURB (NTU) | — |
| | | | Field | Lab | Sat (20˚C) | Field | Lab | | |
| 22-06-30 | 43.9 | -1.32 | 7.4 | 7.2 | 8.5 | 90.35 | 77 | 9.1 | — |
| 22-07-26 | 56.0 | -0.93 | 7.5 | 7.4 | 8.3 | 118.30 | 97 | 10.4 | — |
| 22-08-29 | 41.0 | -1.42 | 7.6 | 7.2 | 8.6 | 77.35 | 98 | 4.6 | — |
| 22-09-28 | 16.3 | -3.19 | 6.6 | **6.4** | 9.6 | 38.35 | 64 | 1.7 | — |

**Table 29: Nutrient results for ScdB, 2022.**

| SITE ScdB: 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) |
| 22-06-30 | 44.9 | 0.05 | 14.4 | 0.067 | 20.0 | 0.30 | 0.44 | 1.94 | 9.97 | 0.06 |
| 22-07-26 | 55.9 | 0.06 | 18.5 | 0.132 | 24.4 | 0.29 | 0.61 | 2.37 | 13.70 | 0.06 |
| 22-08-29 | 37.9 | 0.05 | 13.6 | 0.056 | 13.9 | 0.43 | 0.60 | 1.72 | 8.42 | 0.06 |
| 22-09-28 | 10.0 | 0.03 | 5.1 | 0.002 | 10.5 | 0.52 | 0.42 | 0.85 | 5.60 | <0.05 |
| Date (yy-mm-dd) | NH3T_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) | — |
| 22-06-30 | <0.001 | <0.05 | <0.05 | <0.05 | <5 | — | 0.9 | 23.0 | **0.064** | — |
| 22-07-26 | <0.001 | <0.05 | <0.05 | <0.05 | <1 | — | 0.8 | 17.9 | **0.069** | — |
| 22-08-29 | <0.001 | <0.05 | <0.05 | <0.05 | 3 | — | 0.7 | 31.0 | **0.049** | — |
| 22-09-28 | <0.001 | <0.05 | <0.05 | <0.05 | 2 | — | 0.7 | 32.0 | **0.023** | — |

**Table 30: Inorganics results for ScdB, 2022.**

| SITE ScdB: HEAVY METALS AND OTHER ELEMENTS | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Date (yy-mm-dd) | Al (mg/L) | As (mg/L) | B (mg/L) | Ba (mg/L) | Cd (mg/L) | Co (mg/L) | Cr (mg/L) | Cu (mg/L) | Fe (mg/L) | Li (mg/L) |
| 22-06-30 | **0.144** | <0.001 | 0.011 | 0.034 | 0.00002 | 0.0006 | <0.001 | <0.001 | **1.37** | 0.0006 |
| 22-07-26 | **0.120** | 0.001 | 0.010 | 0.040 | 0.00001 | 0.0007 | <0.001 | <0.001 | **1.69** | 0.0007 |
| 22-08-29 | **0.198** | <0.001 | 0.016 | 0.035 | 0.00002 | 0.0007 | <0.001 | <0.001 | **1.60** | 0.0008 |
| 22-09-28 | **0.357** | <0.001 | 0.011 | 0.025 | 0.00001 | 0.0002 | <0.001 | <0.001 | **0.83** | 0.0007 |
| Date (yy-mm-dd) | Mn (mg/L) | Mo (mg/L) | Ni (mg/L) | Pb (mg/L) | Rb (mg/L) | Sb (mg/L) | Sr (mg/L) | U (mg/L) | V (mg/L) | Zn (mg/L) |
| 22-06-30 | 0.566 | 0.0003 | <0.001 | 0.0005 | 0.0012 | <0.0001 | 0.059 | 0.0002 | <0.001 | 0.005 |
| 22-07-26 | 0.779 | 0.0003 | <0.001 | 0.0006 | 0.0016 | <0.0001 | 0.075 | 0.0003 | <0.001 | 0.004 |
| 22-08-29 | 0.504 | 0.0003 | <0.001 | 0.0005 | 0.0014 | <0.0001 | 0.053 | 0.0002 | <0.001 | 0.003 |
| 22-09-28 | 0.067 | <0.0001 | <0.001 | 0.0004 | 0.0008 | <0.0001 | 0.023 | <0.0001 | <0.001 | 0.004 |

### 3.1.8 ScdE-2

The water sampling results for site ScdE-2 in 2022 exceeded the *CCME Recommended Guidelines for the Protection of Aquatic Life* for pH in September, and dissolved oxygen in June and July. Water temperature exceeded the 22.5˚C limit for thermal stress in salmonids in July (Table 31).

Bacterial levels did not exceed the maximum concentration of *E. coli* from the *Guidelines for Canadian Recreational Water Quality* (≤ 235 MPN/100 mL) (Table 31).

Total phosphorus levels for long-term eutrophic conditions, according to the *CCME Guidance Framework for Total Phosphorus*, were in the eutrophic range (0.035 – 0.100 mg/L) in June, the meso-eutrophic range (0.020 – 0.035 mg/L) in July, the eutrophic range in August and the meso-eutrophic range again in September (Table 32).

Concentrations of aluminum exceeded the *CCME Recommended Guidelines for the Protection of Aquatic Life* (0.100 mg/L, pH ≥ 6.5) in June, August and September. Iron levels exceeded the guideline of 0.3 mg/L in every sample taken in 2022 (Table 33).

**Table 31: Water chemistry data and *E. coli* results for ScdE-2, 2022.**

| SITE ScdE-2: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Date (yy-mm-dd) | Temp (˚C) | | SAL (ppt) | DO (mg/L) | *E. coli* (MPN/100 mL) | ALK_T (mg/L) | CLRA (TCU) | COND (mS/cm) | |
| | Air | Water | | | | | | Field | Lab |
| 22-06-30 | 24 | 21.0 | 0.05 | 6.18 | 85 | 30 | 191 | 0.091 | 0.096 |
| 22-07-26 | 25 | 22.9 | 0.07 | 5.45 | 211 | 43 | 103 | 0.136 | 0.127 |
| 22-08-29 | 22 | 17.5 | 0.04 | 7.40 | 20 | 25 | 287 | 0.072 | 0.080 |
| 22-09-28 | 16 | 13.6 | 0.03 | 6.97 | 63 | 9 | 235 | 0.046 | 0.590 |
| Date (yy-mm-dd) | HARD (mg/L) | Lang_Ind (20˚C) | pH | | | TDS (mg/L) | | TURB (NTU) | — |
| | | | Field | Lab | Sat (20˚C) | Field | Lab | | |
| 22-06-30 | 29.3 | -1.76 | 7.4 | 7.1 | 8.9 | 63.70 | 55 | 1.9 | — |
| 22-07-26 | 39.3 | -1.09 | 7.5 | 7.5 | 8.6 | 92.30 | 75 | 2.8 | — |
| 22-08-29 | 27.0 | -1.87 | 7.6 | 7.1 | 9.0 | 54.60 | 80 | 2.9 | — |
| 22-09-28 | 15.7 | -3.45 | 6.1 | 6.2 | 9.7 | 38.35 | 58 | 1.5 | — |

**Table 32: Nutrient results for ScdE-2, 2022.**

| SITE ScdE-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) |
| 22-06-30 | 30.0 | 0.05 | 9.53 | 0.036 | 15.5 | 0.30 | 0.32 | 1.33 | 8.57 | <0.05 |
| 22-07-26 | 42.9 | 0.07 | 12.90 | 0.128 | 20.0 | 0.25 | 0.46 | 1.72 | 12.30 | <0.05 |
| 22-08-29 | 25.0 | 0.05 | 8.90 | 0.030 | 10.5 | 0.48 | 0.49 | 1.18 | 7.03 | <0.05 |
| 22-09-28 | 9.0 | 0.03 | 4.90 | 0.001 | 11.0 | 0.45 | 0.48 | 0.84 | 5.40 | <0.05 |
| Date (yy-mm-dd) | NH3T_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) | — |
| 22-06-30 | <0.001 | <0.05 | <0.05 | <0.05 | <5 | — | 0.8 | 22.0 | 0.038 | — |
| 22-07-26 | <0.001 | <0.05 | <0.05 | <0.05 | <1 | — | 0.5 | 14.0 | 0.026 | — |
| 22-08-29 | <0.001 | <0.05 | 0.06 | 0.06 | 2 | — | 0.8 | 32.0 | 0.049 | — |
| 22-09-28 | <0.001 | <0.05 | <0.05 | <0.05 | 2 | — | 0.7 | 27.0 | 0.025 | — |

**Table 33: Inorganics results for ScdE-2, 2022.**

| SITE ScdE-2: HEAVY METALS AND OTHER ELEMENTS | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Date (yy-mm-dd) | Al (mg/L) | As (mg/L) | B (mg/L) | Ba (mg/L) | Cd (mg/L) | Co (mg/L) | Cr (mg/L) | Cu (mg/L) | Fe (mg/L) | Li (mg/L) |
| 22-06-30 | 0.117 | <0.001 | 0.028 | 0.028 | <0.00001 | 0.0002 | <0.001 | <0.001 | 1.09 | 0.0006 |
| 22-07-26 | 0.060 | <0.001 | 0.029 | 0.029 | <0.00001 | 0.0002 | <0.001 | <0.001 | 0.69 | 0.0007 |
| 22-08-29 | 0.183 | <0.001 | 0.031 | 0.031 | 0.00001 | 0.0004 | <0.001 | <0.001 | 1.67 | 0.0007 |
| 22-09-28 | 0.295 | <0.001 | 0.027 | 0.027 | 0.00002 | 0.0002 | <0.001 | <0.001 | 0.78 | 0.0007 |
| Date (yy-mm-dd) | Mn (mg/L) | Mo (mg/L) | Ni (mg/L) | Pb (mg/L) | Rb (mg/L) | Sb (mg/L) | Sr (mg/L) | U (mg/L) | V (mg/L) | Zn (mg/L) |
| 22-06-30 | 0.118 | 0.0001 | <0.001 | 0.0003 | 0.0010 | <0.0001 | 0.052 | <0.0001 | <0.001 | 0.003 |
| 22-07-26 | 0.120 | 0.0002 | <0.001 | 0.0002 | 0.0013 | <0.0001 | 0.071 | <0.0001 | <0.001 | 0.002 |
| 22-08-29 | 0.221 | 0.0002 | <0.001 | 0.0004 | 0.0014 | <0.0001 | 0.047 | <0.0001 | <0.001 | 0.003 |
| 22-09-28 | 0.086 | <0.0001 | <0.001 | 0.0003 | 0.0009 | <0.0001 | 0.025 | <0.0001 | <0.001 | 0.004 |

### 3.1.9 ScdF

The water sampling results for site ScdF in 2022 met or exceeded the *CCME Recommended Guidelines for the Protection of Aquatic Life* based on dissolved oxygen. pH results from the lab were below the 6.5 guideline in September. Water temperature did not exceed the 22.5˚C limit for thermal stress in salmonids (Table 34).

Bacterial levels exceeded the maximum concentration of *E. coli* from the *Guidelines for Canadian Recreational Water Quality* (≤ 235 MPN/100 mL) in September (Table 34).

Total phosphorus levels for long-term eutrophic conditions, according to the *CCME Guidance Framework for Total Phosphorus*, were in the eutrophic range (0.035 – 0.100 mg/L) in June, the meso-eutrophic range (0.020 – 0.035 mg/L) in July, the eutrophic range in August and the meso-eutrophic range in September (Table 35).

Concentrations of aluminum exceeded the *CCME Recommended Guidelines for the Protection of Aquatic Life* (0.100 mg/L, pH ≥ 6.5) in each sample collected in 2022. Iron also exceeded the guideline of 0.3 mg/L in every sample in 2022 (Table 36). Lead exceeded its guideline (0.001mg/L, HARD ≤ 60 mg/L) at this particular site in August.

**Table 34: Water chemistry data and *E. coli* results for ScdF, 2022.**

| SITE ScdF: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Date (yy-mm-dd) | Temp (˚C) | | SAL (ppt) | DO (mg/L) | *E. coli* (MPN/100 mL) | ALK_T (mg/L) | CLRA (TCU) | COND (mS/cm) | |
| | Air | Water | | | | | | Field | Lab |
| 22-06-30 | 19 | 18.2 | 0.03 | 6.95 | 132 | 32 | 259 | 0.089 | 0.074 |
| 22-07-26 | 21 | DND | DND | DND | 173 | 53 | 119 | DND | 0.103 |
| 22-08-29 | 19 | 16.4 | 0.03 | 7.30 | 110 | 24 | 422 | 0.060 | 0.063 |
| 22-09-28 | 15 | 13.4 | 0.03 | 10.10 | 1,529 | 5 | 226 | 0.054 | 0.068 |
| Date (yy-mm-dd) | HARD (mg/L) | Lang_Ind (20˚C) | pH | | | TDS (mg/L) | | TURB (NTU) | — |
| | | | Field | Lab | Sat (20˚C) | Field | Lab | | |
| 22-06-30 | 30.7 | -1.63 | 8.9 | 7.2 | 8.8 | 48.70 | 44 | 4.3 | — |
| 22-07-26 | 46.5 | -0.94 | DND | 7.5 | 8.4 | DND | 62 | 4.1 | — |
| 22-08-29 | 28.2 | -1.88 | 8.1 | 7.1 | 9 | 46.80 | 75 | 6.0 | — |
| 22-09-28 | 18.5 | -3.99 | 7.1 | 5.9 | 9.9 | 45.50 | 61 | 2.0 | — |

**Table 35: Nutrient results for ScdF, 2022.**

| SITE ScdF: 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) |
| 22-06-30 | 31.9 | 0.03 | 9.53 | 0.048 | 5.1 | 0.30 | 0.47 | 1.68 | 4.23 | <0.05 |
| 22-07-26 | 52.8 | 0.03 | 14.80 | 0.157 | 5.3 | 0.23 | 0.62 | 2.31 | 5.30 | <0.05 |
| 22-08-29 | 24.0 | 0.03 | 8.80 | 0.028 | 6.0 | 0.46 | 0.60 | 1.53 | 4.56 | <0.05 |
| 22-09-28 | 5.0 | 0.04 | 5.10 | 0.000 | 16.9 | 0.37 | 0.53 | 1.37 | 5.10 | <0.05 |
| Date (yy-mm-dd) | NH3T_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) | — |
| 22-06-30 | <0.001 | <0.05 | <0.05 | <0.05 | 1.6 | — | 0.8 | 23 | 0.039 | — |
| 22-07-26 | <0.001 | <0.05 | 0.05 | 0.05 | <1.0 | — | 0.6 | 12 | 0.031 | — |
| 22-08-29 | <0.001 | <0.05 | <0.05 | <0.05 | 2.0 | — | 0.6 | 35 | 0.043 | — |
| 22-09-28 | <0.001 | <0.05 | <0.05 | <0.05 | 2.0 | — | 0.6 | 26 | 0.022 | — |

**Table 36: Inorganics results for ScdF, 2022.**

| SITE ScdF: HEAVY METALS AND OTHER ELEMENTS | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Date (yy-mm-dd)** | **Al (mg/L)** | **As (mg/L)** | **B (mg/L)** | **Ba (mg/L)** | **Cd (mg/L)** | **Co (mg/L)** | **Cr (mg/L)** | **Cu (mg/L)** | **Fe (mg/L)** | **Li (mg/L)** |
| 22-06-30 | **0.203** | 0.001 | 0.004 | 0.037 | 0.00001 | 0.0003 | <0.001 | <0.001 | **1.46** | 0.0006 |
| 22-07-26 | **0.096** | 0.001 | 0.005 | 0.040 | <0.00001 | 0.0003 | <0.001 | <0.001 | **1.07** | 0.0006 |
| 22-08-29 | **0.352** | 0.001 | 0.004 | 0.051 | 0.00002 | 0.0006 | <0.001 | <0.001 | **1.62** | 0.0008 |
| 22-09-28 | **0.367** | <0.001 | 0.005 | 0.049 | 0.00003 | 0.0005 | <0.001 | <0.001 | **0.88** | 0.0012 |
| **Date (yy-mm-dd)** | **Mn (mg/L)** | **Mo (mg/L)** | **Ni (mg/L)** | **Pb (mg/L)** | **Rb (mg/L)** | **Sb (mg/L)** | **Sr (mg/L)** | **U (mg/L)** | **V (mg/L)** | **Zn (mg/L)** |
| 22-06-30 | 0.118 | 0.0002 | <0.001 | 0.0006 | 0.0013 | 0.0002 | 0.062 | 0.0002 | 0.001 | 0.002 |
| 22-07-26 | 0.172 | 0.0002 | <0.001 | 0.0005 | 0.0013 | <0.0001 | 0.084 | 0.0002 | <0.001 | 0.001 |
| 22-08-29 | 0.195 | 0.0001 | <0.001 | **0.0011** | 0.0012 | <0.0001 | 0.054 | 0.0003 | 0.001 | 0.004 |
| 22-09-28 | 0.158 | <0.0001 | <0.001 | 0.0005 | 0.0009 | <0.0001 | 0.036 | <0.0001 | <0.001 | 0.006 |

### 3.1.10 ScdH

The water sampling results for ScdH in 2022 met or exceeded the *CCME Recommended Guidelines for the Protection of Aquatic Life* based on pH and dissolved oxygen. Water temperature did not exceed the 22.5˚C limit for thermal stress in salmonids (Table 37).

Bacterial levels exceeded the maximum concentration of *E. coli* from the *Guidelines for Canadian Recreational Water Quality* (≤ 235 MPN/100 mL) in June, July and August (Table 37).

Total phosphorus levels for long-term eutrophic conditions, according to the *CCME Guidance Framework for Total Phosphorus*, were in the mesotrophic range (0.010 – 0.020 mg/L) in June, the meso-eutrophic range (0.020 – 0.035 mg/L) in July and August, and the eutrophic range (0.035 – 0.100 mg/L) in September (Table 38).

Concentrations of aluminum exceeded the *CCME Recommended Guidelines for the Protection of Aquatic Life* (0.100 mg/L, pH ≥ 6.5) in September. Iron levels also exceeded the guideline of 0.3 mg/L in September (Table 39).

**Table 37: Water chemistry data and *E. coli* results for ScdH, 2022.**

| SITE ScdH: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Date (yy-mm-dd)** | **Temp (˚C)** | | **SAL (ppt)** | **DO (mg/L)** | ***E. coli* (MPN/100 mL)** | **ALK_T (mg/L)** | **CLRA (TCU)** | **COND (mS/cm)** | |
| | **Air** | **Water** | | | | | | **Field** | **Lab** |
| 22-06-30 | 23 | 16.7 | 0.16 | 9.85 | **336** | 90 | 25 | 0.276 | 0.326 |
| 22-07-26 | 23 | 17.7 | 0.19 | 7.99 | **425** | 140 | 27 | 0.344 | 0.523 |
| 22-08-29 | 20 | 15.1 | 0.18 | 10.33 | **379** | 90 | 33 | 0.309 | 0.384 |
| 22-09-28 | 15 | 13.0 | 0.10 | 10.60 | 41 | 35 | 114 | 0.157 | 0.203 |
| **Date (yy-mm-dd)** | **HARD (mg/L)** | **Lang_Ind (20˚C)** | **pH** | | | **TDS (mg/L)** | | **TURB (NTU)** | **—** |
| | | | **Field** | **Lab** | **Sat (20˚C)** | **Field** | **Lab** | | |
| 22-06-30 | 72.0 | -0.15 | 8.1 | 7.9 | 8.0 | 213.55 | 180 | 0.6 | — |
| 22-07-26 | 93.1 | 0.13 | 8.3 | 7.9 | 7.8 | 260.00 | 287 | 1.8 | — |
| 22-08-29 | 71.9 | -0.25 | 7.7 | 7.8 | 8.0 | 248.30 | 210 | 1.2 | — |
| 22-09-28 | 30.9 | -1.39 | 7.2 | 7.4 | 8.8 | 132.60 | 123 | 2.1 | — |

**Table 38: Nutrient results for ScdH, 2022.**

| SITE ScdH: 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)** |
| 22-06-30 | 89.3 | 0.07 | 23.9 | 0.667 | 57.8 | 0.16 | 1.31 | 3.00 | 38.8 | <0.05 |
| 22-07-26 | 139.0 | 0.13 | 31.3 | 1.040 | 89.2 | 0.21 | 2.58 | 3.62 | 74.1 | <0.05 |
| 22-08-29 | 89.4 | 0.09 | 24.1 | 0.530 | 68.3 | 0.25 | 2.14 | 2.84 | 49.3 | <0.05 |
| 22-09-28 | 34.9 | 0.06 | 10.2 | 0.082 | 43.3 | 0.37 | 1.53 | 1.32 | 28.4 | <0.05 |
| **Date (yy-mm-dd)** | **NH3T_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)** | **—** |
| 22-06-30 | <0.001 | <0.05 | <0.05 | <0.05 | <1 | — | 0.3 | 6.2 | **0.017** | — |
| 22-07-26 | <0.001 | <0.05 | <0.05 | <0.05 | <1 | — | 0.3 | 6.2 | **0.029** | — |
| 22-08-29 | <0.001 | <0.05 | 0.08 | 0.08 | <1 | — | 0.4 | 8.0 | **0.025** | — |
| 22-09-28 | <0.001 | <0.05 | <0.05 | <0.05 | <5 | — | 0.6 | 16.4 | **0.036** | — |

**Table 39: Inorganics results for ScdH, 2022.**

| SITE ScdH: HEAVY METALS AND OTHER ELEMENTS | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Date (yy-mm-dd)** | **Al (mg/L)** | **As (mg/L)** | **B (mg/L)** | **Ba (mg/L)** | **Cd (mg/L)** | **Co (mg/L)** | **Cr (mg/L)** | **Cu (mg/L)** | **Fe (mg/L)** | **Li (mg/L)** |
| 22-06-30 | 0.034 | <0.001 | 0.073 | 0.073 | <0.00001 | 0.0001 | <0.001 | <0.001 | 0.14 | 0.0011 |
| 22-07-26 | 0.061 | <0.001 | 0.099 | 0.099 | 0.00001 | 0.0002 | <0.001 | <0.001 | 0.20 | 0.0015 |
| 22-08-29 | 0.057 | <0.001 | 0.076 | 0.076 | <0.00001 | 0.0001 | <0.001 | <0.001 | 0.17 | 0.0010 |
| 22-09-28 | **0.187** | <0.001 | 0.043 | 0.043 | 0.00001 | 0.0001 | <0.001 | <0.001 | **0.42** | 0.0007 |
| **Date (yy-mm-dd)** | **Mn (mg/L)** | **Mo (mg/L)** | **Ni (mg/L)** | **Pb (mg/L)** | **Rb (mg/L)** | **Sb (mg/L)** | **Sr (mg/L)** | **U (mg/L)** | **V (mg/L)** | **Zn (mg/L)** |
| 22-06-30 | 0.041 | 0.0010 | <0.001 | <0.0001 | 0.0010 | <0.0001 | 0.117 | 0.0002 | <0.001 | 0.002 |
| 22-07-26 | 0.222 | 0.0018 | <0.001 | <0.0001 | 0.0018 | <0.0001 | 0.167 | 0.0004 | <0.001 | 0.002 |
| 22-08-29 | 0.039 | 0.0008 | <0.001 | <0.0001 | 0.0013 | <0.0001 | 0.122 | 0.0002 | <0.001 | <0.001 |
| 22-09-28 | 0.028 | 0.0007 | <0.001 | 0.0003 | 0.0008 | <0.0001 | 0.048 | <0.0001 | <0.001 | 0.002 |

### 3.1.11 Sampling Summary

In the Shediac River, sites ShdC, ShdG and ShdH all had samples that exceeded the maximum concentration of *E. coli* from the *Guidelines for Canadian Recreational Water Quality* (Figure 25).

In the Scoudouc River, sites ScdB, ScdF, and ScdH all had samples that exceeded the maximum concentration of *E. coli* from the *Guidelines for Canadian Recreational Water Quality* (Figure 26).

The average total phosphorous levels for the Shediac and Scoudouc rivers sites fell into three different categories; mesotrophic (0.010–0.020 mg/L), meso-eutrophic (0.020–0.035 mg/L), and eutrophic (0.035–0.100 mg/L) (Table 40). These categories are derived from the *CCME Guidance Framework for Total Phosphorus*.

All sites on both the Shediac and Scoudouc rivers had at least one exceedance of both aluminum and iron. ScdB, ScdE-2 and ScdF in particular had elevated levels during almost every sampling event. It is common to have elevated iron concentrations in New Brunswick, which can occur naturally due to geological influence. Further research into the surrounding land use, elevation and direction of flow in these areas could help determine a probable cause for some of these elevated values.

