# Management Plan for Kouchibouguacis and Kouchibouguac River Watersheds

**2023**

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# Table of Contents

# Table of Figures

# List of Tables

# 1. Introduction

The management plan proposed for the Kouchibouguacis and Kouchibouguac River watersheds has been developed as the result of over 20 years of various monitoring and restoration initiatives within the region that have been performed by the Friends of the Kouchibouguacis (TFK) and relevant partners; and additionally of consultations with numerous: residents, businesses, non-governmental organizations, educational institutions, local government agencies and various regional partners concerned about the health of the respective ecosystems and the environment in general.

This management plan is meant to serve as a guide for current and future work for TFK, its partners, and the community alike. While it is not possible to document every single issue of concern - now or in the future - this plan will provide a solid foundation to be referred to for numerous situations that currently exist or may occur over time. With the Kouchibouguac and Kouchibouguacis watersheds being in close proximity to one another - and having multiple communities/areas intersecting both - this report will present information and advise on issues and recommendations that will apply to both.

## 1.1 The Friends of the Kouchibouguacis (TFK)

The Friends of the Kouchibouguacis (TFK) is a non-profit organization serving as a forum for ecological sustainability in the region of the Kouchibouguacis and Kouchibouguac River watersheds in New Brunswick. TFK was established in 1999, shortly after the closure of the recreational Atlantic salmon fishery in 1998.

TFK's mission is to secure a future in which these watersheds are sustainable: ecologically, economically and socially. TFK has been performing many monitoring and restoration initiatives since the year 2000. Various annual monitoring exercises and significant results already established make it possible to show the positive effects of the various works carried out; and to continue to monitor for possible effects of human activities still present in the watershed. TFK must continue this critical work to help improve and preserve the sustainability of the region; while also spreading awareness and educating community members to help achieve long-term viability. TFK believes encouraging the community to be stewards of the watersheds is one of the most effective methods to restoring and maintaining a sustainable terrestrial and aquatic ecosystem for all.

## 1.2 Organizational Structure

TFK is comprised of a board of directors (committee) elected at an annual general meeting and seeks to represent various sectors of our communities. Members of TFK committee is comprised of representatives of various sectors within the region, including: residents within the watersheds; government agency representatives; education; and local enterprise owners.

The TFK committee is a democratic body. It holds an annual general meeting of its members to: make changes to its status; strategic objectives; to approve the annual reports of operation and to elect the board of directors. The board of directors meets on a regular basis to keep members informed of the progress of the activities taking place.

## 1.3 Partnerships

The mission of TFK is facilitated by cooperation and communication between individuals and groups involved in various aspects of the environment in the region. TFK works in close collaboration with the Kouchibouguac National Park (KNP), Department of Fisheries and Oceans (DFO) Canada, New Brunswick Department of Natural Resources and Energy Development (NBDNRED), and Beaurivage Municipality. TFK also frequently collaborates and supports other non-governmental organizations (NGOs) throughout the region.

# 2. Physical and Environmental Characteristics

The following sections will provide a breakdown of the existing environmental conditions and characteristics for each of the Kouchibouguacis River and Kouchibouguac River watersheds. Some information will be collected from publicly available sources (e.g., GeoNB), while some information will be derived from TFK's years of studying these watersheds. The Kouchibouguac and Kouchibouguacis watersheds are ranked 3rd and 4th largest respectively among all river systems that drain into the Northumberland Strait (**see Table 1 below**).

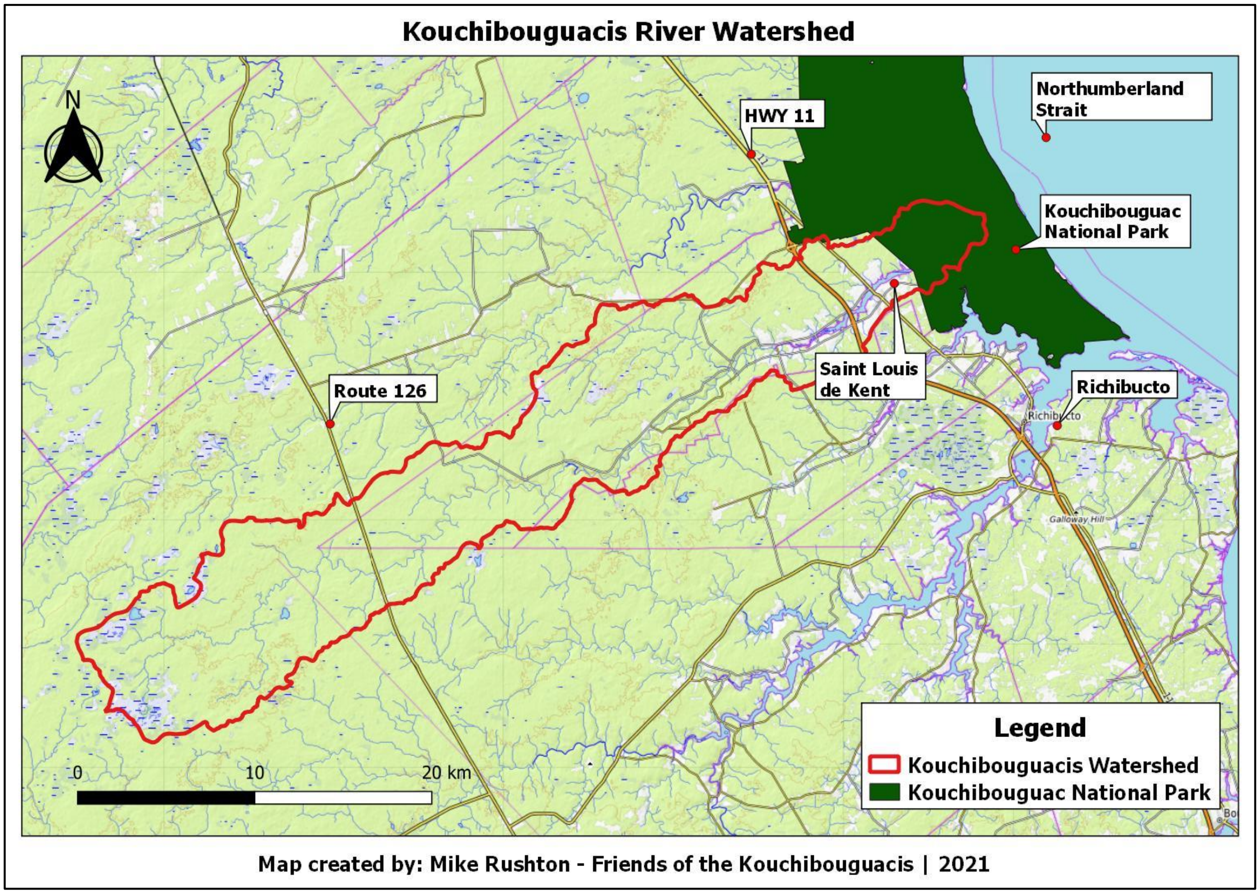
**Table 1: Northumberland Strait drainage network along with individual drainage basin surface areas**

| Watershed | Approximate Surface Area (km$^2$) |
|---|---|
| Richibucto River | 1093 |
| Bouctouche River | 613.44 |
| **Kouchibouguac River** | **437.59** |
| **Kouchibouguacis River** | **362.5** |
| Cocagne River | 344.73 |
| Chapman Brook | 316.16 |
| Kinnear River | 305 |
| Shediac River | 216.41 |
| Chockpish River | 210.2 |
| Gaspereau River | 190.7 |
| Scoudouc River | 164.77 |
| Saint-Charles River | 144.63 |
| Eel River | 135.04 |
| Black River | 103.99 |
| Portage River | 102.51 |
| Fontaine River | 45.96 |

## 2.1 Kouchibouguacis Watershed

The Kouchibouguacis River watershed is located in Kent County, New Brunswick and is part of the Northumberland Strait drainage system (**see Figure 1 on the following page**). It covers an area of approximately 362.5 km$^2$. The watershed's water network is divided into three parts: the lagoon, estuary and river. The lagoon and estuary fall within the jurisdiction of Kouchibouguac National Park (KNP), however, TFK and KNP frequently collaborate within and outside of these boundaries. TFK's mandated management area is anywhere within the watershed – outside of the park boundaries.

**Figure 1: Map of the Kouchibouguacis watershed**



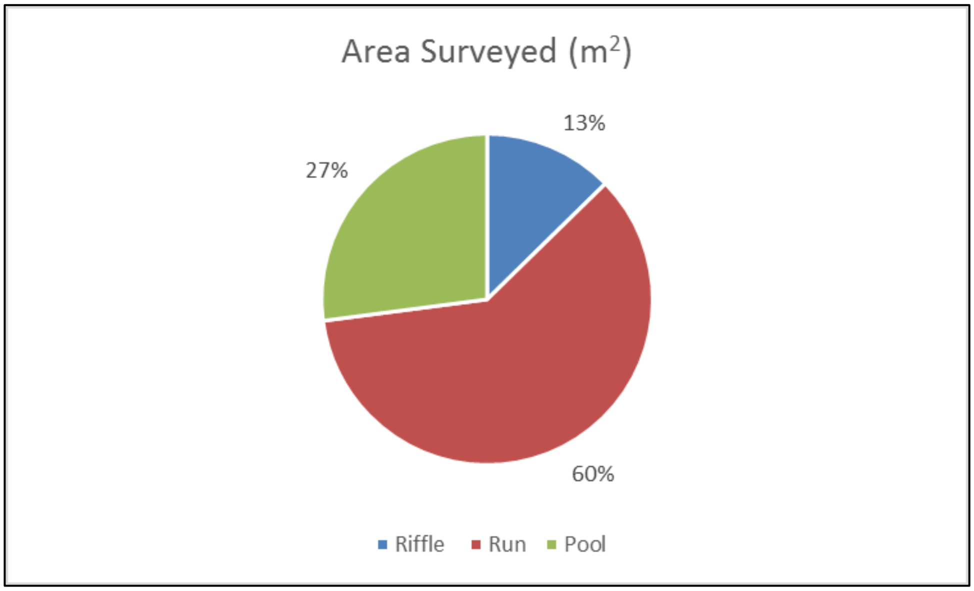

### 2.1.1 Summary of Kouchibouguacis Watershed Characteristics

The following data was gathered from stream surveys conducted in the Kouchibouguacis watershed between 2015 and 2018 and provides a snapshot of the conditions observed. The total linear measured length of stream surveyed in the watershed was 19,825.5 meters (m). Starting at the coordinates 65˚08'19.4", 46˚40'17.2", and ending at the coordinates 65°13'10.6", 46°38'14.3". The total area surveyed, obtained by multiplying the wetted width of a section by said sections length and summing all sections, was 366,353.97 square meters ($m^2$). During the stream surveys, each section is divided up based upon existing stream features (habitat types) (e.g, run, riffle, pool) though in some cases "micro-habitats" (e.g., small run within a riffle) are identified and measured accordingly with a modified evaluation protocol. The total area measured of each habitat type during the surveys are listed in **Table 2 below** and displayed in **Figure 2 on the following page**. As per these charts the habitat type (e.g., run, riffle, pool) making up the largest portion of the area surveyed is runs (60%), followed by pools (27%), and then riffles (13%).

**Table 2: Total area of Kouchibouguacis watershed by habitat type**

| Area Surveyed ($m^2$) | |
|---|---|
| Riffle | 43,507.76 |
| Run | 206,985.98 |
| Pool | 929,45.98 |
| Total | 366,353.97 |

**Figure 2: Area surveyed by habitat type Kouchibouguacis River**




Physical parameters of each section measured include averaged stream depth (of three measurements), averaged wet width (of two measurements), bankfull width, bankfull depth, and linear length. Additional measurements for each section were taken in the case of exceptionally long sections to provide a better average. These parameters have been averaged both by habitat type and overall in order to provide a reference for how they correspond and relate to each habitat type. These averages can be found in **Table 3 below** and displayed in **Figure 3 on the following page.**

**Table 3: Average physical stream parameters by habitat type Kouchibouguacis River**

| Average Site Measurement Parameters | | | | | |
|---|---|---|---|---|---|
| | Depth (cm) | Wet Width (m) | Bankfull Width (m) | Bankfull Depth (cm) | Average Length (m) |
| Riffle | 24.16 | 17.63 | 24.45 | 50.68 | 58.46 |
| Run | 31.99 | 18.73 | 22.03 | 56.76 | 82.47 |
| Pool | 54.35 | 18.65 | 22.40 | 68.70 | 93.74 |
| Overall | 35.07 | 18.32 | 22.38 | 57.91 | 79.30 |

Water quality parameters and related parameters affecting water quality were also measured for each section; these include, ambient air temperature, water temperature, dissolved oxygen content of water, pH of water, water velocity (averaged from three measurements), and water conductivity. As with physical stream parameters extra measurements were taken in exceptionally long sections to provide an accurate average. These measurements were averaged by habitat type and for the sake of assessment and comparison. These averages are listed in **Table 4 on the following page.**

**Figure 3: Averaged physical stream parameters by habitat type Kouchibouguacis River**

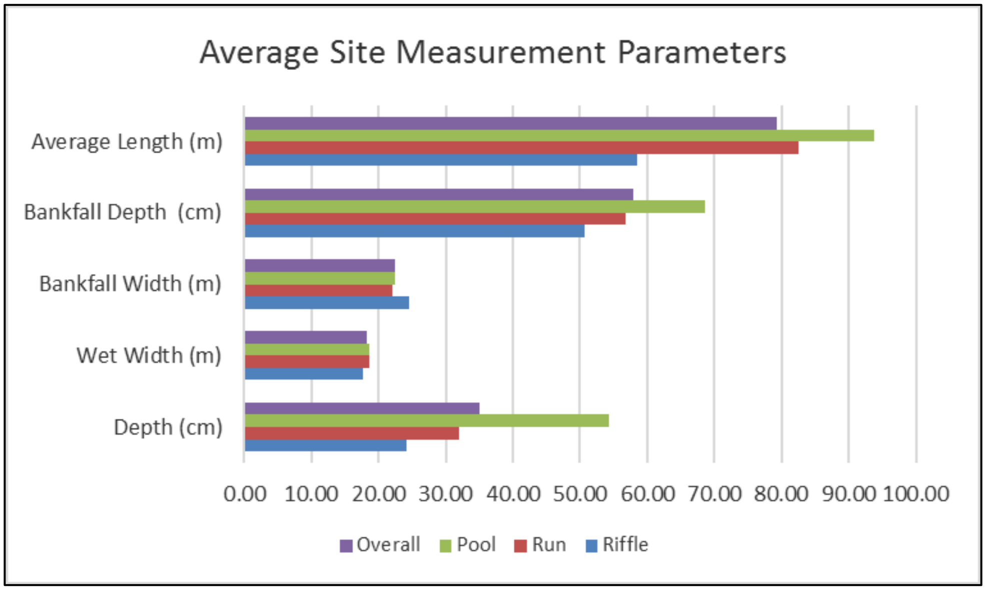



**Table 4: Averaged water quality and associated parameters by habitat Kouchibouguacis River**

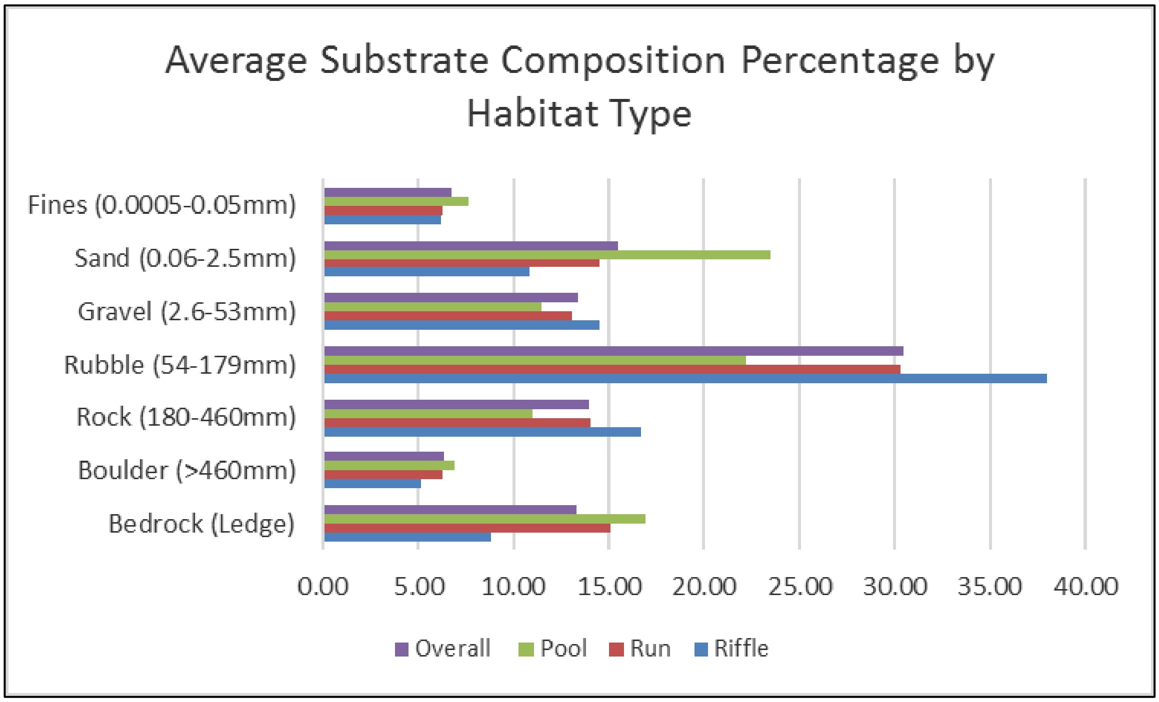
| Average Water Parameter and Associated Measurements | | | | | | |
|---|---|---|---|---|---|---|
| | Air Temp (°C) | Water Temp (°C) | Dissolved Oxygen (ppm) | pH | Velocity (m/s) | Conductivity (uS/cm) |
| Riffle | 24.71 | 22.62 | 11.21 | 7.90 | 0.394 | 63.40 |
| Run | 24.66 | 22.61 | 10.84 | 7.85 | 0.362 | 63.96 |
| Pool | 24.88 | 22.75 | 10.40 | 7.87 | 0.604 | 64.09 |
| Overall | 24.61 | 22.61 | 10.94 | 7.87 | 0.421 | 63.76 |

Substrate composition and embeddedness of substrate of each section was estimated. The average overall embeddedness of the watershed areas surveyed was approximately 29.45%. The estimated composition of each section was averaged by habitat type and overall. The averaged percentages can be found in **Table 5 below**, along with the category size specifications, and displayed in **Figure 4 on the following page**.

**Table 5: Average substrate composition percentage Kouchibouguacis River**

| Average Substrate Composition Percentage by Habitat Type | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Bedrock (Ledge) | Boulder (>460mm) | Rock (180-460mm) | Rubble (54-179mm) | Gravel (2.6-53mm) | Sand (0.06-2.5mm) | Fines (0.0005-0.05mm) |
| Riffle | 8.81 | 5.12 | 16.67 | 37.98 | 14.52 | 10.83 | 6.19 |
| Run | 15.11 | 6.31 | 14.07 | 30.34 | 13.06 | 14.55 | 6.27 |
| Pool | 16.91 | 6.91 | 10.96 | 22.23 | 11.49 | 23.51 | 7.66 |
| Overall | 13.35 | 6.33 | 14.00 | 30.43 | 13.40 | 15.49 | 6.78 |

**Figure 4: Average substrate composition percentage Kouchibouguacis River**

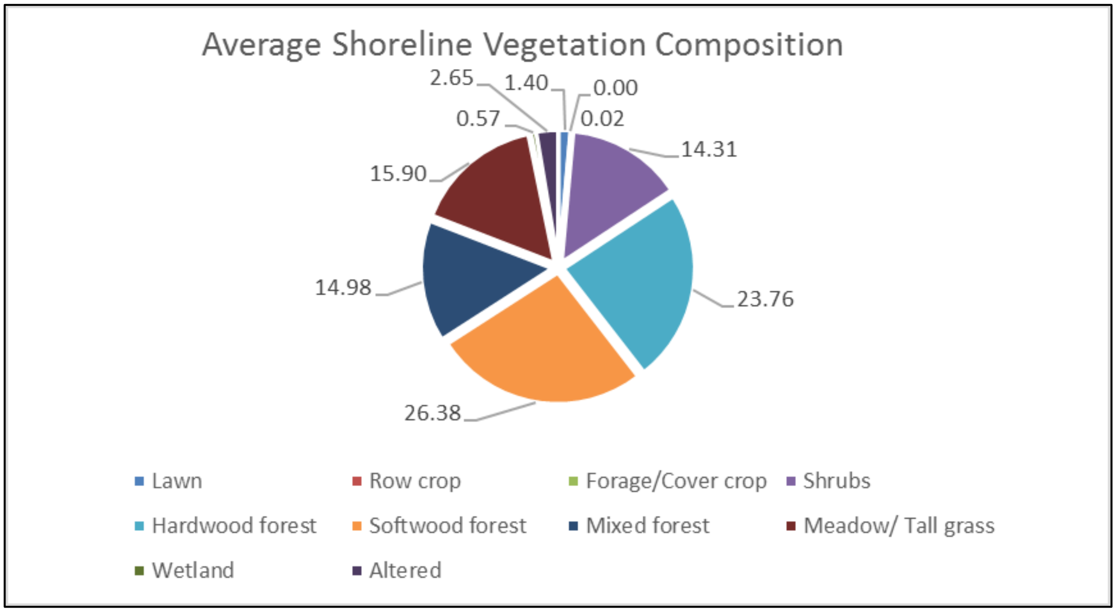



Assessments of bank stability including riparian vegetation were taken during surveying. The banks of the stream were estimated to be 88.75% stable on average along the entire surveyed section. Estimations of riparian vegetation composition can be found in **Table 6 below** and are displayed in **Figure 5 on the following page**.

**Table 6: Average riparian vegetation composition Kouchibouguacis River**

| **Average Riparian Vegetation Composition (%)** | |
|---|---|
| Lawn | 1.40 |
| Row crop | 0.00 |
| Forage/Cover crop | 0.02 |
| Shrubs | 14.31 |
| Hardwood forest | 23.76 |
| Softwood forest | 26.38 |
| Mixed forest | 14.98 |
| Meadow/ Tall grass | 15.90 |
| Wetland | 0.57 |
| Altered | 2.65 |

**Figure 5: Average riparian vegetation composition Kouchibouguacis River**




Qualities of habitat that are conductive to fish life were also measured. These include protection from predators and sunlight such as estimated percent of river covered by canopy cover, woody debris estimated by length of shelter providing debris, and estimated length of shoreline undercut capable of providing cover; as listed in **Table 7 below**. A total number of 9 cold-water inputs capable within the length of stream surveyed were identified.