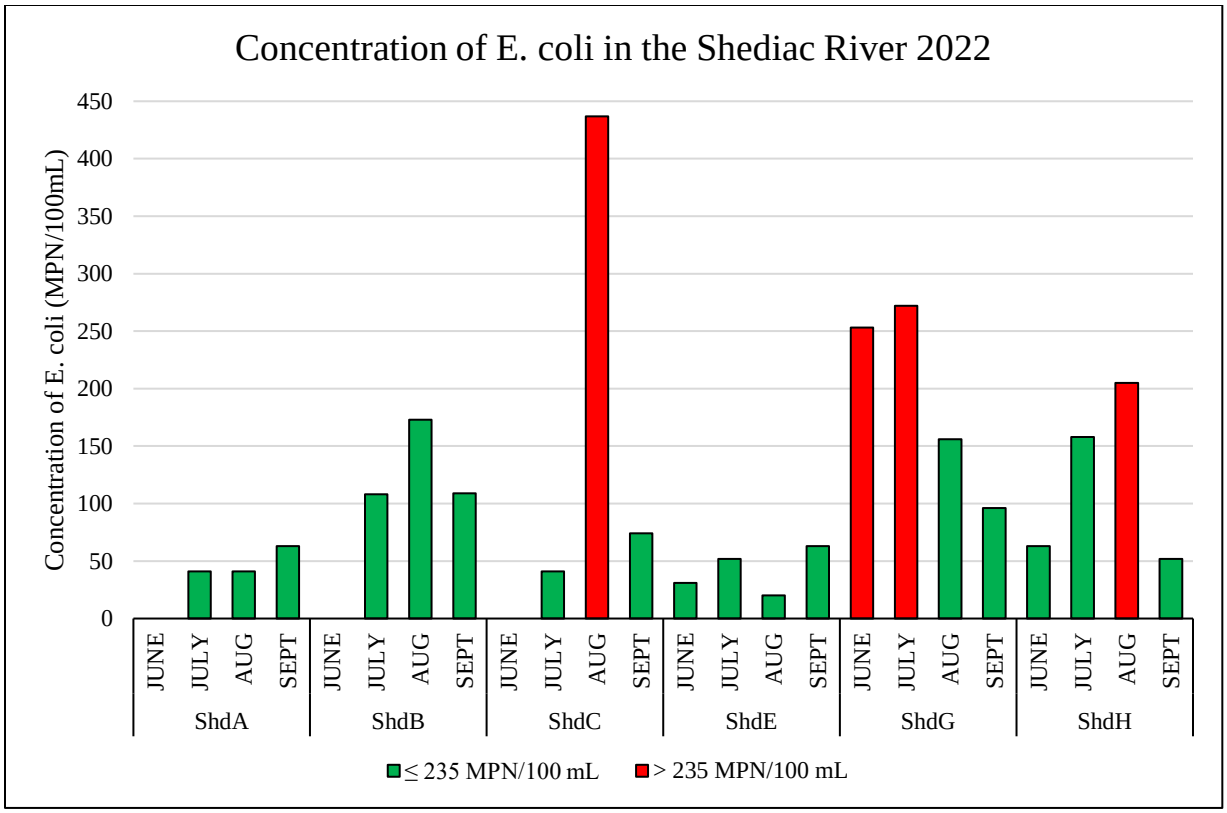



**Figure 25: Summary of *E. coli* results, Shediac River 2022.**

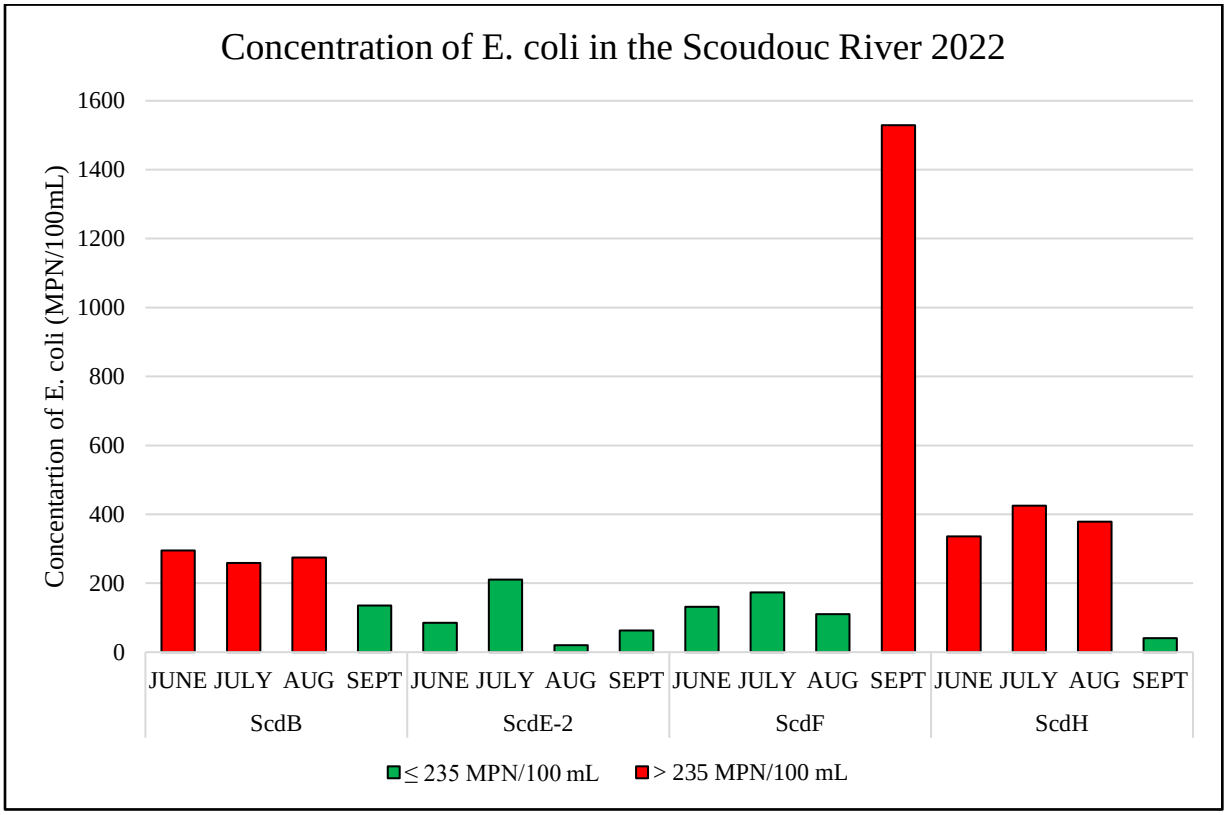



**Figure 26: Summary of *E. coli* results, Scoudouc River 2022.**

**Table 40: Average total phosphorous for the Shediac and Scoudouc rivers in 2022.**

| Sampling Site | Average of TP-L (mg/L) |
|---|---|
| ScdB | **0.051** |
| ScdE-2 | **0.035** |
| ScdF | **0.034** |
| ScdH | **0.027** |
| ShdA | **0.016** |
| ShdB | **0.015** |
| ShdC | **0.015** |
| ShdE | **0.015** |
| ShdG | **0.032** |
| ShdH | **0.022** |

## 3.2 Shediac Bay Small Stream Sampling

The following section describes the water quality data collected at the 11 small stream sampling sites for the 2022 field season. All water samples were assigned with a designated field number so that they can be logged into the NB DELG database.

The purpose of a long-term monitoring program is to evaluate a waterbody under various conditions, such as changes in surrounding land uses and changes in climate patterns. A long-term monitoring program establishes baseline trends in water quality and can detect abnormalities and significant changes over time.

In 2022, most water quality samplings were done under ambient conditions, with a one sampling event performed following a moderate rain event. In September, 13.2 mm of rain fell the day before sampling. Water quality results reflect these conditions in several areas, namely *E. coli*, total phosphorus, aluminum, and iron.

### 3.2.1 WQ-1

The water sampling results for site WQ-1 in 2022 met or exceeded the *CCME Recommended Guidelines for the Protection of Aquatic Life* based on pH and dissolved oxygen. Water temperature did not exceed the 22.5˚C limit for thermal stress in salmonids (Table 41).

Bacterial levels exceeded the maximum concentration of *E. coli* from the *Guidelines for Canadian Recreational Water Quality* (≤ 235 MPN/100 mL) in September (Table 41).

Total phosphorus levels for long-term eutrophic conditions, according to the CCME *Guidance Framework for Total Phosphorus*, were in the meso-eutrophic range (0.020 – 0.035 mg/L) in June, the mesotrophic range (0.010 – 0.020 mg/L) in July, the meso-eutrophic range again in August, and the hyper-eutrophic range (> 0.100 mg/L) in September (Table 42).

Concentrations of aluminum exceeded the *CCME Recommended Guidelines for the Protection of Aquatic Life* (0.100 mg/L, pH ≥ 6.5) in September. Iron levels exceeded the guideline of 0.3 mg/L in June and September. Lead also exceeded its guideline (0.001mg/L, HARD ≤ 60 mg/L) at this particular site in September, as did copper (0.002 mg/L, HARD 0 - 82 mg/L) (Table 43).

**Table 41: Water chemistry data and *E. coli* results for WQ-1, 2022.**

| 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/100 mL) | ALK_T (mg/L) | CLRA (TCU) | COND (mS/cm) | |
| | Air | Water | | | | | | Field | Lab |
| 22-06-22 | 17 | 11.6 | 0.15 | 12.54 | 41 | 42 | 59 | 0.236 | 0.326 |
| 22-07-21 | 22 | 13.7 | 0.19 | 9.94 | 187 | 52 | 15 | 0.309 | 0.393 |
| 22-08-24 | 20 | 14.5 | 0.17 | 12.15 | 74 | 45 | 48 | 0.286 | 0.361 |
| 22-09-21 | 14 | 13.0 | 0.10 | 11.98 | **7,270** | 26 | 106 | 0.166 | 0.240 |
| Date (yy-mm-dd) | HARD (mg/L) | Lang_Ind (20˚C) | pH | | | TDS (mg/L) | | TURB (NTU) | — |
| | | | Field | Lab | Sat (20˚C) | Field | Lab | | |
| 22-06-22 | 67.8 | -0.52 | 7.88 | 7.9 | 8.4 | 206.05 | 165 | 1.1 | — |
| 22-07-21 | 85.1 | -0.44 | 8.05 | 7.8 | 8.2 | 256.75 | 197 | 0.7 | — |
| 22-08-24 | 72.7 | -0.86 | 7.86 | 7.5 | 8.4 | 233.25 | 182 | 0.8 | — |
| 22-09-21 | 29.5 | -1.76 | 8.16 | 7.2 | 9.0 | 142.35 | 129 | 34.9 | — |

**Table 42: Nutrient results for WQ-1, 2022.**

| 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) |
| 22-06-22 | 41.6 | 0.04 | 21.2 | 0.311 | 70.9 | 0.27 | 0.91 | 3.60 | 33.2 | <0.05 |
| 22-07-21 | 51.7 | 0.05 | 26.9 | 0.307 | 87.9 | 0.10 | 0.96 | 4.35 | 36.8 | <0.05 |
| 22-08-24 | 44.9 | 0.05 | 22.8 | 0.133 | 79.1 | 0.16 | 1.11 | 3.82 | 37.7 | <0.05 |
| 22-09-21 | 26.0 | 0.02 | 9.5 | 0.039 | 62.9 | 0.27 | 1.58 | 1.42 | 35.2 | <0.05 |
| Date (yy-mm-dd) | NH3T_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) | — |
| 22-06-22 | <0.001 | <0.05 | 0.47 | 0.47 | <1 | — | 0.6 | 6.7 | **0.031** | — |
| 22-07-21 | <0.001 | <0.05 | 0.56 | 0.56 | 6 | — | 0.7 | 3.0 | **0.019** | — |
| 22-08-24 | <0.001 | <0.05 | 0.58 | 0.58 | 1 | — | 0.7 | 6.3 | **0.025** | — |
| 22-09-21 | <0.001 | <0.05 | 0.28 | 0.28 | <1 | — | 0.8 | 11.4 | **0.183** | — |

**Table 43: Inorganics results for WQ-1, 2022.**

| SITE WQ-1: HEAVY METALS AND OTHER ELEMENTS | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Date (yy-mm-dd) | Al (mg/L) | As (mg/L) | B (mg/L) | Ba (mg/L) | Cd (mg/L) | Co (mg/L) | Cr (mg/L) | Cu (mg/L) | Fe (mg/L) | Li (mg/L) |
| 22-06-22 | 0.066 | <0.001 | 0.068 | 0.068 | <0.00001 | <0.0001 | <0.001 | <0.001 | **0.32** | 0.0008 |
| 22-07-21 | 0.043 | <0.001 | 0.083 | 0.083 | <0.00001 | 0.0001 | <0.001 | <0.001 | 0.17 | 0.0009 |
| 22-08-24 | 0.046 | <0.001 | 0.068 | 0.068 | <0.00001 | <0.0001 | <0.001 | <0.001 | 0.23 | 0.0009 |
| 22-09-21 | **0.472** | <0.001 | 0.058 | 0.058 | 0.00003 | 0.0006 | <0.001 | **0.003** | **0.80** | 0.0006 |
| Date (yy-mm-dd) | Mn (mg/L) | Mo (mg/L) | Ni (mg/L) | Pb (mg/L) | Rb (mg/L) | Sb (mg/L) | Sr (mg/L) | U (mg/L) | V (mg/L) | Zn (mg/L) |
| 22-06-22 | 0.071 | <0.0001 | <0.001 | 0.0002 | 0.0010 | <0.0001 | 0.062 | <0.0001 | <0.001 | 0.001 |
| 22-07-21 | 0.103 | <0.0001 | <0.001 | 0.0002 | 0.0011 | <0.0001 | 0.071 | <0.0001 | <0.001 | 0.001 |
| 22-08-24 | 0.065 | <0.0001 | <0.001 | 0.0001 | 0.0014 | <0.0001 | 0.068 | <0.0001 | <0.001 | 0.003 |
| 22-09-21 | 0.402 | <0.0001 | <0.001 | **0.0014** | 0.0018 | 0.0001 | 0.029 | 0.0001 | 0.001 | 0.007 |

### 3.2.2 WQ-2

The water sampling results for site WQ-2 in 2022 met or exceeded the *CCME Recommended Guidelines for the Protection of Aquatic Life* based on pH and dissolved oxygen. Water temperature did not exceed the 22.5˚C limit for thermal stress in salmonids (Table 44).

Bacterial levels exceeded the maximum concentration of *E. coli* from the *Guidelines for Canadian Recreational Water Quality* (≤ 235 MPN/100 mL) in July and September (Table 44).

Total phosphorus levels for long-term eutrophic conditions, according to the *CCME Guidance Framework for Total Phosphorus*, were in the meso-eutrophic range (0.020 – 0.025 mg/L) in June, the mesotrophic range (0.010 – 0.020 mg/L) in July and August, and in the hyper-eutrophic range (> 0.100 mg/L) in September (Table 45).

Concentrations of aluminum exceeded the *CCME Recommended Guidelines for the Protection of Aquatic Life* (0.100 mg/L, pH ≥ 6.5) in September. Iron exceeded the guideline of 0.3 mg/L in September, as well as lead (0.001mg/L, HARD ≤ 60 mg/L) and copper (0.002 mg/L, HARD 0 - 82 mg/L) (Table 46).

**Table 44: Water chemistry data and *E. coli* results for WQ-2, 2022.**

| SITE WQ-2: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Date (yy-mm-dd) | Temp (˚C) | | SAL (ppt) | DO (mg/L) | *E. coli* (MPN/100 mL) | ALK_T (mg/L) | CLRA (TCU) | COND (mS/cm) | |
| | Air | Water | | | | | | Field | Lab |
| 22-06-22 | 17 | 11.6 | 0.22 | 11.01 | 96 | 57 | 21 | 0.331 | 0.458 |
| 22-07-21 | 24 | 14.3 | 0.22 | 8.09 | **627** | 68 | 7 | 0.366 | 0.463 |
| 22-08-24 | 19 | 15.7 | 0.22 | 11.47 | 146 | 59 | 6 | 0.377 | 0.470 |
| 22-09-21 | 15 | 13.5 | 0.09 | 10.37 | **12,033** | 31 | 63 | 0.147 | 0.185 |
| Date (yy-mm-dd) | HARD (mg/L) | Lang_Ind (20˚C) | pH | | | TDS (mg/L) | | TURB (NTU) | — |
| | | | Field | Lab | Sat (20˚C) | Field | Lab | | |
| 22-06-22 | 87.5 | -0.40 | 7.69 | 7.8 | 8.2 | 284.25 | 227 | 1.2 | — |
| 22-07-21 | 107.0 | -0.14 | 7.74 | 7.9 | 8.0 | 297.70 | 230 | 0.7 | — |
| 22-08-24 | 98.1 | -0.44 | 7.61 | 7.7 | 8.1 | 298.35 | 229 | 0.7 | — |
| 22-09-21 | 41.3 | -1.43 | 7.79 | 7.3 | 8.7 | 122.85 | 108 | 57.5 | — |

**Table 45: Nutrient results for WQ-2, 2022.**

| 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) |
| 22-06-22 | 56.6 | 0.05 | 27.1 | 0.336 | 96.7 | 0.22 | 1.05 | 4.82 | 51.0 | <0.05 |
| 22-07-21 | 67.5 | 0.05 | 33.2 | 0.504 | 97.5 | 0.12 | 1.11 | 5.76 | 41.8 | <0.05 |
| 22-08-24 | 58.7 | 0.05 | 30.5 | 0.277 | 95.2 | 0.09 | 1.21 | 5.33 | 49.1 | <0.05 |
| 22-09-21 | 30.9 | 0.02 | 13.4 | 0.058 | 37.1 | 0.23 | 2.04 | 1.91 | 19.7 | <0.05 |
| Date (yy-mm-dd) | NH3T_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) | — |
| 22-06-22 | <0.001 | <0.05 | 0.36 | 0.36 | 5 | — | 0.6 | 4.2 | **0.021** | — |
| 22-07-21 | <0.001 | <0.05 | 0.36 | 0.36 | 7 | — | 0.4 | 1.8 | **0.011** | — |
| 22-08-24 | <0.001 | <0.05 | 0.37 | 0.37 | 7 | — | 0.5 | 2.5 | **0.017** | — |
| 22-09-21 | <0.001 | <0.05 | 0.54 | 0.54 | 12 | — | 0.9 | 8.3 | **0.200** | — |

**Table 46: Inorganics results for WQ-2, 2022.**

| SITE WQ-2: HEAVY METALS AND OTHER ELEMENTS | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Date (yy-mm-dd) | Al (mg/L) | As (mg/L) | B (mg/L) | Ba (mg/L) | Cd (mg/L) | Co (mg/L) | Cr (mg/L) | Cu (mg/L) | Fe (mg/L) | Li (mg/L) |
| 22-06-22 | 0.063 | <0.001 | 0.104 | 0.104 | <0.00001 | <0.0001 | <0.001 | <0.001 | 0.23 | 0.0012 |
| 22-07-21 | 0.025 | <0.001 | 0.117 | 0.117 | <0.00001 | <0.0001 | <0.001 | <0.001 | 0.15 | 0.0015 |
| 22-08-24 | 0.022 | <0.001 | 0.119 | 0.119 | <0.00001 | <0.0001 | <0.001 | <0.001 | 0.09 | 0.0015 |
| 22-09-21 | **0.437** | <0.001 | 0.071 | 0.071 | 0.00003 | 0.0003 | <0.001 | **0.007** | **0.53** | 0.0007 |
| Date (yy-mm-dd) | Mn (mg/L) | Mo (mg/L) | Ni (mg/L) | Pb (mg/L) | Rb (mg/L) | Sb (mg/L) | Sr (mg/L) | U (mg/L) | V (mg/L) | Zn (mg/L) |
| 22-06-22 | 0.107 | <0.0001 | <0.001 | <0.0001 | 0.0010 | <0.0001 | 0.079 | 0.0004 | <0.001 | 0.001 |
| 22-07-21 | 0.097 | 0.0001 | <0.001 | <0.0001 | 0.0011 | <0.0001 | 0.095 | 0.0006 | <0.001 | <0.001 |
| 22-08-24 | 0.084 | <0.0001 | <0.001 | <0.0001 | 0.0010 | <0.0001 | 0.088 | 0.0003 | <0.001 | <0.001 |
| 22-09-21 | 0.128 | 0.0003 | <0.001 | **0.0015** | 0.0018 | 0.0002 | 0.041 | 0.0011 | 0.001 | 0.006 |

### 3.2.3 WQ-3

The water sampling results for site WQ-3 in 2022 met or exceeded the *CCME Recommended Guidelines for the Protection of Aquatic Life* based on pH and dissolved oxygen. Water temperature did not exceed the 22.5˚C limit for thermal stress in salmonids (Table 47.)

Bacterial levels exceeded the maximum concentration *E. coli* from the *Guidelines for Canadian Recreational Water Quality* (≤ 235 MPN/100 ml) for all samples taken in 2022 (Table 47).

Total phosphorus levels for long-term eutrophic conditions, according to the *CCME Guidance Framework for Total Phosphorus*, were in the eutrophic range (0.035 – 0.100 mg/L) from June to August, and in the hyper-eutrophic range (> 0.100 mg/L) in September (Table 48).

Concentrations of aluminum exceeded the *CCME Recommended Guidelines for the Protection of Aquatic Life* (0.100 mg/L, pH ≥ 6.5) in June, July and September. Iron levels exceeded the guideline of 0.3 mg/L in September, along with lead (0.001mg/L, HARD ≤ 60 mg/L) and copper (0.002 mg/L, HARD 0 - 82 mg/L) (Table 49).

**Table 47: Water chemistry data and *E. coli* results for WQ-3, 2022**

| SITE WQ-3: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Date (yy-mm-dd) | Temp (˚C) | | SAL (ppt) | DO (mg/L) | *E. coli* (MPN/100 mL) | ALK_T (mg/L) | CLRA (TCU) | COND (mS/cm) | |
| | Air | Water | | | | | | Field | Lab |
| 22-06-22 | 19 | 12.7 | 0.22 | 10.57 | **3,076** | 90 | 57 | 0.342 | 0.461 |
| 22-07-21 | 25 | 16.5 | 0.19 | 8.49 | **748** | 100 | 13 | 0.333 | 0.393 |
| 22-08-24 | 20 | 17.4 | 0.18 | 9.97 | **1,354** | 111 | 15 | 0.325 | 0.381 |
| 22-09-21 | 15 | 14.1 | 0.18 | 11.37 | **6,131** | 40 | 152 | 0.294 | 0.360 |
| Date (yy-mm-dd) | HARD (mg/L) | Lang_Ind (20˚C) | pH | | | TDS (mg/L) | | TURB (NTU) | — |
| | | | Field | Lab | Sat (20˚C) | Field | Lab | | |
| 22-06-22 | 99.1 | 0.07 | 7.85 | 8.0 | 7.9 | 290.55 | 247 | 8.4 | — |
| 22-07-21 | 114 | 0.28 | 7.98 | 8.1 | 7.8 | 258.70 | 216 | 10.9 | — |
| 22-08-24 | 127.0 | 0.28 | 7.92 | 8.0 | 7.7 | 247.00 | 226 | 3.4 | — |
| 22-09-21 | 40.0 | -1.14 | 7.57 | 7.5 | 8.6 | 241.80 | 204 | 414.0 | — |

**Table 48: Nutrient results for WQ-3, 2022**

| 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) |
| 22-06-22 | 89.1 | 0.05 | 33.2 | 0.838 | 81.3 | 0.30 | 1.41 | 3.93 | 51.9 | <0.05 |
| 22-07-21 | 98.8 | 0.05 | 37.7 | 1.170 | 62.7 | 0.17 | 1.65 | 4.73 | 32.8 | <0.05 |
| 22-08-24 | 110.0 | 0.06 | 43.0 | 1.030 | 54.1 | 0.18 | 1.83 | 4.74 | 32.2 | <0.05 |
| 22-09-21 | 39.9 | 0.03 | 13.6 | 0.119 | 84.4 | 0.34 | 2.17 | 1.47 | 56.7 | <0.05 |
| Date (yy-mm-dd) | NH3T_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) | — |
| 22-06-22 | <0.001 | <0.05 | 1.12 | 1.12 | 8 | — | 1.1 | 7.0 | **0.056** | — |
| 22-07-21 | <0.001 | <0.05 | 1.10 | 1.10 | 10 | — | 1.1 | 2.5 | **0.062** | — |
| 22-08-24 | <0.001 | <0.05 | 1.52 | 1.52 | 11 | — | 1.5 | 4.4 | **0.039** | — |
| 22-09-21 | <0.001 | <0.05 | 0.80 | 0.80 | 16 | — | 1.2 | 12.4 | **1.020** | — |

**Table 49: Inorganics results for WQ-3, 2022**

| SITE WQ-3: HEAVY METALS AND OTHER ELEMENTS | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Date (yy-mm-dd)** | **Al (mg/L)** | **As (mg/L)** | **B (mg/L)** | **Ba (mg/L)** | **Cd (mg/L)** | **Co (mg/L)** | **Cr (mg/L)** | **Cu (mg/L)** | **Fe (mg/L)** | **Li (mg/L)** |
| 22-06-22 | **0.219** | <0.001 | 0.091 | 0.091 | <0.00001 | 0.0001 | <0.001 | 0.001 | 0.27 | 0.0009 |
| 22-07-21 | **0.130** | <0.001 | 0.102 | 0.102 | <0.00001 | <0.0001 | <0.001 | <0.001 | 0.13 | 0.0008 |
| 22-08-24 | 0.083 | <0.001 | 0.111 | 0.111 | <0.00001 | <0.0001 | <0.001 | 0.001 | 0.08 | 0.0007 |
| 22-09-21 | **1.370** | 0.001 | 0.137 | 0.137 | 0.00004 | 0.0012 | <0.001 | **0.005** | **0.86** | 0.0012 |
| **Date (yy-mm-dd)** | **Mn (mg/L)** | **Mo (mg/L)** | **Ni (mg/L)** | **Pb (mg/L)** | **Rb (mg/L)** | **Sb (mg/L)** | **Sr (mg/L)** | **U (mg/L)** | **V (mg/L)** | **Zn (mg/L)** |
| 22-06-22 | 0.025 | 0.0002 | <0.001 | 0.0003 | 0.0014 | <0.0001 | 0.087 | 0.0010 | 0.001 | 0.002 |
| 22-07-21 | 0.016 | 0.0004 | <0.001 | 0.0003 | 0.0014 | <0.0001 | 0.097 | 0.0016 | <0.001 | 0.001 |
| 22-08-24 | 0.016 | 0.0003 | <0.001 | 0.0001 | 0.0015 | 0.0001 | 0.111 | 0.0024 | <0.001 | 0.001 |
| 22-09-21 | 0.173 | 0.0005 | 0.001 | **0.0030** | 0.0022 | 0.0002 | 0.049 | 0.0022 | 0.003 | 0.007 |

### 3.2.4 WQ-4

The water sampling results for site WQ-4 in 2022 met or exceeded the *CCME Recommended Guidelines for the Protection of Aquatic Life* based on pH and dissolved oxygen. Water temperature did not exceed the 22.5˚C limit for thermal stress in salmonids (Table 50).