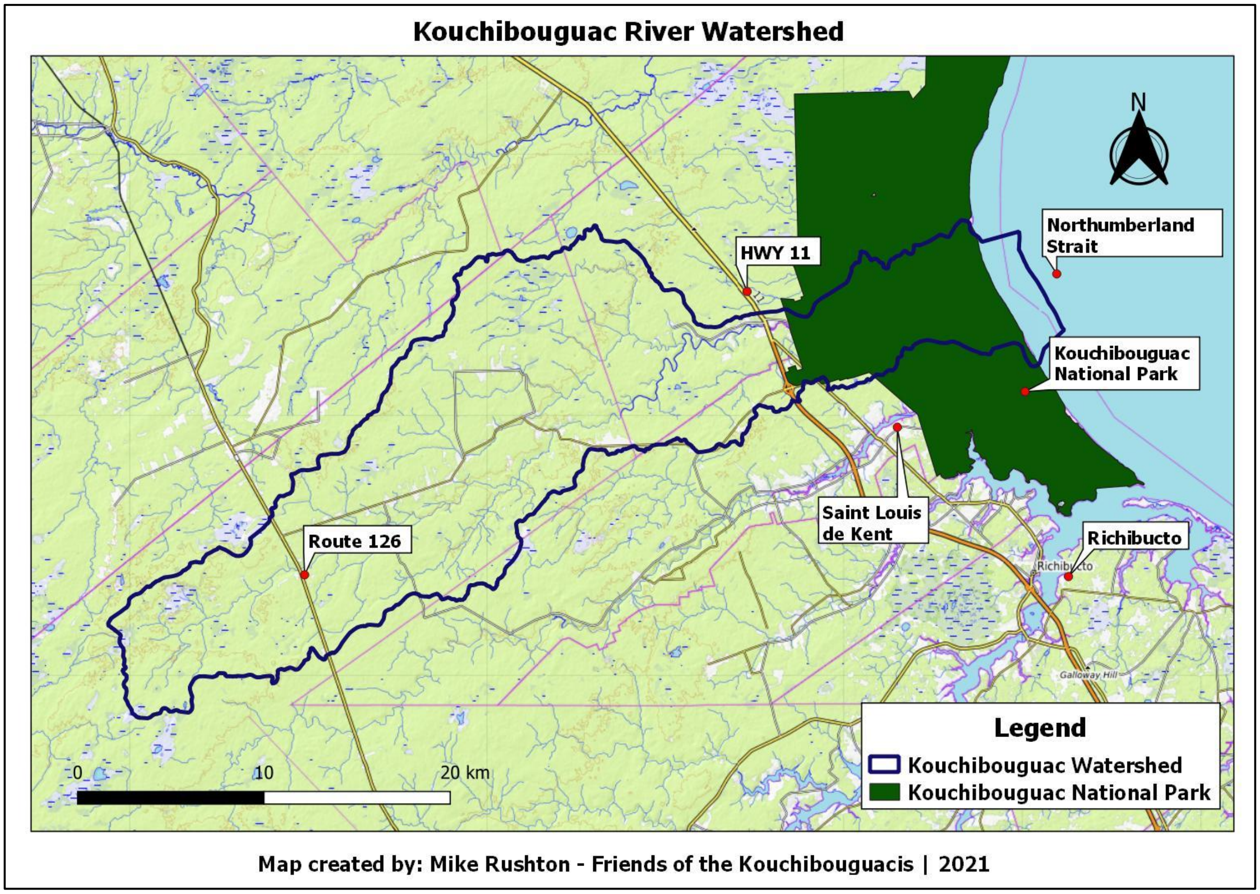
**Table 7: Canopy cover, woody debris, and total undercut – Kouchibouguacis River**

| | |
|---|---|
| Average Canopy Cover (%) | 6.88 |
| Total Woody Debris (m) | 2495.45 |
| Total Undercut (m) | 1089 |

## 2.2 Kouchibouguac Watershed

The Kouchibouguac River watershed is located in Kent County, New Brunswick and is part of the Northumberland Strait drainage system (**see figure 6 on the following page**). It covers an area of approximately 437.59 km$^2$. The watershed's water network is divided into three parts: the lagoon, estuary and river. The lagoon and estuary fall within the jurisdiction of Kouchibouguac National Park (KNP), however, TFK and KNP frequently collaborate within and outside of these boundaries. TFK's mandated management area is anywhere within the watershed – outside of the park boundaries.

**Figure 6: Map of the Kouchibouguac watershed**



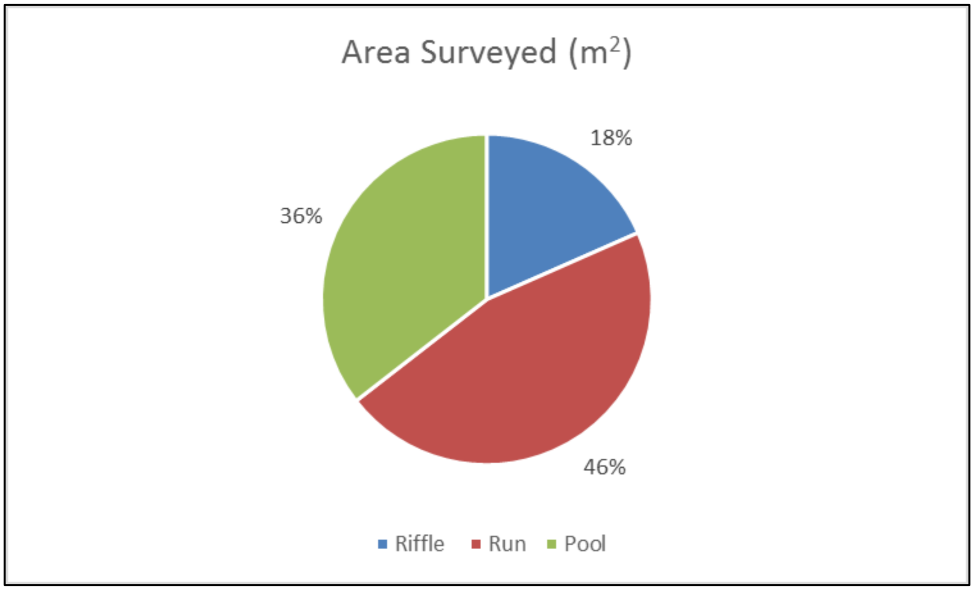

### 2.2.1 Summary of Kouchibouguac Watershed Characteristics

The following data was gathered from stream surveys conducted by TFK in the Kouchibouguac watershed (Kouchibouguac River) from 2019 to 2021, that is to date, and provides a snapshot of the conditions observed. The total linear measured length of stream surveyed in the watershed was 2,5649.4 (m). Starting at the coordinates 46.79262° X 65.05804° Y, and ending at the coordinates 46.71735° X 65.25326° Y. The total area surveyed, obtained by multiplying the wetted width of a section by said sections length and summing all sections was 492,477.80 square meters ($m^2$). This can be further broken down by area surveyed per stream habitat type (riffle, run, or pool); as listed in **Table 8 below** and displayed in **Figure 7 on the following page**. As per these charts the habitat type (e.g., run, riffle, pool) making up the largest portion of the area surveyed is runs (46%), followed by pools (36%), and then riffles (18%).

**Table 8: Kouchibouguac Area Surveyed**

| Area Surveyed (m2) | |
|---|---|
| Riffle | 88616.88 |
| Run | 221988.84 |
| Pool | 171033.79 |
| Total | 492477.80 |

**Figure 7: Area surveyed by habitat type Kouchibouguac River**

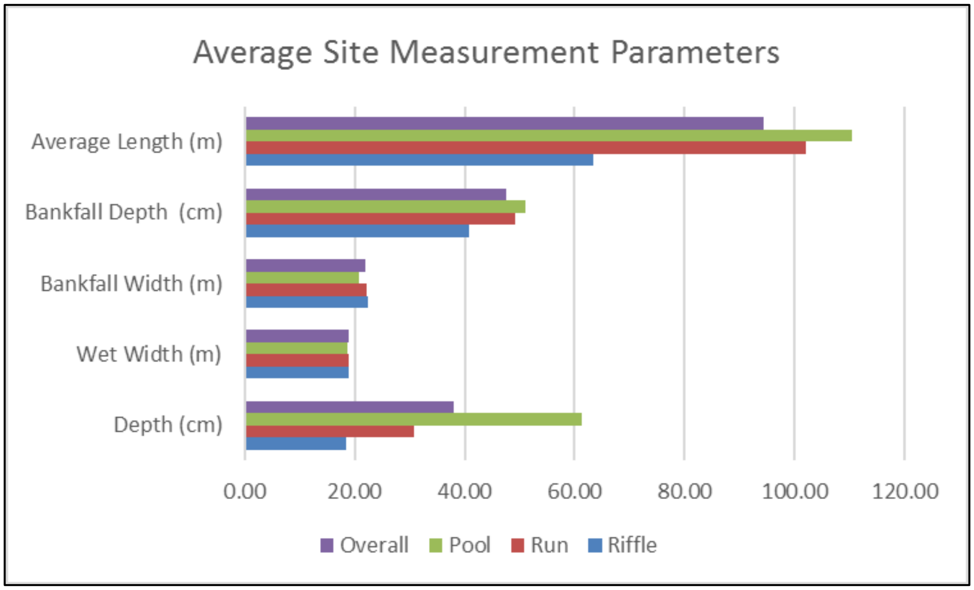



Physical parameters of each section measured include averaged stream depth (of three measurements), averaged wet width (of two measurements), bankfull width, bankfull depth, and linear length. Additional measurements for each section were taken in the case of exceptionally long sections to provide a better average. These parameters have been averaged both by habitat type and overall in order to provide a reference for how they correspond and relate to each habitat type. These averages can be found in **Table 9 below** and are displayed in **Figure 8 on the following page.**

**Table 9: Averaged physical stream parameters by habitat type Kouchibouguac River**

| Average Site Measurement Parameters | | | | | |
|---|---|---|---|---|---|
| | Depth (cm) | Wet Width (m) | Bankfull Width (m) | Bankfull Depth (cm) | Average Length (m) |
| Riffle | 18.32 | 18.94 | 22.50 | 40.70 | 63.43 |
| Run | 30.77 | 18.87 | 22.21 | 49.16 | 101.94 |
| Pool | 61.33 | 18.55 | 20.79 | 51.01 | 110.51 |
| Overall | 37.90 | 18.80 | 21.86 | 47.50 | 94.30 |

**Figure 8: Averaged physical stream parameters by habitat type Kouchibouguac River**




Water quality parameters and related parameters affecting water quality were also measured for each section; these include, ambient air temperature, water temperature, dissolved oxygen content of water, pH of water, water velocity (averaged from three measurements), and water conductivity. As with physical stream parameters extra measurements were taken in exceptionally long sections to provide an accurate average. These measurements were averaged by habitat type and for the sake of assessment and comparison. These averages are listed in **Table 10 below**.

**Table 10: Averaged water quality and associated parameters by habitat Kouchibouguac River**

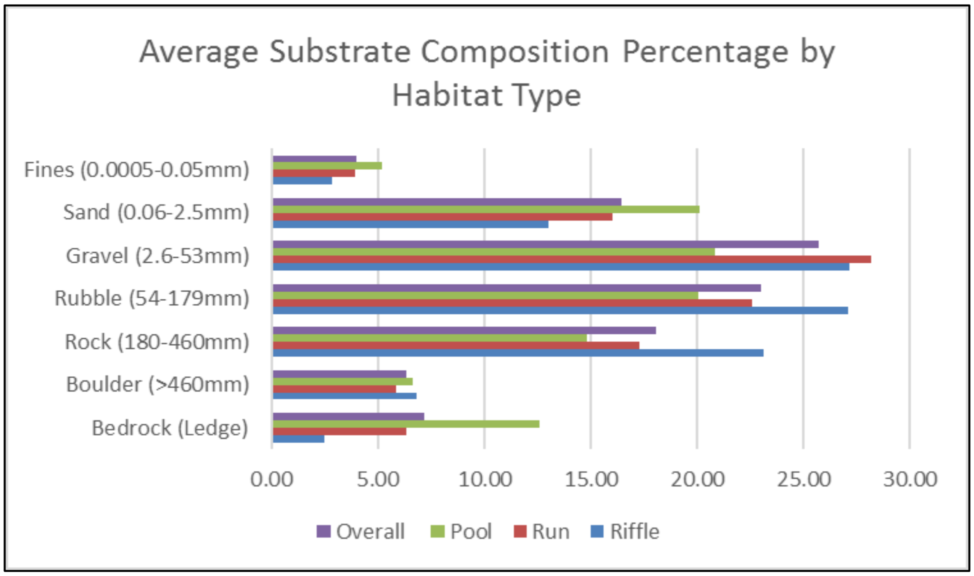
| Average Water Measurements | | | | | | |
|---|---|---|---|---|---|---|
| | **Air Temp (°C)** | **Water Temp (°C)** | **Dissolved Oxygen (ppm)** | **pH** | **Velocity (m/s)** | **Conductivity (uS/cm)** |
| Riffle | 22.38 | 18.98 | 10.21 | 7.33 | 0.849 | 70.75 |
| Run | 22.44 | 18.79 | 10.32 | 7.37 | 0.396 | 73.76 |
| Pool | 22.11 | 18.94 | 9.93 | 8.26 | 0.320 | 70.14 |
| Overall | 22.33 | 18.89 | 10.18 | 7.62 | 0.493 | 71.88 |

Substrate composition and embeddedness of substrate of each section was estimated. The average overall embeddedness of the watershed areas surveyed was approximately 19.63%. The estimated composition of each section was averaged by habitat type and overall. The averaged percentages can be found in **Table 11 on the following page**, along with the category size specifications, and displayed in **Figure 9 on the following page.**

**Table 11: Average substrate composition percentage Kouchibouguac River**

| Average Substrate Composition Percentage by Habitat Type | | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Bedrock (Ledge)** | **Boulder (>460mm)** | **Rock (180-460mm)** | **Rubble (54-179mm)** | **Gravel (2.6-53mm)** | **Sand (0.06-2.5mm)** | **Fines (0.0005-0.05mm)** |
| Riffle | 2.50 | 6.81 | 23.11 | 27.08 | 27.15 | 12.99 | 2.85 |
| Run | 6.30 | 5.84 | 17.27 | 22.56 | 28.15 | 16.01 | 3.91 |
| Pool | 12.59 | 6.60 | 14.81 | 20.06 | 20.80 | 20.12 | 5.19 |
| Overall | 7.17 | 6.32 | 18.08 | 23.01 | 25.70 | 16.43 | 4.01 |

**Figure 9: Average substrate composition percentage Kouchibouguac River**

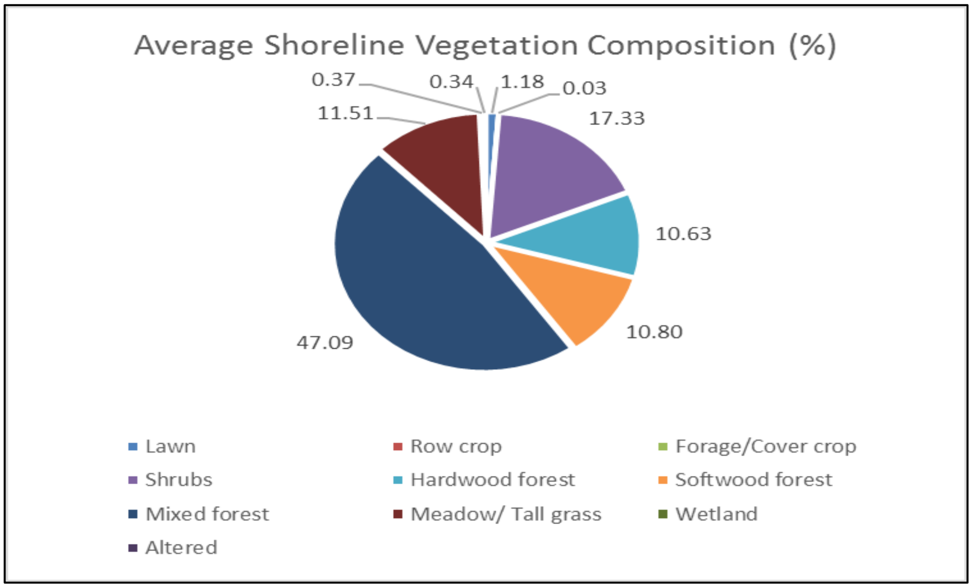



Assessments of bank stability including riparian vegetation were taken during surveying. The banks of the stream were estimated to be 92.91% stable on average along the entire surveyed section. Estimations of riparian zone vegetation composition can be found in **Table 12 below** and are displayed in **Figure 10 on the following page**.

**Table 12: Average riparian vegetation composition Kouchibouguac River**

| Average riparian Vegetation Composition (%) | |
|---|---|
| Lawn | 1.18 |
| Row crop | 0.00 |
| Forage/Cover crop | 0.03 |
| Shrubs | 17.33 |
| Hardwood forest | 10.63 |
| Softwood forest | 10.80 |
| Mixed forest | 47.09 |
| Meadow/Tall grass | 11.51 |
| Wetland | 0.37 |
| Altered | 0.34 |

**Figure 10: Average riparian line vegetation composition Kouchibouguac River**




Qualities of habitat that are favorable to fish species (e.g., Atlantic salmon, Brook trout, etc.) were also measured. These include protection from predators and sunlight such as estimated percent of river covered by canopy cover, woody debris estimated by length of shelter providing debris, and estimated length of shoreline undercut capable of providing cover; as listed in **Table 13 below**. A total number of 24 cold-water inputs capable within the length of stream surveyed were identified, with an average temperature of 9.1°C.

**Table 13: Canopy cover, woody debris, and total undercut – Kouchibouguac River**

| | |
|---|---|
| Average Canopy Cover (%) | 9.75 |
| Total Woody Debris (m) | 2199.50 |
| Total Undercut (m) | 514.50 |

## 2.3 2023 Stream Survey

TFK decided to restart their stream survey form where there originally started to be able to compare the results to see how our streams are changing over time.

In 2023, TFK conducted stream surveys and aquatic habitat inventories in order to assess indicators of ecological health and habitat potential of the aquatic environment. Areas of assessment include substrate composition and embeddedness, water quality and related measurements, riparian zone vegetation and environment composition, area surveyed by habitat composition, site parameters of each section were segmented down by habitat, stream canopy cover, bank stability, and cold-water/groundwater inputs, among many others. The method of survey consisted of identifying a given "section" by habitat type (riffle, run, or pool; distinguished by depth, velocity, and other features) and obtaining set measurements of said section; the section at ruisseau baptiste ended upon the start of a new habitat type.

In 2023 a total of approximately 245.09 meters of linear length was surveyed starting with a section identified as RB1-23, coordinate N 46.74360° W 64, 98506°, and ending with section RB6-23, coordinates N 46 ,74358° W64,98759°. a map of the area surveyed with start and end points identified can be found in **Annex A**. . Ruisseau a baptiste was evaluated via stream survey this year (2023) as part of a remediation assessment of the stream. This was determined to be appropriate to help track changes over time after the prior remediation efforts upstream.

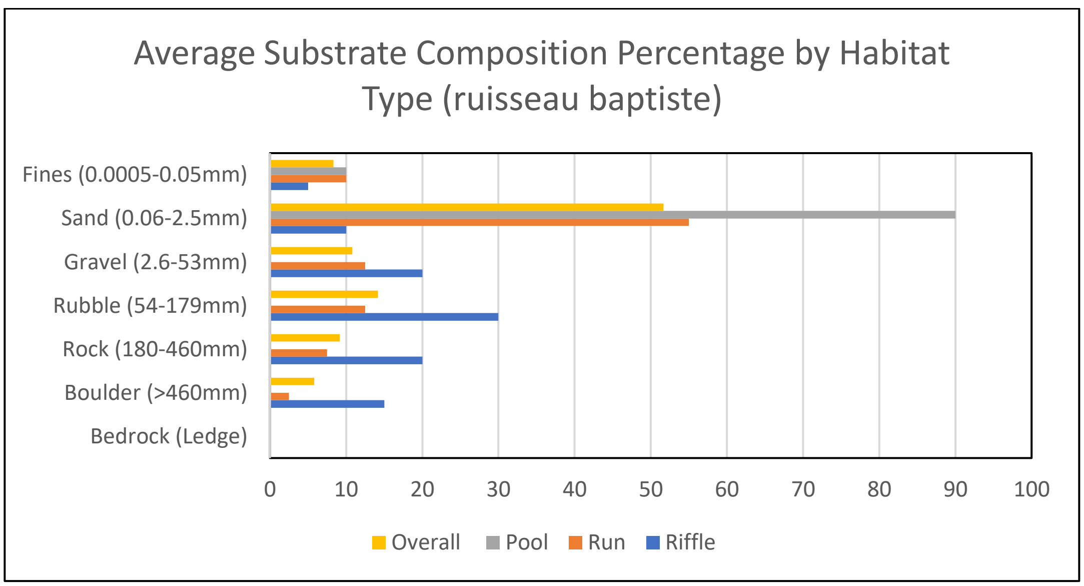
Due to the fluctuation in habitats, we only included the habitats which were no less then 90% a riffle, run or pool to the data below. This method was deemed appropriate to give a representative outlook on each habitat.

Stream substrate was assessed due to its affects on fish life, such as reproduction or shelter, and because of its ability to indicate water quality impairments. Substrate was estimated by percentage within each section and then these estimates were averaged both by habitat type and as overall, in order to give an idea of the general composition. This breakdown of substrate composition can be found in **Table 14 below** along with the corresponding size specifications, this information is then visualized in **Figure 11 below**.

**Table 14: Average substrate composition percentage by habitat type (Ruisseau Baptiste)**

| Average Substrate Composition Percentage by Habitat Type (ruisseau baptiste) | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Bedrock (Ledge) | Boulder (>460mm) | Rock (180-460mm) | Rubble (54-179mm) | Gravel (2.6-53mm) | Sand (0.06-2.5mm) | Fines (0.0005-0.05mm) |
| Riffle | 0 | 15 | 20 | 30 | 20 | 10 | 5 |
| Run | 0 | 2.5 | 7.5 | 12.5 | 12.5 | 55 | 10 |
| Pool | 0 | 0 | 0 | 0 | 0 | 90 | 10 |
| Overall | 0.00 | 5.83 | 9.17 | 14.17 | 10.83 | 51.67 | 8.33 |

**Figure 11: Average Substrate Composition Percentage by Habitat Type (Ruisseau Baptiste)**




Percent embeddedness, that is the percentage of substrate buried by fine particles, was also estimated in each section due to its implications of stream health, across all sections was an average embeddedness of 69%.

Parameters of water quality and related ambient environmental factors were also measured in order to give an assessment of ecological health. Parameters assessed include ambient air temperature, water temperature, dissolved oxygen, pH, water velocity and conductivity. These results were averaged by habitat type and as an overall value across all sections. These results and their units of measurement can be found in **Table 15 below**.

Riparian vegetation and habitat were assessed for their possible implication of stream habitat health. The percentage of each bank within each section belonging to a corresponding habitat type was estimated by percentage. These percentages when then averaged by each bank side and then along both banks in order to achieve an accurate average estimated composition of total bank length by percentage. These composition percentages can be found in **Table 16 below** and are visualized in **Figure 12 on the following page**.