Bacterial levels exceeded the maximum concentration of *E. coli* from the *Guidelines for Canadian Recreational Water Quality* (≤ 235 MPN/100 mL) in July and September (Table 50).

Total phosphorus levels for long-term eutrophic conditions, according to the *CCME Guidance Framework for Total Phosphorus*, were in the mesotrophic range (0.020 – 0.025 mg/L) in June, the mesotrophic range (0.010 – 0.020 mg/L) in July and August, and in the hyper-eutrophic range (> 0.100 mg/L) in September. Chloride levels were above the long-term concentration guideline of 120 mg/L at this site in June, July and August (Table 51).

Concentrations of aluminum exceeded the *CCME Recommended Guidelines for the Protection of Aquatic Life* (0.100 mg/L, pH ≥ 6.5) in September. Iron levels exceeded the guideline of 0.3 mg/L in September as well. Based on the guideline equation for copper in Table 2, copper exceeded its guideline at this site in both May and September (Table 52).

**Table 50: Water chemistry data and *E. coli* results for WQ-4, 2022.**

| 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/100 mL)** | **ALK_T (mg/L)** | **CLRA (TCU)** | **COND (mS/cm)** | |
| | **Air** | **Water** | | | | | | **Field** | **Lab** |
| 22-06-22 | 20 | 14.0 | 0.34 | 11.26 | 119 | 100 | <5 | 0.550 | 0.725 |
| 22-07-21 | 25 | 15.7 | 0.37 | 9.39 | **801** | 120 | <5 | 0.610 | 0.764 |
| 22-08-24 | 20 | 16.2 | 0.38 | 11.00 | 41 | 140 | <5 | 0.650 | 0.799 |
| 22-09-21 | 15 | 15.3 | 0.19 | 10.61 | **2,359** | 80 | 26 | 0.286 | 0.342 |
| **Date (yy-mm-dd)** | **HARD (mg/L)** | **Lang_Ind (20˚C)** | **pH** | | | **TDS (mg/L)** | | **TURB (NTU)** | **—** |
| | | | **Field** | **Lab** | **Sat (20˚C)** | **Field** | **Lab** | | |
| 22-06-22 | 168.0 | 0.29 | 7.60 | 8.0 | 7.7 | 455.00 | 378 | 1.5 | — |
| 22-07-21 | 184.0 | 0.41 | 7.69 | 8.0 | 7.6 | 487.50 | 413 | 0.7 | — |
| 22-08-24 | 200.0 | 0.21 | 7.60 | 7.7 | 7.5 | 507.00 | 452 | 0.7 | — |
| 22-09-21 | 92.6 | -0.40 | 7.59 | 7.6 | 8.0 | 228.15 | 194 | 85.8 | — |

**Table 51: Nutrient results for WQ-4, 2022.**

| 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)** |
| 22-06-22 | 99.0 | 0.07 | 53.1 | 0.931 | **154.0** | 0.19 | 2.54 | 8.62 | 71.3 | <0.05 |
| 22-07-21 | 119.0 | 0.07 | 59.4 | 1.120 | **165.0** | 0.17 | 2.60 | 8.73 | 78.7 | <0.05 |
| 22-08-24 | 139.0 | 0.08 | 64.5 | 0.656 | **175.0** | 0.16 | 2.70 | 9.42 | 85.3 | <0.05 |
| 22-09-21 | 79.7 | 0.04 | 30.6 | 0.298 | 55.3 | 0.19 | 2.05 | 3.94 | 31.7 | 0.05 |
| **Date (yy-mm-dd)** | **NH3T_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)** | **—** |
| 22-06-22 | <0.001 | <0.05 | 1.91 | 1.91 | 17 | — | 1.8 | 1.8 | **0.023** | — |
| 22-07-21 | <0.001 | <0.05 | 1.83 | 1.83 | 17 | — | 1.8 | 1.3 | **0.016** | — |
| 22-08-24 | <0.001 | <0.05 | 2.10 | 2.10 | 18 | — | 2.2 | 2.1 | **0.016** | — |
| 22-09-21 | <0.001 | <0.05 | 1.72 | 1.72 | 13 | — | 1.9 | 4.4 | **0.233** | — |

**Table 52: Inorganics results for WQ-4, 2022.**

| SITE WQ-4: HEAVY METALS AND OTHER ELEMENTS | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Date (yy-mm-dd)** | **Al (mg/L)** | **As (mg/L)** | **B (mg/L)** | **Ba (mg/L)** | **Cd (mg/L)** | **Co (mg/L)** | **Cr (mg/L)** | **Cu (mg/L)** | **Fe (mg/L)** | **Li (mg/L)** |
| 22-06-22 | 0.067 | <0.001 | 0.223 | 0.223 | <0.00001 | <0.0001 | <0.001 | **0.004** | 0.16 | 0.0025 |
| 22-07-21 | 0.035 | <0.001 | 0.234 | 0.234 | <0.00001 | <0.0001 | <0.001 | 0.001 | 0.07 | 0.0032 |
| 22-08-24 | 0.033 | <0.001 | 0.228 | 0.228 | <0.00001 | <0.0001 | <0.001 | 0.001 | 0.10 | 0.0031 |
| 22-09-21 | **0.456** | <0.001 | 0.153 | 0.153 | 0.00002 | 0.0004 | <0.001 | **0.004** | **0.44** | 0.0020 |
| **Date (yy-mm-dd)** | **Mn (mg/L)** | **Mo (mg/L)** | **Ni (mg/L)** | **Pb (mg/L)** | **Rb (mg/L)** | **Sb (mg/L)** | **Sr (mg/L)** | **U (mg/L)** | **V (mg/L)** | **Zn (mg/L)** |
| 22-06-22 | 0.041 | 0.0023 | <0.001 | 0.0002 | 0.0017 | <0.0001 | 0.186 | 0.0026 | <0.001 | 0.002 |
| 22-07-21 | 0.019 | 0.0027 | <0.001 | <0.0001 | 0.0018 | <0.0001 | 0.211 | 0.0026 | <0.001 | 0.001 |
| 22-08-24 | 0.032 | 0.0025 | <0.001 | <0.0001 | 0.0019 | <0.0001 | 0.206 | 0.0027 | <0.001 | 0.003 |
| 22-09-21 | 0.071 | 0.0009 | <0.001 | 0.0016 | 0.0018 | 0.0002 | 0.113 | 0.0046 | 0.002 | 0.009 |

### 3.2.5 WQ-5

The water sampling results for site WQ-5 in 2022 met or exceeded the *CCME Recommended Guidelines for the Protection of Aquatic Life* based on pH and dissolved oxygen. Water temperature did not exceed the 22.5˚C limit for thermal stress in salmonids (Table 53).

Bacterial levels exceeded the maximum concentration of *E. coli* from the *Guidelines for Canadian Recreational Water Quality* (≤ 235 MPN/100 mL) in September (Table 53).

Total phosphorus levels for long-term eutrophic conditions, according to the *CCME Guidance Framework for Total Phosphorus*, were in the eutrophic range (0.035 – 0.100 mg/L) in June, the meso-eutrophic range (0.020 – 0.035 mg/L) in July and August, and the hyper-eutrophic range (> 0.100 mg/L) in September. Chloride levels were above the long-term concentration guideline of 120 mg/L in June, July, August and September (Figure 54).

Concentrations of aluminum exceeded the *CCME Recommended Guidelines for the Protection of Aquatic Life* (0.100 mg/L, pH ≥ 6.5) in June and September. Iron levels exceeded the guideline of 0.3 mg/L in June and September as well (Table 55).

**Table 53: Water chemistry data and *E. coli* results for WQ-5, 2022.**

| SITE WQ-5: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Date (yy-mm-dd) | Temp (˚C) | | SAL (ppt) | DO (mg/L) | *E. coli* (MPN/100 mL) | ALK_T (mg/L) | CLRA (TCU) | COND (mS/cm) | |
| | Air | Water | | | | | | Field | Lab |
| 22-06-22 | 20 | 15.4 | 0.38 | 10.87 | 173 | 80 | 43 | 0.630 | 0.799 |
| 22-07-21 | 26 | 17.6 | 0.43 | 8.44 | 20 | 84 | 23 | 0.740 | 0.882 |
| 22-08-24 | 20 | 18.1 | 0.37 | 10.05 | 10 | 82 | 24 | 0.650 | 0.762 |
| 22-09-21 | 14 | 13.1 | 0.40 | 11.85 | **4,884** | 47 | 61 | 0.630 | 0.828 |
| Date (yy-mm-dd) | HARD (mg/L) | Lang_Ind (20˚C) | pH | | | TDS (mg/L) | | TURB (NTU) | — |
| | | | Field | Lab | Sat (20˚C) | Field | Lab | | |
| 22-06-22 | 100.0 | 0.00 | 7.69 | 8.0 | 8.0 | 500.50 | 417 | 4.0 | — |
| 22-07-21 | 126.0 | -0.08 | 7.76 | 7.8 | 7.9 | 559.00 | 448 | 1.1 | — |
| 22-08-24 | 118.0 | -0.11 | 7.68 | 7.8 | 7.9 | 487.50 | 414 | 1.0 | — |
| 22-09-21 | 91.7 | -0.77 | 7.56 | 7.5 | 8.3 | 553.00 | 432 | 23.3 | — |

**Table 54: Nutrient results for WQ-5, 2022.**

| 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) |
| 22-06-22 | 79.2 | 0.06 | 34.2 | 0.744 | **205** | 0.33 | 1.44 | 3.65 | 113.0 | <0.05 |
| 22-07-21 | 83.5 | 0.06 | 43.3 | 0.495 | **229** | 0.13 | 1.95 | 4.34 | 114.0 | <0.05 |
| 22-08-24 | 81.5 | 0.06 | 40.9 | 0.483 | **197** | 0.16 | 1.84 | 3.81 | 107.0 | <0.05 |
| 22-09-21 | 46.8 | 0.05 | 30.7 | 0.139 | **236** | 0.27 | 3.04 | 3.65 | 120.0 | <0.05 |
| Date (yy-mm-dd) | NH3T_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) | — |
| 22-06-22 | <0.001 | <0.05 | 0.10 | 0.10 | <1 | — | 0.5 | 9.0 | **0.044** | — |
| 22-07-21 | <0.001 | <0.05 | 0.06 | 0.06 | 3 | — | 0.4 | 5.1 | **0.025** | — |
| 22-08-24 | <0.001 | <0.05 | 0.14 | 0.14 | 4 | — | 0.5 | 7.4 | **0.025** | — |
| 22-09-21 | <0.001 | <0.05 | 0.18 | 0.18 | 7 | — | 0.7 | 10.4 | **0.112** | — |

**Table 55: Inorganics results for WQ-5, 2022.**

| SITE WQ-5: HEAVY METALS AND OTHER ELEMENTS | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Date (yy-mm-dd) | Al (mg/L) | As (mg/L) | B (mg/L) | Ba (mg/L) | Cd (mg/L) | Co (mg/L) | Cr (mg/L) | Cu (mg/L) | Fe (mg/L) | Li (mg/L) |
| 22-06-22 | **0.124** | <0.001 | 0.156 | 0.156 | <0.00001 | 0.0002 | <0.001 | <0.001 | **0.59** | 0.0004 |
| 22-07-21 | 0.014 | <0.001 | 0.155 | 0.155 | <0.00001 | 0.0001 | <0.001 | <0.001 | 0.27 | 0.0005 |
| 22-08-24 | 0.012 | <0.001 | 0.169 | 0.169 | <0.00001 | 0.0001 | <0.001 | <0.001 | 0.28 | 0.0004 |
| 22-09-21 | **0.292** | <0.001 | 0.178 | 0.178 | 0.00001 | 0.0004 | <0.001 | 0.001 | **0.89** | 0.0005 |
| Date (yy-mm-dd) | Mn (mg/L) | Mo (mg/L) | Ni (mg/L) | Pb (mg/L) | Rb (mg/L) | Sb (mg/L) | Sr (mg/L) | U (mg/L) | V (mg/L) | Zn (mg/L) |
| 22-06-22 | 0.634 | <0.0001 | <0.001 | 0.0002 | 0.0015 | <0.0001 | 0.087 | 0.0001 | <0.001 | 0.001 |
| 22-07-21 | 0.543 | <0.0001 | <0.001 | <0.0001 | 0.0019 | <0.0001 | 0.097 | <0.0001 | <0.001 | <0.001 |
| 22-08-24 | 0.655 | 0.0001 | <0.001 | <0.0001 | 0.0017 | <0.0001 | 0.084 | <0.0001 | <0.001 | <0.001 |
| 22-09-21 | 0.883 | 0.0001 | <0.001 | 0.0006 | 0.0025 | <0.0001 | 0.088 | 0.0001 | <0.001 | 0.002 |

### 3.2.6 WQ-6

The water sampling results for site WQ-6 in 2022 met or exceeded the *CCME Recommended Guidelines for the Protection of Aquatic Life* based on pH and dissolved oxygen. Water temperature did not exceed the 22.5˚C limit for thermal stress in salmonids (Table 56).

Bacterial levels exceeded the maximum concentration of *E. coli* from the *Guidelines for Canadian Recreational Water Quality* (≤ 235 MPN/100 mL) in August and September (Table 56).

Total phosphorus levels for long-term eutrophic conditions, according to the *CCME Guidance Framework for Total Phosphorus*, were in the mesotrophic range (0.010 – 0.020 mg/L) from June through to August, and in the eutrophic range (0.035 – 0.100 mg/L) in September. Chloride levels were above the long-term concentration guideline of 120 mg/L at this site in June, August and September (Table 57).

Concentrations of aluminum exceeded the *CCME Recommended Guidelines for the Protection of Aquatic Life* (0.100 mg/L, pH ≥ 6.5) in September. Iron also exceeded the guideline of 0.03 mg/L in September (Table 58).

**Table 56: Water chemistry data and *E. coli* results for WQ-6, 2022.**

| SITE WQ-6: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Date (yy-mm-dd) | Temp (˚C) | | SAL (ppt) | DO (mg/L) | *E. coli* (MPN/100 mL) | ALK_T (mg/L) | CLRA (TCU) | COND (mS/cm) | |
| | Air | Water | | | | | | Field | Lab |
| 22-06-22 | 20 | 12.8 | 0.28 | 8.80 | 10 | 100 | 23 | 0.496 | 0.584 |
| 22-07-21 | 26 | 14.2 | 0.23 | 7.10 | 131 | 96 | 10 | 0.372 | 0.451 |
| 22-08-24 | 21 | 16.0 | 0.26 | 10.04 | **359** | 100 | 12 | 0.444 | 0.555 |
| 22-09-21 | 14 | 13.5 | 0.26 | 10.89 | **3,448** | 64 | 58 | 0.409 | 0.531 |
| Date (yy-mm-dd) | HARD (mg/L) | Lang_Ind (20˚C) | pH | | | TDS (mg/L) | | TURB (NTU) | — |
| | | | Field | Lab | Sat (20˚C) | Field | Lab | | |
| 22-06-22 | 113 | -0.06 | 7.59 | 7.8 | 7.9 | 375.70 | 318 | 0.9 | — |
| 22-07-21 | 113 | 0.04 | 7.76 | 7.9 | 7.9 | 304.20 | 248 | 0.7 | — |
| 22-08-24 | 134 | -0.08 | 7.66 | 7.7 | 7.8 | 349.05 | 318 | 0.4 | — |
| 22-09-21 | 63 | -0.68 | 7.67 | 7.6 | 8.3 | 341.25 | 280 | 10.5 | — |

**Table 57: Nutrient results for WQ-6, 2022.**

| 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) |
| 22-06-22 | 99.4 | 0.05 | 36.1 | 0.590 | 133 | 0.24 | 1.09 | 5.54 | 69.1 | <0.05 |
| 22-07-21 | 95.2 | 0.04 | 36.4 | 0.711 | 87.3 | 0.10 | 1.33 | 5.40 | 48.0 | <0.05 |
| 22-08-24 | 99.5 | 0.05 | 43.6 | 0.469 | **127.0** | 0.14 | 1.55 | 6.11 | 63.6 | <0.05 |
| 22-09-21 | 63.7 | 0.03 | 20.6 | 0.238 | **125.0** | 0.25 | 2.18 | 2.81 | 79.8 | <0.05 |
| Date (yy-mm-dd) | NH3T_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) | — |
| 22-06-22 | <0.001 | <0.05 | 0.79 | 0.79 | 3 | — | 0.8 | 4.8 | **0.020** | — |
| 22-07-21 | <0.001 | <0.05 | 1.19 | 1.19 | 5 | — | 1.1 | 2.5 | **0.016** | — |
| 22-08-24 | <0.001 | <0.05 | 0.90 | 0.90 | 6 | — | 0.9 | 4.4 | **0.014** | — |
| 22-09-21 | <0.001 | <0.05 | 0.27 | 0.27 | 9 | — | 0.7 | 9.4 | **0.073** | — |

**Table 58: Inorganics results for WQ-6, 2022.**

| SITE WQ-6: HEAVY METALS AND OTHER ELEMENTS | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Date (yy-mm-dd) | Al (mg/L) | As (mg/L) | B (mg/L) | Ba (mg/L) | Cd (mg/L) | Co (mg/L) | Cr (mg/L) | Cu (mg/L) | Fe (mg/L) | Li (mg/L) |
| 22-06-22 | 0.022 | <0.001 | 0.082 | 0.082 | <0.00001 | <0.0001 | <0.001 | <0.001 | 0.20 | 0.0005 |
| 22-07-21 | 0.009 | <0.001 | 0.081 | 0.081 | <0.00001 | <0.0001 | <0.001 | <0.001 | 0.13 | 0.0006 |
| 22-08-24 | 0.008 | <0.001 | 0.097 | 0.097 | <0.00001 | <0.0001 | <0.001 | <0.001 | 0.10 | 0.0006 |
| 22-09-21 | **0.314** | <0.001 | 0.057 | 0.057 | <0.00001 | 0.0002 | <0.001 | 0.002 | **0.50** | 0.0004 |
| Date (yy-mm-dd) | Mn (mg/L) | Mo (mg/L) | Ni (mg/L) | Pb (mg/L) | Rb (mg/L) | Sb (mg/L) | Sr (mg/L) | U (mg/L) | V (mg/L) | Zn (mg/L) |
| 22-06-22 | 0.081 | <0.0001 | <0.001 | <0.0001 | 0.0008 | <0.0001 | 0.070 | 0.0002 | <0.001 | 0.001 |
| 22-07-21 | 0.111 | <0.0001 | <0.001 | <0.0001 | 0.0009 | <0.0001 | 0.058 | 0.0001 | <0.001 | <0.001 |
| 22-08-24 | 0.087 | <0.0001 | <0.001 | <0.0001 | 0.0011 | <0.0001 | 0.072 | 0.0002 | <0.001 | <0.001 |
| 22-09-21 | 0.083 | 0.0002 | <0.001 | 0.0006 | 0.0020 | 0.0001 | 0.041 | <0.0001 | <0.001 | 0.002 |

### 3.2.7 WQ-7

The water sampling results for site WQ-7 in 2022 met or exceeded the *CCME Recommended Guidelines for the Protection of Aquatic Life* based on pH and dissolved oxygen. Water temperature did not exceed the 22.5˚C limit for thermal stress in salmonids (Table 59.)

Bacterial levels exceeded the maximum concentration of *E. coli* from the *Guidelines for Canadian Recreational Water Quality* (≤ 235 MPN/100 mL) in July and September (Table 59).

Total phosphorus levels for long-term eutrophic conditions, according to the *CCME Guidance Framework for Total Phosphorus*, were in the meso-eutrophic range in June (0.020 – 0.035 mg/L), the hyper-eutrophic range (> 0.100 mg/L) in July, the meso-eutrophic range again in August and the eutrophic range (0.035 – 0.100 mg/L) in September (Table 60).

Concentrations of aluminum exceeded the *CCME Recommended Guidelines for the Protection of Aquatic Life* (0.100 mg/L, pH ≥ 6.5) in June and September. Iron levels exceeded the guideline of 0.3 mg/L in June and September as well (Table 61).

**Table 59: Water chemistry data and *E. coli* results for WQ-7, 2022.**

| SITE WQ-7: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Date (yy-mm-dd) | Temp (˚C) | | SAL (ppt) | DO (mg/L) | *E. coli* (MPN/100 mL) | ALK_T (mg/L) | CLRA (TCU) | COND (mS/cm) | |
| | Air | Water | | | | | | Field | Lab |
| 22-06-22 | 20 | 16.9 | 0.15 | 8.8 | 197 | 53 | 37 | 0.267 | 0.323 |
| 22-07-21 | 26 | 19.4 | 0.16 | 7.7 | **379** | 60 | 11 | 0.306 | 0.348 |
| 22-08-24 | 21 | 19.1 | 0.19 | 9.65 | 226 | 58 | 8 | 0.351 | 0.401 |
| 22-09-21 | 14 | 14.0 | 0.09 | 10.44 | **1,376** | 32 | 19 | 0.156 | 0.195 |
| Date (yy-mm-dd) | HARD (mg/L) | Lang_Ind (20˚C) | pH | | | TDS (mg/L) | | TURB (NTU) | — |
| | | | Field | Lab | Sat (20˚C) | Field | Lab | | |
| 22-06-22 | 86.6 | -0.45 | 7.69 | 7.8 | 8.2 | 205.40 | 167 | 1.6 | — |
| 22-07-21 | 93.5 | -0.36 | 7.69 | 7.8 | 8.2 | 222.95 | 176 | 33.4 | — |
| 22-08-24 | 110.0 | -0.31 | 7.63 | 7.8 | 8.1 | 257.40 | 199 | 0.9 | — |
| 22-09-21 | 55.4 | -1.32 | 7.64 | 7.3 | 8.6 | 128.70 | 105 | 12.6 | — |

**Table 60: Nutrient results for WQ-7, 2022.**

| 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) |
| 22-06-22 | 52.7 | 0.04 | 25.5 | 0.313 | 64.5 | 0.18 | 0.97 | 5.57 | 26.3 | <0.05 |
| 22-07-21 | 59.6 | 0.04 | 27.6 | 0.353 | 69.0 | 0.13 | 1.09 | 5.96 | 26.2 | <0.05 |
| 22-08-24 | 57.6 | 0.04 | 32.8 | 0.342 | 79.4 | 0.09 | 1.31 | 6.76 | 30.6 | <0.05 |
| 22-09-21 | 31.9 | 0.02 | 16.7 | 0.060 | 39.7 | 0.11 | 1.29 | 3.32 | 14.8 | <0.05 |
| Date (yy-mm-dd) | NH3T_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) | — |
| 22-06-22 | <0.001 | <0.05 | 0.10 | 0.10 | 8 | — | 0.3 | 3.3 | **0.028** | — |
| 22-07-21 | <0.001 | <0.05 | 0.08 | 0.08 | 9 | — | 0.6 | 4.2 | **0.124** | — |
| 22-08-24 | <0.001 | <0.05 | 0.15 | 0.15 | 9 | — | 0.3 | 3.0 | **0.021** | — |
| 22-09-21 | <0.001 | <0.05 | 0.11 | 0.11 | 9 | — | 0.3 | 4.0 | **0.041** | — |

**Table 61: Inorganics results for WQ-7, 2022.**

| SITE WQ-7: HEAVY METALS AND OTHER ELEMENTS | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Date (yy-mm-dd)** | **Al (mg/L)** | **As (mg/L)** | **B (mg/L)** | **Ba (mg/L)** | **Cd (mg/L)** | **Co (mg/L)** | **Cr (mg/L)** | **Cu (mg/L)** | **Fe (mg/L)** | **Li (mg/L)** |
| 22-06-22 | **0.100** | <0.001 | 0.081 | 0.081 | <0.00001 | 0.0001 | <0.001 | <0.001 | **0.31** | 0.0016 |
| 22-07-21 | 0.061 | <0.001 | 0.081 | 0.081 | <0.00001 | <0.0001 | <0.001 | <0.001 | 0.18 | 0.0017 |
| 22-08-24 | 0.025 | <0.001 | 0.096 | 0.096 | <0.00001 | <0.0001 | <0.001 | <0.001 | 0.14 | 0.0018 |
| 22-09-21 | **0.312** | <0.001 | 0.056 | 0.056 | <0.00001 | 0.0002 | <0.001 | <0.001 | **0.39** | 0.0013 |
| **Date (yy-mm-dd)** | **Mn (mg/L)** | **Mo (mg/L)** | **Ni (mg/L)** | **Pb (mg/L)** | **Rb (mg/L)** | **Sb (mg/L)** | **Sr (mg/L)** | **U (mg/L)** | **V (mg/L)** | **Zn (mg/L)** |
| 22-06-22 | 0.077 | <0.0001 | <0.001 | 0.0004 | 0.0008 | <0.0001 | 0.060 | 0.0001 | <0.001 | 0.003 |
| 22-07-21 | 0.058 | <0.0001 | <0.001 | <0.0001 | 0.0008 | <0.0001 | 0.065 | 0.0001 | <0.001 | 0.002 |
| 22-08-24 | 0.041 | <0.0001 | <0.001 | <0.0001 | 0.0010 | <0.0001 | 0.075 | 0.0001 | <0.001 | 0.005 |
| 22-09-21 | 0.047 | <0.0001 | <0.001 | 0.0003 | 0.0012 | <0.0001 | 0.038 | <0.0001 | <0.001 | 0.002 |

### 3.2.8 WQ-8

The water sampling results for site WQ-8 met or exceeded the *CCME Recommended Guidelines for the Protection of Aquatic Life* based on pH. Levels of dissolved oxygen dropped well below the guideline of 6.5 mg/L for general cold-water organisms in July and August. Water temperature did not exceed the 22.5˚C limit for thermal stress in salmonids (Table 62).

Bacterial levels exceeded the maximum concentration of *E. coli* from the *Guidelines for Canadian Recreational Water Quality* (≤ 235 MPN/100 mL) in June, July and September (Table 62).