**Table 15: Average Water Measurements (Ruisseau Baptiste)**

| Average Water Measurements (ruisseau baptiste) | | | | | |
|---|---|---|---|---|---|
| | Air Temp (°C) | Water Temp (°C) | Disolved Oxygen (ppm) | Velocity (m/s) | Conductvity (uS/cm) |
| Riffle | 27 | 15.2 | 12.97 | 0.2703 | 109.80 |
| Run | 29 | 14.75 | 11.555 | 0.4028 | 108.85 |
| Pool | 27.75 | 14.9 | 12.465 | 0.3604 | 109.7 |
| Overall | 27.92 | 14.95 | 12.33 | 0.3445 | 109.45 |

**Table 16: Average riparian vegetation composition**

| Average Riparian Vegetation Composition | |
|---|---|
| Lawn | 0% |
| Row crop | 0% |
| Forage/Cover crop | 0% |
| Shrubs | 39% |
| Hardwood forest | 11% |
| Softwood forest | 29% |
| Mixed forest | 0% |
| Meadow/ Tall grass | 21% |
| Wetland | 0% |
| Altered | 0% |

The total flat area of stream survey was calculated in order give an idea of area of available habitat. The total was then further broken-down by habitat, accounting for both the area of the main section and the smaller "sub habitats" found within each section. Area was calculated using the measured length of each section and multiplying that by the averaged "wetted width" of each section. The total cumulative area of each habitat type and total area surveyed can be found in **Table 17 below**, the breakdown by habitat is shown in **Figure 13 on the following page.**

**Figure 12: Average riparian vegetation Composition (Ruisseau Baptiste)**

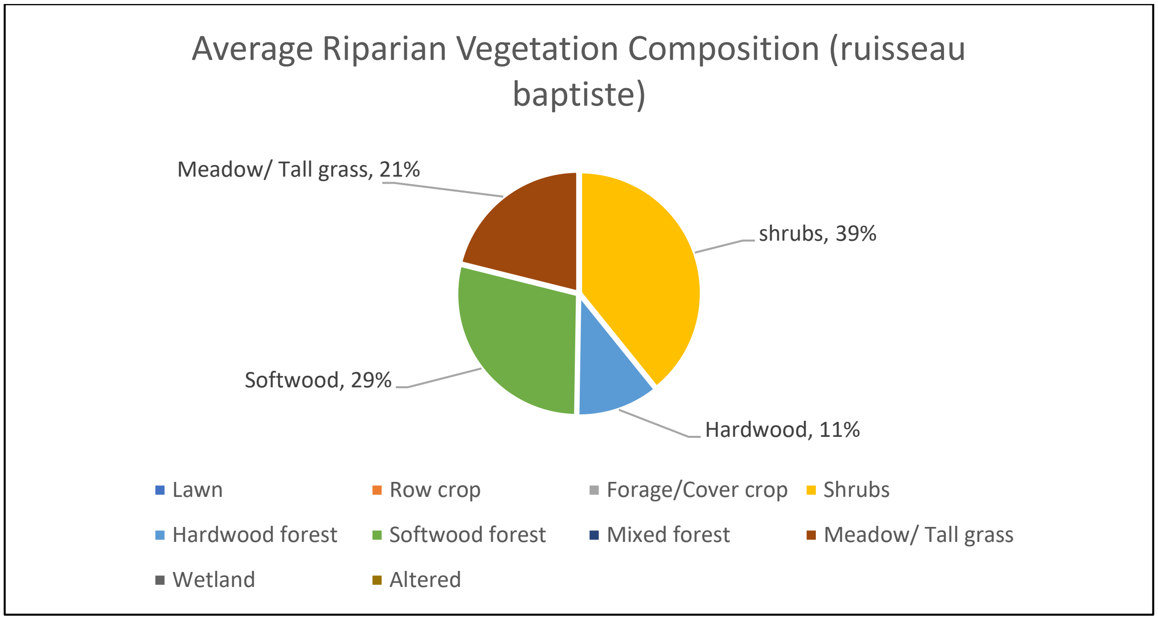
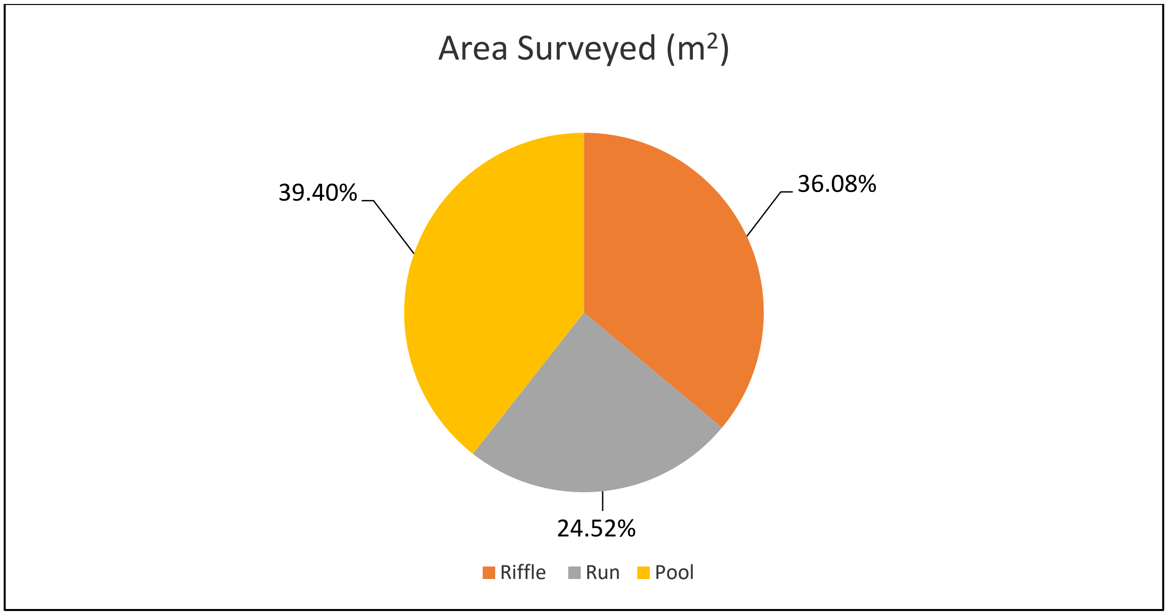



**Table 17: Area surveyed ($m^2$) (Ruisseau Baptiste)**

| Area Surveyed ($m^2$) | |
|---|---|
| Riffle | 276.55 |
| Run | 392.26 |
| Pool | 219.92 |
| Total | 888.73 |

**Figure 13: Area stream surveyed by habitat type (Ruisseau Baptiste)**



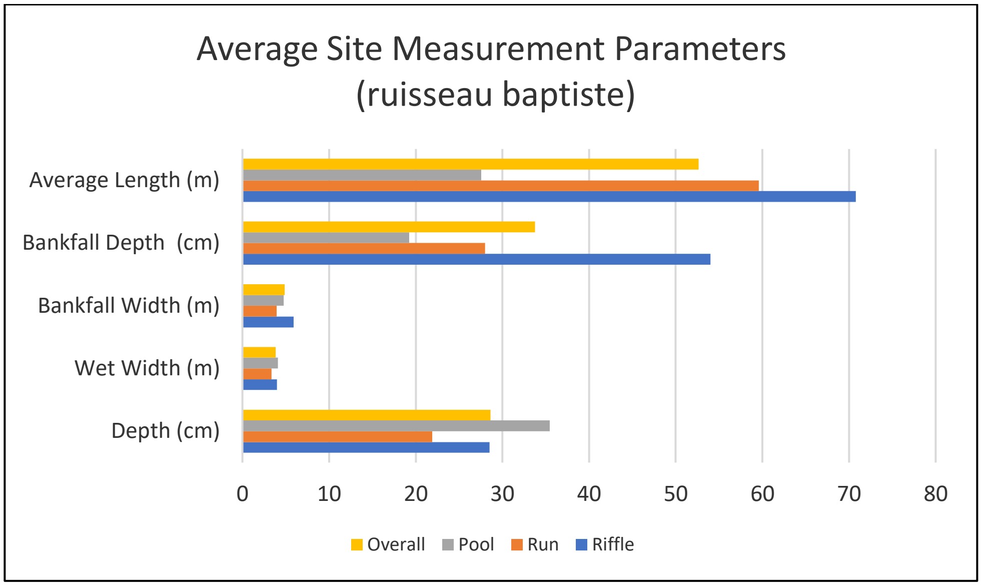

Site parameters of each stream section were measured in order to provided habitat and hydrological data. Measured parameters include average water depth, average wetted width, average bank full width, average bank full depth, and the average length of each section. These parameters were then averaged according to habitat type and as an overall value; these can be found in **Table 18 below** and visualized in **Figure 14 on the following page.**

Several other parameters relating to potential habitat and ecological health were also assessed. In terms of stream shelter an average of 47%% canopy cover, 102m woody debris, and 20m undercut was estimated across the entire section surveyed. The total bank stability, bank length free of erosion, was estimated as an average of 97% stable across the entire area surveyed.

**Table 18 : Average site measurement parameters (ruisseau baptiste)**

| Average Site Measurement Parameters (ruisseau baptiste) | | | | | |
|---|---|---|---|---|---|
| | Depth (cm) | Wet Width (m) | Bankfall Width (m) | Bankfall Depth (cm) | Average Length (m) |
| Riffle | 28.5 | 4 | 5.9 | 54 | 70.8 |
| Run | 21.9 | 3.35 | 3.95 | 28 | 59.6 |
| Pool | 35.45 | 4.1 | 4.75 | 19.25 | 27.54 |
| Overall | 28.62 | 3.82 | 4.87 | 33.75 | 52.65 |

**Figure 14 : Average site measurement parameters (ruisseau baptiste)**




The section on the Kouchibouguacis Main Branch ended upon the start of a new habitat type. In 2022 a total of approximately 2142 meters of linear length was surveyed starting with the section identified as KS1-23, coordinate N46.70135° W65.08177°, and ending with a braided section KS24-23L / KS24-23R, coordinates N46.69107° W65.09708°. a map of the area surveyed with start and end points identified can be found in **Annex A**.

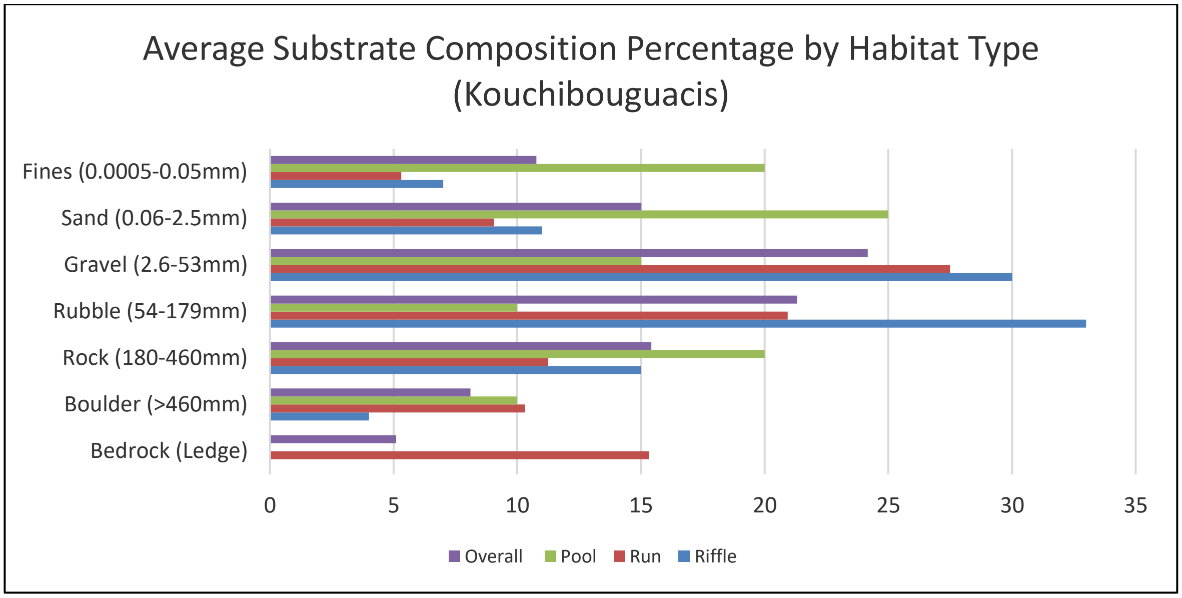
Stream substrate was assessed due to its affects on fish life, such as reproduction or shelter, and because of its ability to indicate water quality impairments. Substrate was estimated by percentage within each section and then these estimates were averaged both by habitat type and as overall, in order to give an idea of the general composition. This breakdown of substrate composition can be found in **Table 19 below** along with the corresponding size specifications, this information is then visualized in **Figure 15 on the following page.**

Percent embeddedness, that is the percentage of substrate buried by fine particles, was also estimated in each section due to its implications of stream health, across all sections was an average embeddedness of 32.24%.

**Table 19 : Average substrate composition percentage by habitat type (Kouchibouguacis)**

| Average Substrate Composition Percentage by Habitat Type (Kouchibouguacis) | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Bedrock (Ledge) | Boulder (>460mm) | Rock (180-460mm) | Rubble (54-179mm) | Gravel (2.6-53mm) | Sand (0.06-2.5mm) | Fines (0.0005-0.05mm) |
| Riffle | 0 | 4 | 15 | 33 | 30 | 11 | 7 |
| Run | 15 | 10 | 11 | 21 | 28 | 9 | 5 |
| Pool | 0 | 10 | 20 | 10 | 15 | 25 | 20 |
| Overall | 5.10 | 8.10 | 15.42 | 21.31 | 24.17 | 15.02 | 10.77 |

**Figure 15 : Average Substrate Composition Percentage by Habitat Type (Kouchibouguacis)**




Parameters of water quality and related ambient environmental factors were also measured in order to give an assessment of ecological health. Parameters assessed include ambient air temperature, water temperature, dissolved oxygen, pH, water velocity and conductivity. These results were averaged by habitat type and as an overall value across all sections. These results and their units of measurement can be found in **Table 20 on the below.**

**Table 20 : Average Water Measurements (Kouchibouguacis)**

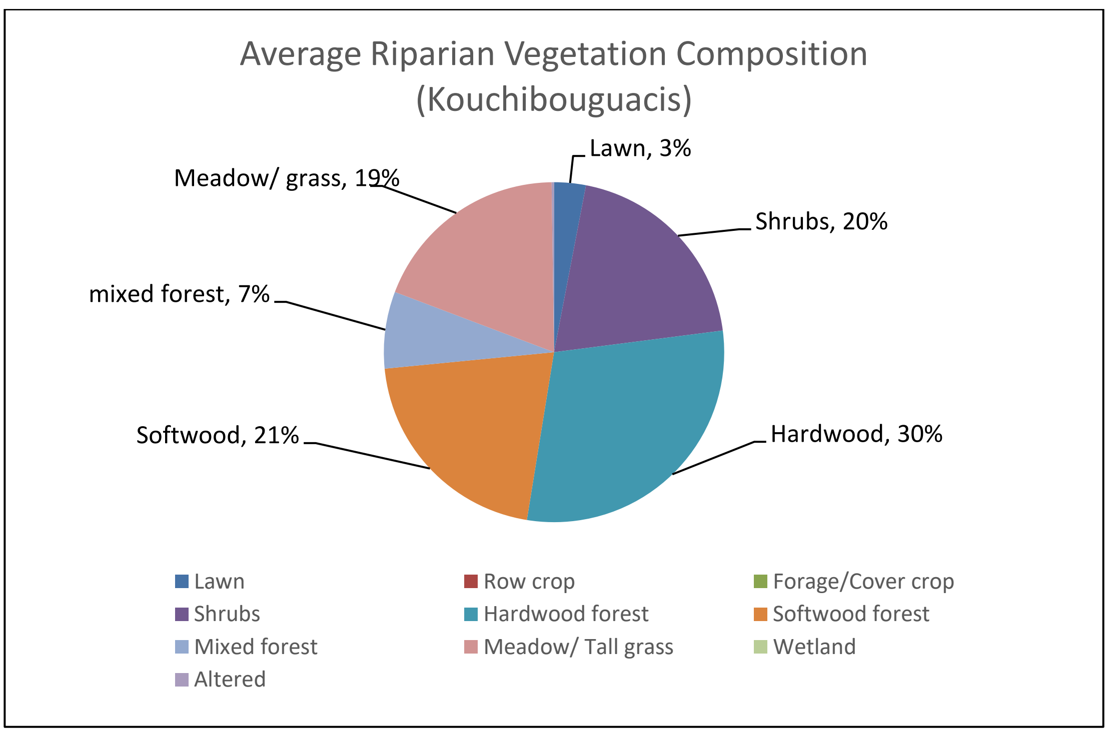
| Average Water Measurements (Kouchibouguacis) | | | | | |
|---|---|---|---|---|---|
| | Air Temp (°C) | Water Temp (°C) | Disolved Oxygen (ppm) | Velocity (m/s) | Conductvity (uS/cm) |
| Riffle | 29.4 | 22.9 | 162.32 | 0.565 | 56.34 |
| Run | 27.47 | 22.28 | 62.79 | 0.3691 | 46.32 |
| Pool | 25.4 | 21.5 | 11.36 | 0.1205 | 37 |
| Overall | 27.42 | 22.23 | 78.82 | 0.35 | 46.55 |

Riparian vegetation and habitat were assessed for their possible implication of stream habitat health. The percentage of each shore within each section belonging to a corresponding habitat type was estimated by percentage. These percentages when then averaged by each bank side and then along both banks in order to achieve an accurate average estimated composition of total shore length by percentage. These composition percentages can be found in **Table 21** and are visualized in **Figure 13 on the following page.**

**Table 21 : Average riparian vegetation composition (%)**

| Average Shoreline Vegetation Composition | |
|---|---|
| Lawn | 3% |
| Row crop | 0% |
| Forage/Cover crop | 0% |
| Shrubs | 20% |
| Hardwood forest | 30% |
| Softwood forest | 21% |
| Mixed forest | 7% |
| Meadow/ Tall grass | 19% |
| Wetland | 0% |
| Altered | 0% |

**Figure 16 : Average riparian vegetation Composition (Kouchibouguacis)**

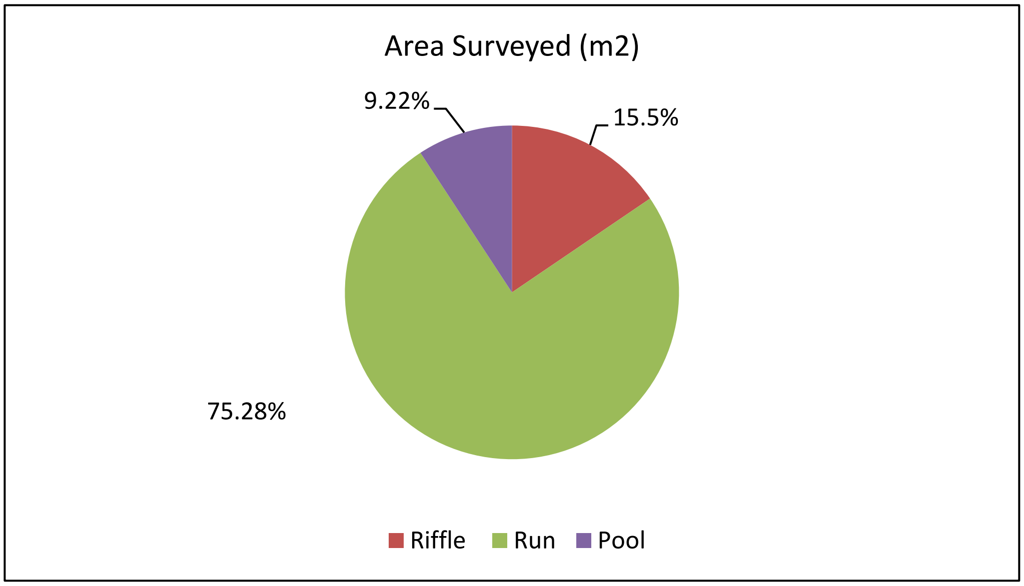


The total flat area of stream survey was calculated in order give an idea of area of available habitat. The total was then further broken-down by habitat, accounting for both the area of the main section and the smaller "sub habitats" found within each section. Area was calculated using the measured length of each section and multiplying that by the averaged "wetted width" of each section. The total cumulative area of each habitat type and total area surveyed can be found in **Table 22 below,** the breakdown by habitat is visualized in **Figure 17 on below**.

**Table 22 : Area surveyed (m²) (Kouchibouguacis)**

| Area Surveyed ($m^2$) | |
|---|---|
| Riffle | 6558.65 |
| Run | 31870.03 |
| Pool | 3905.59 |
| Total | 42334.27 |

**Figure 17 : Area surveyed (m²) (Kouchibouguacis)**



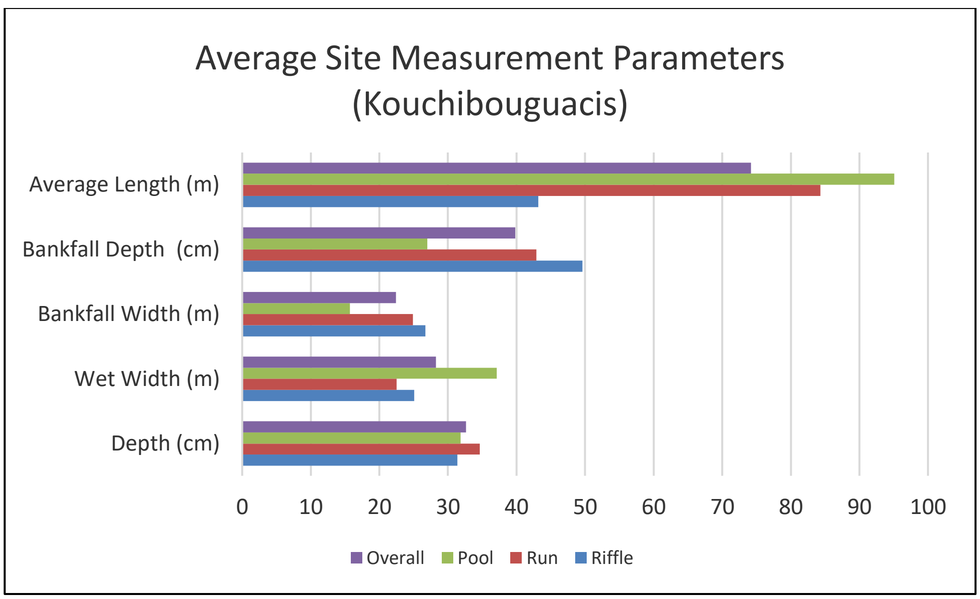

Site parameters of each stream section were measured in order to provided habitat and hydrological data. Measured parameters include average water depth, average wetted width, average bankfull width, average bankfull depth, and the average length of each section. These parameters were then averaged according to habitat type and as an overall value; these can be found in **Table 23** and visualized in **Figure 18 on the following page.**

**Table 23 : Average site measurement parameters (Kouchibouguacis)**

| Average Site Measurement Parameters (Kouchibouguacis) | | | | | |
|---|---|---|---|---|---|
| | Depth (cm) | Wet Width (m) | Bankfull Width (m) | Bankfull Depth (cm) | Average Length (m) |
| Riffle | 31.39 | 25.10 | 26.7 | 49.6 | 43.17 |
| Run | 34.65 | 22.53 | 24.89 | 42.91 | 84.29 |
| Pool | 31.83 | 37.13 | 15.7 | 27 | 95.1 |
| Overall | 32.62 | 28.25 | 22.43 | 39.84 | 74.19 |

Several other parameters relating to potential habitat and ecological health were also assessed. In terms of stream shelter an average of 13.62% canopy cover, 260.4m woody debris, and 131.6m undercut was estimated across the entire section surveyed. The total bank stability, bank length free of erosion, was estimated as an average of 91.29% stable across the entire area surveyed. A total of seven ground water inputs, which have the potential to create thermal refuges for fish, and were found to have an average temperature of 13°C.

**Figure 18 : Average site measurement parameters (Kouchibouguacis)**



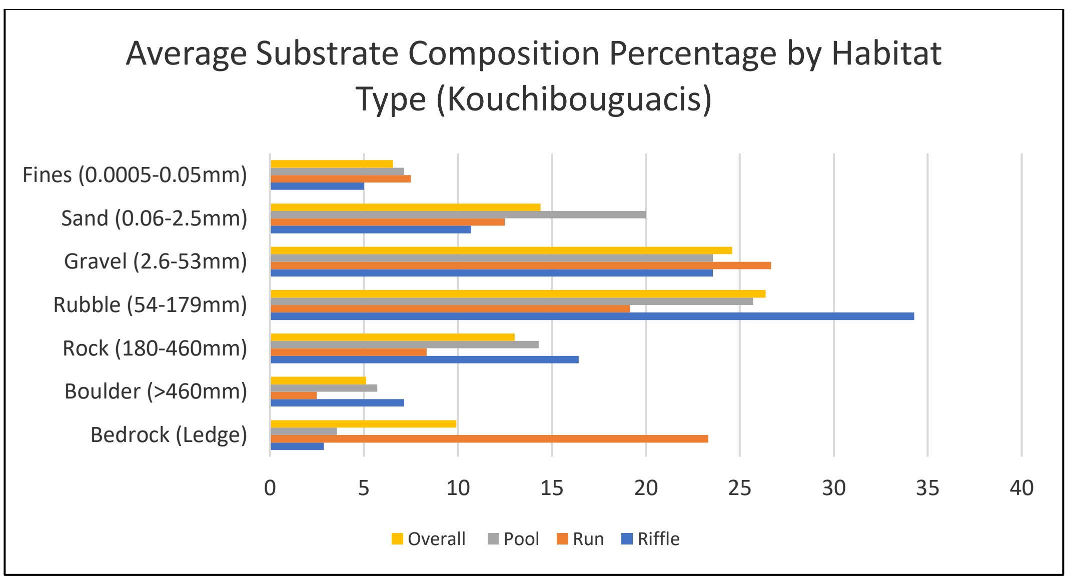

The section on the Kouchibouguac Main Branch ended upon the start of a new habitat type. In 2023 a total of approximately 1842 meters of linear length was surveyed starting with the section identified as KR1-23, coordinate N46.74313° W65.20407°, and ending with the section KR23-23, coordinates N46.73206° W65.21243°. a map of the area surveyed with start and end points identified can be found in **Annex A**. Stream substrate was assessed due to its affects on fish life, such as reproduction or shelter, and because of its ability to indicate water quality impairments. Substrate was estimated by percentage within each section and then these estimates were averaged both by habitat type and as overall, in order to give an idea of the general composition. This breakdown of substrate composition can be found in **Table 24 below** along with the corresponding size specifications, this information is then visualized in **Figure 19 below.**

**Table 24: Average substrate composition percentage by habitat type (Kouchibouguacis)**

| Average Substrate Composition Percentage by Habitat Type (Kouchibouguac) | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Bedrock (Ledge) | Boulder (>460mm) | Rock (180-460mm) | Rubble (54-179mm) | Gravel (2.6-53mm) | Sand (0.06-2.5mm) | Fines (0.0005-0.05mm) |
| Riffle | 3 | 7 | 16 | 34 | 24 | 11 | 5 |
| Run | 23 | 3 | 8 | 19 | 27 | 13 | 8 |
| Pool | 4 | 6 | 14 | 26 | 24 | 20 | 7 |
| Overall | 10 | 5 | 13 | 26 | 25 | 14 | 7 |

Percent embeddedness, that is the percentage of substrate buried by fine particles, was also estimated in each section due to its implications of stream health, across all sections was an average embeddedness of 28.91%.

**Figure 19 : Average Substrate Composition Percentage by Habitat Type (Kouchibouguacis)**




Parameters of water quality and related ambient environmental factors were also measured in order to give an assessment of ecological health. Parameters assessed include ambient air temperature, water temperature, dissolved oxygen, pH, water velocity and conductivity. These results were averaged by habitat type and as an overall value across all sections. These results and their units of measurement can be found in **Table 25 below.**

**Table 25 : Average Water Measurements (Kouchibouguac)**

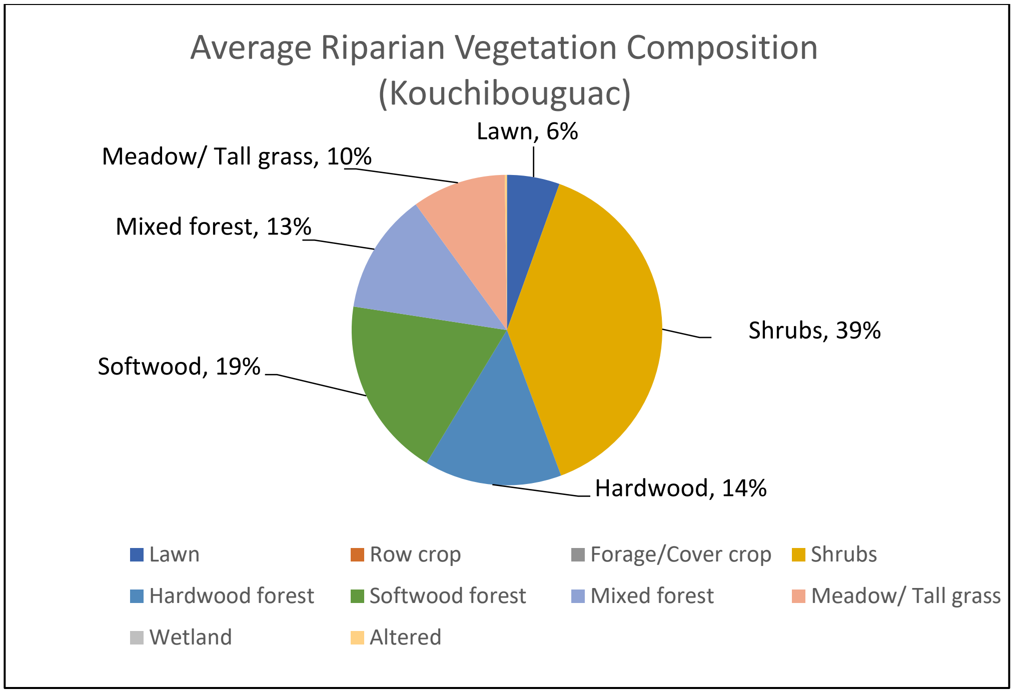
| Average Water Measurements (Kouchibouguac) | | | | | |
|---|---|---|---|---|---|
| | Air Temp (°C) | Water Temp (°C) | Disolved Oxygen (ppm) | Velocity (m/s) | Conductvity (uS/cm) |
| Riffle | 23.20 | 16.77 | 11.61 | 0.4499 | 41.69 |
| Run | 23.18 | 16.63 | 11.59 | 0.4469 | 41.38 |
| Pool | 23.05 | 16.74 | 11.64 | 0.4211 | 42.55 |
| Overall | 23.14 | 16.71 | 11.61 | 0.4393 | 41.87 |

Riparian vegetation and habitat were assessed for their possible implication of stream habitat health. The percentage of each shore within each section belonging to a corresponding habitat type was estimated by percentage. These percentages when then averaged by each bank side and then along both banks in order to achieve an accurate average estimated composition of total shore length by percentage. These composition percentages can be found in **Table 26 below** and are visualized in **Figure 20 on the following page.**

**Table 26 : Average riparian vegetation composition (Kouchibouguac)**

| Average Shoreline Vegetation Composition (%) | |
|---|---|
| Lawn | 6% |
| Row crop | 0% |
| Forage/Cover crop | 0% |
| Shrubs | 39% |
| Hardwood forest | 14% |
| Softwood forest | 19% |
| Mixed forest | 13% |
| Meadow/ Tall grass | 10% |
| Wetland | 0% |
| Altered | 0% |

**Figure 20 : Average riparian vegetation composition (Kouchibouguac)**

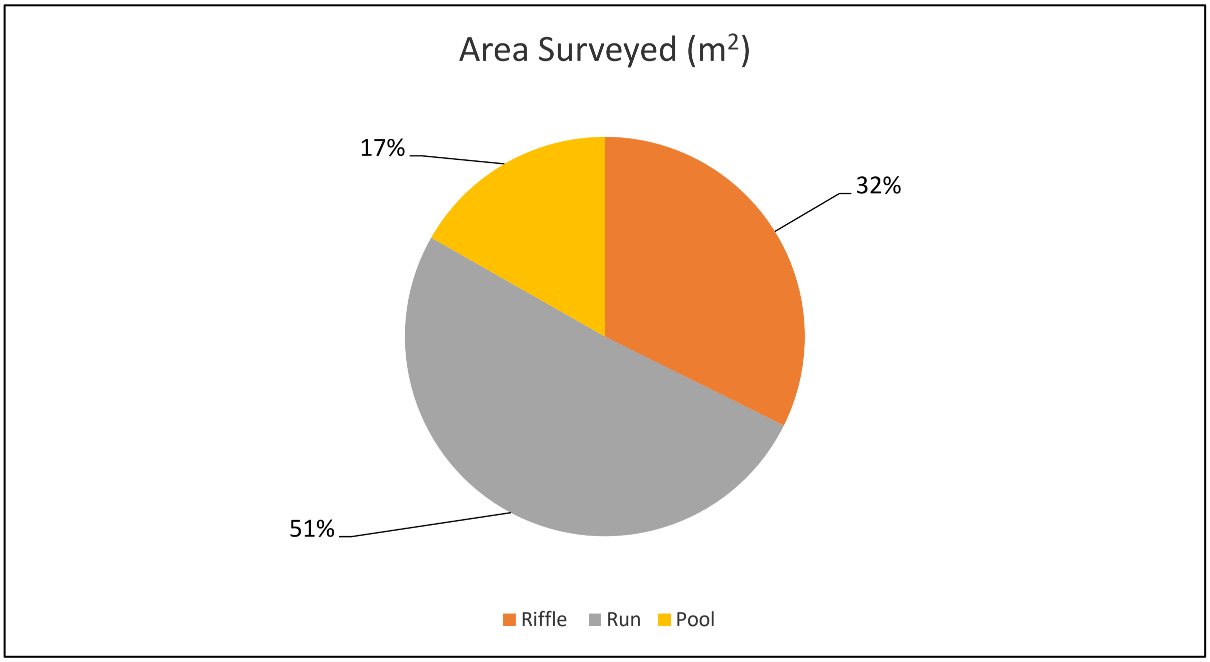



The total flat area of stream survey was calculated in order give an idea of area of available habitat. The total was then further broken-down by habitat, accounting for both the area of the main section and the smaller "sub habitats" found within each section. Area was calculated using the measured length of each section and multiplying that by the averaged "wetted width" of each section. The total cumulative area of each habitat type and total area surveyed can be found in **Table 27 below** and the breakdown by habitat is visualized in **Figure 21 on the following page**.

**Table 27 : Area surveyed (m$^2$) (Kouchibouguac)**

| Area Surveyed (m$^2$) | |
|---|---|
| Riffle | 9157.15 |
| Run | 14396.52 |
| Pool | 4741.66 |
| Total | 28295.33 |

**Figure 21 : Area surveyed (m$^2$) (Kouchibouguac)**



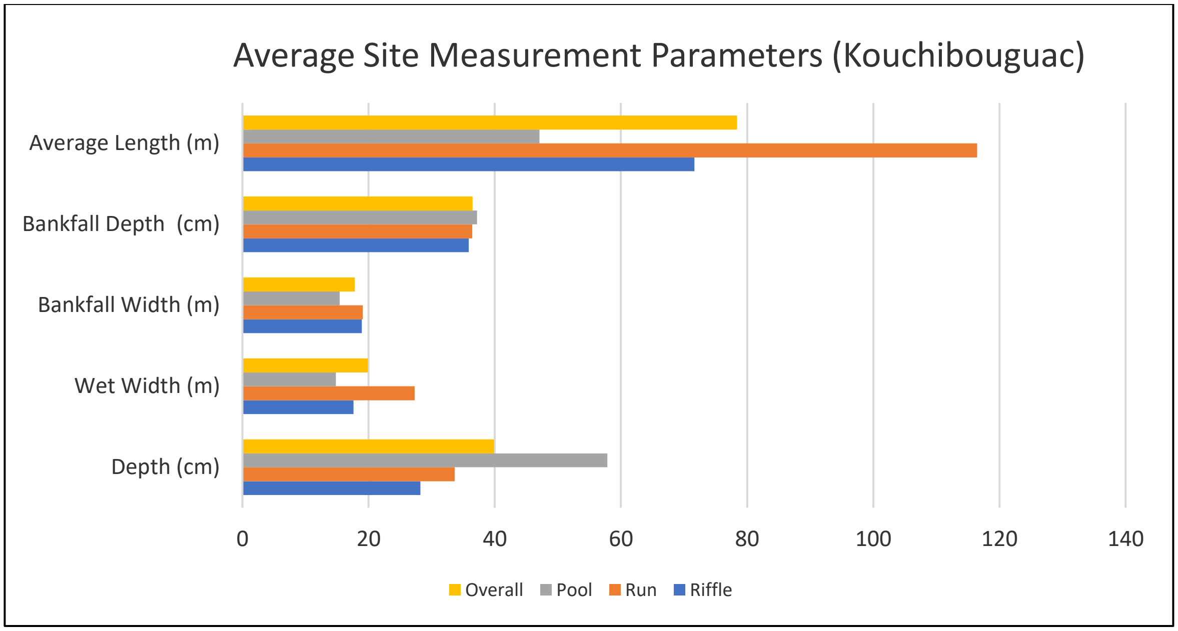

Site parameters of each stream section were measured in order to provided habitat and hydrological data. Measured parameters include average water depth, average wetted width, average bankfull width, average bankfull depth, and the average length of each section. These parameters were then averaged according to habitat type and as an overall value; these can be found in **Table 28 below** and visualized in **Figure 22 on the following page.**

**Table 28 : Average site measurement parameters (Kouchibouguac)**

| Average Site Measurement Parameters (Kouchibouguac) | | | | | |
|---|---|---|---|---|---|
| | Depth (cm) | Wet Width (m) | Bankfall Width (m) | Bankfall Depth (cm) | Average Length (m) |
| Riffle | 28.21 | 17.59 | 18.94 | 35.86 | 71.67 |
| Run | 33.62 | 27.31 | 19.1 | 36.41 | 116.45 |
| Pool | 57.86 | 14.82 | 15.4 | 37.17 | 47.11 |
| Overall | 39.90 | 19.91 | 17.81 | 36.48 | 78.41 |

Several other parameters relating to potential habitat and ecological health were also assessed. In terms of stream shelter an average of 14% canopy cover, 456.8m woody debris, and 121m undercut was estimated across the entire section surveyed. The total bank stability, bank length free of erosion, was estimated as an average of 89.46% stable across the entire area surveyed. A total of eight ground water inputs, which have the potential to create thermal refuges for fish, and were found to have an average temperature of 11.45°C.

**Figure 22 : Average site measurement parameters (Kouchibouguacis)**




# 3.0 Environmental Monitoring Conducted by Kouchibouguac National Park

Monitoring of environmental health, indicators, and existing issues has been conducted by Kouchibouguac National Park staff for some years. This data has been gathered mostly within the boundaries of the park but also from the surrounding area in some cases. The data gathered relevant to this document includes water quality, potential salmon thermal stress, invasive plant species, and Canadian Aquatic Biomonitoring Network (CABIN) assessments.

Water quality measurements were sampled in the Tweedie Brook, Black River, Rankin Brook, and Portage River tributaries of the Kouchibouguac River; as well as the Kouchibouguacis River (referred to as Saint Ignace River in KNP databanks). These tributaries were sample once a month and assessed for air temperature, water temperature, dissolved oxygen (MG/L, %, PPM) (**found in Table 29 below**), specific conductivity, conductivity, salinity, Ph, width, mean depth (**found in Table 30 on the following page**), superficial velocity, flow rate, Phosphorus total, total Nitrogen, and Nitrates (**found in Table 31 on the following page**). The mean average of each parameter at each site across all time monitored was found and an overall average across all site was also calculated. The span of years during which each site was tested are listed in **Table 32 on the following page**.

**Table 29: Water quality sampling of major tributaries part 1**

| Name of Tributary | Air Temperature (°C) | Water Temperature (°C) | Dissolved Oxygen (MG/L) | Dissolved Oxygen (%) | Dissolved Oxygen (PPM) |
|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| Kouchibouguacis River | 20.08 | 16.82 | 10.73 | 106.88 | 9.95 |
| Tweedie Brook | 19.71 | 13.17 | 10.81 | 100.63 | 9.02 |
| Black River | 17.08 | 13.34 | 10.74 | 100.12 | 9.22 |
| Rankin Brook | 17.49 | 14.02 | 9.92 | 92.62 | 8.13 |
| Portage River | 16.74 | 13.96 | 9.74 | 91.96 | 55.61 |
| Overall | 18.18 | 14.25 | 10.39 | 98.46 | 24.89 |

**Table 30: Water quality sampling of major tributaries part 2**

| Name of Tributary | Specific Conductivity (µS/CM) | Conductivity (µS/CM) | Salinity (PPM) | Ph | Width (m) | Mean Depth (cm) |
|---|---|---|---|---|---|---|
| Kouchibouguacis River | 54.36 | 62.80 | 0.03 | 7.23 | 29.29 | 27.11 |
| Tweedie Brook | 68.98 | 74.44 | 0.04 | 7.08 | 7.78 | 30.58 |
| Black River | 74.73 | 84.53 | 0.04 | 7.00 | 9.21 | 24.04 |
| Rankin Brook | 62.13 | 76.62 | 0.04 | 6.88 | 7.96 | 24.68 |
| Portage River | 41.92 | 45.61 | 0.02 | 6.17 | 10.95 | 22.77 |
| Overall | 60.41 | 68.83 | 0.03 | 6.87 | 13.00 | 25.83 |

**Table 31: Water quality sampling of major tributaries part 3**

| Name of Tributary | Superficial Velocity (M/S) | Flow Rate ($M^3/S$) | Phosphorus Total (MG/L) | Total Nitrogen (MG/L) | Nitrate (MG/L) |
|---|---|---|---|---|---|
| Kouchibouguacis River | 0.41 | 2.97 | 0.01 | 0.22 | 0.02 |
| Tweedie Brook | 0.35 | 0.75 | 0.01 | 0.23 | 0.04 |
| Black River | 0.32 | 0.66 | 0.02 | 0.20 | 0.03 |
| Rankin Brook | 0.33 | 0.57 | 0.02 | 0.28 | 0.03 |
| Portage River | 0.42 | 0.81 | 0.03 | 0.34 | 0.03 |
| Overall | 0.37 | 1.16 | 0.02 | 0.26 | 0.03 |

**Table 32: Water quality sampling of major tributaries years sampled**

| Name of Tributary | Kouchibouguacis River | Tweedie Brook | Black River | Rankin Brook | Portage River | Overall |
|---|---|---|---|---|---|---|
| Date Range | 1996 to 2019 | 1997 to 2019 | 1996 to 2019 | 1996 to 2019 | 1996 to 2019 | 1996 to 2019 |

Days of potential thermal stress were measured in terms of hot days and consecutive hot days. A “hot day” is a day when daily minimum water temperature equals or exceeds 20 degrees Celsius; this temperature was chosen as it is the thermal tolerance of Atlantic Salmon, one of the most thermally sensitive fish species. Extended times exceeding this tolerance can lead to deteriorating health and eventually death, provided some thermal refuge is not found. “Consecutive hot days” are periods of over 48 hours where daily minimum water temperature equals or exceeds 20 degrees Celsius.

Sites were sampled hourly via data logger from late spring to early fall on the Kouchibouguacis River **(see Figure 23 and Figure 24 below**), the Kouchibouguac River was not sampled for unspecified reasons.

**Figure 23: Kouchibouguacis river - periods of consecutive hot days**

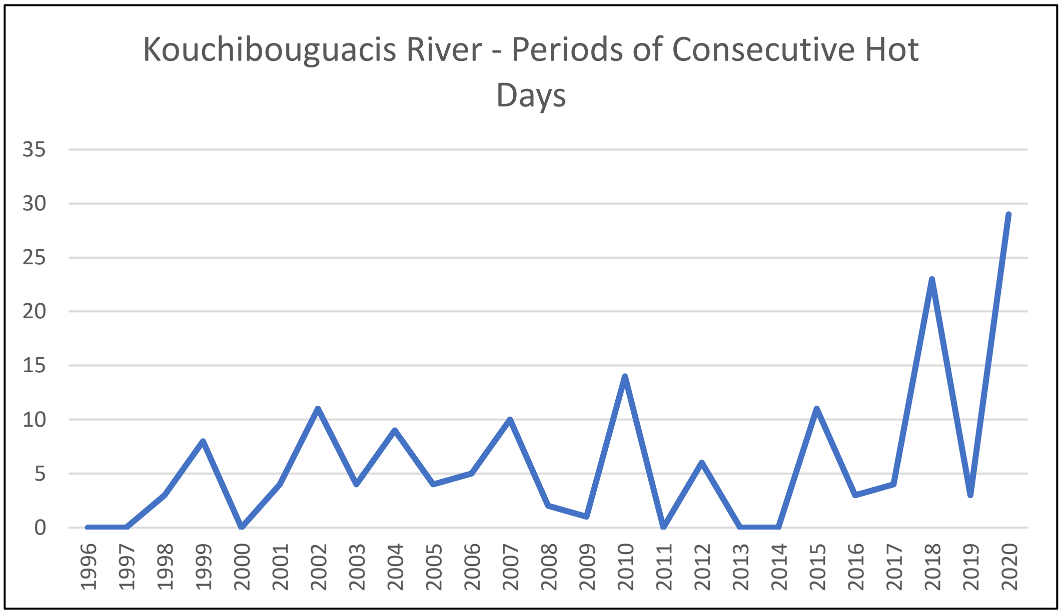
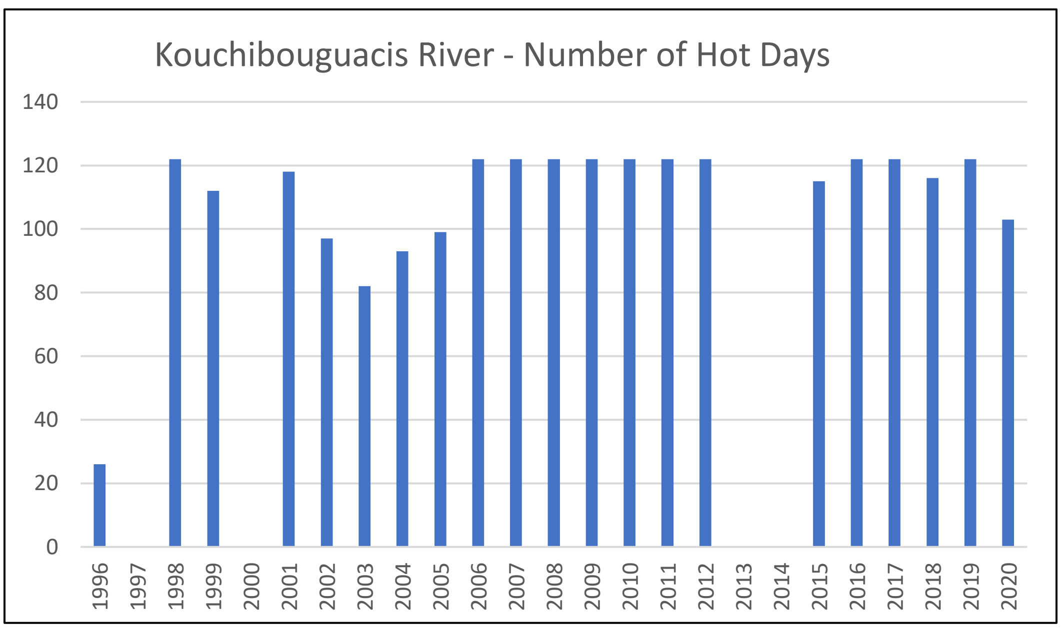



**Figure 24: Kouchibouguacis river - number of hot days**




Monitoring of benthic invertebrates, following the CABIN protocol has been conducted in the Kouchibouguac and Kouchibouguacis for the purposes of ecological assessment within the aquatic ecosystem. Depending on number of and abundances of species found scores are rated in three categories; over time changes in these scores can indicate ecosystem deterioration through reductions in total taxa richness, EPT index (i.e., pollution-sensitive taxa richness), or an increase in the Hilsenhoff Biotic Index (HBI) for organic pollution. The range of data collected for the Kouchibouguacis can be found in **Table 33 below**, while the corresponding data for the Kouchibouguac can also be found in **Table 34 below**.