Total phosphorus levels for long-term eutrophic conditions, according to the *CCME Guidance Framework for Total Phosphorus,* were in the hyper-eutrophic range (>0.100 mg/L) in June and July, the eutrophic range (0.035 – 0.100 mg/L) in August and the hyper-eutrophic range again in September (Table 63).

Concentrations of aluminum exceeded the *CCME Recommended Guidelines for the Protection of Aquatic Life* (0.100 mg/L, pH ≥ 6.5) in June, August and September. Iron exceeded the guideline of 0.3 mg/L in every sample collected in 2022 (Table 64).

It is important to note that this site is impacted by tides, therefore, the flagged exceedances for chloride are dismissed.

**Table 62: Water chemistry data and *E. coli* results for WQ-8, 2022.**

| SITE WQ-8: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Date (yy-mm-dd)** | **Temp (˚C)** | | **SAL (ppt)** | **DO (mg/L)** | ***E. coli* (MPN/100 mL)** | **ALK_T (mg/L)** | **CLRA (TCU)** | **COND (mS/cm)** | |
| | **Air** | **Water** | | | | | | **Field** | **Lab** |
| 22-06-22 | 21 | 18.6 | 0.35 | 9.47 | **19,863** | 86 | 33 | 0.650 | 0.477 |
| 22-07-21 | 27 | 21.4 | 25.74 | **4.94** | **24,196** | 140 | 20 | 37.330 | 3.500 |
| 22-08-24 | 21 | 21.4 | 23.70 | **0.51** | 231 | 110 | 18 | 33.600 | 2.300 |
| 22-09-21 | 14 | 13.6 | 0.22 | 8.99 | **3,654** | 43 | 77 | 0.364 | 0.367 |
| **Date (yy-mm-dd)** | **HARD (mg/L)** | **Lang_Ind (20˚C)** | **pH** | | | **TDS (mg/L)** | | **TURB (NTU)** | **—** |
| | | | **Field** | **Lab** | **Sat (20˚C)** | **Field** | **Lab** | | |
| 22-06-22 | 96.3 | -0.16 | 7.72 | 7.9 | 8.1 | 461.50 | 240 | 3.2 | — |
| 22-07-21 | 354 | -0.08 | 7.76 | 7.7 | 7.8 | 26,116.00 | 1710 | 4.7 | — |
| 22-08-24 | 272.0 | -0.28 | 7.21 | 7.6 | 7.9 | 24,102.00 | 1180 | 10.4 | — |
| 22-09-21 | 68.4 | -1.22 | 7.32 | 7.3 | 8.5 | 289.90 | 195 | 30.9 | — |

**Table 63: Nutrient results for WQ-8, 2022.**

| 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)** |
| 22-06-22 | 85.3 | 0.26 | 25.5 | 0.637 | 82.9 | 0.33 | 3.10 | 7.92 | 48.7 | 0.91 |
| 22-07-21 | 139.0 | 2.74 | 45.2 | 0.656 | **904.0** | 0.24 | 17.20 | 58.50 | 471.0 | 3.40 |
| 22-08-24 | 110.0 | 0.69 | 41.3 | 0.410 | **610.0** | 0.22 | 14.10 | 41.00 | 326.0 | 0.15 |
| 22-09-21 | 42.9 | 0.26 | 17.1 | 0.080 | 80.9 | 0.24 | 2.97 | 6.23 | 43.2 | 0.32 |
| **Date (yy-mm-dd)** | **NH3T_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)** | **—** |
| 22-06-22 | 0.028 | <0.05 | 0.52 | 0.52 | 11 | — | 1.5 | 3.9 | **0.226** | — |
| 22-07-21 | 0.066 | <0.05 | 0.05 | 0.05 | 119 | — | 4.3 | 5.2 | **0.440** | — |
| 22-08-24 | 0.002 | <0.05 | 0.26 | 0.26 | 78 | — | 0.6 | 4.1 | **0.099** | — |
| 22-09-21 | 0.003 | <0.05 | 0.14 | 0.14 | 16 | — | 1.3 | 13.9 | **0.263** | — |

**Table 64: Inorganics results for WQ-8, 2022.**

| SITE WQ-8: HEAVY METALS AND OTHER ELEMENTS | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Date (yy-mm-dd)** | **Al (mg/L)** | **As (mg/L)** | **B (mg/L)** | **Ba (mg/L)** | **Cd (mg/L)** | **Co (mg/L)** | **Cr (mg/L)** | **Cu (mg/L)** | **Fe (mg/L)** | **Li (mg/L)** |
| 22-06-22 | **0.107** | <0.001 | 0.065 | 0.065 | <0.00001 | 0.0002 | <0.001 | <0.001 | **0.49** | 0.0015 |
| 22-07-21 | 0.084 | <0.005 | 0.082 | 0.082 | <0.00005 | <0.0005 | <0.005 | <0.005 | **1.00** | 0.0085 |
| 22-08-24 | **0.144** | <0.002 | 0.096 | 0.096 | <0.00002 | 0.0003 | <0.002 | <0.002 | **0.94** | 0.0061 |
| 22-09-21 | **0.295** | <0.001 | 0.058 | 0.058 | 0.00002 | 0.0004 | <0.001 | 0.001 | **1.04** | 0.0011 |
| **Date (yy-mm-dd)** | **Mn (mg/L)** | **Mo (mg/L)** | **Ni (mg/L)** | **Pb (mg/L)** | **Rb (mg/L)** | **Sb (mg/L)** | **Sr (mg/L)** | **U (mg/L)** | **V (mg/L)** | **Zn (mg/L)** |
| 22-06-22 | 0.174 | 0.0001 | <0.001 | 0.0003 | 0.0016 | <0.0001 | 0.095 | 0.0002 | <0.001 | 0.002 |
| 22-07-21 | 0.664 | 0.0005 | <0.005 | <0.0005 | 0.0064 | <0.0005 | 0.374 | <0.0005 | <0.005 | <0.005 |
| 22-08-24 | 0.458 | 0.0005 | <0.002 | 0.0007 | 0.0046 | <0.0002 | 0.307 | 0.0003 | <0.002 | <0.002 |
| 22-09-21 | 0.223 | <0.0001 | <0.001 | 0.0010 | 0.0022 | <0.0001 | 0.073 | 0.0001 | 0.002 | 0.003 |

### 3.2.9 WQ-9

The water sampling results for site WQ-9 in 2022 met or exceeded the *CCME Recommended Guidelines for the Protection of Aquatic Life* based on pH. Levels of dissolved oxygen dropped below the guideline of 6.5 mg/L for general cold-water organisms in July. Water temperature did not exceed the 22.5˚C limit for thermal stress in salmonids (Table 65).

Bacterial levels exceeded the maximum concentration of *E. coli* from the *Guidelines for Recreational Water Quality* (≤ 235 MPN/100 mL) in all samples collected in 2022 (Table 65).

Total phosphorus levels for long-term eutrophic conditions, according to the *CCME Guideline Framework for Total Phosphorus*, were in the eutrophic range (0.035 – 0.100 mg/L) in June, the meso-eutrophic range (0.020 – 0.035 mg/L) in July and August, and the hyper-eutrophic range (> 0.100 mg/L) in September (Table 66).

Concentrations of aluminum exceeded the *CCME Recommended Guidelines for the Protection of Aquatic Life* (0.100 mg/L, pH ≥ 6.5) in June and September. Iron levels exceeded the guideline of 0.3 mg/L in all samples collected in 2022 (Table 67).

**Table 65: Water chemistry data and *E. coli* results for WQ-9, 2022.**

| SITE WQ-9: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Date (yy-mm-dd) | Temp (˚C) | | SAL (ppt) | DO (mg/L) | *E. coli* (MPN/100 mL) | ALK_T (mg/L) | CLRA (TCU) | COND (mS/cm) | |
| | Air | Water | | | | | | Field | Lab |
| 22-06-22 | 21 | 20.3 | 0.05 | 7.93 | **301** | 46 | 116 | 0.106 | 0.116 |
| 22-07-21 | 28 | 19.3 | 0.08 | **5.16** | **420** | 60 | 44 | 0.143 | 0.157 |
| 22-08-24 | 22 | 20.2 | 0.08 | 7.48 | **667** | 66 | 31 | 0.151 | 0.160 |
| 22-09-21 | 15 | 13.5 | 0.06 | 9.12 | **5,475** | 33 | 75 | 0.097 | 0.122 |
| Date (yy-mm-dd) | HARD (mg/L) | Lang_Ind (20˚C) | pH | | | TDS (mg/L) | | TURB (NTU) | — |
| | | | Field | Lab | Sat (20˚C) | Field | Lab | | |
| 22-06-22 | 43.6 | -0.81 | 7.69 | 7.7 | 8.5 | 75.00 | 75 | 3.7 | — |
| 22-07-21 | 58.5 | -0.48 | 7.99 | 7.8 | 8.3 | 107.90 | 82 | 1.9 | — |
| 22-08-24 | 62.9 | -0.71 | 7.96 | 7.5 | 8.2 | 107.90 | 94 | 1.4 | — |
| 22-09-21 | 41.7 | -1.57 | 7.46 | 7.1 | 8.7 | 80.60 | 63 | 31.6 | — |

**Table 66: Nutrient results for WQ-9, 2022.**

| 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) |
| 22-06-22 | 45.8 | 0.04 | 14.2 | 0.216 | 11.0 | 0.30 | 0.67 | 1.98 | 6.49 | <0.05 |
| 22-07-21 | 59.6 | 0.03 | 19.4 | 0.353 | 12.4 | 0.17 | 0.94 | 2.44 | 8.48 | <0.05 |
| 22-08-24 | 65.8 | 0.03 | 20.9 | 0.196 | 11.1 | 0.15 | 0.76 | 2.59 | 6.90 | <0.05 |
| 22-09-21 | 33.0 | 0.03 | 13.8 | 0.039 | 10.0 | 0.21 | 2.35 | 1.76 | 7.00 | <0.05 |
| Date (yy-mm-dd) | NH3T_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) | — |
| 22-06-22 | <0.001 | <0.05 | 0.06 | 0.06 | <1 | — | 0.4 | 11.2 | **0.041** | — |
| 22-07-21 | <0.001 | <0.05 | 0.12 | 0.12 | <1 | — | 0.4 | 5.7 | **0.027** | — |
| 22-08-24 | <0.001 | <0.05 | 0.11 | 0.11 | 3 | — | 0.5 | 7.3 | **0.022** | — |
| 22-09-21 | <0.001 | <0.05 | 0.50 | 0.50 | 4 | — | 0.8 | 9.0 | **0.152** | — |

**Table 67: Inorganics results for WQ-9, 2022.**

| SITE WQ-9: HEAVY METALS AND OTHER ELEMENTS | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Date (yy-mm-dd) | Al (mg/L) | As (mg/L) | B (mg/L) | Ba (mg/L) | Cd (mg/L) | Co (mg/L) | Cr (mg/L) | Cu (mg/L) | Fe (mg/L) | Li (mg/L) |
| 22-06-22 | **0.174** | 0.001 | 0.041 | 0.041 | <0.00001 | 0.0001 | <0.001 | <0.001 | **0.95** | 0.0006 |
| 22-07-21 | 0.049 | <0.001 | 0.066 | 0.066 | <0.00001 | <0.0001 | <0.001 | <0.001 | **0.58** | 0.0007 |
| 22-08-24 | 0.027 | <0.001 | 0.064 | 0.064 | <0.00001 | <0.0001 | <0.001 | <0.001 | **0.33** | 0.0007 |
| 22-09-21 | **0.392** | <0.001 | 0.050 | 0.050 | 0.00002 | 0.0003 | <0.001 | 0.002 | **0.85** | 0.0005 |
| Date (yy-mm-dd) | Mn (mg/L) | Mo (mg/L) | Ni (mg/L) | Pb (mg/L) | Rb (mg/L) | Sb (mg/L) | Sr (mg/L) | U (mg/L) | V (mg/L) | Zn (mg/L) |
| 22-06-22 | 0.204 | 0.0001 | <0.001 | 0.0002 | 0.0008 | <0.0001 | 0.042 | 0.0001 | <0.001 | 0.001 |
| 22-07-21 | 0.262 | 0.0001 | <0.001 | 0.0001 | 0.0010 | <0.0001 | 0.062 | <0.0001 | <0.001 | 0.003 |
| 22-08-24 | 0.281 | 0.0001 | <0.001 | <0.0001 | 0.0008 | <0.0001 | 0.061 | <0.0001 | <0.001 | 0.001 |
| 22-09-21 | 0.274 | 0.0001 | <0.001 | 0.0007 | 0.0020 | <0.0001 | 0.030 | 0.0001 | 0.001 | 0.003 |

### 3.2.10 WQ-10

The water sampling results for site WQ-10 in 2022 met or exceeded the *CCME Recommended Guidelines for the Protection of Aquatic Life* based on pH and dissolved oxygen. Water temperature did not exceed the 22.5˚C limit for thermal stress in salmonids (Table 68).

Bacterial levels exceeded the maximum concentration of *E. coli* from the *Guidelines for Canadian Recreational Water Quality* (≤ 235 MPN/100 mL) in all samples collected in 2022 (Table 68).

Total phosphorus levels for long-term eutrophic conditions, according to the *CCME Guidance Framework for Total Phosphorus*, were in the meso-eutrophic range (0.020 – 0.035 mg/L) in June and July, the hyper-eutrophic range (> 0.100 mg/L) in August and the eutrophic range (0.035 – 0.100 mg/L) in September (Table 69).

Concentrations of aluminum exceeded the *CCME Recommended Guidelines for the Protection of Aquatic Life* (0.100 mg/L, pH ≥ 6.5) in June, August and September. Iron levels exceeded the guideline of 0.3 mg/L in every sample taken in 2022 (Table 70).

**Table 68: Water chemistry data and *E. coli* results for WQ-10, 2022.**

| SITE WQ-10: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Date (yy-mm-dd) | Temp (˚C) | | SAL (ppt) | DO (mg/L) | *E. coli* (MPN/100 mL) | ALK_T (mg/L) | CLRA (TCU) | COND (mS/cm) | |
| | Air | Water | | | | | | Field | Lab |
| 22-06-22 | 22 | 14.3 | 0.05 | 11.00 | **691** | 26 | 259 | 0.089 | 0.111 |
| 22-07-21 | 28 | 17.0 | 0.10 | 6.53 | **798** | 42 | 145 | 0.177 | 0.197 |
| 22-08-24 | 21 | 17.8 | 0.09 | 8.36 | **24,196** | 39 | 287 | 0.161 | 0.184 |
| 22-09-21 | 15 | 13.3 | 0.07 | 11.28 | **8,164** | 15 | 171 | 0.115 | 0.145 |
| Date (yy-mm-dd) | HARD (mg/L) | Lang_Ind (20˚C) | pH | | | TDS (mg/L) | | TURB (NTU) | — |
| | | | Field | Lab | Sat (20˚C) | Field | Lab | | |
| 22-06-22 | 30.1 | -1.53 | 7.41 | 7.4 | 8.9 | 72.80 | 82 | 2.8 | — |
| 22-07-21 | 56.1 | -0.87 | 7.70 | 7.6 | 8.5 | 135.85 | 105 | 1.7 | — |
| 22-08-24 | 50.5 | -1.34 | 7.41 | 7.2 | 8.5 | 121.55 | 126 | 2.5 | — |
| 22-09-21 | 22.5 | -2.49 | 7.22 | 6.8 | 9.3 | 95.55 | 78 | 10.6 | — |

**Table 69: Nutrient results for WQ-10, 2022.**

| 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) |
| 22-06-22 | 25.9 | 0.04 | 9.4 | 0.061 | 22.2 | 0.59 | 0.41 | 1.60 | 10.8 | 0.07 |
| 22-07-21 | 41.8 | 0.04 | 18.0 | 0.156 | 39.5 | 0.31 | 0.62 | 2.70 | 16.2 | <0.05 |
| 22-08-24 | 38.9 | 0.04 | 16.2 | 0.058 | 37.9 | 0.52 | 0.96 | 2.45 | 14.5 | 1.10 |
| 22-09-21 | 15.0 | 0.03 | 7.2 | 0.009 | 34.0 | 0.43 | 1.51 | 1.13 | 18.5 | <0.05 |
| Date (yy-mm-dd) | NH3T_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) | — |
| 22-06-22 | <0.001 | <0.05 | 0.08 | 0.08 | <5 | — | 0.7 | 19.7 | **0.033** | — |
| 22-07-21 | <0.001 | <0.05 | 0.26 | 0.26 | <5 | — | 0.6 | 11.9 | **0.026** | — |
| 22-08-24 | 0.007 | <0.05 | 0.27 | 0.27 | <5 | — | 1.9 | 26.0 | **0.146** | — |
| 22-09-21 | <0.001 | <0.05 | 1.16 | 1.16 | <5 | — | 1.6 | 19.8 | **0.077** | — |

**Table 70: Inorganics results for WQ-10, 2022.**

| SITE WQ-10: HEAVY METALS AND OTHER ELEMENTS | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Date (yy-mm-dd) | Al (mg/L) | As (mg/L) | B (mg/L) | Ba (mg/L) | Cd (mg/L) | Co (mg/L) | Cr (mg/L) | Cu (mg/L) | Fe (mg/L) | Li (mg/L) |
| 22-06-22 | **0.285** | <0.001 | 0.029 | 0.029 | 0.00001 | 0.0001 | <0.001 | <0.001 | **0.77** | 0.0004 |
| 22-07-21 | 0.085 | <0.001 | 0.036 | 0.036 | <0.00001 | <0.0001 | <0.001 | <0.001 | **0.62** | 0.0004 |
| 22-08-24 | **0.210** | <0.001 | 0.040 | 0.040 | 0.00001 | <0.0001 | <0.001 | 0.001 | **0.82** | 0.0005 |
| 22-09-21 | **0.453** | <0.001 | 0.034 | 0.034 | 0.00002 | 0.0003 | <0.001 | 0.001 | **0.65** | 0.0004 |
| Date (yy-mm-dd) | Mn (mg/L) | Mo (mg/L) | Ni (mg/L) | Pb (mg/L) | Rb (mg/L) | Sb (mg/L) | Sr (mg/L) | U (mg/L) | V (mg/L) | Zn (mg/L) |
| 22-06-22 | 0.087 | <0.0001 | <0.001 | 0.0003 | 0.0006 | <0.0001 | 0.031 | <0.0001 | <0.001 | 0.001 |
| 22-07-21 | 0.148 | <0.0001 | <0.001 | 0.0001 | 0.0010 | <0.0001 | 0.047 | <0.0001 | <0.001 | <0.001 |
| 22-08-24 | 0.155 | 0.0001 | <0.001 | 0.0002 | 0.0015 | <0.0001 | 0.043 | 0.0001 | <0.001 | 0.002 |
| 22-09-21 | 0.120 | <0.0001 | <0.001 | 0.0009 | 0.0019 | <0.0001 | 0.025 | <0.0001 | <0.001 | 0.002 |

### 3.2.11 WQ-11B

The water sampling results for site WQ-11B in 2022 met or exceeded the *CCME Recommended Guidelines for the Protection of Aquatic Life* based on pH. Levels of dissolved oxygen dropped below the guideline of 6.5 mg/L for general cold-water organisms in July. Water temperature did not exceed the 22.5˚C limit for thermal stress in salmonids (Table 71).

Bacterial levels exceeded the maximum concentration of *E. coli* from the *Guidelines for Canadian Recreational Water Quality* (≤ 235 MPN/100 mL) in June, July and September (Table 71).

Total phosphorus levels for long-term eutrophic conditions, according to the *CCME Guidance Framework for Total Phosphorus*, were in the meso-eutrophic range (0.020 – 0.035 mg/L) in June, the eutrophic range (0.035 – 0.100 mg/L) in July and August, and the hyper-eutrophic range (> 0.100 mg/L) in September (Table 72).

Concentrations of aluminum exceeded the *CCME Recommended Guidelines for the Protection of Aquatic Life* (0.100 mg/L, pH ≥ 6.5) in September. Iron levels exceeded the guideline of 0.3 mg/L in every sample taken in 2022 (Table 73).

It is important to note that this site is impacted by tides, therefore, the flagged exceedances for chloride are dismissed.

**Table 71: Water chemistry data and *E. coli* results for WQ-11B, 2022.**

| SITE WQ-11B: FIELD DATA COLLECTED BY YSI AND LAB SAMPLES | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Date (yy-mm-dd) | Temp (˚C) | | SAL (ppt) | DO (mg/L) | *E. coli* (MPN/100 mL) | ALK_T (mg/L) | CLRA (TCU) | COND (mS/cm) | |
| | Air | Water | | | | | | Field | Lab |
| 22-06-22 | 21 | 16.4 | 1.42 | 9.33 | 253 | 80 | 22 | 3.360 | 0.479 |
| 22-07-21 | 28 | 20.4 | 0.53 | 5.80 | 2,613 | 64 | 54 | 0.960 | 1.600 |
| 22-08-24 | 21 | 18.6 | 0.68 | 7.52 | 187 | 49 | 119 | 1.120 | 0.534 |
| 22-09-21 | 15 | 14.2 | 0.06 | 10.76 | 24,196 | 26 | 97 | 0.101 | 0.111 |
| Date (yy-mm-dd) | HARD (mg/L) | Lang_Ind (20˚C) | pH | | | TDS (mg/L) | | TURB (NTU) | — |
| | | | Field | Lab | Sat (20˚C) | Field | Lab | | |
| 22-06-22 | 97.8 | -0.30 | 7.16 | 7.8 | 8.1 | 2,450.50 | 249 | 2.3 | — |
| 22-07-21 | 145.0 | -0.58 | 7.39 | 7.7 | 8.3 | 689.00 | 686 | 2.5 | — |
| 22-08-24 | 82.4 | -1.28 | 7.39 | 7.2 | 8.5 | 864.50 | 300 | 4.0 | — |
| 22-09-21 | 28.7 | -1.77 | 7.12 | 7.2 | 9.0 | 81.90 | 59 | 9.4 | — |

**Table 72: Nutrient results for WQ-11B, 2022.**

| SITE WQ-11B: 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) |
| 22-06-22 | 79.5 | 0.29 | 25.0 | 0.472 | 87.6 | 0.23 | 2.96 | 8.60 | 56.3 | 0.05 |
| 22-07-21 | 63.7 | 0.88 | 24.5 | 0.300 | 384.0 | 0.26 | 7.34 | 20.30 | 154.0 | 0.08 |
| 22-08-24 | 48.9 | 0.39 | 17.1 | 0.073 | 134.0 | 0.26 | 3.42 | 9.65 | 67.6 | 0.06 |
| 22-09-21 | 26.0 | 0.05 | 8.5 | 0.039 | 17.2 | 0.28 | 2.76 | 1.79 | 9.8 | <0.05 |
| Date (yy-mm-dd) | NH3T_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) | — |
| 22-06-22 | 0.001 | <0.05 | 0.08 | 0.08 | 13.0 | — | 0.5 | 5.2 | 0.029 | — |
| 22-07-21 | 0.002 | <0.05 | 0.15 | 0.15 | 54.0 | — | 0.6 | 7.5 | 0.041 | — |
| 22-08-24 | <0.001 | <0.05 | 0.20 | 0.20 | 18.0 | — | 0.9 | 16.4 | 0.080 | — |
| 22-09-21 | <0.001 | <0.05 | 0.43 | 0.43 | <1.0 | — | 1.3 | 16.5 | 0.124 | — |

**Table 73: Inorganics results for WQ-11B, 2022.**

| SITE WQ-11B: HEAVY METALS AND OTHER ELEMENTS | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Date (yy-mm-dd) | Al (mg/L) | As (mg/L) | B (mg/L) | Ba (mg/L) | Cd (mg/L) | Co (mg/L) | Cr (mg/L) | Cu (mg/L) | Fe (mg/L) | Li (mg/L) |
| 22-06-22 | 0.074 | <0.001 | 0.041 | 0.041 | <0.00001 | 0.0002 | <0.001 | <0.001 | 0.31 | 0.0010 |
| 22-07-21 | 0.092 | <0.002 | 0.057 | 0.057 | <0.00002 | 0.0004 | <0.002 | <0.002 | 1.49 | 0.0026 |
| 22-08-24 | 0.071 | 0.002 | 0.050 | 0.050 | <0.00001 | 0.0003 | <0.001 | <0.001 | 1.92 | 0.0013 |
| 22-09-21 | 0.349 | <0.001 | 0.027 | 0.027 | 0.00002 | 0.0002 | <0.001 | 0.002 | 0.35 | 0.0003 |
| Date (yy-mm-dd) | Mn (mg/L) | Mo (mg/L) | Ni (mg/L) | Pb (mg/L) | Rb (mg/L) | Sb (mg/L) | Sr (mg/L) | U (mg/L) | V (mg/L) | Zn (mg/L) |
| 22-06-22 | 0.150 | 0.0002 | <0.001 | 0.0001 | 0.0014 | <0.0001 | 0.099 | 0.0001 | <0.001 | <0.001 |
| 22-07-21 | 0.540 | 0.0004 | <0.002 | 0.0004 | 0.0030 | <0.0002 | 0.187 | <0.0002 | <0.002 | 0.003 |
| 22-08-24 | 0.327 | 0.0003 | <0.001 | 0.0002 | 0.0023 | <0.0001 | 0.115 | <0.0001 | <0.001 | 0.002 |
| 22-09-21 | 0.041 | <0.0001 | <0.001 | 0.0005 | 0.0024 | <0.0001 | 0.031 | <0.0001 | <0.001 | 0.002 |

### 3.2.12 Sampling Summary

The bacterial levels in the small stream sites in 2022 exceeded the Canadian Recreational Water Quality Guideline (235 MPN/100 mL) on 28 occasions. The sites WQ-3, WQ-9 and WQ-10 were the worst in terms of bacterial levels; they exceeded the limit every sampling month. Every site had at least one bacterial exceedance, with many of those occurring in September after a moderate rain event (Figure 28).