**Table 33: CABIN results Kouchibouguacis**

| CABIN - Kouchibouguacis | | | |
|---|---|---|---|
| YEAR | TAXA RICHNESS | EPT RICHNESS INDEX | HILSENHOFF BIOTIC INDEX (HBI) |
| 2008 | 29.3 | 17.3 | 3.13 |
| 2009 | 28 | 17 | 2.97 |
| 2010 | 31.7 | 17.3 | 3.22 |
| 2011 | 25 | 14 | 4.47 |
| 2012 | 26.3 | 16 | 3.42 |
| 2013 | 27 | 15 | 4.12 |
| 2014 | 26 | 16 | 3.58 |
| 2015 | 30 | 16 | 3.89 |
| 2016 | 28.3 | 17 | 3.14 |
| 2017 | 31 | 17 | 3.59 |
| 2018 | 31.7 | 20 | 3.65 |
| 2019 | 36 | 20 | 3.88 |

**Table 34: CABIN results Kouchibouguac**

| CABIN - Kouchibouguac | | | |
|---|---|---|---|
| YEAR | TAXA RICHNESS | EPT RICHNESS INDEX | HILSENHOFF BIOTIC INDEX (HBI) |
| 2008 | 32 | 20 | 2.89 |
| 2009 | 25.3 | 12.66 | 2.68 |
| 2010 | 32 | 18 | 2.71 |
| 2014 | 26 | 15 | 3.29 |
| 2015 | 30.3 | 16.67 | 2.75 |
| 2016 | 26 | 17 | 3.34 |
| 2017 | 29 | 16.67 | 3.45 |
| 2018 | 31 | 19 | 3.67 |
| 2019 | 29 | 17.3 | 2.91 |

The area within and to some extent surrounding Kouchibouguac National Park is monitored for invasive plant species. Attempts at management of these species are typically made wherever possible. The encroachment of these invasive species presents a threat to the biological diversity and ecological integrating of the area's ecosystems, including aquatic ecosystems. These invasive plants have been identified, given: a priority ranking (1 is the highest priority rating), an invasion potential rating, had their distribution and abundance noted, and have been given an eradication feasibility estimate; all of this information can be found **in Table 35 on the following page**.

**Table 35: Invasive plant species overview**

| Species | PRIORITY RANK | INVASION POTENTIAL | DISTRIBUTION AND ABUNDANCE NOTES | ERADICATION FEASIBILITY |
|---|---|---|---|---|
| Common or Lesser Burdock | 3 | Moderate | Uncommon | Moderate |
| Manitoba Maple; Box Elder | 2 | Moderate-High | Rare | High |
| Norway Maple | 2 | Moderate-High | Rare | High |
| Beach Wormwood; Dusty Miller | 4 | Low - Moderate | Locally common and widespread in coastal areas | Infeasible |
| Smooth Brome | 4 | Low-Moderate | Common and widespread | Infeasible |
| Creeping or Canada Thistle | 4 | Low-Moderate | Common and widespread | Infeasible |
| European Lily-of-the-Valley | 3 | Low-Moderate | Rare | High |
| Black Knapweed; Starthistle | 3 | Moderate | Rare and localized but locally common | Moderate |
| Purple Crown-Vetch | 4 | Low-Moderate | Rare but locally common | Moderate |
| Bull Thistle | 4 | Low-Moderate | Rare to uncommon | Moderate |
| Ground Ivy | 4 | Low-Moderate | Fairly common to common | Low |
| Smooth or White Bedstraw | 4 | Low-Moderate | Common and widespread | Infeasible |
| Meadow or Field Hawkweed | 4 | Moderate | Common and widespread | Infeasible |
| Common or Wall Hawkweed | 3 | Moderate-High | Common and widespread | Infeasible |
| Common Hop | 4 | Moderate | N/A | N/A |
| Jerusalem Artichoke | 3 | Low-Moderate | Rare | High |
| Tall Fescue | 3 | Low-Moderate | Fairly common and widespread | Moderate |
| Purple Loosestrife | 1 | High | Rare and localized | High |
| White Sweetclover | 4 | Low-Moderate | Common and widespread | Low |
| Yellow Sweetclover | 4 | Low-Moderate | Rare but locally common | Moderate |
| European Common Reed | 4 | High | N/A | N/A |
| Reed Canary Grass | 1 | High | Common and widespread | Low to moderate |
| Canada Bluegrass | 4 | Low-Moderate | Fairly common and widespread | Low to moderate |

| | | | | |
|---|---|---|---|---|
| Japanese Knotweed | 2 | Moderate-High | Rare | High |
| Kentucky Bluegrass | 4 | Low-Moderate | Very common and widespread | Infeasible |
| Virginia Creeper | 3 | Moderate | Fairly common | Moderate |
| Virginia or Thicket Creeper | 3 | Moderate | Fairly common | Moderate |
| Thicket Creeper | 3 | Moderate | Fairly common | Moderate |
| Black Locust | 3 | Moderate | Rare and localized | High |
| Creeping Buttercup | 3 | Moderate-High | Common and widespread | Infeasible |
| Rugosa Rose | 2 | Moderate-High | Rare | High |
| Field or Perennial Sow-Thistle | 3 | Moderate-High | Common and widespread | Infeasible |
| Tansy Ragwort | 4 | Low-Moderate | Rare | High |
| False Spirea | 3 | Low-Moderate | Rare and fairly localized | Moderate |
| Common Lilac | 4 | Moderate | N/A | N/A |
| Colt's Foot | 4 | Low-Moderate | Common and widespread | Infeasible |
| Common Tansy | 4 | Low-Moderate | Common and widespread | Infeasible |
| Common Speedwell | 4 | Moderate | Uncommon but possibly under-recorded | Moderate |

# 4.0 Fish Population Monitoring

The following sections provide a breakdown of all fish population monitoring initiatives within the Kouchibouguac and Kouchibouguacis watersheds.

## 4.1 Trap-Net Population Monitoring

The following tables/charts display the historical trap-net data for the Kouchibouguacis River (all-time data for Kouchibouguac River is currently being compiled and organized by KNP staff and will be available in 2023-2024 for an updated version of management plan).

**Table 36 below and on the following page** displays an overall summary of all species captured throughout the trap-net monitoring initiatives during the 2023 season. Due to the abundance of fish species and data collected over the years an all-time summary was deemed unfeasible to include in the management plan. Though, all data is available in our in-house database at any time for any specific species or questions.

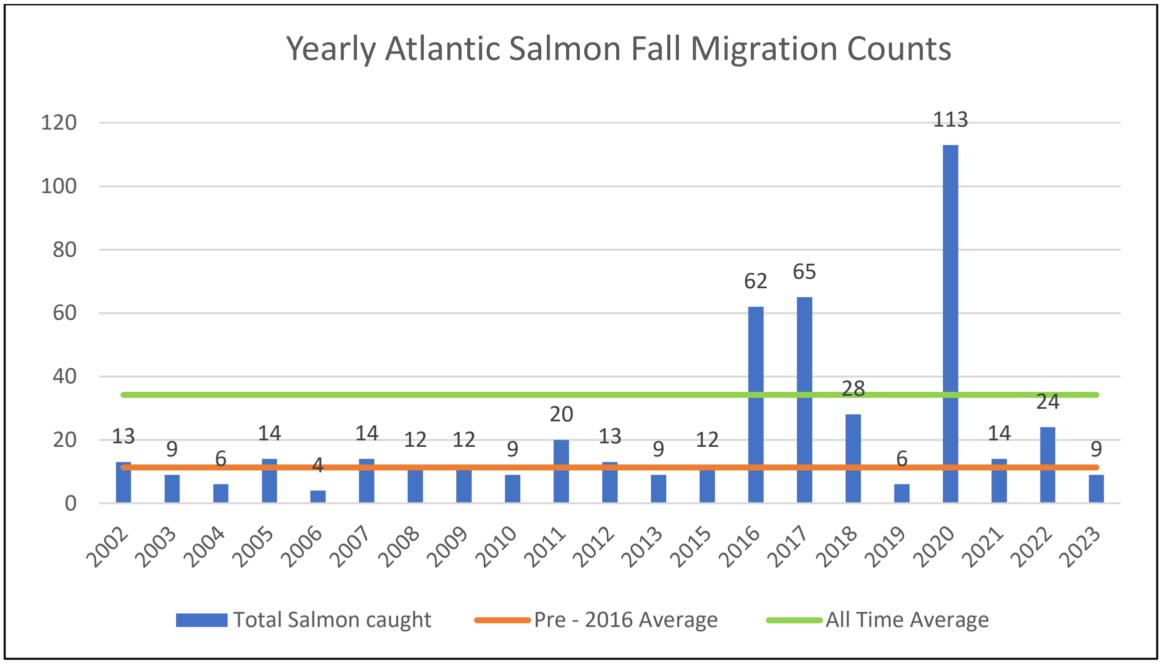
**Table 36: Fish species caught with 2 trap-nets installed on the Kouchibouguacis River in 2023. Exercise held for salmon brood stock collection, fish migration and fish presence evaluation**

| | **U\S** | **D\S** |
|---|---|---|

| Species | Total (56 Days) | Max (1 Haul) *if above 1 | Total (56 Days) | Max (1 Haul) *if above 1 |
|---|---|---|---|---|
| White Sucker | 1447 | 362 (Oct, 23) | 49 | 23 (Oct, 25) |
| Striped Bass | 362 | 56 (Oct, 20) | 156 | 39 (Sept, 6) |
| Atlantic Salmon | 9 | 3 (Sept, 7) | N/A | N/A |
| Rainbow Smelt | 5 | 2 (Oct, 15) | 2 | 1(Sept, 9 & Oct, 17) |
| Atlantic Tomcod | 280 | 41 (Sept, 27) | 38 | 11 (Oct, 21) |
| Flounder | 11 | 2 (Sept, 29 & Oct, 27) | 16 | 6 (Sept, 22) |
| Gaspereau | 179 | 65 (Oct,7) | 1545 | 362 (Sept, 9) |
| American Eel | 740 | 137 (Sept, 23) | N/A | N/A |
| White Perch | 5653 | 765 (Oct, 27) | 622 | 190 (Oct,25) |
| Mummichog | 75 | 18 (Oct, 27) | 17 | 4 (Sept, 6 & Oct, 2) |
| Banded killifish | 8 | 4 (Sept, 27 & Oct, 2) | N/A | N/A |
| Chub | 3 | 2 (Sept, 30) | N/A | N/A |
| Mackerel | N/A | N/A | 11 | 4 (Sept, 9 & Sept 29) |
| Brook trout | 11 | 4 (Sept, 29) | 1 | 1 (Sept, 30) |
| Others | 1 | 1 (Oct,27) | N/A | N/A |

**Figure 25 on the following page** displays the number of adult (including both grilse and mature) Atlantic salmon observed during population monitoring activities in the Kouchibouguacis River. The "pre–2016 average" is distinguished because our incubation program was first implemented in 2012, making 2016 the first year for possible mature salmon that were recruits from the incubation initiative. It is noteworthy that there is a trend of increased counted individuals after this date, and that most yearly counts pre-2016 are either at or below this average. The "pre - 2016 average" is 11.3 while the "all-time average" slightly more than doubles to 22.9 with post 2016 years considered. It is noteworthy that 2019 is a remarkably poor year by recent comparisons, this can likely be mostly attributed to equipment malfunction and inclement weather-related issues. The location of the nets also experienced lower water levels than in previous years, likely due to natural changes within the river, which also reduced their effectiveness. In 2021 a lower than typical fish count was also observed though it is noteworthy that fish counts in neighboring watersheds, the Kouchibouguacis and Richibucto, also experienced below typical fish numbers in this year. In 2023, an additional drop was observed in numbers, though some experts/partners including TFK suspect the fall migration may have went up river earlier and before the nets were installed due to the higher than normal water levels. This overall decrease in the areas that displayed lower salmon numbers will be discussed and investigated with related agencies and experts.

**Figure 25: Yearly Atlantic salmon fall migration counts in the Kouchibouguacis river**




### 4.1.1 Electrofishing Data

The following subsection provides a summary of all-time electrofishing data for juvenile Atlantic salmon within the Kouchibouguacis and Kouchibouguac watersheds, respectively. Due to the numerous species, and a lack of all species data from some participating partners over the years, TFK deemed it appropriate to only focus the data presented on Atlantic salmon. It should be noted, that due to varying protocols over the years and differing age class identification (parr vs fry), to keep things consistent for presentation, TFK simply calculated juvenile Atlantic salmon as a whole – negating the age classification portions.

All data is available at the office within TFK's in-house databank. Data within this subsection includes data collected by TFK, KNP and DFO over the years. Neither rivers have data presented for 2020 due to DFO canceling their electrofishing due to Covid-19. Data for both rivers in 2023 will be updated next year (2024) once DFO's electrofishing is received. **In Table 37 and Table 38 on the following page** shows Catch, predicted densities, size, PHS, biomass, and condition factor for fry and parr captured by site in the Kouchibouguac and Kouchibouguacis rivers in 2022 preformed by DFO.

**Figure 26 on the following page and figure 27 on page 35** displays the visual representation of Densities of Atlantic salmon fry and parr expressed as number of fish per 100 $m^2$ in both watersheds between 1974 and 2022. The horizontal dashed line represents the average fry density over the time series while the solid horizontal line represents the average parr density over the time series.

**Table 37 :** Catch, predicted densities, size, PHS, biomass, and condition factor for fry and parr captured by site in the Kouchibouguac and Kouchibouguacis rivers in 2021.

| | | | | | | | Total catch | | | CPUE per 500 sec | | Predicted density (per 100m$^2$) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | Month | Day | Site | Basin | River | Area (m2) | fry | parr | Effort (sec) | fry | parr | Fry | Parr |
| 2022 | 10 | 6 | K1 | Kouchibouguac | Kouchibouguac | 182.1 | 29 | 32 | 529 | 27.4 | 30.2 | 45.6 | 39.9 |
| 2022 | 9 | 22 | K2 | Kouchibouguac | Kouchibouguac | 119.3 | 30 | 14 | 495 | 30.3 | 14.1 | 50.5 | 18.6 |
| 2022 | 10 | 6 | K3 | Kouchibouguac | Kouchibouguac | 200.2 | 22 | 18 | 523 | 21.0 | 17.2 | 35.0 | 22.7 |
| 2022 | 10 | 7 | K4 | Kouchibouguac | Kouchibouguac | 106.8 | 38 | 12 | 528 | 36.0 | 11.4 | 59.9 | 15.0 |
| 2022 | 9 | 27 | K5 | Kouchibouguac | Kouchibouguac | 96.1 | 10 | 13 | 545 | 9.2 | 11.9 | 15.3 | 15.7 |
| 2022 | 9 | 27 | KS1 | Kouchibouguacis | Kouchibouguacis | 128.4 | 11 | 1 | 552 | 10.0 | 0.9 | 16.6 | 1.2 |
| 2022 | 9 | 22 | KS2 | Kouchibouguacis | Kouchibouguacis | 155.6 | 9 | 3 | 562 | 8.0 | 2.7 | 13.3 | 3.5 |
| 2022 | 10 | 5 | KS3 | Kouchibouguacis | Kouchibouguacis | 192.1 | 10 | 1 | 542 | 9.2 | 0.9 | 15.4 | 1.2 |
| 2022 | 10 | 5 | KS4 | Kouchibouguacis | Kouchibouguacis | 165.5 | 14 | 5 | 512 | 13.7 | 4.9 | 22.8 | 6.4 |

**Table 38 :** Catch, predicted densities, size, PHS, biomass, and condition factor for fry and parr captured by site in the Kouchibouguac and Kouchibouguacis rivers in 2021.

| | | | | | | Length (mm) at age | | PHS at age | | | Weight (g) at age | | Biomass | | | Condition Factor | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | Month | Day | Site | Basin | River | Age 0+ | Age 1+, 2+ | Age 0+ | Age 1+, 2+ | Total | Age 0+ | Age 1+, 2+ | Age 0+ | Age 1+, 2+ | Total | Age 0 | Age 1+, 2+ |
| 2022 | 10 | 6 | K1 | Kouchibouguac | Kouchibouguac | 61.8 | 98.1 | 9.3 | 27.2 | 36.5 | 2.6 | 10.6 | 119.0 | 424.1 | 543.1 | 1.1 | 1.1 |
| 2022 | 9 | 22 | K2 | Kouchibouguac | Kouchibouguac | 58.9 | 95.1 | 9.1 | 11.7 | 20.8 | 2.2 | 9.8 | 111.0 | 182.3 | 293.3 | 1.1 | 1.1 |
| 2022 | 10 | 6 | K3 | Kouchibouguac | Kouchibouguac | 62.0 | 105.3 | 7.2 | 18.6 | 25.8 | 2.6 | 12.8 | 90.1 | 290.8 | 380.9 | 1.1 | 1.1 |
| 2022 | 10 | 7 | K4 | Kouchibouguac | Kouchibouguac | 57.9 | 92.7 | 10.3 | 8.8 | 19.1 | 2.0 | 9.3 | 121.3 | 139.6 | 260.9 | 1.0 | 1.2 |
| 2022 | 9 | 27 | K5 | Kouchibouguac | Kouchibouguac | 57.5 | 95.2 | 2.6 | 9.9 | 12.5 | 2.2 | 10.4 | 33.0 | 162.8 | 195.8 | 1.1 | 1.2 |
| 2022 | 9 | 27 | KS1 | Kouchibouguacis | Kouchibouguacis | 58.3 | 86.0 | 2.9 | 0.6 | 3.5 | 2.1 | 7.1 | 34.3 | 8.5 | 42.8 | 1.0 | 1.1 |
| 2022 | 9 | 22 | KS2 | Kouchibouguacis | Kouchibouguacis | 54.9 | 87.3 | 2.0 | 1.8 | 3.8 | 1.7 | 7.4 | 23.2 | 26.1 | 49.3 | 1.1 | 1.1 |
| 2022 | 10 | 5 | KS3 | Kouchibouguacis | Kouchibouguacis | 54.0 | 113.0 | 2.2 | 1.2 | 3.4 | 1.6 | 16.1 | 25.1 | 19.5 | 44.6 | 1.0 | 1.1 |
| 2022 | 10 | 5 | KS4 | Kouchibouguacis | Kouchibouguacis | 63.0 | 99.3 | 4.9 | 4.5 | 9.4 | 2.9 | 13.9 | 66.2 | 89.4 | 155.6 | 1.2 | 1.4 |

**Figure 26 :** . Densities of Atlantic salmon fry and parr expressed as number of fish per 100 m$^2$ in the Kouchibouguacis River between 1974 and 2022. The horizontal dashed line represents the average fry density over the time series while the solid horizontal line represents the average parr density over the time series.

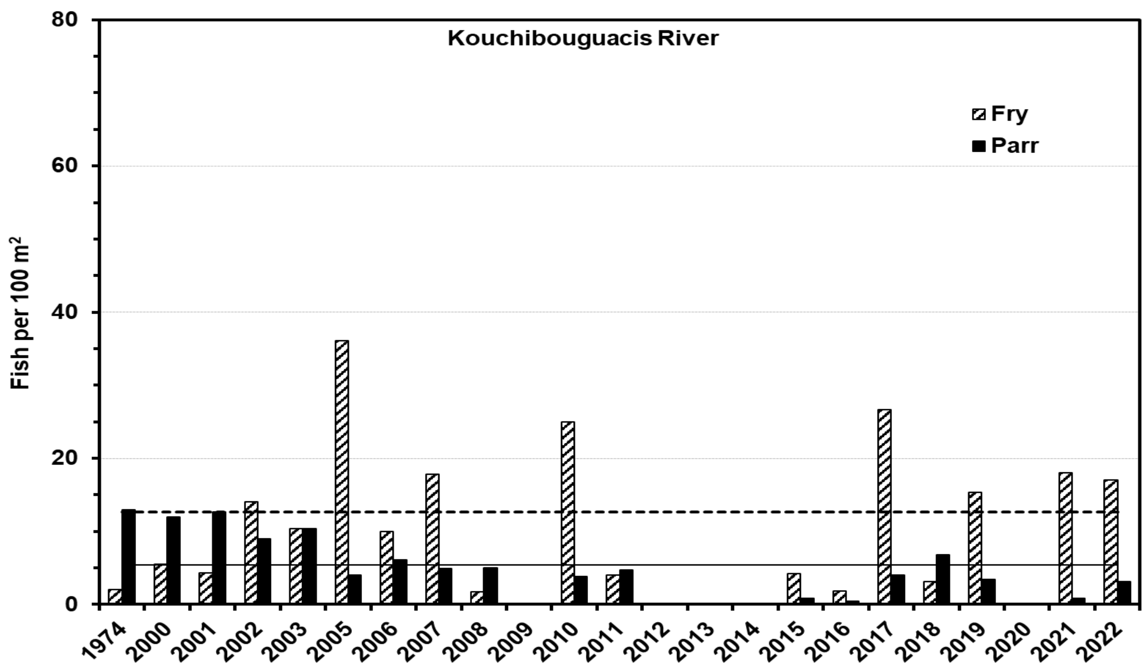
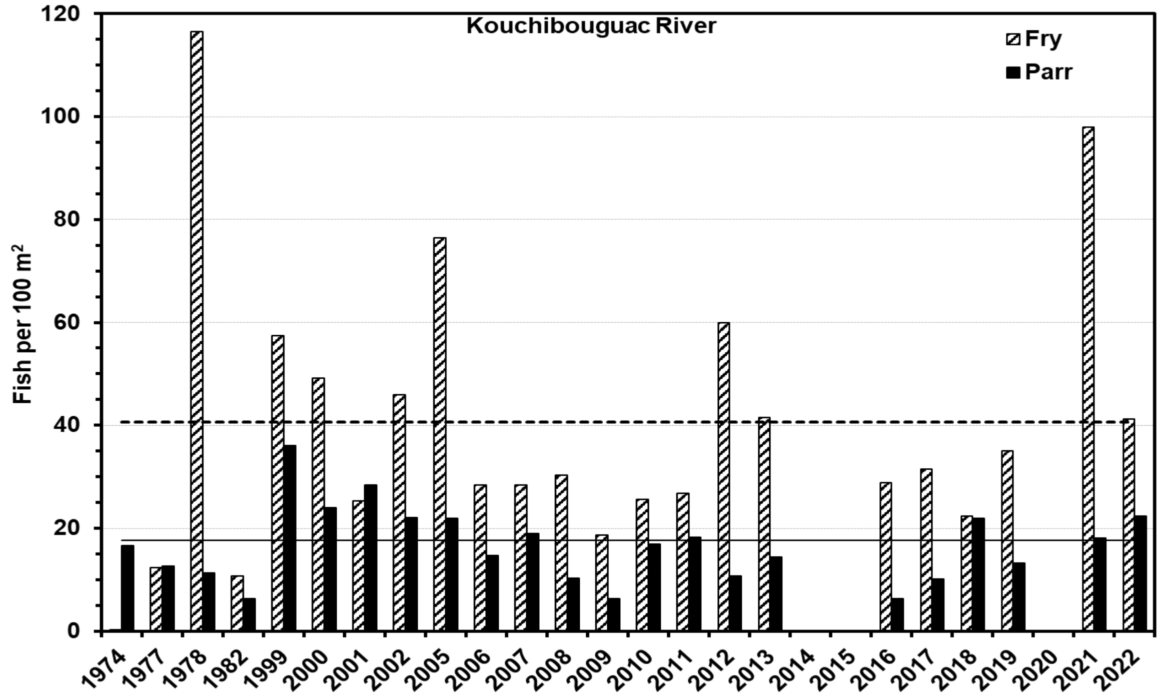


**Figure 27** : Densities of Atlantic salmon fry and parr expressed as number of fish per 100 m2 in the Kouchibouguac River between 1974 and 2021. The horizontal dashed line represents the average fry density over the time series while the solid horizontal line represents the average parr density over the time series.




## Kouchibouguacis watershed:

This section displays the average number of fish caught per site per year in the Kouchibouguacis watershed following an open site catch per unit effort (CUPE) protocol.