The average total phosphorous for the small stream sites fell into three different categories: meso-eutrophic (0.020–0.035 mg/L), eutrophic (0.035–0.100 mg/L), and hyper-eutrophic (> 0.100 mg/L) (Table 74). These categories are derived from the *CCME Guidance Framework for Total Phosphorus*.

All small stream sites had at least one exceedance of both aluminum and iron. WQ-8, WQ-9 and WQ-10 in particular had elevated levels. It is important to note that it is common to have elevated iron concentrations in New Brunswick, which can occur naturally due to geological influence. Further research into the surrounding land use, elevation and direction of flow in these areas could help determine a probable cause for some of these elevated values.

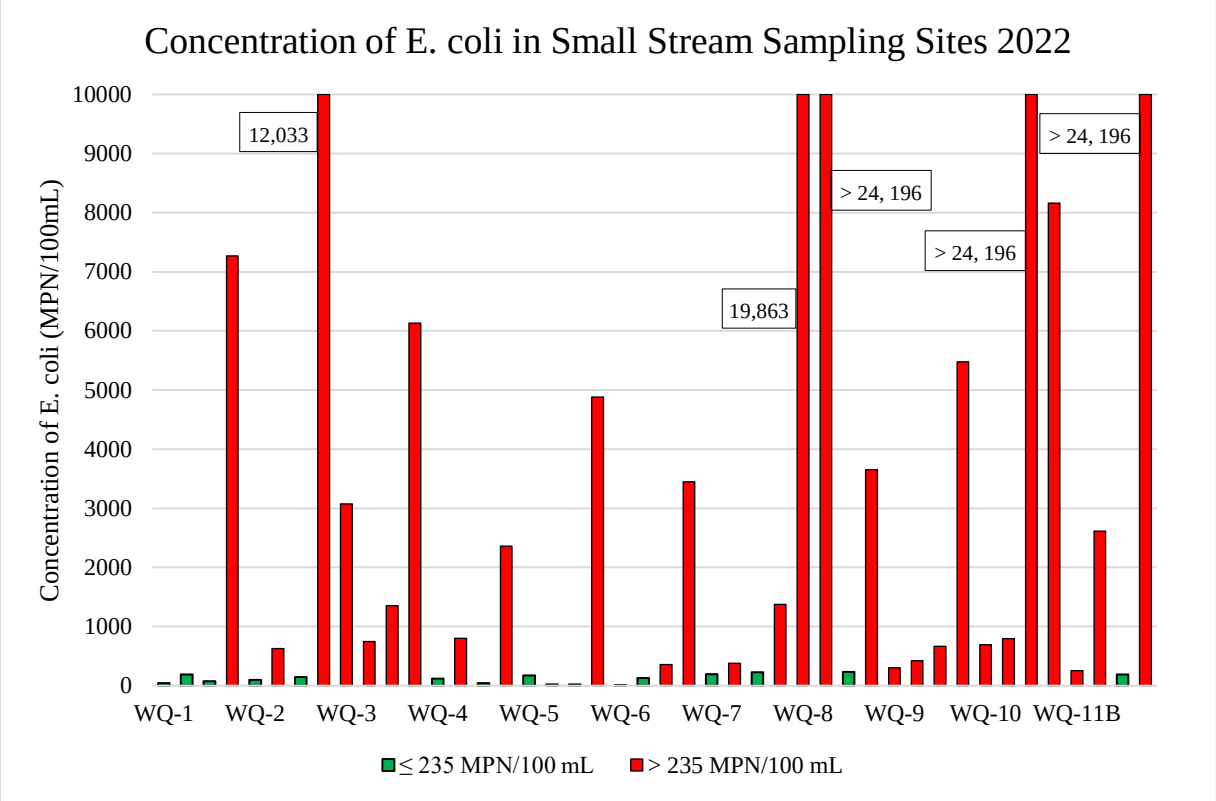



**Figure 27: Summary of *E. coli* results, small streams 2022.**

**Table 74: Average total phosphorous for the small streams in 2022.**

| Sampling Site | Average TP-L (mg/L) |
|---|---|
| WQ-1 | **0.065** |
| WQ-2 | **0.062** |
| WQ-3 | **0.294** |
| WQ-4 | **0.072** |
| WQ-5 | **0.052** |
| WQ-6 | **0.031** |
| WQ-7 | **0.054** |
| WQ-8 | **0.257** |
| WQ-9 | **0.061** |
| WQ-10 | **0.071** |
| WQ-11B | **0.069** |

## 3.3 Water Quality Index

### 3.3.1 Shediac and Scoudouc Rivers

The WQI scores for 2022 are presented in Figure 28. All sites within the Shediac sub-watershed fell within the “Good” category, while the sites within the Scoudouc sub-watershed fell within the “Fair” and “Good” categories. A rating of “Good” means water quality rarely exceeds the guidelines, and conditions rarely depart from natural or desirable levels. A rating of “Fair” means water quality occasionally exceeds the guidelines, and conditions sometimes depart from natural or desirable levels.

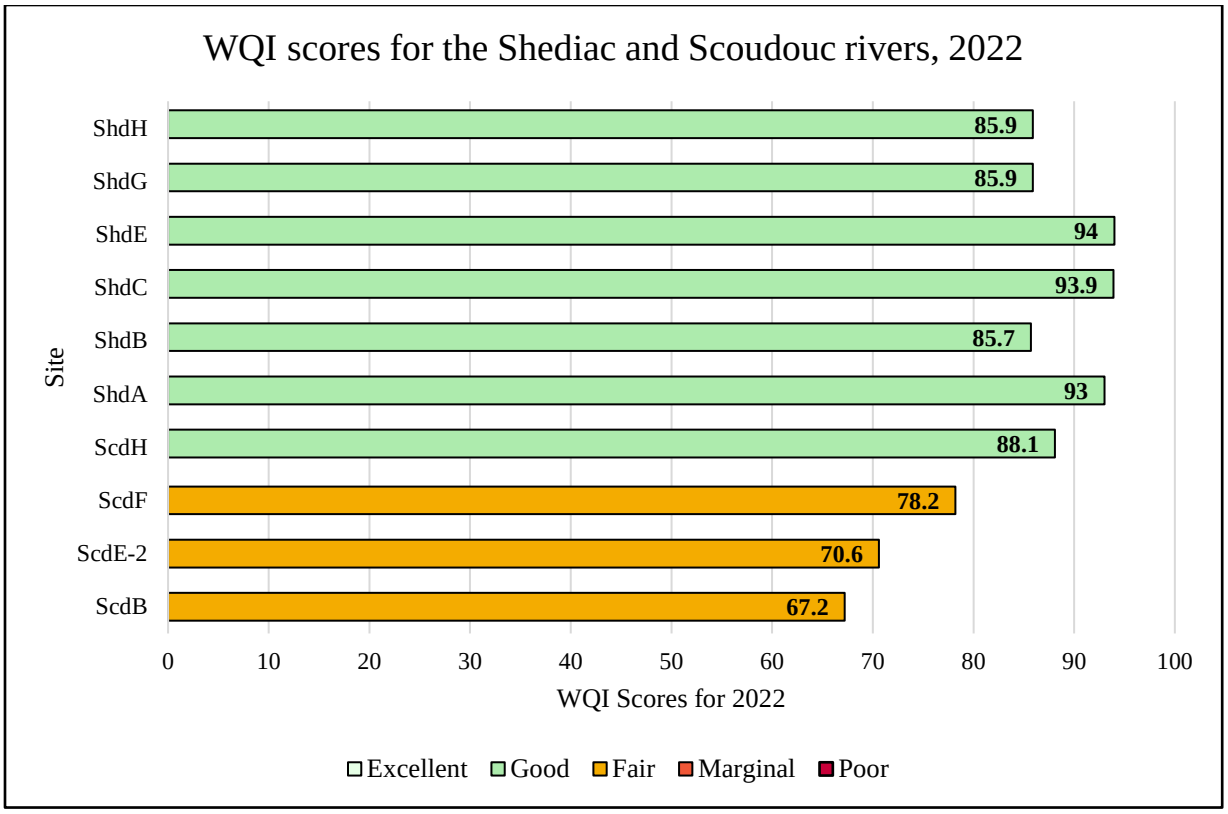



**Figure 28: WQI scores for the Shediac and Scoudouc rivers in 2022.**

Figure 29 shows the number of exceedances of each parameter (values above the established guidelines). The combined effect of these exceedances lower the overall WQI score at each site.

Iron and phosphorus have the most exceedances overall in 2022, followed by dissolved oxygen, pH and turbidity. There were no exceedances of arsenic, copper, ammonia, nitrate, chloride or zinc in 2022.

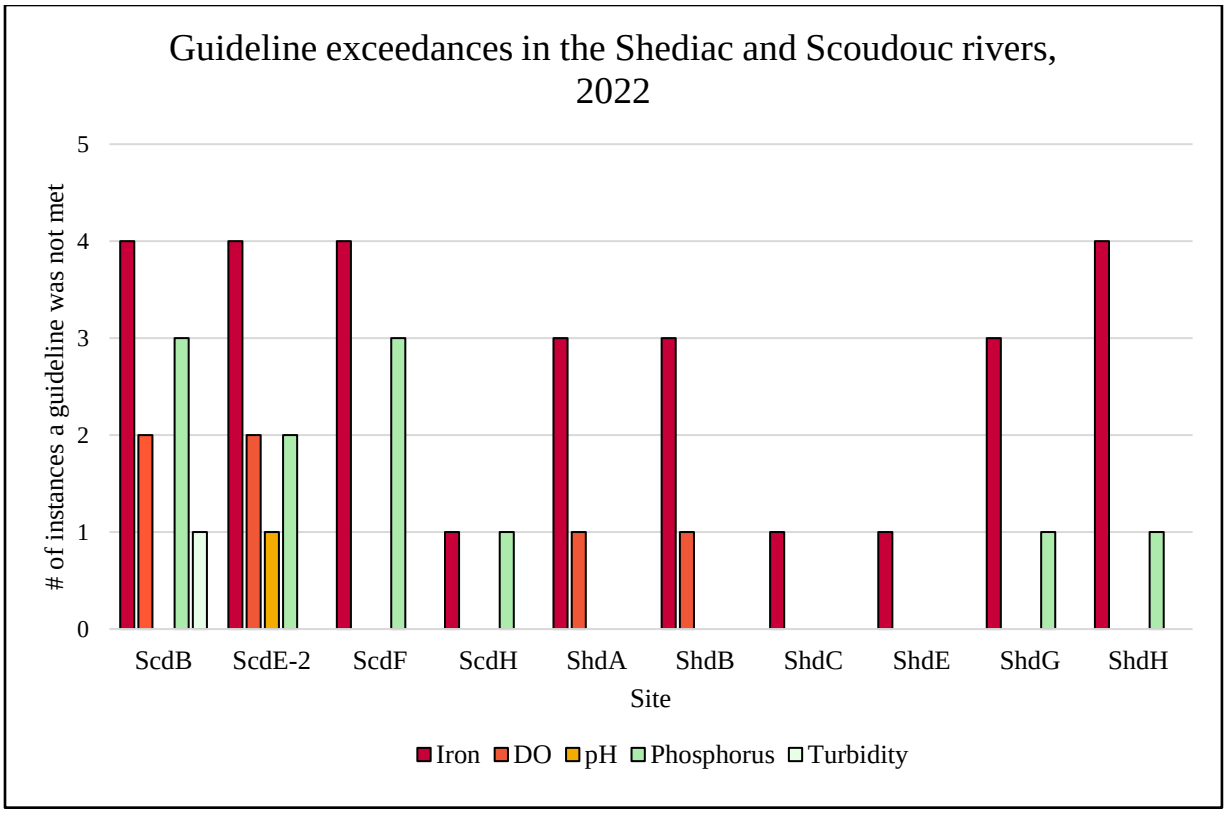



**Figure 29: Guideline exceedances for the Shediac and Scoudouc rivers.**

### 3.3.2 Small Streams

The WQI scores for 2022 are presented in Figure 30. Water quality at these sites had more variation than the Shediac and Scoudouc river sites, falling within the “Marginal” to “Fair” categories. A rating of “Fair” means water quality occasionally exceeds the guidelines, and conditions sometimes depart from natural or desirable levels. A rating of “Marginal” means water quality often exceeds the guidelines, and conditions often depart from natural or desirable levels. These sites are located in more urbanized areas than the Shediac and Scoudouc river sites, which likely correlates with their lower WQI values.

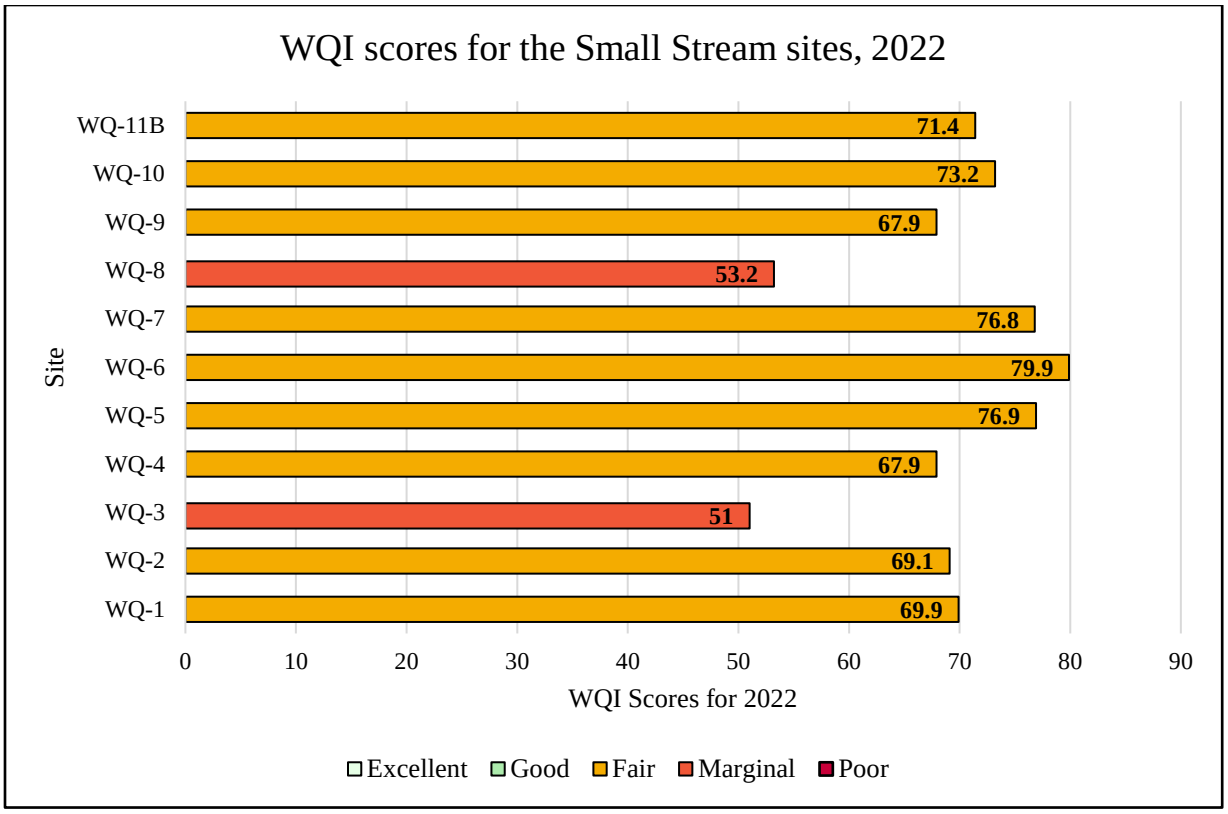



**Figure 30: WQI scores for the Small Stream sites in 2022.**

Figure 31 shows the number of exceedances of each parameter (values above the established guidelines). The combined effect of these exceedances lower the overall WQI score at each site.

Iron and phosphorus had the most exceedances overall in 2022, followed by turbidity, copper, and dissolved oxygen. There were no exceedances of arsenic, ammonia, nitrate, pH or zinc in 2022.

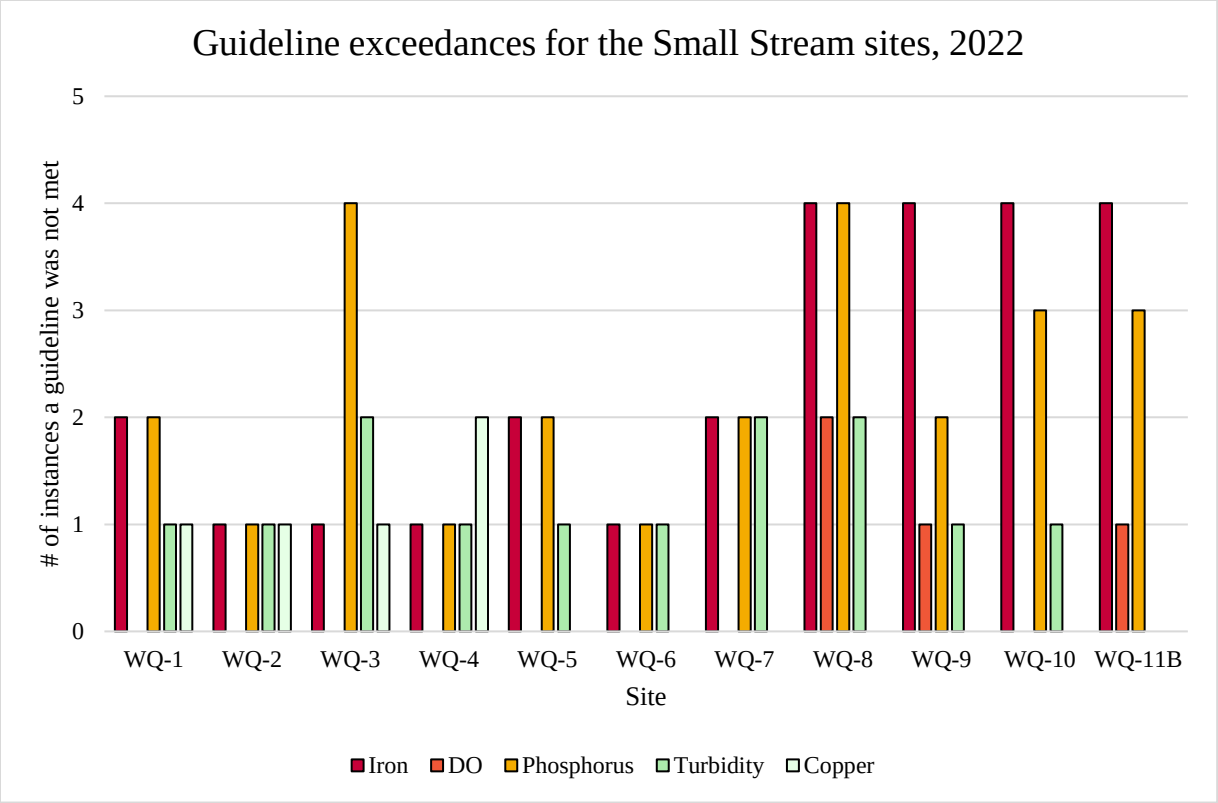



**Figure 31: Guideline exceedances for the small stream sites.**

# 4. WATER TEMPERATURE MONITORING

The SBWA water temperature monitoring project is done in partnership with the Institut national de la recherche scientifique (INRS) in the province of Quebec. This partnership began in 2016, when the INRS provided the SBWA with three temperature loggers in addition to the ones purchased with funding from the NB ETF.

The strategy is to monitor temperatures fluctuations in strategic locations. Areas of interest are those determined to be high risk for thermal stress in juvenile salmonids and other cold-water species. Other areas of interest are those determined to be colder zones suitable for thermal refugia, i.e. habitats containing colder water that provides a refuge for fish from high water temperatures.

The monitoring program includes seven sites in the watershed (Table 75). Two loggers were lost in the water in 2020, and another two in 2021. This year, all seven loggers were retrieved. The following section reports on the data retrieved from these temperature loggers.

**Table 75: Thermograph Monitoring Sites information, SBWA 2022.**

| Site ID | Watercourse Name | Latitude | Longitude | Installation date | Date of retrieval |
|---|---|---|---|---|---|
| T-ShdA | Shediac River | N46° 11' 36.7" | W64° 48' 56.0" | June 1st | September 16th |
| T-ShdB | McQuade Brook | N46° 13' 54.9" | W64° 44' 31.9" | May 31st | September 15th |
| T-ShdE | Shediac River | N46° 14' 41.5" | W64° 39' 56.3" | May 31st | September 15th |
| T-ShdE-2A | Weisner Brook | W64° 39' 46.0" | W64° 39' 46.0" | June 1st | September 16th |
| T-ShdM | Weisner Brook | N46° 12' 27.1" | W64° 40' 21.0" | May 31st | September 15th |
| T-ScdD | Scoudouc River | N46° 11' 2.3" | W64° 30' 39.8" | May 31st | September 15th |
| T-ScdB | Scoudouc River | N46° 08' 39.2" | W64° 33' 36.6" | June 1st | September 16th |

The temperature loggers were installed on May 31st and June 1st and retrieved on September 15th and 16th. The following section of this report shows the thermograph data (daily maximum temperatures) recorded. The recommended temperature limits indicate the threshold for thermal stress beginning at 22.5°C for juvenile Atlantic salmon, and lethal limit of 25°C or greater (Crisp, 1993).

## 4.1 Water Temperature Monitoring – Shediac and Scoudouc Rivers

Five sites are monitored in the Shediac River and its tributaries; two in the main branch, two in the Weisner Brook and one in the McQuade Brook. Two sites are monitored in the Scoudouc River (Figure 32). The following section reports on temperature logger data for 2022.

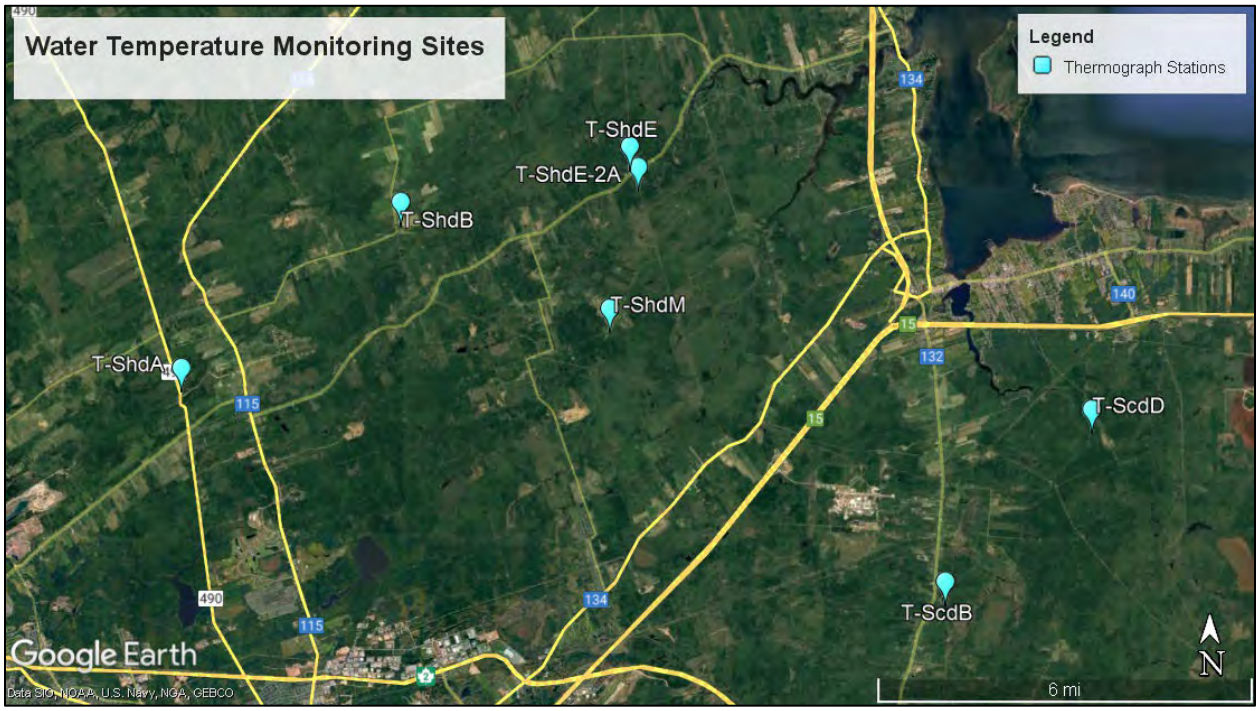



**Figure 32: Temperature logger locations in the Shediac and Scoudouc rivers.**

### 4.1.1 T-ShdA Monitoring Site

This temperature logger is located in the main branch of the Shediac River, in the upper reaches near Irishtown. This area was predicted to have lower temperatures due to canopy coverage and its narrow water channel.

The thermograph shows the maximum daily temperatures between June 1st and September 15th (Figure 33). The maximum temperatures exceeded the thermal stress threshold (22.5°C) on 27 occasions during the summer months. Of those 27 days, the maximum temperatures exceeded the lethal limit (25°C) on six occasions. There was a 12-day stretch during which the maximum daily temperatures surpassed the thermal stress level, from July 17th to July 28th. During that period, the maximum daily temperature surpassed the lethal levels on three occasions. The highest temperature recorded during the summer was 26.4°C on August 7th. The highest average daily temperature for this site was 24.6°C.