The chart displays a combination of data provided by the Department of Fisheries and Oceans and that collected by the Friends of the Kouchibouguacis. Open site CUPE protocol means the site was not closed off to fish passage and the fishing process was stopped when the timer on the electrofishing unit reached 500 seconds.

Site measurements were taken of the area surveyed and the area was estimated using the length of the area fished and its width at its widest point, these averaged roughly 100m2.

**In Figure 28 and Table 39 on the following page** the number of Atlantic Salmon is represented as the density of fish caught or the number of fish caught per 100m2. The figures presented are also an average of the density across all sites within a given year, in order to allow comparisons between years with different numbers of sites sampled.

**Figure 28: Kouchibouguacis Open Site Electrofishing Summary**

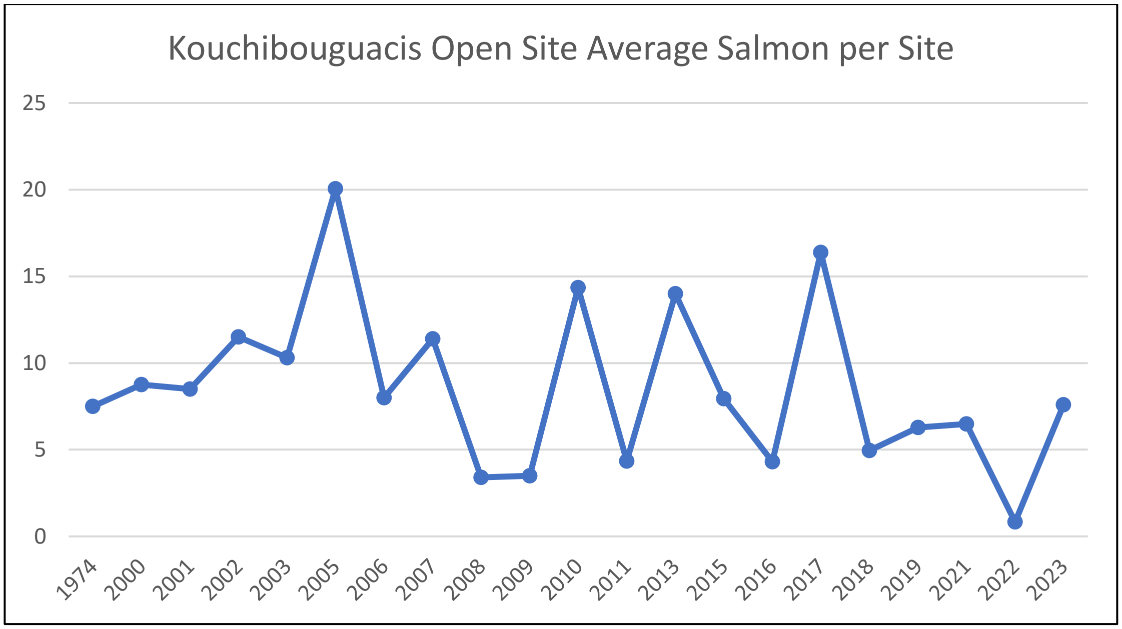



**Table 39: Kouchibouguacis Open Site Electrofishing Summary**

| Kouchibouguacis Open Site | |
|---|---|
| Year | Average Salmon per Site |
| 1974 | 7.50 |
| 2000 | 8.75 |
| 2001 | 8.50 |
| 2002 | 11.50 |
| 2003 | 10.30 |
| 2005 | 20.05 |
| 2006 | 8.00 |
| 2007 | 11.40 |
| 2008 | 3.40 |
| 2009 | 3.50 |
| 2010 | 14.35 |
| 2011 | 4.35 |
| 2013 | 14.00 |
| 2015 | 7.95 |
| 2016 | 4.30 |
| 2017 | 16.37 |
| 2018 | 4.95 |
| 2019 | 6.28 |
| 2021 | 6.48 |
| 2022 | 0.83 |
| 2023 | 7.60 |

**Table 40 below** shows the summary of average fish caught per site per year in the Kouchibouguacis watershed following the closed site diminishing return protocol. This protocol requires isolating a portion of stream by creating barriers to fish passage (in this case nets were used) and performing multiple sweeps until the number of target species (Atlantic Salmon) caught on the most recent sweep is 10 or less, there is no time limit. The area prescribed for this protocol is $200m^2$ and all areas sampled are as close to this as reasonably possible. As such the densities listed are the number of salmon captured per site per year per $200m^2$.

**Table 40: Kouchibouguacis Closed Site Electrofishing Summary**

| Kouchibouguacis Closed Site | |
|---|---|
| Year | Average Salmon per Site |
| 2020 | 4 |
| 2021 | 17 |
| 2022 | 44.25 |
| 2023 | 8 |

**Kouchibouguac watershed:**

**Figure 29 below** displays the average number of fish caught per site per year in the Kouchibouguac watershed following open site CUPE (500 seconds) protocol. The chart displays a combination of data provided by the Department of Fisheries and Oceans and that collected by the Friends of the Kouchibouguacis. Once again, these sites averaged at roughly $100m^2$. **Table 41 on the following page** displays the figures of the same data more precisely. The figures presented are once again an average of the density across all sites within a given year.

**Figure 29: Kouchibouguac Open Site Electrofishing Summary**

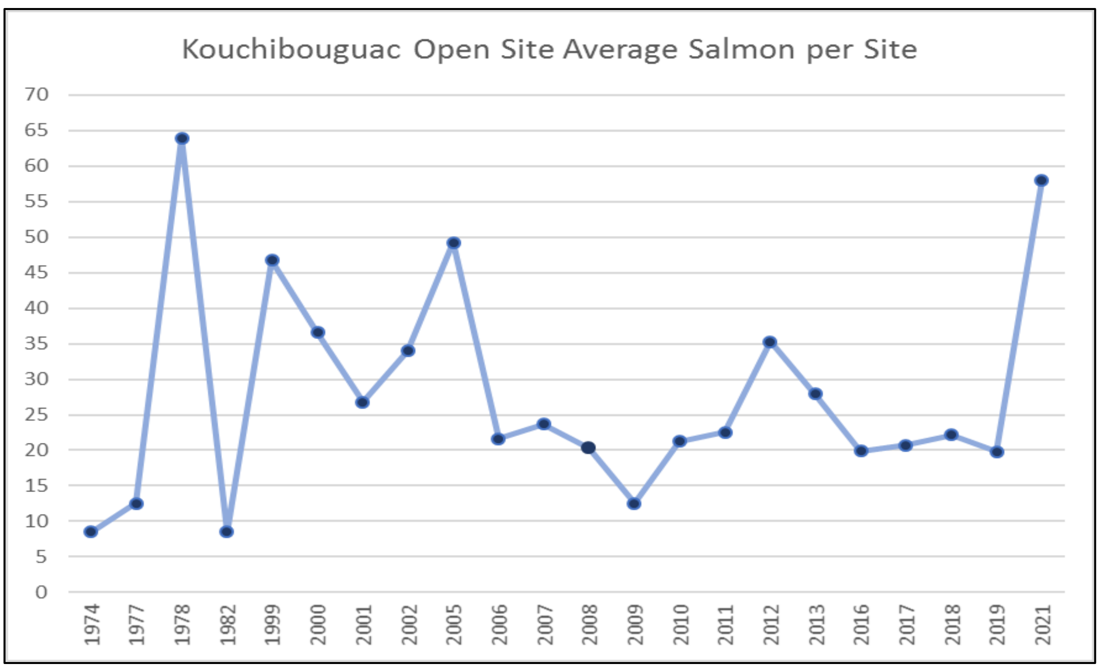


**Table 41: Kouchibouguac Open Site Electrofishing Summary**

| Kouchibouguac Open Site | |
|---|---|
| Year | Average Salmon per Site |
| 1974 | 8.40 |
| 1977 | 12.50 |
| 1978 | 63.90 |
| 1982 | 8.50 |
| 1999 | 46.75 |
| 2000 | 36.60 |
| 2001 | 26.80 |
| 2002 | 34.00 |
| 2005 | 49.20 |
| 2006 | 21.60 |
| 2007 | 23.65 |
| 2008 | 20.30 |
| 2009 | 12.50 |
| 2010 | 21.25 |
| 2011 | 22.50 |
| 2012 | 35.30 |
| 2013 | 27.95 |
| 2016 | 19.85 |
| 2017 | 20.75 |
| 2018 | 22.15 |
| 2019 | 19.80 |
| 2021 | 58.00 |

**Table 42 below** shows the summary of average fish caught per site per year in the Kouchibouguac watershed following the closed site diminishing return protocol. Once again, the densities listed are the number of salmon captured per site per year per $200m^2$ as per the closed site protocol.

**Table 42: Kouchibouguac Closed Site Electrofishing Summary**

| Kouchibouguac Closed Site | |
|---|---|
| Year | Average Salmon per Site |
| 2020 | 35.86 |
| 2021 | 90.50 |
| 2022 | 52.33 |
| 2023 | 23.00 |

## 4.2 Atlantic Salmon Population Enhancement

Atlantic salmon population enhancement efforts are focused on addressing the two major threats relevant to our area of freshwater ecosystem according to the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assessment for the Atlantic salmon - Gaspé-Southern Gulf of St. Lawrence population. These threats are:

- **Obstacles in fresh water:**

Obstacles in fresh water in our region can include faulty culverts, debris jams, dams, and in-filled streams to name a few.

- **Degraded Freshwater habitat:**

Degraded freshwater habitat in our region can include: degraded water quality, sedimentation, degraded spawning grounds (e.g., embedded substrates, turbid water, decreased dissolved oxygen, etc.), lack of access to freshwater habitats due to fragmentation, among others.

TFK has been working on improving aquatic habitat quality and availability through various restoration and monitoring initiatives over the years and will continue to do so as this serves as a critical foundation in any population restoration effort. In the short-term though, with such low numbers of Atlantic salmon present in our river systems, after consultation with other experts TFK began an in-stream Atlantic salmon egg incubation initiative in 2012 using Jordan-Scotty units. This is intended to help protect the eggs during their critical development stage to improve hatch rates and increase the number of surviving juveniles. These incubator units protect eggs from: sedimentation, infection from neighboring eggs, and predation, while also exposing them fully to natural existing conditions in the wild (e.g., water quality, pollution, microbes, natural pathogens, temperature fluctuations, etc.). TFK believes this helps the resulting Atlantic salmon retain as many wild characteristics as possible while eliminating the need for captivity (e.g., hatchery, rearing tanks, etc.) commonly associated with stocking programs.

TFK previously operated a rearing tank operation to stock juvenile Atlantic salmon in the area, but this project was eventually cancelled due to difficulty with maintaining juvenile fish health without the use of numerous chemicals or treatments, and high fish mortality.

TFK believes that this unique combination of using a wild-focused stocking initiative along with habitat enhancement and monitoring will produce positive results while working in a synergistic fashion. Recent results also seem to indicate this may be a reality as we began to see significant results in 2020 regarding our Atlantic salmon populations, including the highest adult salmon numbers since our establishment (113 unique captures, 140 including recaptures – representing a 528% increase over our past average to date of 18). TFK and KNP are awaiting genetic analyses results from DNA tissue samples collected since 2018 on both juvenile and adult Atlantic salmon to help determine the potential efficacy of the incubation project before making any conclusions about the impact it is having on the population.

The following tables/charts display the historical Atlantic salmon egg incubation data for each specified river system.

**Kouchibouguacis Watershed :**

**Figure 30 below** displays the number of eggs incubated versus the estimated number of eggs hatched by year within the Kouchibouguacis watershed. It should be noted that methods for incubation have changed and evolved over the years. In this chart, 2017 displays significant egg mortality; which can be explained by extreme stream conditions during the winter and spring incubation period (e.g., early winter thaw and flooding). Of the eleven incubators installed in 2017, five could not be accounted for upon retrieval attempts. The remaining incubators showed signs of heavy sedimentation and detritus build up.

**Figure 30: Eggs Incubated versus estimated surviving eggs in the Kouchibouguacis river**

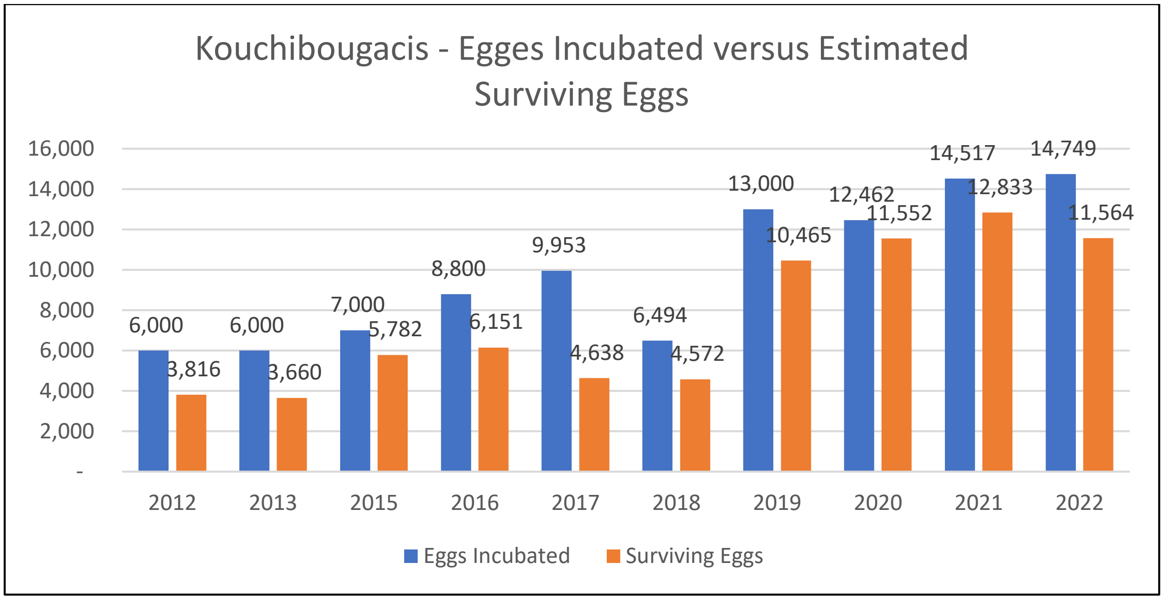
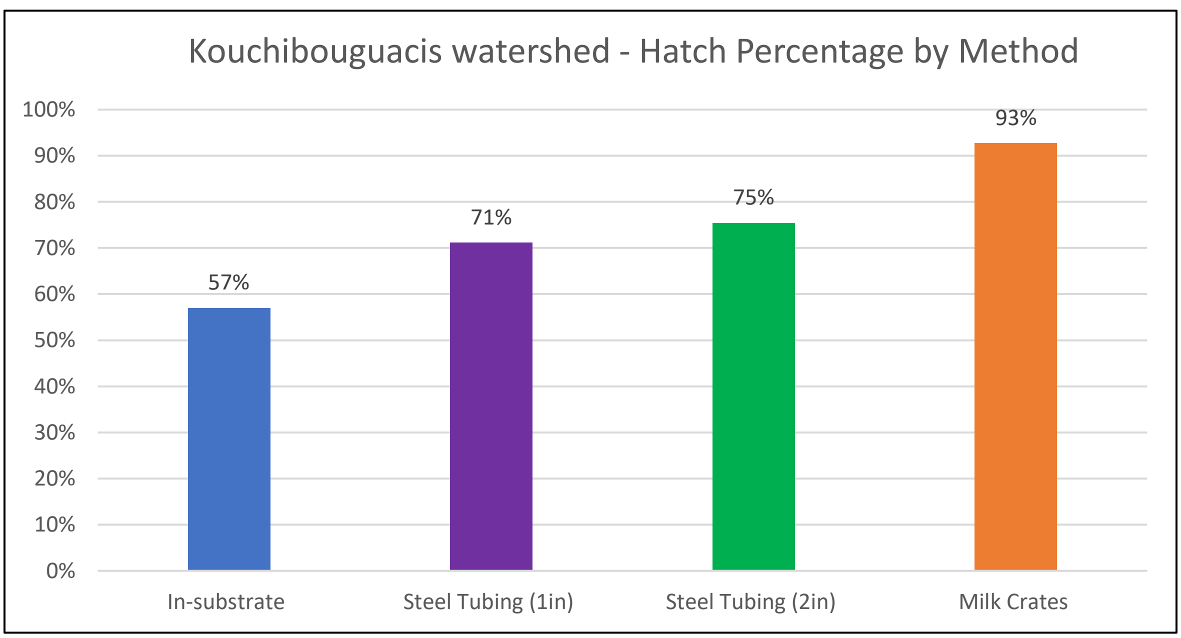



**Figure 31 below** displays the estimated hatch rate associated with various incubator installation methods between 2012 and 2022; with earliest to latest iterations from left to right.

**Figure 31: Estimated hatch percentage comparison by method within the Kouchibouguacis**



**First method:**

The first method of incubator installation, implemented in 2012, was “in-substrate” installation according to the Jordan-Scotty protocols established for rivers in British Columbia, Canada. In this method a trench was dug into the substrate into which the incubator unit was placed before being covered with large (2 to 6 inches in diameter) stones; this method hoped to emulate the salmon redds of natural spawning practices and achieved an average hatch percentage of **57%**. It should be noted for the sake of representative comparison between methods the incubator that was dislodged from the substrate was discounted from the data as it achieved a significantly higher hatch rate and was the inspiration for the innovative “out of substrate” methods developed by TFK.

**Second method:**

The second method implemented was an “out of substrate” method in which incubator units were secured in place by being tied to three pieces of rebar which were driven into the ground; these units were also elevated above the substrate by means of 1-inch diameter hollow square pipe fixed to the bottom of the unit in hopes of decreasing sedimentation of the unit by allowing water to flow around and under the incubators.

This method was implemented from 2013 to 2017 and achieved an average estimated hatch rate of 71%. It should be noted that for the sake of representative comparison the results from the year 2017 were excluded due to the stream conditions of these year being extreme and detrimental to the project with almost half of the incubators being lost entirely, and all remaining units showing heavy sedimentation and wear.

**Third method:**

The third method was an attempt to reduce the effects of sedimentation on the incubators observed in 2017. In this iteration the diameter of the square piping on the bottom of the incubators were doubled from 1-inch to 2 -inches. This protocol was used from in 2018 and 2019 and achieved an estimated hatch rate of 75%, an improvement over the previous method.

**Final method:**

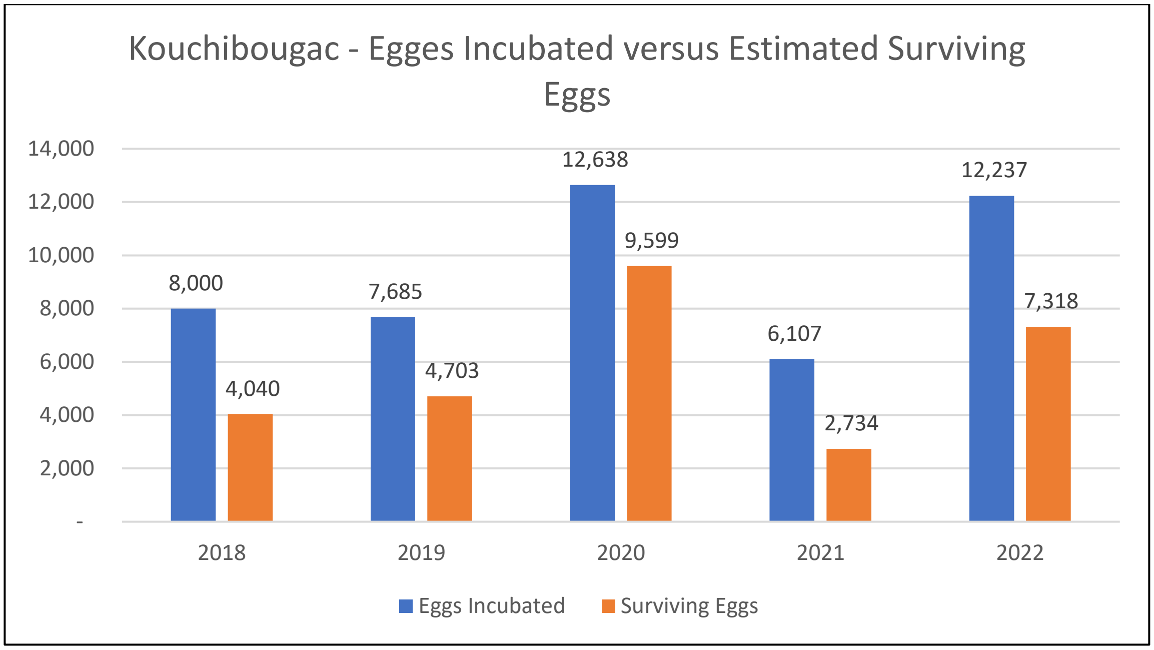
The final method present in the comparison and current method in use is the “milk crate” method. In this protocol incubators are still placed “out of substrate” within a milk crate which is secured to three pieces of rebar in a triangular pattern. Within the milk crate there are two stretches of rope/hose that keep the incubator elevated ~1-2 inches from the bottom of the milk crate; this allows the incubator to lightly shake with the current of the stream which helps clear and remove sediment that may normally accumulate within the cells – without impacting the bottom of the milk crates (this impact could potentially damage the incubator and/or the eggs themselves).

This method was used in 2019, 2020, 2021 and 2022 and achieved an estimated hatch rate of 93%. It should be noted this analysis only considers incubation within the Kouchibouguacis watershed. The Kouchibouguac watershed was excluded due to the lack of sample size in both years incubated and methods used and due to the use of multiple methods with given years.

**Kouchibouguac Watershed (Tweedie brook, Black river, Rankin brook):**

**Figure 32 below** displays the number of eggs incubated and the estimated number of eggs successfully hatched by year within the Kouchibouguac watershed

**Figure 32: Eggs Incubated versus estimated surviving eggs in the Kouchibouguac watershed**




# 3.0 General Information on Various Environmental Subjects

Overall land/aquatic habitat and quality in general have been significantly impacted due to many factors that will be listed in the following sections. Each section will provide information about a specific topic, and recommendations for remedial solutions (if appropriate). These sections can be referred to during evaluation of appropriate steps in the proceeding action plans, and during project planning/development in the future. TFK has worked relentlessly to identify issues that can be managed at a local level (e.g., restoring riparian zones, stabilizing eroding streambanks, etc.); versus larger-scale issues that are out of localized control (e.g., climate change, air pollution, etc.). Identifying problems and implementing solutions on a local scale is the most effective strategy for improving and protecting the local ecosystem in the short-term and long-term. Community members should be encouraged/educated on these existing problems and recommended solutions, and the reasons for them; however, TFK does not pressure or attempt to force anyone to abide by these suggestions. Typically, when people know better, they do better – education and awareness is the greatest tool in improving the management of our watersheds.

## 3.1 What is a Watershed?

A watershed is an area of land dictated by geology and slopes that drains precipitation and groundwater to a common outlet (e.g., stream, river, creek, etc.). A properly functioning watershed requires healthy amounts of vegetation and root systems throughout the upland and riparian zones. Vegetation is often removed through various means such as residential and industrial practices. It is understandably common that residential practices occur along waterways, due to the aesthetically-pleasing surroundings; however, these residential practices often result in vegetation removal – especially within the riparian zone. Vegetation removal within the riparian zone results in a lack of stability and an increased susceptibility to erosion.

Having a well-vegetated and functioning watershed is crucial in providing more consistent flow regimes, as root systems provided by vegetation allow infiltration of precipitation into the ground. Infiltration of precipitation as opposed to allowing it to disperse as surface water runoff is a key factor in: reducing erosive forces; reducing pollution inputs (e.g., warm water, fertilizers, pesticides, etc.); providing water-security for wells (e.g., during drought water wells often run dry due to lack of groundwater infiltration and/or retention); providing more consistent flow regimes (e.g., less extreme flooding events, higher water-levels during periods of drought, etc.); reduces water-loss to evaporation; and increased retention of water provides healthier vegetation, agricultural crop production and reduces risk of wildfires.

## 3.2 What is a Riparian Zone?

The riparian zone is the area between the shoreline and the upland area of any land (typically 30 meters from the shore). The riparian zone provides critical functions to a watershed, such as: critical habitat for various species; regulating water temperatures (e.g., cold water inputs during summer, warm water inputs during winter); acting as a filtration buffer to any water prior to entering the stream; and vegetation/root systems provide structure and stability to streambanks. Without dense and deep root systems the streambanks are susceptible to erosion caused by the stream flow and/or surface water runoff. Unvegetated streambanks are also more prone to severe damage from ice floes.

Vegetation along the streams provides invaluable canopy cover and shade from sunlight. Canopy cover is a critical tool in keeping water temperatures cooler during the warmer periods; as well as combatting the effects of climate change. Organic debris (e.g., leaves, branches, fallen trees, etc.) from vegetation along the streambanks also offers great habitat for various wildlife and aquatic species. There is a natural system in place where erosion naturally occurs, resulting in leaning and/or fallen trees; these leaning and/or fallen trees provide habitat, but also act as a filter – collecting sediment from the water column as the current passes; this also begins to rebuild the eroded streambank as the deposited sediment collects over time.

## 3.3 Surface Water Management

Surface water management is a crucial aspect of any watershed, as it can affect many processes and/or structures. With climate change, it is expected that precipitation and storms will increase is both severity and quantity over time, which illustrates the importance of managing surface water within the area. Surface water runoff at high velocities can damage streambanks and/or overwhelm infrastructure such as culverts and bridges. Highly acute precipitation events are becoming more frequent with the changing climate, and many municipal infrastructures are being overwhelmed and/or failing by surface water. Surface water also commonly carries with it many potentially harmful pollutants (e.g., hydrocarbon waste and chemicals from vehicle traffic, pesticides, etc.). As all surface water eventually makes its way into the nearby streams, it is critical to manage it properly as much as possible. A list of recommendations for surface water management follows:

**Recommendations:**

- Often enough, simply slowing down surface water through various means (e.g., check dams, rain gardens, bio-swales, etc.) can be a powerful method to remove harmful impurities and reduce the potential damage that fast-flowing surface water can impose;
- Maintaining and/or planting vegetation can also decrease surface water amounts and velocities by allowing more water to infiltrate into the ground. Allowing more groundwater infiltration has many benefits, including: increased water security (e.g., less dry-wells, less crop loss due to drought); less water loss during

dry periods due to less evaporation; less strain on infrastructure (e.g., culverts, storm drains, ditches, etc.); providing more consistent flow regimes to watercourses;

- On a smaller scale (e.g., private residences, community areas, etc.), various gardening techniques can be implemented to utilize and control excess surface water; one great example is hügelkultur (**see images below**).

Hügelkultur is a Germanic-traditional permaculture method that utilizes organic debris (e.g., sticks, logs, compost, etc.) along with soil to form berm-like structures that can be shaped to divert or slow surface water. The action of diverting surface water can slow down the speed and assist in directing the runoff to an area more capable of handling it. This technique can be implemented in private or public settings, vegetation such as produce and/or aesthetic plants can be planted very successfully; as each hügelkultur bed absorbs water and feeds plants adequately – this stored water also allows for a more consistent water-supply during periods of drought. Hügelkultur also produces heat as a by-product of the natural composting processes taking place within the soil, which can extend growing seasons in areas like ours (provides heat when cold weather comes).

## 3.4 Fish and Water Passage

Fish and water passage is extremely important for all aquatic species, especially the Atlantic salmon. Pristine habitat and water quality provide no benefit if species cannot access it. Many aquatic species require access to various habitats for food, escaping predation, spawning, over-wintering habitat in deeper pools, etc. Habitat can be disconnected by many obstacles, typically man-made infrastructure (e.g., damaged or improperly functioning culverts, hydro dams, etc.) is the most common cause. Atlantic salmon specifically need proper fish passage to spawning grounds to help reproduce and improve population numbers. A well-connected watershed also allows proper sediment transport to occur. Typically, when there are blockages or obstructions to flow/fish passage, there is also an associated sedimentation/erosion issue as a result. Water will almost always find a way to restore its natural flow regimes, which often results in obstructions being flanked (e.g., clogged culvert causing flooding of road) and causes damages/erosion. In some cases, insufficient flow can cause habitat fragmentation, this can be due to low precipitation amounts; excessive embeddedness of substrate/over-widening of streams; or potentially a problem further upstream (e.g., beaver dams, water withdrawal/stream diversion activities, etc.). Fish need water conditions that are conducive to swimming for migration (e.g., sufficient depth and velocity). This rivers in this area do have some significant sedimentation and over-widening concerns. Input sources of sediment should be mitigated and/or repaired wherever possible; this will restore the natural sediment load of the watercourse, and eventually lead to a narrowing and deepened stream. A proper sediment load will also enable the stream to begin to properly restructure itself, and allow proper spacing of stream features (e.g., riffles, runs, pools, etc.), though a watercourse is constantly in flux and changes are natural and should be expected.

Each stream feature has its own function and purpose, and serves fish in many important ways, for example:

**Riffles:** Shallow sections of any watercourse that allow increased mixing of oxygen into the water column using wave action formed by rocks and other debris. Riffles are a crucial component to any river system as they reintroduce well-oxygenated water into the streams. Riffles also provide great habitat for benthic invertebrates (a key foundational food source for many aquatic species, as well as a great bio-indicator of water quality).

**Runs:** Runs are more medium depth sections of any watercourse, typically found in between a riffle and a pool. These act as connectors between different stream features and allow otherwise potentially fragmented habitats to remain connected.

**Pools:** Pools are deeper sections of any watercourse (typically greater than 45 cm in depth). Pools provide deeper water, which allows stratification to occur (varying levels of temperature) and provides critical cool water refuges in the warmer times of the season. These are often a lifesaver for many fish species in the hot summer, especially during periods of drought. Pools allow fish, such as the Atlantic salmon, to rest and escape the resistance of swimming against the current of the stream. Pools also allow fish to hide at the bottom, protecting them from predation (e.g., Bald eagles). Once fully rested the fish can then begin their upstream journey through the next stream feature and onto the next pool when available. A list of recommendations follows:

**Recommendations:**

- Areas where fish and water passage is/or could potentially be a concern should be evaluated periodically when possible. Common obstructions to fish and water passage are faulty culverts (e.g., damaged, collapsed, plugged, etc.) and dams (e.g., hydroelectric dams, beaver dams, etc.);
- Any obstructions to fish and water passage should be evaluated, documented and cleared (with required permits when needed). In the cases of culverts, this can sometimes be a simple removal of debris blocking the inlet/outlet; installing fish baffles or culvert shoots; or it may require an entire replacement performed by NB- Department of Transportation and Infrastructure (NBDTI);
- In cases of insufficient flow, past/recent precipitation should be considered, but an investigation upstream could be performed to determine if there are obstructions or reasons for the low-flow levels (e.g., beaver dams, stream diversion, water withdrawal, etc.). Input sources of sediment (e.g., eroding stream banks, dirt roads, etc.) should be evaluated and repaired (e.g., planting vegetation, installing silt control systems, etc.);
- Excessive organic/woody debris jams can be cleared in waterways if they appear to pose an obstruction to fish passage; however, this should be done carefully (and perhaps after consultation with experts) as some organic/woody debris is necessary/beneficial to aquatic habitat as it can provide shelter and protection to fish from predation, and can help settle out sediment in the water column and reduce velocities (i.e., reducing erosive forces and potential of waterway).

## 3.5 Agricultural Practices

Agriculture is a very necessary and important aspect of any community, especially a rural one like ours. However, there are various common agricultural practices that are beginning to be revealed as detrimental to the ecosystem. Nature does not like bare soil - though it may happen naturally at times - it either gets covered by new vegetation, or it gets washed away by surface water and/or wind. Many agricultural facilities leave enormous amounts of bare soil exposed to the elements, through tilling and/or harvesting processes (**see image below**).

Every particle of dust/soil and molecule of water will likely make its way into the nearby waterways. This illustrates the importance of using methods that reduce the amount of bare soil exposure. Regenerative agriculture is comprised of practices that utilize: crop rotation, livestock rotation, and the elimination of tilling. Implementing these practices allows for the maintenance and/or restoration of soil organic matter (SOM) and the natural soil composition; which in turn absorbs and stores carbon from the atmosphere, while also improving crop/land resiliency and the water cycle (e.g., increased water retention, reduced evaporation, increased nutrient retention, reduced soil loss, etc.). It should be noted that some crops or instances do not allow for no-till practices (e.g., deep planted crops such as potatoes, etc.) though minimally disturbing practices and/or measures that mitigate sedimentation and runoff (e.g., ditching, sedimentation ponds, etc.) from entering nearby waterways can still be implemented around these areas **(see on the following page).**

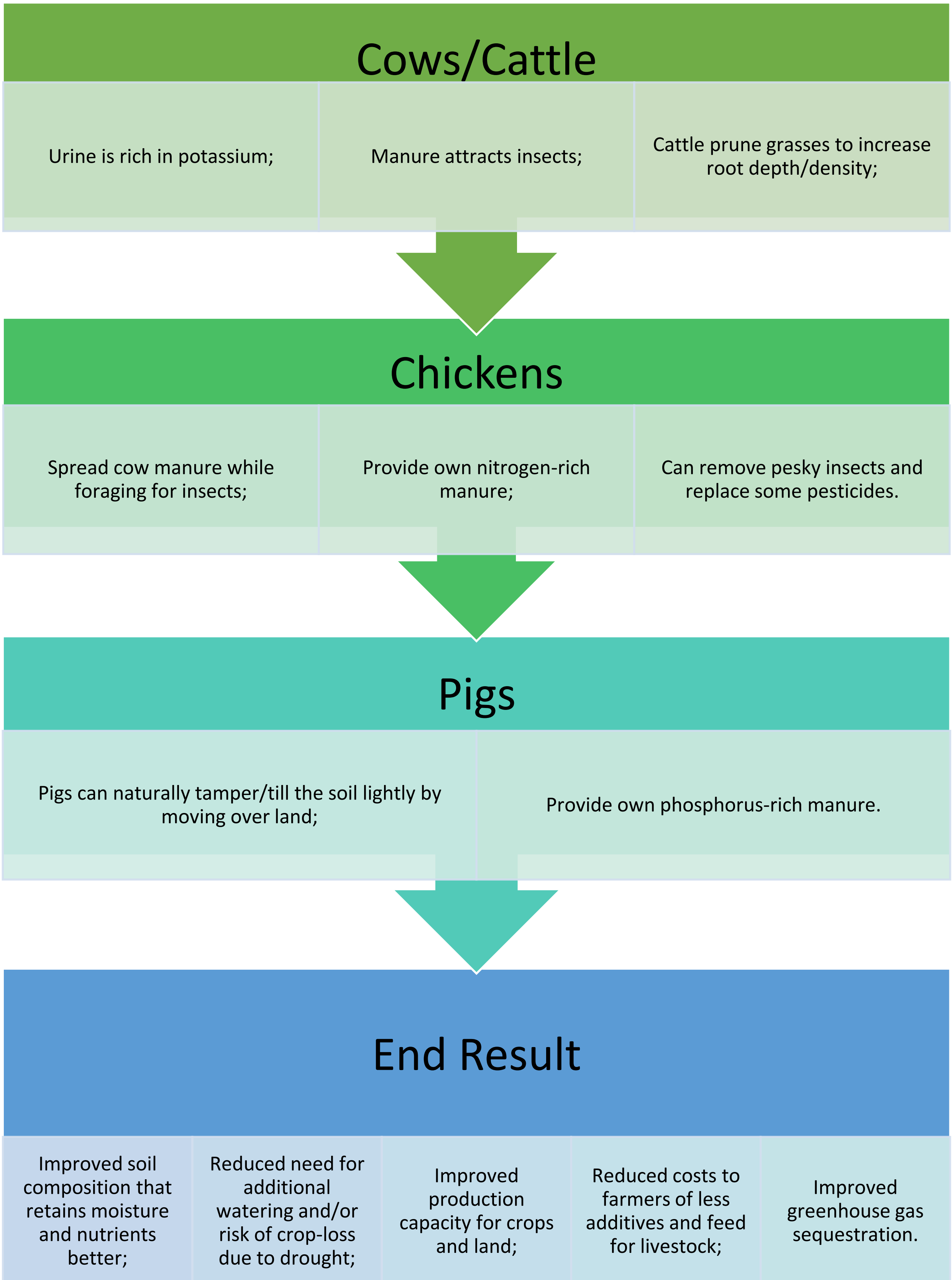
This image shows a ditching process that uses a minimum of three trenches dug in a parallel direction in relation to drainage ditches, these act as a final catchment for any debris/sediment that may otherwise wash away with surface water runoff. The following recommendations can be used individually, or collectively to achieve greater results.

**Recommendations:**

- **Crop rotation** involves the strategic planting and alternating of various crops that each uptake and release certain nutrients. By rotating crops each season, this allows the farmer to utilize specific nutrients introduced in a certain plot of land by a previous crop and continue the symbiotic relationship through various plots of land at regular intervals. This reduces the need/costs for adding fertilizers (synthetic or natural);
- **Livestock rotation** is similar to crop rotation but occurs on a much shorter-time scale (this rotation occurs within one season). A relationship similar to rotating crops can be observed in different livestock species (**see Figure 33 on the following page**).

- **Cover crops and no-till**; the use of cover crops and eliminating tillage allows the soil composition - which includes many microbes, root systems and complex symbiotic relationships - to naturally decompose and retain its structure. Some cover crops can provide a valuable crop yield depending on species or growing season, though many can simply be used to protect/retain the soil and add organic matter in between primary crops – which can benefit the commercially-viable crops. Allowing the soil composition to retain its structure and natural processes decreases the amount of bare soil exposed to the elements; which reduces the amount of soil-loss often experienced by farmers and reduces the inputs of harmful pollutants to the streams. Natural soil composition is also extremely valuable as it: retains more water (e.g., reducing risk of crop damages/losses due to drought); reduces water waste as crops require less irrigation (watering) which helps lessen the burden on well or municipal systems; retains more nutrients which reduces the need/costs associated with applying synthetic or additional fertilizers (also reducing harmful inputs of excess chemicals into streams); and it stores more greenhouse gases to help combat climate change (e.g., carbon, etc.);

**Figure 33: Livestock rotation process example**



These practices can increase overall productive capacity of the land; enhance greenhouse gas storage capacity of the land; provide more nutrient-rich foods; and reduce soil-loss as well as pollution of any nearby waterways. Modifying current agricultural practices could economically benefit farmers whom have been hurting in recent years due to changing market prices as well as climate change; and it could simultaneously ecologically, socially, and economically bolster the community by restoring aquatic habitat quality – which can in turn support a potential thriving fishery (e.g., tourism, fishing supply businesses, commercial fisheries, etc.).

## 3.6 Vegetation Removal and Deforestation

Many portions of land within the community have succumbed to vegetation removal and deforestation to some degree (e.g., forestry activities, agriculture, development, etc.). This severely impacts the function of the watersheds in many negative ways (e.g., increased surface water runoff, increased pollution inputs, less consistent water levels in streams, etc.).

Similarly, to how aquatic habitats can fragment, so too can terrestrial habitats. Various terrestrial species (e.g., birds, deer, moose, bats, etc.) can have their migratory patterns and/or living spaces severed by a lack of vegetation or forested areas. Urbanization, agriculture, deforestation can all contribute to habitat fragmentation. TFK is planning to assess various deforested/abandoned areas throughout the watersheds and assess if a reforestation program is feasible.

**Recommendations:** Steps should be taken to restore forest and vegetation in these areas (when possible), and to encourage less land alteration as much as is feasible. This can be done through various outreach and educational efforts by TFK as people tend to implement changes in their practices when they know better. Additionally, TFK could implement a revegetation/reforestation initiative; an example could be identifying an abandoned farmland that had been deforested long ago - and is now a grassland - and re-foresting the site through various propagation efforts (e.g., transplanting mature trees, planting seeds, etc.). A few trees throughout a property can then spread their seeds naturally over a period of time, eventually resulting in a re-forested property. TFK also aims to encourage less proportions of lawn on each property through education. Lawns pose a risk to the overall function of a watershed as they absorb very little ground water and increase surface water runoff - which can carry various pollutants. Specifically, TFK tries to discourage lawn mowing within the 30-meter buffer zone as that is a major contributor to erosion and sedimentation.

## 3.7 Land Management and Land Use

There are a large variety of land management and land use practices that can have a significant impact on the condition of the land and water (e.g., riparian zone alteration, excessive lawn mowing, tree removal on shorelines, off-roading/stream crossing, etc.). TFK spends significant time assessing streambank and riparian zone integrity each year, as well as working with private landowners to evaluate current environmental conditions on their land. This enables TFK to monitor any arising issues over time, and to respond in a timely manner when possible.

**Recommendations:** Steps should be taken to continue the assessment of streambank and riparian zone integrity each year, both natural and unnatural (i.e., man-made) issues can arise and need to be consistently monitored. This includes TFK’s stream survey program which measures numerous parameters both in and out of the water. Any problem areas observed should be carefully documented and revisited after thorough planning is conducted, and any landowners are contacted for approval. Education of watershed residents should also take place in order to encourage sound land management practices, as what happens on the land – happens in the water. TFK recommends following the provincial guidelines of maintaining a vegetated 30 m buffer zone along any watercourse to protect streambank integrity and to filter/slow surface water runoff prior to entry into the stream. Any alteration (e.g., tree removal, vegetation removal, dock installation, etc.) that takes place within the 30 m buffer zone does require a Watercourse and Wetland Alteration (WAWA) permit to be acquired. Based on the conditions and land management commonly seen throughout the province, it is rare that the 30 m buffer zone is entirely adhered to, it is quite common to see lawns mowed right to the stream bank leaving no buffer zone at all (**see image below**). In these extreme situations, TFK recommends encouraging residents to at least maintain a 5-8 m buffer zone of full vegetation to provide minimal protection to the stream - as any protection is better than none. Again, TFK does not try to enforce or dictate these instructions to residents, and can only recommend and offer to provide aid in these instances. Thankfully, most people are very cooperative, and when they know better – they do better.

# 3.0 Past Restoration Projects

## 3.1 Shoreline Restoration

Local Resident Property on Kouchibouguacis River (46.735752, -64.986598):

In 2014, an aging creosote wall that was used to support the shoreline located on a private property situated along the main branch of Kouchibouguacis River was removed. This creosote wall was failing, which resulted in a compromised/eroding shoreline as well as a source of pollution (e.g., hydrocarbons, sediment, etc.) into the Kouchibouguacis River. The creosote wall was removed, and the remaining land was regraded with a rock toe being installed to support the shoreline. Various types of native vegetation were also planted to help stabilize the soil using the natural root systems (**see image on the following page**).

Pre-restoration photo displaying failing creosote wall (2012)

Post-restoration photo during follow-up visit displaying successful shoreline restoration (2016)

This project successfully addressed action plans 6.1, 6.2, 6.3, 6.4, and 6.6 of this updated management plan and is considered a successful contribution to the overall ecological health and integrity of the Kouchibouguacis watershed.

## 3.2 Culvert Replacement

Ruisseau sans nom (unnamed brook) (46.721641, -65.067692):

This project consisted of replacing a non-functional culvert that was obstructing flow on the ruisseau sans nom (unnamed brook), a tributary located within the Kouchibouguacis watershed. The obstructed flow was resulting in severe backwatering on the upstream end of the culvert, which converted the stream into a pond temporarily. The replacement of the culvert allowed the reestablishment of appropriate waterflow, and resulted in a restored stream

for our watershed (**see images below for before and after results**).

Before photo displaying effects of severe flow obstruction (2010)

After photo displaying results of flow restoration and revegetation progress (2011)

This project successfully addressed action plans 6.1, 6.2, 6.3, 6.4 and 6.6 of this updated management plan and is considered a successful contribution to the overall ecological health and integrity of the Kouchibouguacis watershed.

## 4.3 ATV Bridge and Trail Restoration

Ruisseau de la truite (Trout Brook) (46.719925, -65.154830):

This project consisted of the restoration of a dilapidated ATV bridge and trail. The degraded trail resulted in large puddles which encouraged ATV riders to drive around into the surrounding wetland **(see images below).**

Before photo displaying large puddle interrupting trail flow (2017)

After photo displaying results of restored trail, bridge and vegetation (2018)

This off-roading into the surrounding wetland resulted in significant damage to vegetation critical to protecting the nearby ruisseau de la truite as well as habitat to any wildlife that relied upon it. A new bridge was constructed, and the trail was built back up to grade to allow for normal ATV trail usage to occur. Vegetation was also planted along the sides of the trail to help encourage ATV riders to stay on the designated trail, and to help restore and protect the nearby wetland and waterway.

This project successfully addressed action plans 6.1, 6.2, 6.3, 6.4 and 6.6 of this updated management plan and is considered a successful contribution to the overall ecological health and integrity of the Kouchibouguacis watershed.

## 4.4 ATV Trail Cancellation and Bridge Removal

Ruisseau de la truite (Trout Brook) (46.708046, -65.180686):

This project consisted of the cancellation of an ATV trail and removal of an ATV bridge that crossed the ruisseau de la truite (Trout Brook). The ATV trail was cancelled to allow for the rerouting of a newly designated trail that would go around the stream as opposed to crossing it. Silt fencing was installed in the stream prior to the bridge removal to prevent excess sediments from polluting the waterway. After the bridge was removed successfully, vegetation was planted throughout each side of the trail. Straw and grass seed were placed strategically to help reduce bare soil exposure and rapidly aid in stabilizing each embankment until more dense root systems and vegetation could take hold (**see images below**).

Before photo displaying bridge removal and exposed trail substrate (2018)

After photo displaying results of restored trail and vegetation (2019)

This project was considered mostly successful, though due to an off-roading incident in which a truck attempted to continue to use the trail and ended up getting stuck in the stream after our efforts, the embankment incurred significant damage. TFK revisited the site afterwards and planted additional vegetation and applied further remedial efforts to restabilize the embankment. Follow-up visits have displayed encouraging results and it appears the trail is well on its way to being restored to its natural conditions.

This project successfully addressed action plans 6.1, 6.2, 6.3, 6.4 and 6.6 of this updated management plan and is considered a successful contribution to the overall ecological health and integrity of the Kouchibouguacis watershed.

## 4.5 Fish and Water Passage Restoration – Ruisseau baptiste

A multi-year initiative to restore fish and water passage on ruisseau baptiste began in 2022-23.

### 4.5.1 Ruisseau baptiste 2022-23

TFK successfully replaced two faulty culverts with two new 1200mm concrete culverts with funding support from DFO-HSP, NB Wildlife Trust Fund, Foundation for Conservation of Atlantic Salmon, and NB Environmental Trust Fund. This restoration work improved fish and water passage on ruisseau a baptiste as well as eliminated sedimentation inputs caused by erosion due to the previously altered water flow. Pre-remediation assessments of the stream (e.g., drone imagery, eDNA sampling, substrate composition, electrofishing, etc.) have been done prior to the culvert replacements to be able to compare the changes in the years to come.

After the culvert replacements, TFK planted vegetation from our nursery along the embankments at both sites to encourage root systems to be established. The root systems will help to stabilize the area and reduce erosion and potential pollution coming from the surrounding areas. The vegetation planted at each site is displayed below.