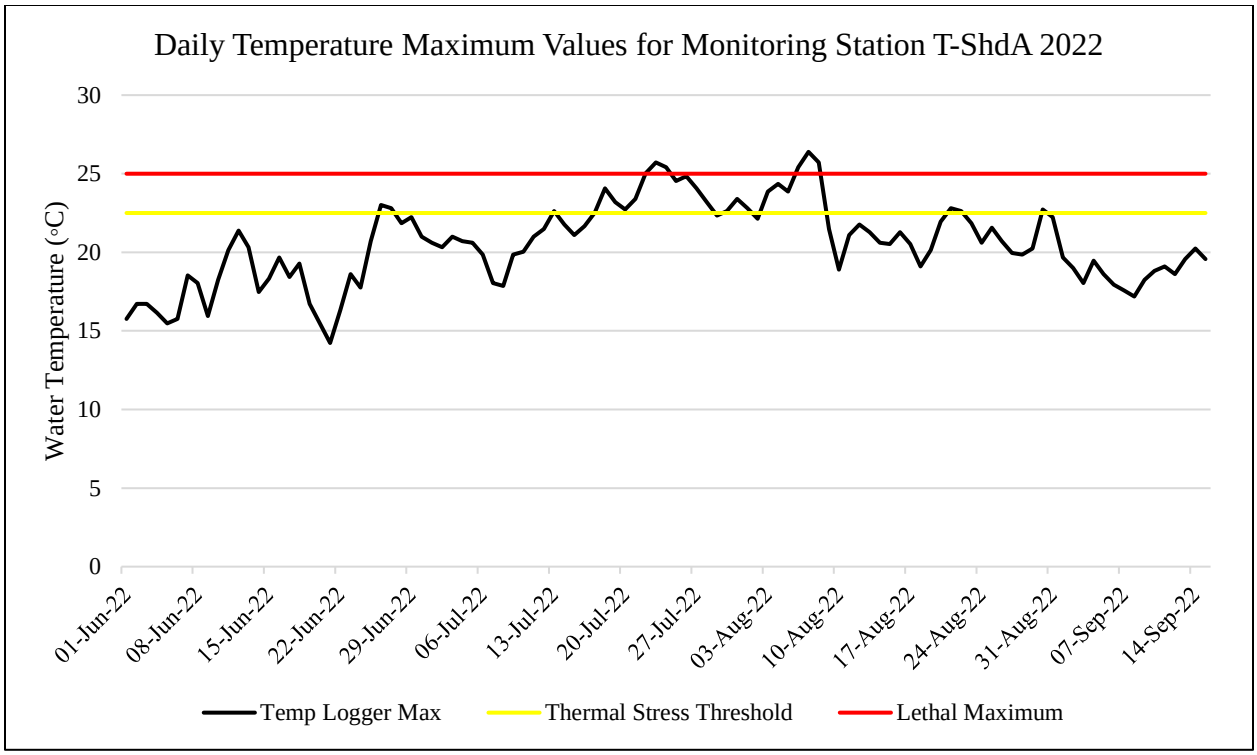



**Figure 33: Thermograph chart for monitoring station T-ShdA.**

### 4.1.2 T-ShdB Monitoring Site

This temperature logger was installed in the McQuade Brook, approximately 35 m downstream of the Scotch Settlement Road.

The thermograph shows the maximum daily temperatures between June 1st and September 14th (Figure 34). The maximum temperatures exceeded the thermal stress threshold (22.5°C) on 43 occasions during the peak of the summer months. Of those 43 days, the maximum temperatures exceeded the lethal limit (25°C) on 13 occasions. There was a 25-day stretch during which the maximum daily temperatures surpassed the thermal stress level, from July 15th to August 8th. During that period, the maximum daily temperature surpassed the lethal levels on 11 occasions. The highest temperature recorded during the summer was 27.7°C on July 23rd. The highest average daily temperature for this site was 24.7°C.

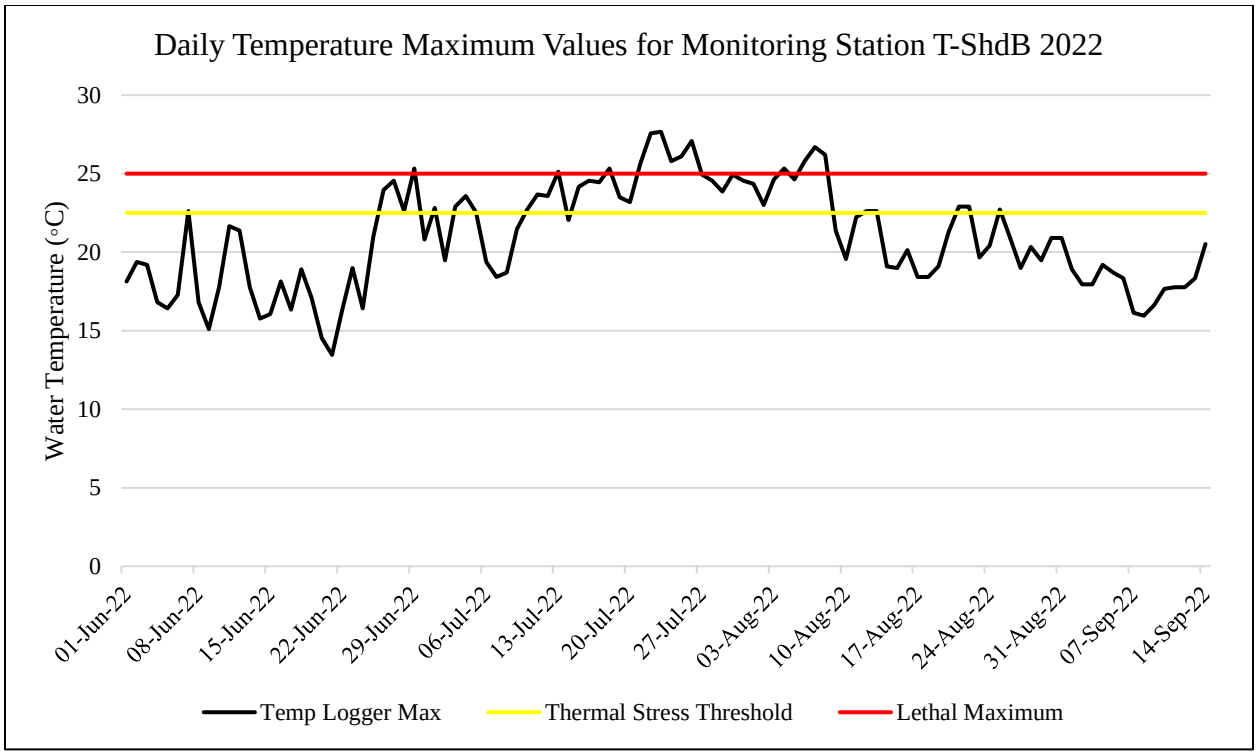



**Figure 34: Thermograph chart for monitoring station T-ShdB.**

### 4.1.3 T-ShdE Monitoring Site

This temperature logger is located in the mid to lower reaches of the main branch of the Shediac River near the Joshua Gallant Covered Bridge. This area was predicted to have warmer waters due to the lack of canopy coverage, and its wide and shallow channel.

The thermograph shows the maximum daily temperature between June 1st and September 14th (Figure 35). The maximum temperatures exceeded the thermal stress threshold (22.5°C) on 53 occasions during the peak of the summer months. There was a 25-day stretch during which the maximum daily temperatures surpassed the thermal stress level, from July 15th to August 8th. During that period, the maximum daily temperature surpassed the lethal levels on 22 occasions. The highest temperature recorded during the summer was 34.9°C on July 23rd. The highest average daily temperature for this site was 26.1°C.

This temperature logger was out of the water when it was collected in September. Looking at the large fluctuations on the thermograph, it is reasonable to believe that it was out of the water for a portion of the summer. This site is a popular spot for locals, and it is possible someone moved it out of the water during that time, or that a high flow event moved it out of the main channel and onto the bank.

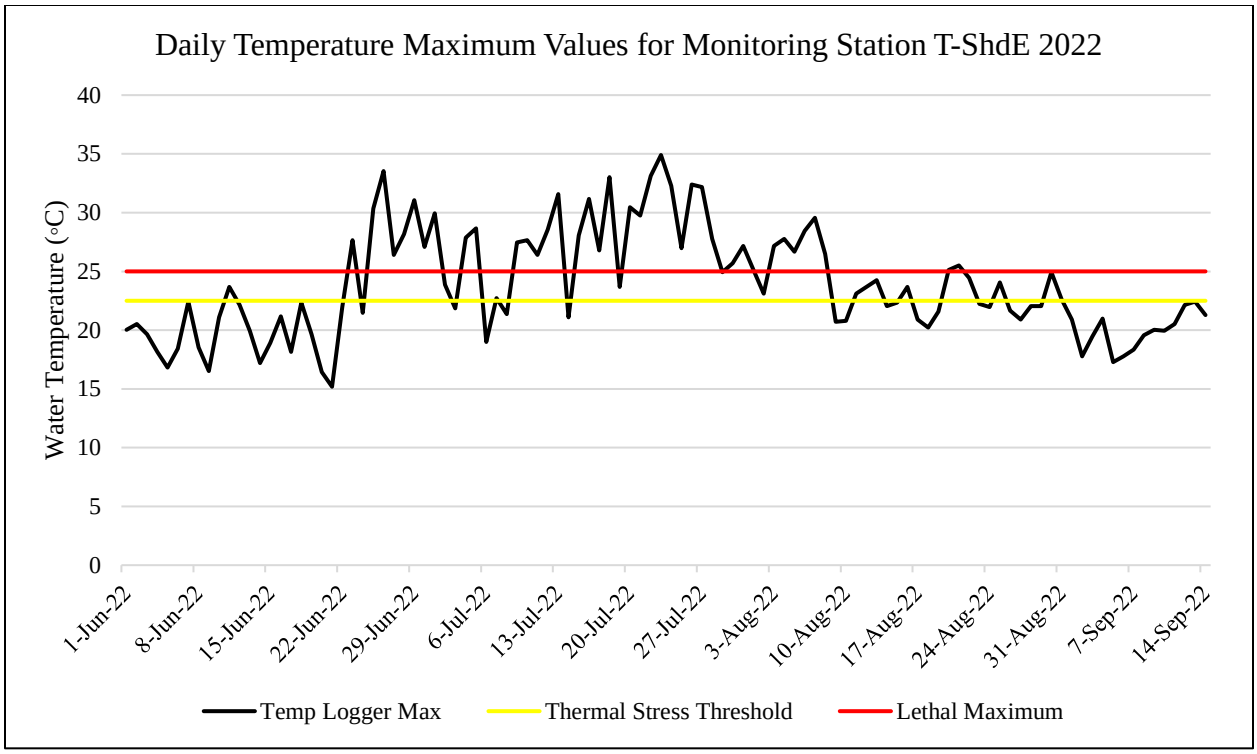



**Figure 35: Thermograph chart for monitoring station T-ShdE.**

### 4.1.4 T-ShdE-2A Monitoring Site

This temperature logger was installed in the Weisner Brook, approximately 300 m upstream from its convergence with the Shediac River. This site is used to compare with station T-ShdE, as it is the closest source of cold water for migrating fish looking for thermal refuge during high temperatures. This site is located approximately 5 km downstream from the second logger in the Weisner Brook; T-ShdM. Just like the other temperature monitoring site in this brook, the surrounding canopy coverage and input of cold water from natural springs contributes to the overall colder water temperatures.

The thermograph shows the maximum daily temperature between June 1st and September 15th (Figure 36). The maximum temperatures exceeded the thermal stress threshold (22.5°C) on 23 occasions during the peak of the summer months. During these 23 days, the maximum temperatures exceeded the lethal limit (25°C) on seven occasions. There was a nine-day stretch during which the maximum daily temperatures surpassed the thermal stress level, from July 20th to 28th. During that period, the maximum daily temperature surpassed the lethal levels on four occasions. The highest temperature recorded during the summer was 26.6°C on August 7th. The highest average daily temperature for this site was 23.2°C.

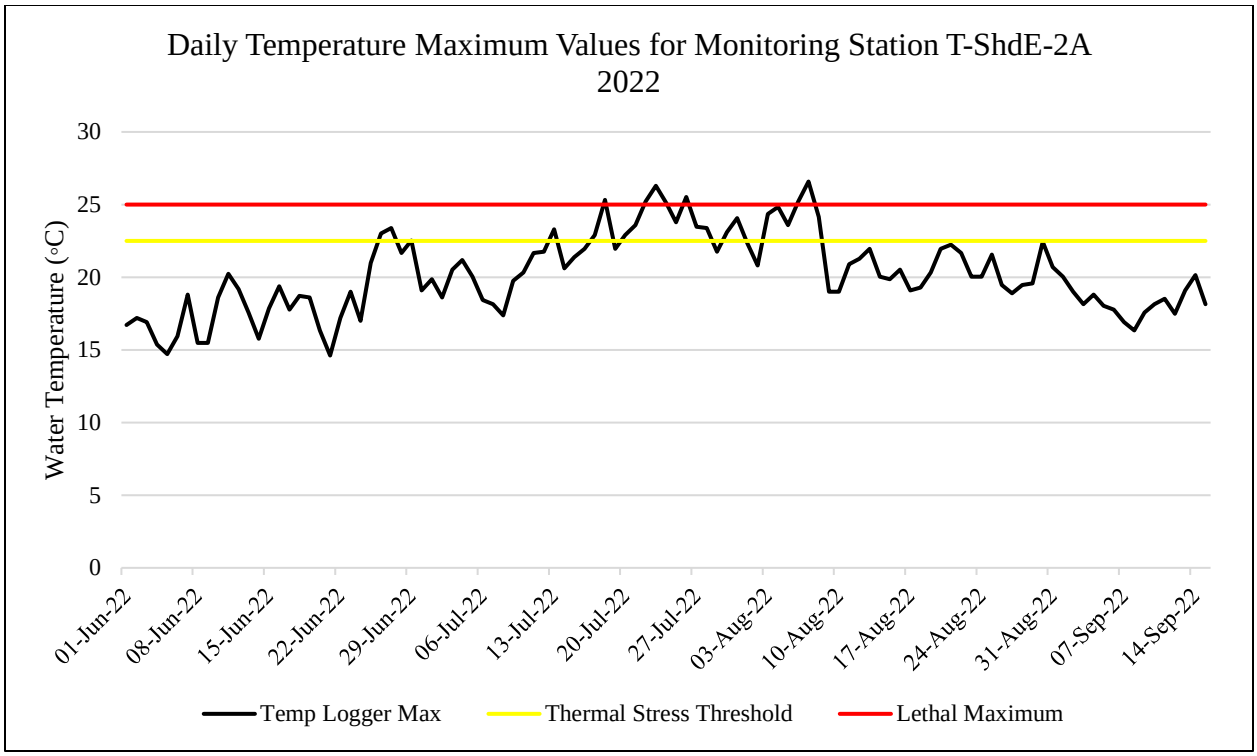



**Figure 36: Thermograph chart for monitoring station T-ShdE-2A.**

### 4.1.5 T-ShdM Monitoring Site

This temperature logger was installed in the Weisner Brook, a tributary of the Shediac River. This logger was predicted to show cooler temperatures, as the brook is recognized as a summer resting area for mature brook trout by the Department of Natural Resources and Energy Development, due to its colder characteristics. This stream has excellent tree coverage and consists of undeveloped forested lands along the majority of the watercourse. It also has inputs of cold water from natural underground springs. These conditions of shade are optimal to keep water temperatures cool.

The thermograph shows the maximum daily temperature between June 1st and September 14th (Figure 37). The maximum temperatures exceeded the thermal stress threshold (22.5°C) on 10 occasions during the peak of the summer months. During these 10 days, the maximum temperatures did not reach or exceeded the lethal limit (25°C). There was a five-day stretch during which the maximum daily temperatures surpassed the thermal stress level, from July 22th to 26th. During that period, the maximum daily temperature did not reach or exceed the lethal limit (Figure 56). The highest temperature recorded during the summer was 24.9°C on August 7th. The highest average daily temperature for this site was 22.2°C.

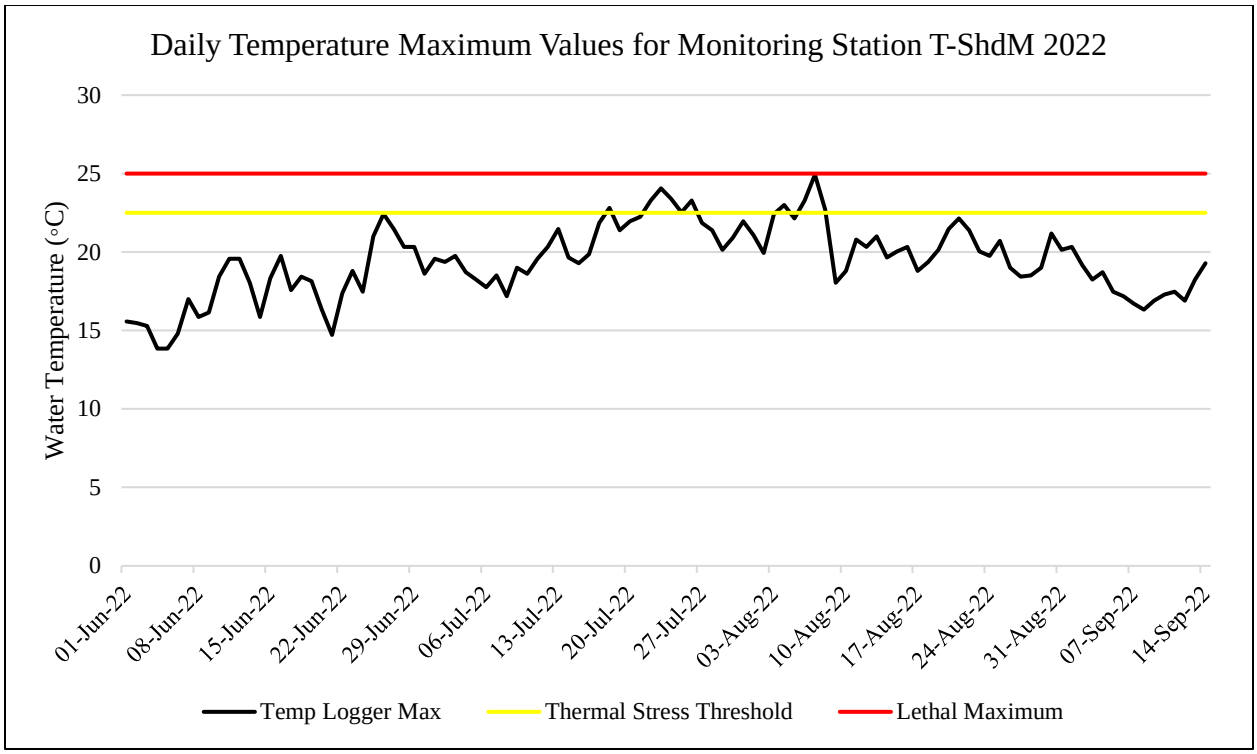



**Figure 37: Thermograph chart for monitoring station T-ShdM.**

### 4.1.6 T-ScdB Monitoring Site

This temperature logger was installed in the main branch of the Scoudouc River, next to the Greater Shediac Sewage Commission's treatment lagoons in Scoudouc. The logger is installed upstream of the effluent discharge pipe and upstream of a canoe access point.

The thermograph shows the maximum daily temperature between June 1st and September 15th (Figure 38). The maximum temperatures exceeded the thermal stress threshold (22.5°C) on 31 occasions during the peak of the summer months. During these 31 days, the maximum temperatures exceeded the lethal limit (25°C) on eight occasions. There was a 17-day stretch during which the maximum daily temperatures surpassed the thermal stress level, from July 16th to August 1st. During that period, the maximum daily temperature exceeds the lethal limit on five occasions. The highest temperature recorded during the summer was 26.2°C on August 7th. The highest average daily temperature for this site was 24.5°C.

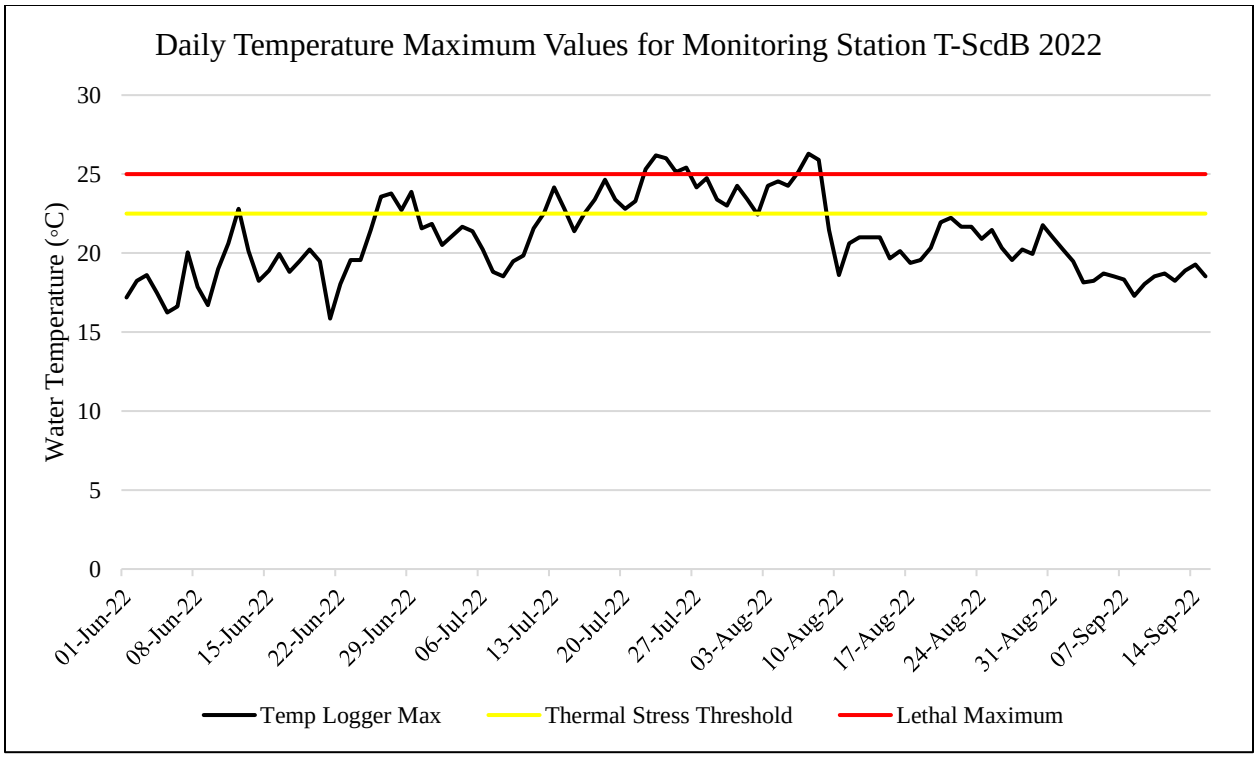



**Figure 38: Thermograph chart for monitoring station T-ScdB.**

### 4.1.7 T-ScdD Monitoring Site

This temperature logger was installed in the Scoudouc River off Pellerin Road, in an area known locally as Edna's Pond.

The thermograph shows the maximum daily temperature between June 1st and September 14th (Figure 39). The maximum temperatures exceeded the thermal stress threshold (22.5°C) on 48 occasions during the peak of the summer months. During these 48 days, the maximum temperatures exceeded the lethal limit (25°C) on 28 occasions. There was a 25-day stretch during which the maximum daily temperatures surpassed the thermal stress level, from July 15th to August 8th. During that period, the maximum daily temperature exceeds the lethal limit on 20 occasions. The highest temperature recorded during the summer was 31.2°C on August 7th. The highest average daily temperature for this site was 25.2°C.

This temperature logger was out of the water when it was collected in September. Looking at the large fluctuations on the thermograph, it is reasonable to believe that it was out of the water for a portion of the summer. It is possible a high flow event moved it out of the main channel and onto the bank.

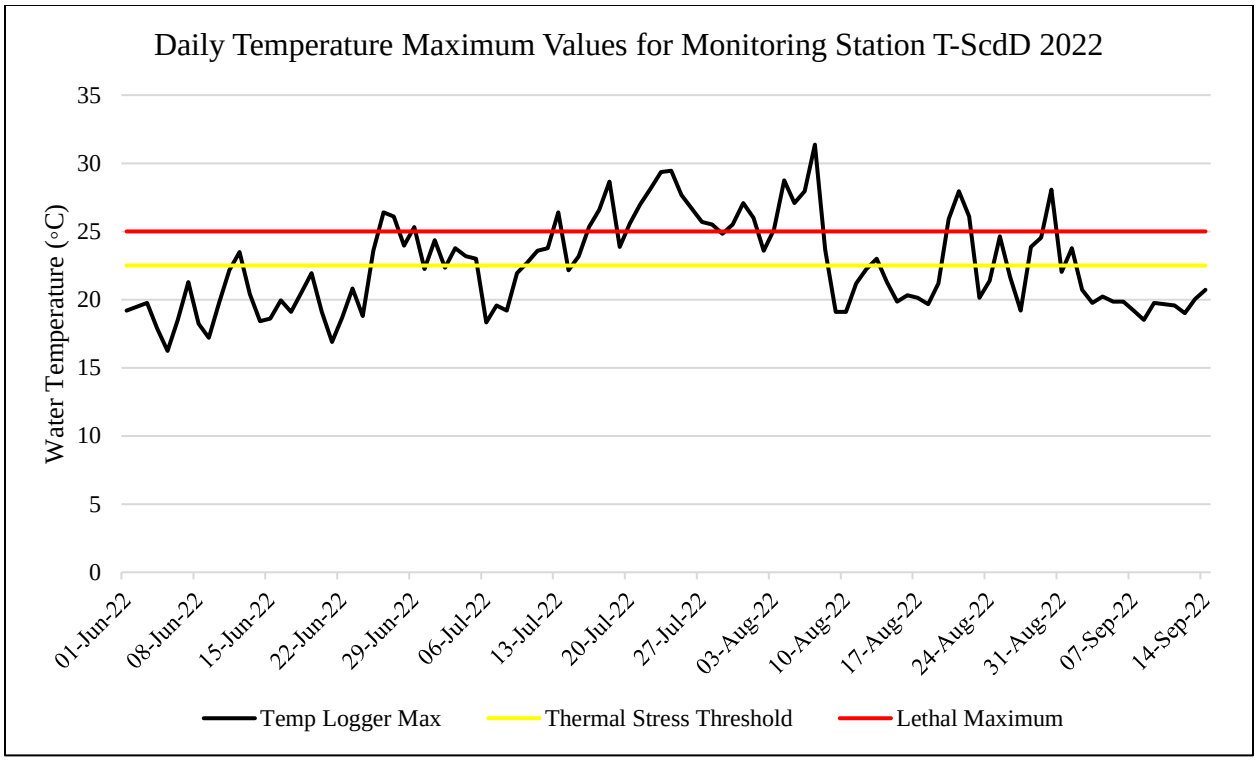



**Figure 39: Thermograph chart for monitoring station T-ScdD.**

# 5. DISCUSSION

The SBWA and its employees do not proclaim to be water quality experts. The purpose of this project is to collect samples, organize the data, look at surrounding land uses, 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. All water quality data recorded by SBWA is uploaded to an open access platform called *Atlantic DataStream.* This platform allows the sharing of water quality datasets.

In collaboration with the Atlantic Water Network (AWN), the SBWA will begin developing a water quality monitoring plan. This plan will help standardize water quality sampling by offering summer students and new employees a comprehensive document detailing the following:

- Program design considerations
- Type of monitoring programs
- Monitoring location and sites
- Monitoring parameters
- Sampling frequency and duration
- Data use and management
- Quality assurance, quality control, and safety

## 5.1 Water Quality Monitoring

### 5.1.1 Shediac and Scoudouc Rivers

The bacterial analysis of the 10 water quality monitoring sites in 2022 has identified some elevated levels of non-point sources of bacterial contamination in certain areas. The results for the Shediac River this year showed only four instances of elevated *E. coli* concentrations. The Scoudouc River sites exceeded the recommended *E. coli* guideline seven times.

All pH levels were found to be within the guidelines except for site ScdE-2 in September. Dissolved oxygen fell below the recommended 6.5 mg/L for the protection of aquatic life for early life stages of cold-water species at sites ShdB, ScdB, and ScdE-2 on five different occasions.

Looking at the averages of total phosphorous levels (TP-L), most sites in the Shediac River fell within the mesotrophic (0.010–0.020 mg/L) to meso-eutrophic range (0.020–0.035 mg/L). For the Scoudouc River and its tributaries, most sites fell within the meso-eutrophic range (0.020–0.035 mg/L) to eutrophic range (0.035–0.100 mg/L).

Inorganic results that were over the *CCME Recommended Guidelines for the Protection of Aquatic Life* were mainly iron and aluminum. The province of New Brunswick is known to have higher levels of naturally occurring aluminum in soils, sediments and bedrock. Every sample taken in September 2022 had elevated levels of aluminum; this follows the seasonal trend of higher quantities of aluminum found in autumn, corresponding with increased rainfall.

### 5.1.2 Small Streams

The bacterial analysis of these 11 water quality monitoring sites in 2022 has demonstrated high levels of non-point sources of bacterial contamination.

All pH levels were found to be within the guidelines for the protection of aquatic life. Dissolved oxygen values were usually with the guidelines except two instances at site WQ-8 and one occasion each at sites WQ-9 and WQ-11B.

The average total phosphorous for the small stream sites fell into four categories: mesotrophic (0.010–0.020 mg/L); meso-eutrophic (0.020–0.035 mg/L); eutrophic (0.035–0.100 mg/L); and hyper-eutrophic (> 0.100 mg/L). These categories are derived from the *CCME Guidance framework for Total Phosphorus.*

Similar to the Shediac and Scoudouc river sites, the small streams sites had elevated levels of both iron and aluminium, in addition to chloride at several sites. Salt water naturally has high concentrations of chloride; since so many of these sites are close to tidal estuaries and inlets, it is reasonable to believe that these values are the result of saltwater mixing with the freshwater in the streams.

## 5.2 Water Quality Index

All scores for the Shediac and Scoudouc rivers in 2022 fell within the “Fair” or “Good” category, based on the 11 parameters used in the calculation of the WQI (Table 9). Iron and phosphorus had the most exceedances overall in 2022, followed by dissolved oxygen, pH and turbidity. There were 31 exceedances in total spread over the 11 water quality monitoring sites.

All scores for the Small Stream sites in 2022 fell within the “Marginal” or “Fair” categories, based on the 10 parameters used in the calculation of the WQI (Table 9). Iron and phosphorus had the most exceedances overall in 2022, followed by turbidity, copper, and dissolved oxygen. There were 95 exceedances in total spread over the 11 water quality monitoring sites.

It is important to note that the WQI is a tool that can be used to provide a “snapshot” of water quality at a specific site for a specific time period. Parameters, guidelines and time periods used in the calculation of the WQI can vary from organization to organization depending on local conditions, the purpose of the use of the index, and water quality issues. The parameters the SBWA have chosen are the same ones used in the Shediac Bay IWMP and by the Province of New Brunswick (see Section 8 for more information on the IWMP).

WQI report cards for each of the 21 long-term monitoring sites have been created, including information on the calculation of the WQI, site information, *E. coli*, phosphorus, temperature and DO, and a map indicating the site location within the watershed. These will be made available on our website.

## 5.3 Water Temperature Monitoring

There are two levels of temperature that are evaluated for the protection of cold-water fish species: thermal stress (22.5°C) and lethal limit (25°C). When water temperatures reach these levels, fish can be forced to move in search of colder water sources, like deep-shaded pools and natural cold springs. The longer these temperatures remain, the higher the risk of fish mortality. Water temperature monitoring using pendant loggers is a widely used tool to monitor temperature fluctuations in watersheds. The goal is to identify hot spots and cold zones suitable for thermal refuge in periods of thermal stress among fish. The data is used to measure changes over time.

Located in the Shediac River, the T-ShdB site had the highest recorded temperature with 34.9°C. Based on the large fluctuations on the thermograph, it is reasonable to believe that this temperature logger was out of the water for a portion of the summer, which could have included the dates when these temperatures were recorded. The logger recorded thermal stress levels on 53 occasions and lethal limits on 39 occasions. There was 25 consecutive days with temperatures exceeding 22.5°C.

The T-ScdD site was the second-warmest site in 2022; the highest temperature reading was 29.5°C, and thermal stress levels were reached 19 times. The lethal limits were exceeded 28 times. This temperature logger was out of the water when it was collected – it is reasonable to believe that it had been out of the water for a portion of the summer, which could have included the dates when these temperatures were recorded.

The Weisner Brook (T-ShdM) had the coolest recorded temperatures. The logger recorded temperatures above the thermal stress level (22.5$^{o}$C) 10 times during the summer. It did not record a temperature above the lethal limit of 25$^{o}$C. The average temperature across the monitoring period was 17.9$^{o}$C.

Our summers are becoming increasingly hot and dry. Longer periods without rainfall, combined with extreme heat can cause water levels to drop and become a threat for cold-water species. Water temperatures will continue to be monitored to measure the impacts of our ever-changing climate.

# 6. Environmental Restoration

The reforestation of buffer zones around streams and wetlands is a priority for the SBWA. The riparian buffer zone is a natural, permanent strip of vegetation bordering a watercourse. Composed of a mixture of wildflowers, grasses, shrubs, and trees, it is a transition zone between aquatic and terrestrial environments. Healthy riparian buffer zones filter pollutants before they can enter watercourses. Improving riparian zones also benefits the fish and insects that live in and around them.

Another area of focus for reforestation is where bank erosion occurs. This erosion often leads to an excess of sediment in a watercourse. Sedimentation can cause various issues for aquatic ecosystems; it can suffocate fish and fish eggs, bury aquatic insects, carry harmful pollutants such as heavy metals and excessive nutrients that can further worsen conditions of the ecosystem, etc. The SBWA uses vegetation and bioengineering techniques to stabilize banks.

In 2022, two sites were selected for buffer zone enhancement and maintenance. Work continued at the existing restoration site along the Scoudouc River known as Edna's Pond. The second site was the edge of an agricultural field on the Weisner Brook.

## 6.1 SBWA Tree Nursery

To help the Association save costs and provide a variety of tree and shrub species, a native tree nursery was developed in 2017. In 2020, significant work was undertaken to improve the nursery. Trees were relocated from three small tree nurseries (École Mgr-François-Bourgeois, École Grande-Digue, and the Greater Shediac Community Garden), to the SBWA's tree nursery at the Shediac Cape Community Garden (Figure 40). Our ongoing thanks to the Anglican Parish of Shediac for dedicating this space for eight tree nursery boxes.

By maintaining a tree nursery, a steady supply of native trees is now available for various tree planting projects. The SBWA can grow species of native trees that are sometimes not available at local commercial nurseries. Also, $CO_2$ emissions are diminished by reducing travelling to various tree nurseries. Finally, perhaps as important as habitat restoration, is the education possibilities that the tree nurseries provide for the community. Presentations and voluntary work often take place at the nursery, involving school students and the community. An educational sign has been placed at the nursery boxes so that patrons of the community garden understand how these trees will be used to restore riparian buffer zones.

In 2022, a total of 96 trees from the nursery were planted: 18 at the restoration site on the Weisner Brook, and 78 at a site along the Tait Brook within the Town of Shediac. To replenish the nursery, approximately 400 young white spruce plugs were planted at the nursery in late summer. These spruces will be allowed to mature for 1-3 years, thereby increasing their survival rate once transplanted to a restoration site.


**Figure 40: Map of the SBWA tree nursery.**

## 6.2 Weisner Brook Restoration Site

The major restoration project of 2022 was at a location along the Weisner Brook on St Philippe Road in Saint-Philippe. The Weisner Brook is a major tributary of the Shediac River; a combination of many small streams and the Calhoun Brook. A defining characteristic of this brook is its cold-water temperatures. This is due to long stretches of forested riparian area and cold spring inputs into its tributaries. It is recognized by the Department of Natural Resources as a "summer resting refuge for mature trout" due to its cooler temperatures.

**Figure 41: Staked haybales and waddle fencing.**

In 2017-2018, the buffer zone next to the brook in this area was cut and the field was tilled in preparation for planting. The clearing reached the riverbank, leaving little vegetation along a 175 m stretch. Alders and shrubs have since recolonized the riverbank area. The SBWA took steps to reduce the amount of sediment and runoff entering the brook in this area through the creation of a sediment catch (Figure 41).

Adjacent the alder and shrub, a 50 m line of hay bales were installed to act as a sediment catchment system. The bales were secured with wooden stakes. A line of native trees were planted beside the hay bales (Figure 42). The trees planted are native to the province of New Brunswick and were provided by the SBWA nursery. The trees were planted behind the sediment catch to avoid losing trees to agricultural activities (Figure 43). The tree species include: four pine (*Pinus sp.*), six maple (*Acer sp.*), and eight spruce (*Picea sp.*). A section of waddle fencing made with alder branches was built on the field side of the hay bales. Alder branches for the fence were sourced from the wooded area of the property.

**Figure 42: Young native trees were planted behind the haybales.**


**Figure 43: Map of restoration work along the Weisner Brook.**

## 6.3 Edna's Pond Restoration Site

Every year the SBWA continues to maintain our restoration site on the Scoudouc River, in the area known locally as Edna`s Pond (Figure 44). This site is an important Atlantic salmon habitat for the Shediac Bay watershed. Assuring that enough trees will take at this location is crucial for the stabilization of the banks and runoff control to minimize sedimentation in the salmon pool.

The five sediment deflectors in the area require constant maintenance every year. They capture sediments from runoff which causes a sediment buildup on the logs. In the summer of 2022, the sediment traps were cleaned manually with shovels so that they could continue to work efficiently.

We have been in contact with a local ATV club who received funding to build a new bridge to cross the Scoudouc River. This bridge was built in 2022, and the ATV crossing at Edna's Pond is no longer needed. ATV traffic will be redirected from Edna's Pond to this new bridge, through the use of signs and further stream restoration techniques.

Students from Shediac Cape School visited this restoration site during Adopt-A-River field trips. They were taught about the importance of buffer zone restoration, sediment control, and the impacts of in-stream crossing by off-road vehicles.


**Figure 44: Map of the tree planting area at Edna`s pond on the Scoudouc River.**

## 6.4 Garbage Cleanup Activities

A trash cleanup was undertaken by staff in the South Cove marsh in Pointe-du-Chêne after Hurricane Fiona in September 2022. Two large bags of garbage and various debris items were removed from the marsh.

In addition to this cleanup, staff perform routine litter pickups throughout the summer at water quality monitoring sites and any other problem areas that are identified throughout the field work season.

# 7. STREAM ASSESSMENTS

Following confirmation of Atlantic salmon through electrofishing surveys, a stream assessment was completed along a portion of the Shediac River located in the Cape Breton area (Figure 45). The purpose of this assessment was to determine if any restoration actions may be required along this stretch of river.

The stream assessment was based on the Nova Scotia Fish Habitat Assessment Protocol (NSFHAP). The NSFHAP records stream characteristics relevant to fish habitat and stream health. The characteristics recorded include:

- Water Quality
- Channel Cross-Sections
- Substrate and Cover
- Riverbanks and Riparian Areas
- Pool Measurements
- Spawning Areas


**Figure 45: Location of the stream assessment completed in fall 2022.**

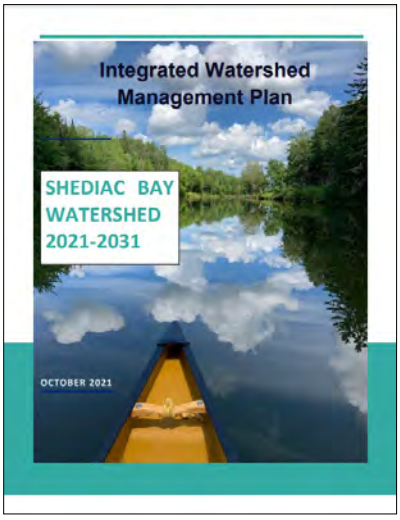
The assessment is designed to help determine the degree of harm and the weakness within the habitat in order to aid future restoration planning (Nova Scotia Salmon Association, 2018). The assessment covered a distance of 26 m and was comprised of three transects. A visual assessment was performed in conjunction with the NSFHAP to evaluate approximately 350 m of the Shediac River. Images and GPS coordinates of potential fish habitat and fish passage barriers can be found in Appendix D.

This section of the Shediac River was found to be suitable for fish, with an abundance of instream cover such as undercut banks and large woody debris. The substrate type was also suitable for fish species such as brook trout and Atlantic salmon.

In certain areas, fallen woody debris has become a partial or potentially complete barrier to fish passage (Figure 46). Some clearing of the fallen debris should be considered in future restoration actions for this stretch of the Shediac River.

**Figure 46: An example of a large woody debris blockage.**

# 8. WATERSHED MANAGEMENT COMMITTEE




In 2019, a working group was formed by the NB DELG to develop a watershed management plan for the Shediac Bay watershed. The Working Group met regularly between November 2019 and July 2021 and in total, three rounds of engagement took place in October 2019, August 2020 and February 2021. The plan was finally published in both official languages on October 22nd, 2021.

With the help of the NB DELG, an Implementation Committee was created. The purpose of the Implementation Committee is to work collaboratively with applicable government agencies, First Nations, and stakeholders in the implementation of the IWMP. Two meetings were held in the 2021-2022 fiscal year. Four meetings were held in the 2022-2023 fiscal year on April 21st, 2022, October 13th, 2022, December 5th, 2022, and February 23rd, 2023.

To further focus on single goals and action items, subcommittees were created for five of the seven goals. The remaining two goals are large in scope and incorporate many action items from the other five goals. Meetings were held for four subcommittees in the 2022-2023 fiscal year. Subcommittee #2 Protect and Improve Water Quality met on October 4th, and Subcommittee #4 Improve Wastewater Management and Subcommittee #5 Protect the Coastal Areas of the Watershed both met separately on November 16th. Subcommittee #3 Improve Stormwater Management met on February 7th, 2023.

The main purpose of the IWMP is to address water quality issues in the watershed, namely anthropogenic or human sources of nutrients and bacteria. This will in turn, help protect and improve water quality at Parlee Beach.

An annual report was produced by SBWA staff to summarize the work done by the implementation committee for 2022-2023. This report serves as the communication and sharing tool, part of the Annual Watershed Management Plan Management Cycle (Appendix E).

Documents relating to the integrated management plan and implementation committee, including meeting minutes, the “Terms of Reference” document, annual reports, and a link to the plan in both languages, has been made publicly available on the Shediac Bay Watershed Association’s website.

# 9. EDUCATION

## 9.1 Adopt-A-River

In the 2022, SBWA continued to partner with Shediac Cape School for the annual Adopt-A-River program. On June 6, two in-person presentations were held at the school gymnasium, touching on the importance of biomonitoring using macroinvertebrates. One session was held for English students and one for the French immersion students.

Later in June, the classes went to the Scoudouc River to do the macroinvertebrate sampling and to collect other habitat measurements and observations (Figure 47). On June 8th, 9th and 10th the field trips for the English classes were held. Field trips for the French immersion students took place on June 16th and 17th. Not accounting for absences, a maximum of 141 students from 6th to 8th grade participated in these activities.

**Figure 47: Students collecting macroinvertebrate samples.**

## 9.2 Pet Waste Awareness Campaign

The SBWA, in partnership with the Town of Shediac, have created an educational campaign around the topic of dog waste and the importance of cleaning up after your pets.

When pet waste accumulates in a yard or is left on the ground in public spaces, it doesn't decompose quickly. When it washes away in the rain, it adds harmful bacteria and excessive nutrients to streams, rivers and the Shediac Bay. This affects water quality, which in turn can affect fish and other aquatic species and makes it unsafe for swimming and other recreational activities.


**Figure 48: Sign designed for the Town of Shediac trail system.**

Signs have been developed that will be posted along the Town of Shediac trail system thanking users for picking up their pet waste and placing it in the garbage (Figure 48). Additionally, a series of infographics and texts have been designed that will be released through social media, highlighting the importance of cleaning up after your pet (Figure 49). Due to staff turnover at the Town of Shediac, there have been some delays in the approval process of the designs and elements of this campaign. Therefore, a spring release has been set to coincide with a changing of the seasons and the beginning of warmer weather. A leaflet has also been designed to be given out with each purchase of a Town of Shediac dog registration tag, sold at the Shediac Veterinary Hospital. The leaflet and additional infographics can be found in Appendix E.


**Figure 49: Infographics explaining how pet waste affects water quality.**

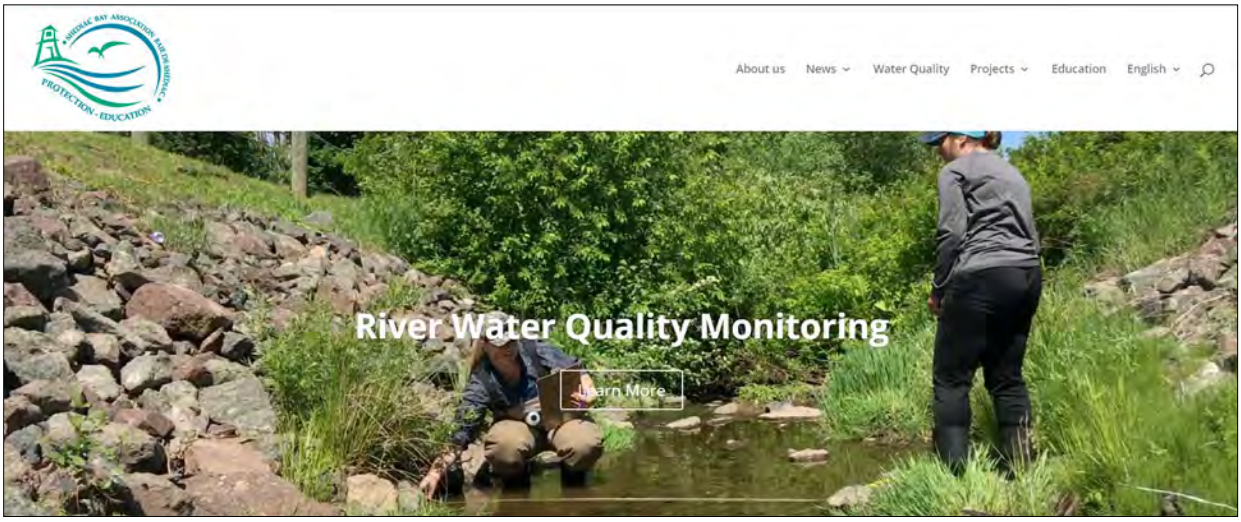
# 10. MEDIA OUTREACH

## 10.1 Newsletter

During the 2022-2023 fiscal year, two bilingual newsletters were produced. The newsletters display information and photos on the various projects that the SBWA has been working on throughout the year. The newsletter is now distributed electronically by email list and is available on our website and Facebook page. Topics in the newsletters included smelt surveys, dune restoration, water quality monitoring, eelgrass monitoring, and much more.

## 10.2 Socials Medias and Website

The SBWA is working to keep its website and social media up to date, posting photos and short descriptions 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.




www.shediacbayassociation.org

www.facebook.com/#!/shediacbaywatershedassociation

https://www.instagram.com/bvshediacwatershed/?hl=en

https://www.youtube.com/channel/UCT1bsN08OyOeIzqqwn9ZhlQ

# 11. CLOSING COMMENTS

The Shediac Bay Watershed Association had a successful year in 2022, thanks to the support of the NB Environmental Trust Fund. The Association has met its targets regarding the monitoring and partnerships created to improve water quality in the Shediac Bay watershed. Sampling results will help in the implementation of the IWMP for the Shediac Bay watershed. Recommendations and action items from the IWMP will help guide future activities of the SBWA.

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

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

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# APPENDIX A - WATER CHEMISTRY METHODOLOGY

**Table 76: RPC Laboratory Analytical Methods**

| RPC LABORATORY ANALYTICAL METHODS | | | | |
|---|---|---|---|---|
| **Analyte** | **Parameter** | **RPC SOP Number** | **Method Preference** | **Method Principle** |
| Ammonia | NH3T | 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 | SO4 | 4.M45 | APHA 4500-SO4 E | Turbidimetry |
| Nitrate + Nitrite (as N) | NOX | 4.M48 | APHA 4500-NO3 H | Hydrazine Red, Derivatization, Colourimetry |
| Nitrite (as N) | NO3 | 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 | EPA200.8/EPA 200.7 | ICP-MS/ICP-ES |

**Table 77: RPC Laboratory Analytical Methods for *E. coli*.**

| RPC LAB ANALYTICAL METHODS FOR *E. COLI* | | |
|---|---|---|
| **Method** | **ID** | **Max Detection Limit** |
| Membrane Filtration | FSA-01 | 10,000 MPN/100mL |
| Colilert | FSA-10 | 2,419.6 MPN/100mL |

# APPENDIX B – SHEDIAC AND SCOUDOUC RIVER SITE PHOTOS AND LOCATIONS

**Table 78: Location of the Shediac and Scoudouc river WQ sampling stations.**

| Site | Latitude & Longitude |
|---|---|
| ShdA | N46°12'13.42" W64°47'53.01" |
| ShdB | N46°13'55.17" W64°44'35.81" |
| ShdC | N46°12'33.10" W64°44'33.24" |
| ShdE | N46°14'43.24" W64°39'52.21" |
| ShdG | N46°12'53.56" W64°40'29.74" |
| ShdH | N46°13'50.95" W64°37'15.89" |
| ScdB | N46° 8'42.74" W64°33'51.55" |
| ScdE-2 | N46° 9'57.12" W64°31'58.13" |
| ScdF | N46°10'50.52" W64°30'17.78" |
| ScdH | N46°12'12.32" W64°34'55.49" |


**Figure 50: Photos of water monitoring site ShdA.**


**Figure 51: Photos of water monitoring site ShdB.**


**Figure 52: Photos of water monitoring site ShdC.**


**Figure 53: Photos of water monitoring site ShdE.**


**Figure 54: Photos of water monitoring site ShdG.**

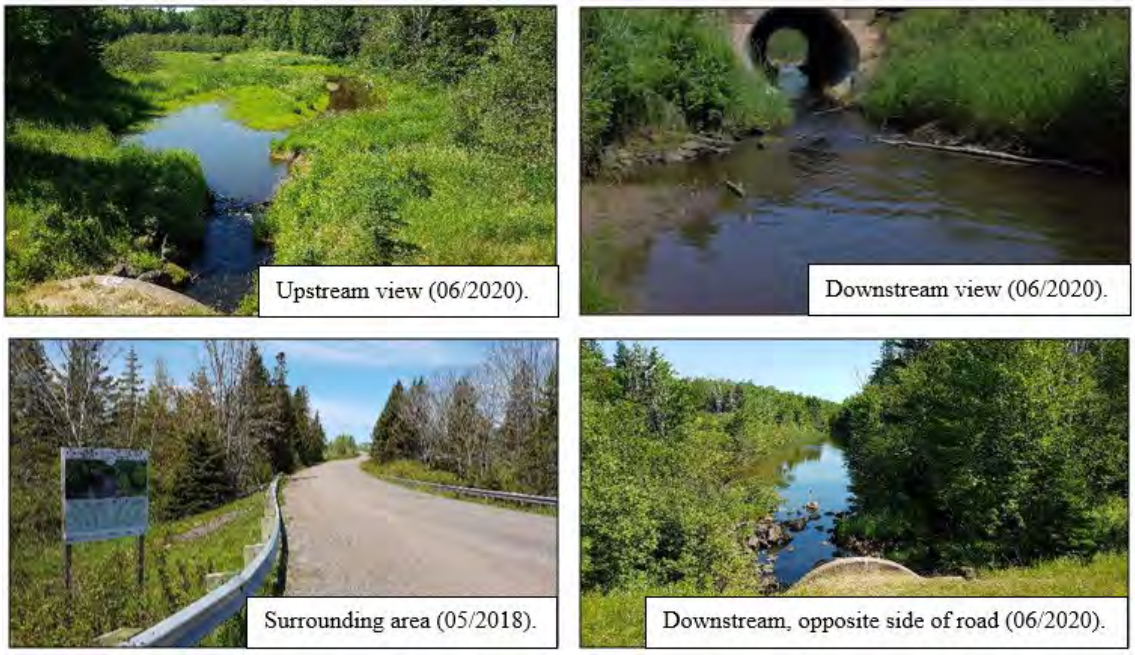



**Figure 55: Photos of water monitoring site ShdH.**

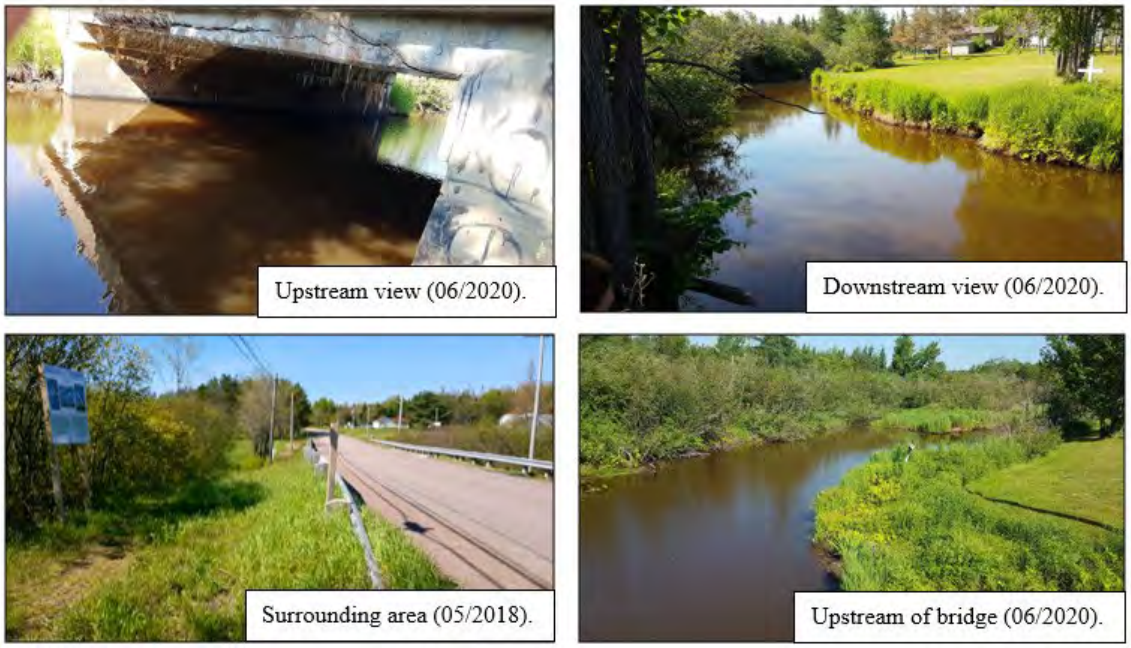



**Figure 56: Photos of water monitoring site ScdB.**


**Figure 57: Photos of water monitoring site ScdE-2.**

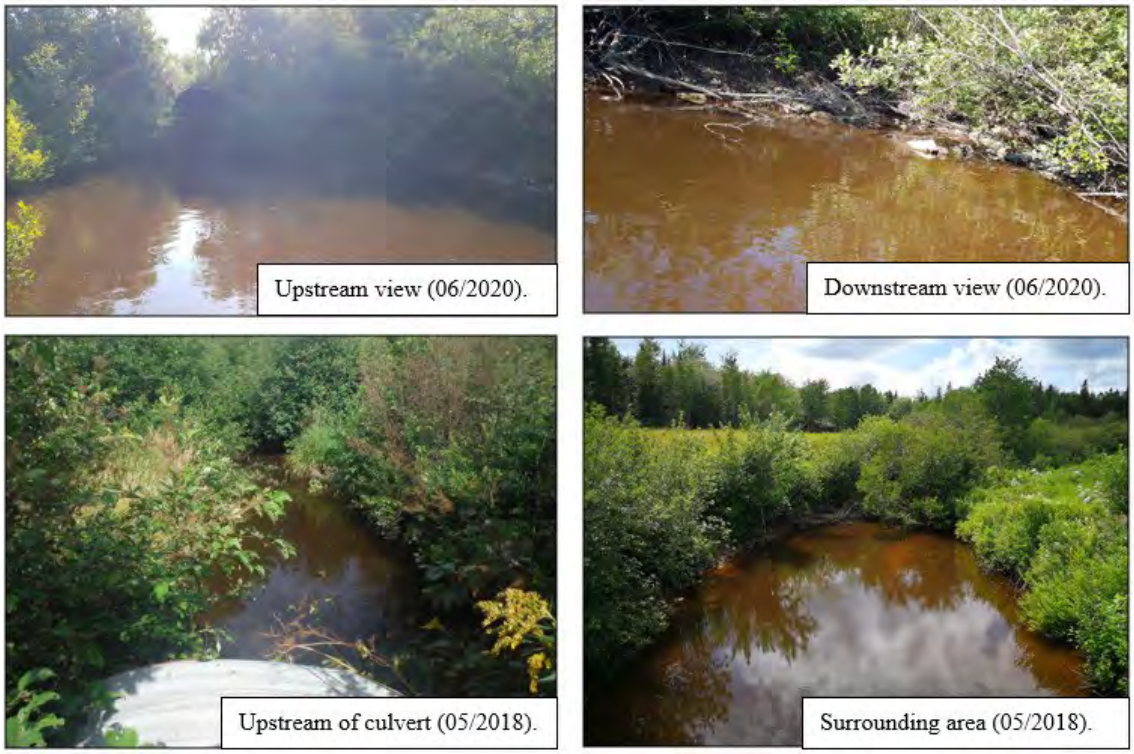



**Figure 58: Photos of water monitoring site ScdF.**


**Figure 59: Photos of water monitoring site ScdH.**

# APPENDIX C – SMALL STREAM SITE PHOTOS AND LOCATIONS

**Table 79: Location of the small stream WQ sampling stations.**

| Site | Latitude & Longitude |
|---|---|
| WQ-1 | N46°13'24.19" W64°28'30.36" |
| WQ-2 | N46°13'35.25" W64°29'48.39" |
| WQ-3 | N46°13'18.25" W64°31'30.94" |
| WQ-4 | N46°13'11.25" W64°32'56.17" |
| WQ-5 | N46°13'22.17" W64°33'58.17" |
| WQ-6 | N46°14'23.90" W64°34'2.29" |
| WQ-7 | N46°14'43.38" W64°34'7.29" |
| WQ-8 | N46°15'11.99" W64°34'14.01" |
| WQ-9 | N46°16'41.70" W64°35'13.77" |
| WQ-10 | N46°17'8.24" W64°34'29.13" |
| WQ-11B | N46°17'52.37" W64°33'18.73" |


**Figure 60: Photos of water monitoring site WQ-1.**


**Figure 61: Photos of water monitoring site WQ-2.**


**Figure 62: Photos of water monitoring site WQ-3.**


**Figure 63: Photos of water monitoring site WQ-4.**


**Figure 64: Photos of water monitoring site WQ-5.**


**Figure 65: Photos of water monitoring site WQ-6.**


**Figure 66: Photos of water monitoring site WQ-7.**


**Figure 67: Photos of water monitoring site WQ-8.**


**Figure 68: Photos of water monitoring site WQ-9.**


**Figure 69: Photos of water monitoring site WQ-10.**

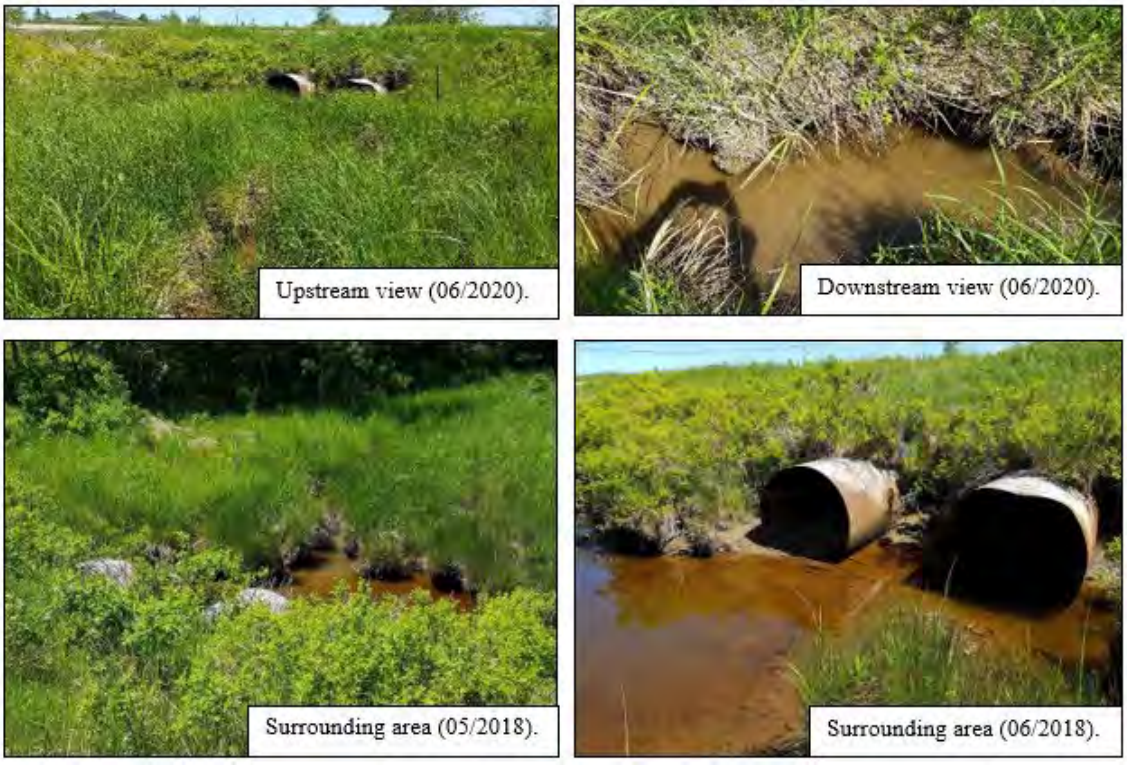
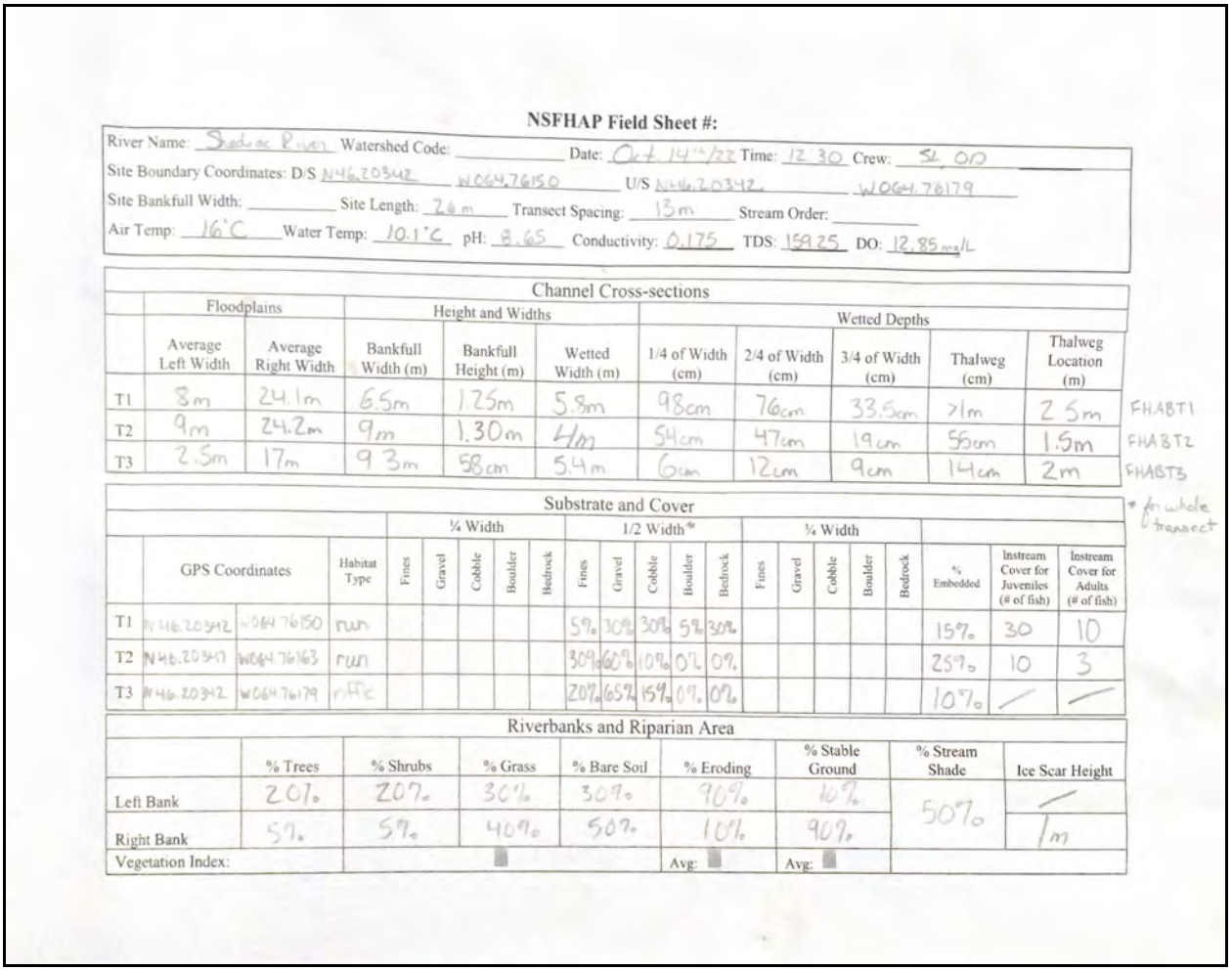



**Figure 70: Photos of water monitoring site WQ-11B.**

# APPENDIX D – STREAM ASSESSMENT DATA AND PHOTOS

**Table 80: Coordinates of stream assessment transects.**

| Transect | Coordinates | |
|---|---|---|
| | Latitude | Longitude |
| 1 (FHABT1) | 46.203420 | -64.761501 |
| 2 (FHABT2) | 46.203474 | -64.761636 |
| 3 (FHABT3) | 46.203417 | -64.761788 |



NSFHAP Field Sheet #:

River Name: Shubenacadie River Watershed Code: _____ Date: Oct. 14th/22 Time: 12:30 Crew: SL OD

Site Boundary Coordinates: D/S N46.20342 W064.76150 U/S N46.20342 W064.76179

Site Bankfull Width: _____ Site Length: 26m Transect Spacing: 13m Stream Order: _____

Air Temp: 16°C Water Temp: 10.1°C pH: 8.65 Conductivity: 0.175 TDS: 159.25 DO: 12.85 mg/L

Channel Cross-sections

| | Floodplains | | Height and Widths | | | Wetted Depths | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Average Left Width | Average Right Width | Bankfull Width (m) | Bankfull Height (m) | Wetted Width (m) | 1/4 of Width (cm) | 2/4 of Width (cm) | 3/4 of Width (cm) | Thalweg (cm) | Thalweg Location (m) |
| T1 | 8m | 24.1m | 6.5m | 1.25m | 5.8m | 98cm | 76cm | 33.5cm | >1m | 2.5m |
| T2 | 9m | 24.2m | 9m | 1.30m | 4m | 54cm | 47cm | 19cm | 55cm | 1.5m |
| T3 | 2.5m | 17m | 9.3m | 58cm | 5.4m | 6cm | 12cm | 9cm | 14cm | 2m |

FHABT1 FHABT2 FHABT3

Substrate and Cover

| | GPS Coordinates | | Habitat Type | ¼ Width | | | | | 1/2 Width* | | | | | ¾ Width | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Fines | Gravel | Cobble | Boulder | Bedrock | Fines | Gravel | Cobble | Boulder | Bedrock | Fines | Gravel | Cobble | Boulder | Bedrock | % Embedded | Instream Cover for Juveniles (# of fish) | Instream Cover for Adults (# of fish) |
| T1 | N46.20342 | W064.76150 | run | | | | | | 5% | 30% | 30% | 5% | 30% | | | | | | 15% | 30 | 10 |
| T2 | N46.20347 | W064.76163 | run | | | | | | 30% | 60% | 10% | 0% | 0% | | | | | | 25% | 10 | 3 |
| T3 | N46.20342 | W064.76179 | riffle | | | | | | 20% | 65% | 15% | 0% | 0% | | | | | | 10% | / | / |

* for whole transect

Riverbanks and Riparian Area

| | % Trees | % Shrubs | % Grass | % Bare Soil | % Eroding | % Stable Ground | % Stream Shade | Ice Scar Height |
|---|---|---|---|---|---|---|---|---|
| Left Bank | 20% | 20% | 30% | 30% | 90% | 10% | 50% | / |
| Right Bank | 5% | 5% | 40% | 50% | 10% | 90% | | 1m |
| Vegetation Index: | | | | | Avg: | Avg: | | |

**Figure 71: Data collected during the stream assessment.**

**Figure 72: Transect FHABT1.**

**Figure 73: Transect FHABT2.**

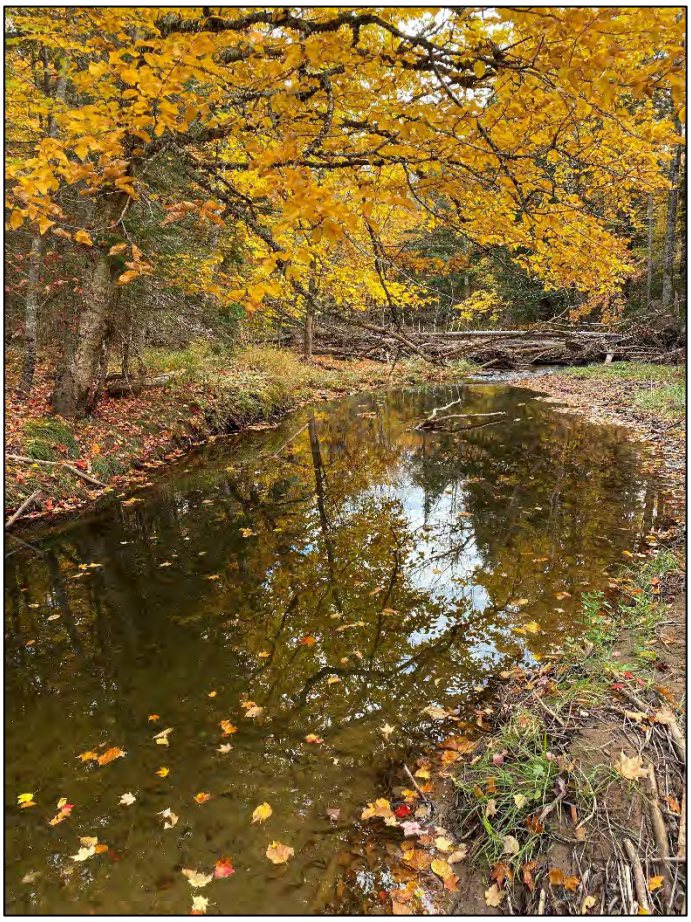


**Figure 74: Transect FHABT3.**

# APPENDIX E – ANNUAL WATERSHED MANAGEMENT PLAN MANAGEMENT CYCLE

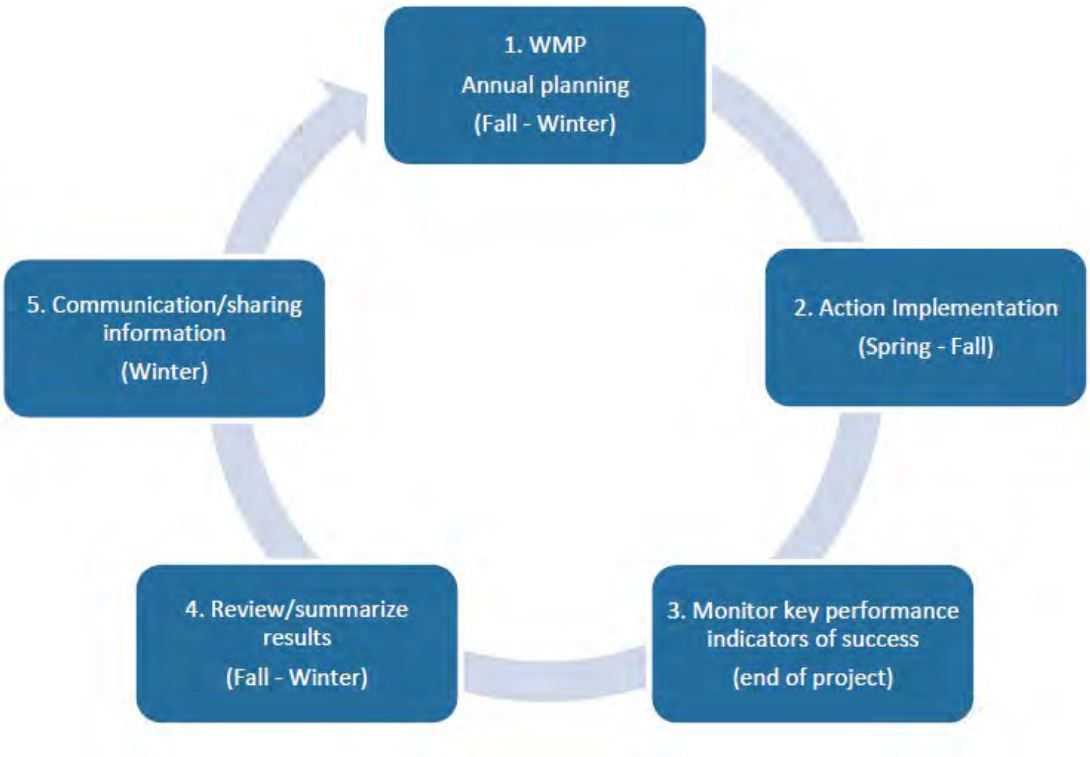



**Figure 75: Annual Watershed Management Plan Management Cycle**

# APPENDIX F – LEAFLET AND ADDITIONAL INFOGRAPHICS - PET WASTE AWARENESS CAMPAIGN

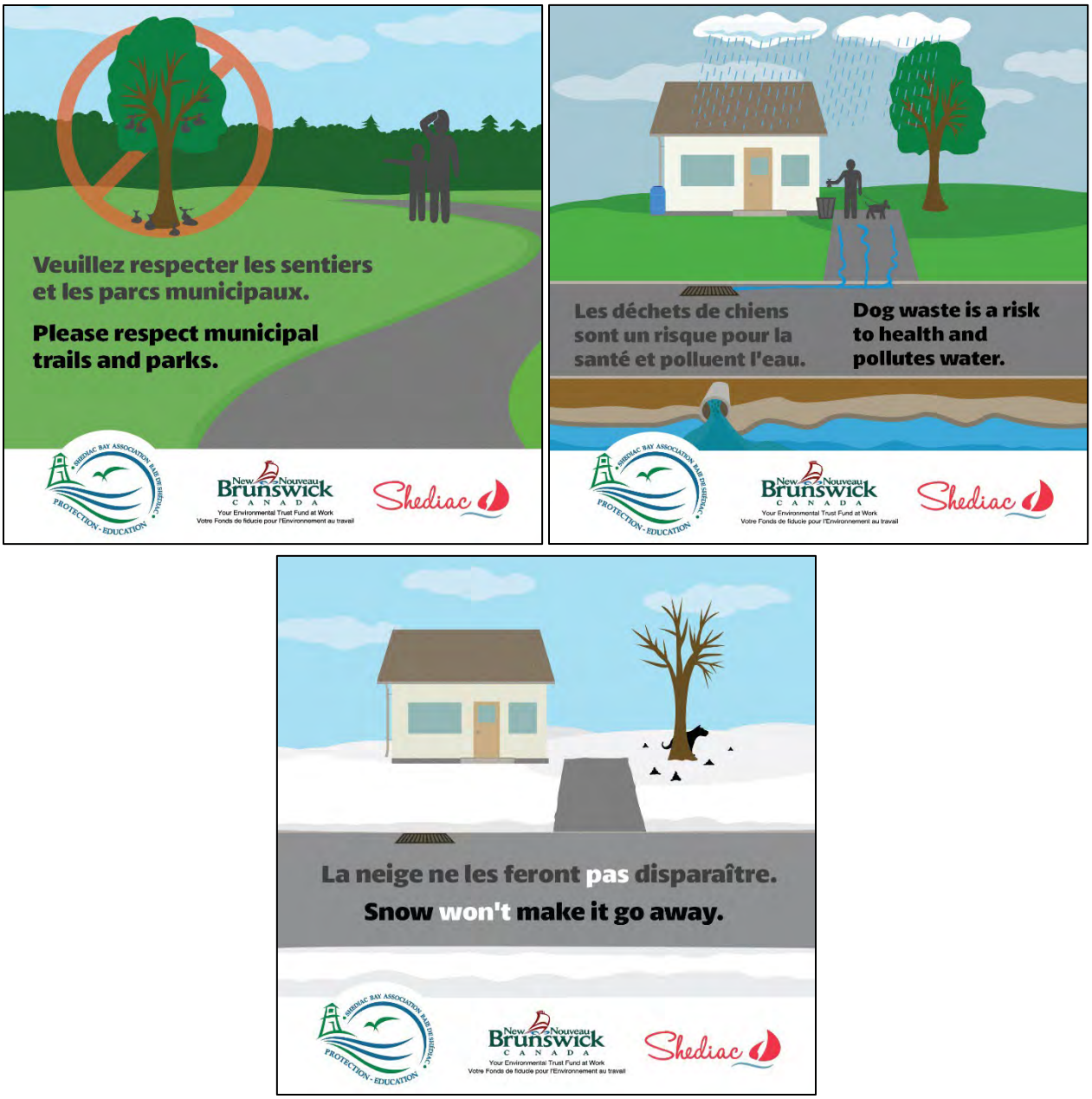



**Figure 76: Infographics for the pet waste awareness campaign.**


**Figure 77: Leaflet to be given out at the Shediac Veterinary Hospital with purchase of dog registration tags.**