**Upstream (U/S) culvert:** 46.75552 -6500109
Vegetation planted:

| Species | Quantity |
|---|---|
| White pine | 2 |
| White ash | 1 |
| Elderberry | 2 |
| Stripe maple | 2 |
| White spruce | 7 |
| Cedar | 2 |
| Common milkweed | 2 |
| Dogwood | 6 |
| Butternut | 2 |

**U\S culvert vegetation**

Note: In the spring of 2023 TFK will return and determine if more vegetation planting is needed.

**Downstream (D/S) culvert:** 46.75492 -6599956
Vegetation planted:

| Species | Quantity |
|---|---|
| White pine | 2 |
| Bur oak | 2 |
| White spruce | 3 |

**D/S culvert vegetation**

Note: This site had plenty of existing vegetation therefore less vegetation was necessary to plant. TFK will return in the spring of 2023 to determine if more vegetation planting is needed.

Significant sediment has accumulated over the years' at these sites and the stream will slowly cleanse itself and reveal a natural channel and substrate via restored water passage. Fish spawning/rearing habitat has been destroyed due to this excessive sedimentation up to this point, and will likely take a few years to be restored fully, though fish and other species can now access these sites for foraging and to navigate to other habitats within the stream. Before and after pictures of the site between the U/S and D/S culverts are displayed below. A more detailed stream restoration report will be generated as this initiative progresses over the years. (**See images on the following page for before and after results**).

Before photo displaying the D/S culvert restricted water flow and flooding.

After photo displaying the D/S culvert with a restored water flow.

### 4.5.2 Ruisseau baptiste 2023-24

TFK continued restoration efforts on ruisseau baptiste in 2023-24 with the removal of a concrete manmade dam **(see image below)** that had obstructed fish and water passage for years.

Before photo displaying manmade dam prior to removal.

This dam was clogged with debris after neglect and resulted in the stream flanking approximately 10 meters to the true left and blowing out the driveway. This resulted in an unstable site which continuously introduced sediment to the waterway. This flanked channel was eventually blocked by beaver activity which stopped fish and water passage for many years. TFK removed the beaver dam to lower the pond to allow contractors to work in the dry. After lowering the pond, the manmade dam was removed, and a new 1200 mm concrete culvert was installed to maintain fish/water passage and land access for the landowners. (**See before and after images of the site on the following page).**

Image displaying restoration site prior to dam removal from above

Image displaying restoration site after dam removal from above

# 4.0 Potential Restoration Projects

Through TFK's monitoring process, TFK has identified 3 streams in need of work to improve the fish and water passage.

The streams ranked in priority for restoration are: 1) Ruisseau a Baptiste, 2) Little Beaver Brook, 3) Beaver Brook. It should be noted that the culverts on Little Beaver Brook and Beaver Brook are located on crown land, and while the Province may be responsible to fix these – their budgets and prioritization of areas based on traffic/land use are hindering the restoration of these sites. TFK is seeking financial assistance in this project to expedite the remediation of these streams and is in conversations with New Brunswick Department of Transportation and Infrastructure (NB-DTI) to provide supplemental work to the project (e.g., grading, ditching, etc.) as well as providing the culvert pipes to reduce the financial burden on TFK and its funders.

## 5.1 Ruisseau a Baptiste

Two remaining manmade dam structures (Middle dam: 46.743166, -64.995534, Lower dam: 46.743996, -64.986484) **(See map in Annex A)** will be removed and/or sites stabilized (based upon funding received) with the use of an experienced contractor company that commonly deals with demolition and construction projects; they will use the heavy equipment necessary to remove and dispose of the structures. All work will include necessary precautions including silt fencing, straw/mulching and seeding of bare soils, vegetation planting to expediate stabilization of embankments, and pump-around systems where/if needed (final details will be worked out as project planning progresses). TFK has already performed some pre-remediation monitoring/evaluation of Ruisseau a Baptiste which includes electrofishing, eDNA sampling, stream survey assessments (e.g., stream widths, velocities, substrate evaluation, vegetation assessments, etc.), drone footage to compare with post-remediation results to monitor effectiveness of the project over time and to allow for educational material to be generated and shared with communities; and securing of landowner permissions. Post-remediation monitoring and maintenance will also be performed as part of this project to help TFK monitor the effectiveness of the remediation and to allow TFK to adapt to any potential issues that may arise quickly and efficiently to ensure a successful restoration takes place. Post-remediation monitoring and maintenance (same tasks will take place for each of the following streams) will include: population assessments (e.g., electrofishing, eDNA sampling, brook floater surveys), stream surveys (e.g., stream conditions, vegetation composition, substrate composition, streambank stability, etc.), streambank maintenance (e.g., planting of vegetation, mulching/seeding bare soil, reinforcement if needed, etc.), debris removal to ensure water flow is maintained (e.g., clear culverts of debris, remove debris jams that may accumulate, natural debris will be left untouched to maintain natural habitats, etc.). (**See image of middle dam below and the downstream dam on the following page).**

Image above displays significant flow alteration caused by dam structure at site 2 (middle dam) on ruisseau baptiste.

Image above displays significant flow alteration caused by dam structure at site 1 (downstream dam) on ruisseau baptiste as seen from drone. Surrounding manmade embankments also eroding and introducing sediment to waterway (~70 cm in close proximity to site).

## 5.2 Little Beaver Brook

Two culverts will be replaced with new and functional culverts to restore fish/water passage and help stabilization/restoration of drainage ditches to allow for sedimentation pollution to be eliminated. The first culvert (46.645750, -65.232470) **(See map in Annex A)** is perched ~30 cm above the stream and is obstructing fish passage; has water flowing under and around the pipe. (**See images below**).

Image above displays inlet of culvert 1 on Little Beaver Brook along with significant sedimentation

Image above displays outlet of culvert 1 on Little Beaver Brook. Culvert is perched and significant sedimentation is observed downstream

The second culvert's inlet (46.645580, -65.235060) **(See map in Annex A)** is completely submerged under water and clogged, resulting in the stream washing over the roadway and contributing significant sediment to the watercourse. TFK has already performed some pre-remediation monitoring/evaluation of Little Beaver Brook which includes: electrofishing, and stream survey assessments (e.g., stream widths, velocities, substrate evaluation, vegetation assessments, etc.). Post-remediation monitoring and maintenance will also be performed as part of this project to help TFK monitor the effectiveness of the remediation and to allow TFK to adapt to any potential issues that may arise quickly and efficiently to ensure a successful restoration. (**See images below and on following page**).

Image above displays Little Beaver Brook flanking culverts and establishing new channel on ch. Desherbiers. This is a significant source of sedimentation into the watercourse

## 5.3 Beaver Brook

The work will be the same as Little Beaver Brook as two culverts will be replaced with new and functional culverts to restore fish/water passage and help stabilization/restoration of drainage ditches to allow for sedimentation pollution to be eliminated. The first culvert (46.652780, -65.253640) **(See map in Annex A)** is made of concrete and is broken in the middle resulting in a tilted culvert and impaired fish passage; this culvert is also significantly undersized (~24” diameter) and NBDTI has recommended a 48” culvert be installed instead to allow sufficient discharge during high flow events. (**See images on the following page)**.

| | |
|---|---|
|  Image above displays inlet of culvert #1 on Beaver Brook. This channel of the stream is usually flowing during high precipitation events. Significant erosion and sedimentation is present due to washouts from roadway. |  Image above displays outlet of culvert #1 on Beaver Brook. Severe erosion occurring on surrounding culvert, culvert is too short (~10 meters) and should be extended to ~15 meters to allow for proper grading. |

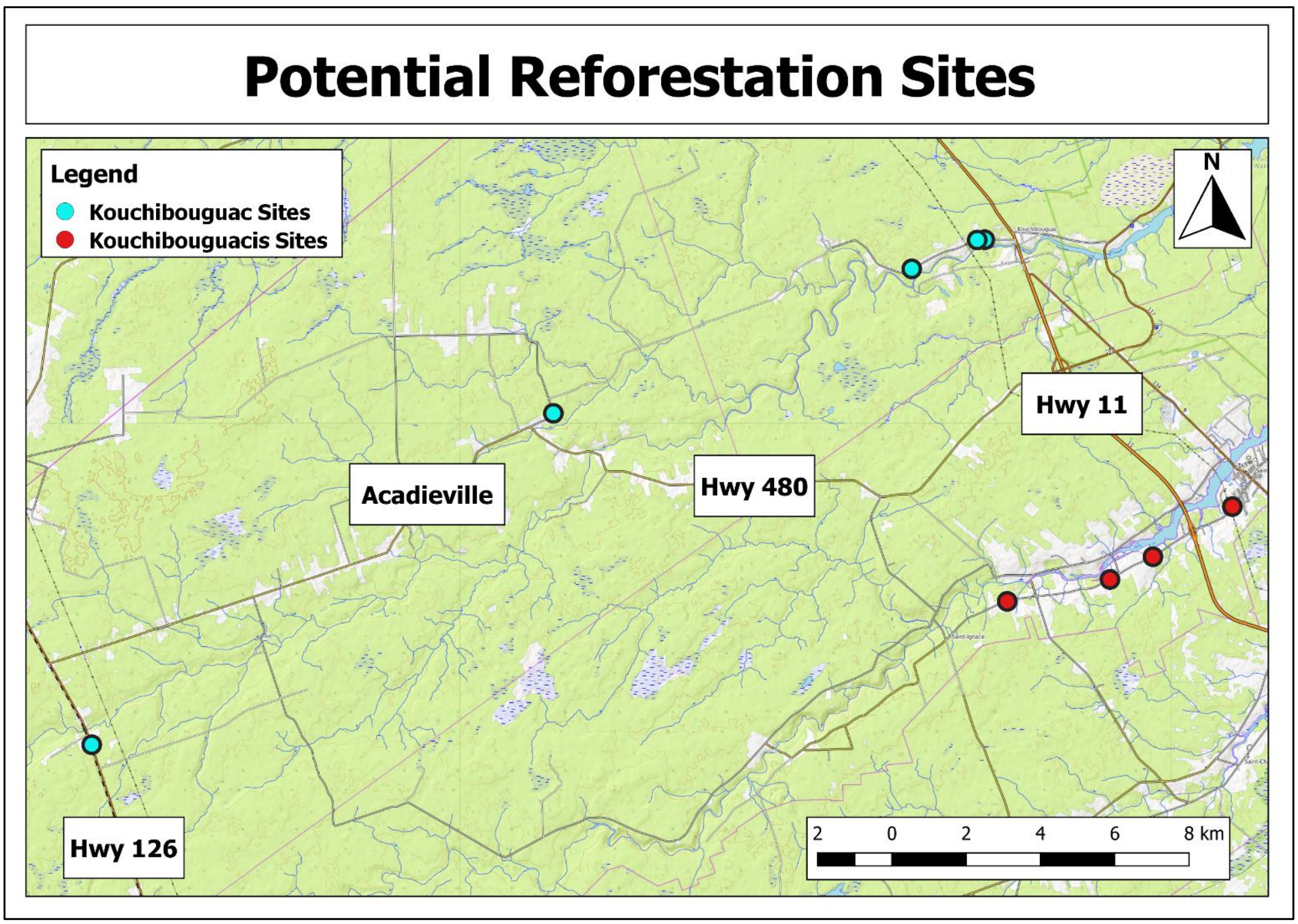
The second culvert (46.657360, -65.265110) is perched ~10 cm and is broken in the middle resulting in impaired fish passage; this pipe is also undersized (~18” diameter) and NBDTI has recommended a 48” diameter pipe be installed. TFK has already performed some pre-remediation monitoring/evaluation of Little Beaver Brook which includes: electrofishing, and stream survey assessments (e.g., stream widths, velocities, substrate evaluation, vegetation assessments, etc.). Post-remediation monitoring and maintenance will also be performed as part of this project to help TFK monitor the effectiveness of the remediation and to allow TFK to adapt to any potential issues that may arise quickly and efficiently to ensure a successful restoration. (**See images below)**.

| | |
|---|---|
|  Image above displays inlet of culvert #2 on Beaver Brook. Significant backwatering is observed. |  Image above displays outlet of culvert #2 on Beaver Brook. Culvert is perched and broken in middle. |

## 4.1 Land Reforestation

## 4.2 Reforestation

In 2021, TFK proposed a project sponsored by the New Brunswick Environmental Trust Fund that included a component of identifying properties throughout the watersheds that could potentially be reforested. Properties that were identified included those which appeared to be either abandoned or unused for their past purposes (e.g., abandoned farm fields, unmaintained/unharvested fields, etc.). These properties offer great potential to increase the amount of root density and vegetation throughout the watersheds which can: improve forest habitat for many species; allow for reduced pollution and erosion near waterways; increase greenhouse gas storage within soil; and help regulate water temperatures. In total, 9 sites were identified (4 in the Kouchibouguacis watershed and 5 in the Kouchibouguac watershed) that are considered to be potential reforestation candidates (**see map below**). TFK will work on identifying and contacting land owners for each to see if they would be interested in reforesting their land. Reforestation can take place through the planting of native tree and shrub species at various life stages; as the plant grow they will naturally propagate and spread additional seeds of their own over time. This can be an effective method of turning a field of grass back into the forested area it was years ago.



# 6.0 Action Plan

The following section is comprised of several action plans which represent TFK and the community's priorities. These plans have been developed after a culmination of years of research, monitoring and consulting by TFK along with various government agencies. Each section will provide the definition of a specific topic/problem, objective, and list concrete steps that can be taken to achieve desired results.

## 6.1 Action Plan 1: Monitor and Evaluate Land Use and Land Management Activities

**Topic:**
Land use and land management activities have a significant impact on the health and quality of the watershed and waterways. Land use and land management activities are always changing and need to be monitored where possible to ensure the best possible function of the watersheds.

**Objective:**
To monitor and evaluate land use and land management activities within the watersheds.

**Actions:**

1. Identify problem areas from previous data and habitat surveys completed by TFK, government agencies (e.g., GeoNB, NBDNRED, etc.), and/or community members.

2. Utilize existing mapping data from government agencies for various habitat information as needed.

3. Perform new land use and land management activities surveys and evaluations (e.g., visual surveys from vehicle, any areas observed during stream survey activities, canoe run during spring/fall, etc.).

4. Attempt to establish contact with agricultural landowners/operators to discuss potential environmental concerns and offer to provide education and/or consider applying for funding for land management improvement initiatives (e.g., exposed soil, significant runoff, excessive tilling, riparian alteration, etc.).

## 6.2 Action Plan 2: Improve Land Use and Land Management Activities

**Topic:**
Land use and land management activities – good or bad – can have major impacts on the overall function and health of the watershed and ecosystem. Poor land conditions can be caused by humans and/or natural events; regardless, these areas need to be repaired and/or managed where possible. Damaged and/or altered land can be a source of many pollutants (e.g., sediment, warm water inputs, erosive forces, etc.) to the watersheds and should be fixed when possible. Regenerative/sustainable agricultural practices should be encouraged/supported when appropriate to relevant landowners/operators.

**Objective:**
To restore and protect any land damaged and/or altered by humans and/or natural events where possible. By restoring and protecting damaged and/or altered areas; this greatly aids in improving overall function and sustainability of the watersheds. Special attention should also be given to mitigating the presence/spread of any invasive plant species which can destroy or impair many ecosystems.

**Actions:**

1. Compile priority list of areas in need of attention from monitoring and evaluation efforts (e.g., abandoned farm/hay fields, deforested areas, construction sites, etc.).

2. Contact landowners (e.g., private land, crown land, agriculture, NB ATV Federation, etc.) to convey concerns about land condition and offer aid to help resolve issues; seek permission and access.

3. Develop work plan for each individual project/site.

4. Apply for and secure funding/permits required for any work from various sources.

5. Perform restoration work (e.g., plant vegetation in area, stabilize embankments, install sediment control devices, cover bare soil with mulch, etc.).

6. Maintain TFK tree nursery and inventory which can be utilized during various restoration projects, funding can be secured to purchase additional or unique trees if needed.

7. Propagate tree and shrub species native to the area as these are easier to grow in existing conditions, ensure more successful restoration efforts, and require less maintenance/special attention.

8. Aim to restore the Acadian forest, with a special focus on plant species at risk (e.g., Maples, Ashes, Cedar, American Beech, Butternut, etc.).

9. Identify sites containing invasive plant species (either through observation by TFK, or via reports from community members) and perform mitigative measures when/if possible and/or monitor the situation.

## 6.3 Action Plan 3: Monitor and Evaluate Aquatic Habitat and Water Quality

**Topic:**

Aquatic habitat and water quality is a critical aspect of the watersheds that requires constant monitoring and evaluation. TFK has been performing various aquatic habitat and water quality monitoring initiatives over the past 20 years and will be required to continue those overs for years to come. This allows TFK to: monitor current conditions; evaluate any positive/negative trends observed; identify new problems and/or areas that require special attention; evaluate efficacy of past restoration work, etc.

**Objective:**

To monitor and evaluate aquatic habitat and water quality within the watersheds (e.g., fish/water passage, habitat connectivity, stability of riparian zones, etc.). Any data collected will be stored within in-house database and combined with previous data collected over the past 20 years.

**Actions:**

1. Perform aquatic habitat and stream survey work following TFK's established protocol to continue building on previous work and database.

2. Assess and evaluate any stream crossings or fish/water passage infrastructure for condition and functionality (e.g., culverts, bridges, etc.).

3. Assess and evaluate habitat quality and availability (e.g., water quality, canopy cover, cold water inputs, etc.).

4. Identify problem areas that need special attention and/or restoration (e.g., eroding streambanks, faulty culverts, pollution sources, etc.).

5. Perform Canadian Aquatic Biomonitoring Network (CABIN) sampling with KNP annually to determine water quality conditions at various sites throughout watershed. TFK can perform its own CABIN sampling if arranged, and new sites are determined to be necessary.

6. Compile data to be evaluated now and in the future. Share results and consult with relevant agencies (KNP, DFO, NBDNRED).

## 6.4 Action Plan 4: Improve Aquatic Habitat and Water Quality

**Topic:**
Aquatic habitat and water quality is a vital aspect of any watershed, and needs to be monitored, improved and maintained where possible. While the entire watershed impacts aquatic habitat and water quality, this section will focus on the more direct factors (e.g., riparian zones, streambanks, in-stream conditions, culverts, etc.).

**Objective:**
To improve aquatic habitat and water quality conditions within the watersheds.

**Actions:**

1. Compile priority list of areas in need of attention from monitoring and evaluation efforts (e.g., obstructions to fish/water passage, eroding streambanks, damaged riparian zones, lack of canopy cover, species at risk habitats, etc.).

2. Contact landowners (e.g., private land, crown land, NB Department of Transportation and Infrastructure, etc.) to convey concerns about land condition and offer aid to help resolve issues; seek permission and access (if required).

3. Develop workplan for each individual project/site.

4. Apply for and secure funding/permits required for any work from various sources.

5. Perform restoration and/or mitigation work (e.g., planting vegetation, stabilizing streambanks, replacing culvert, installing sediment control devices, etc.).

6. Perform post-work monitoring of site if possible, to observe effectiveness and confirm problem is resolved (e.g., follow-up site visits, time-lapse photos, water quality monitoring, etc.).

7. Remove any temporary structures installed (e.g., silt fencing) once no longer required.

## 6.5 Action Plan 5: Monitor and Evaluate Wild Atlantic Salmon Population

**Topic:**
Determining population quantities of wild Atlantic salmon populations of both juveniles and adults, and compiling data collected.

**Objective:**
To monitor and evaluate populations of both juveniles and adult wild Atlantic salmon. The data provided by these efforts will allow TFK and other relevant agencies (KNP, DFO, NBDNRED, etc.) to assess quantities and trends over time; and enable the evaluation of past and current restoration efforts. This data will also provide a foundation to guide future efforts.

**Actions:**

1. Environmental DNA (eDNA) sampling can be utilized to detect presence/absence of Atlantic salmon in previously unsampled or undiscovered habitats.

2. Perform electrofishing sampling to determine juvenile population abundance at various sites. Currently, each Atlantic salmon specimen collected during electrofishing has fork and total length measured, is checked for precociousness and has DNA tissue samples collected from adipose fin for genotyping with KNP.

3. Collaborate with DFO during their annual electrofishing exercises within the watersheds.

4. Install and operate smelt box-nets within main branch tidal waters of each watershed to monitor and evaluate adult Atlantic salmon populations. Currently, KNP performs the monitoring on the Kouchibouguac River, TFK performs monitoring on the Kouchibouguacis River. Each Atlantic salmon specimen collected during trap-net fishing has fork and total length measured, scale samples collected for aging, DNA tissue samples collected from adipose fin, and is tagged with unique ID tags.

5. Perform genetic research to further develop database and information on current wild Atlantic salmon populations within watersheds. Information gathered from genetic research can include: overall health of specimen, number of specimen related to genitors from TFK in-stream incubation efforts, number of specimen native to watershed, number of specimen migrating from other river systems, etc.

6. Compile data to be evaluated now and in the future. Share results and consult with relevant agencies (KNP, DFO, NBDNRED).

## 6.6 Action Plan 6: Restore Wild Atlantic Salmon Population

**Topic:**
Re-establishing a healthy and sustainable wild population of both juvenile and adult Atlantic salmon within the watersheds.

**Objective:**
To restore the wild Atlantic salmon populations of both juveniles and adults to a sustainable level, and enable the reopening of the recreational fishery for the area.

**Actions:**

1. Monitor and improve aquatic habitat availability, quality and access for Atlantic salmon.

2. Improve egg hatch rates by reducing pollution sources (e.g., sedimentation, warm water, etc.) and/or utilizing in-stream incubation initiatives.

3. Collect broodstock during trap-net fishing exercises to secure supply of fertilized eggs for in-stream incubation using Jordan-Scotty boxes.

4. Compile data to be evaluated now and in the future. Share results and consult with relevant agencies (KNP, DFO, NBDNRED).

## 6.7 Action Plan 7: Monitor, Evaluate and Conserve Brook Floater Population and Habitat

**Topic:**
Determining population quantities of various freshwater mussel species, with a focus on the Brook Floater (*Alasmidonta varicosa*), and compiling data collected. Freshwater mussels are important components of the local ecology as they are filter-feeders that actively clean the waterways as they feed.

**Objective:**
To gather more data and information on freshwater mussel species present within the watersheds and their habitat, and provide protection where possible; especially focusing on the Brook Floater due to its current listing as a species of special concern (SARA and COSEWIC listed).

**Actions:**

1. Detect presence/absence of Brook Floater specimen either through visual surveying (e.g., using underwater viewers and/or by eye-sight), or by use of eDNA sampling methods. Visual surveying can be qualitative in nature (e.g., evaluating condition of specimen, taking measurements, etc.); or quantitative in nature (e.g., surveying for as many specimens as possible within time-based survey of 2 hours per site – 1 hour per 2x person team). eDNA sampling initiatives can be utilized to detect presence/absence, previously undetected locations housing Brook floaters, and help further develop eDNA research efforts.

2. Other freshwater mussel species are fairly prevalent to date, however, if there is a sudden absence of any freshwater mussel species observed this should be noted and investigated further.

3. If any Brook Floater specimen are observed/detected, their location should be recorded and mapped, and their habitats should be protected and improved if needed. Brook Floater are sensitive to various types of pollutants, but especially to sediment, as it can bury them and their habitat (e.g., clean gravel-like substrate). If habitat degradation (e.g., sedimentation, pollution, predation, etc.) is a concern where they are detected, various habitat restoration methods should be considered and implemented (e.g., restoring riparian zones, posting signage to educate community members of their presence and to reduce pollution inputs if possible, etc.).

4. Fish/water passage evaluation and restoration as Brook floater rely on host fish to distribute throughout the ecosystem via glochidia attaching to fish travelling through the waterways.

## 6.8 Action Plan 8: Monitor and Evaluate Overall Aquatic Species

**Topic:**

Determining population quantities of various aquatic species (e.g., fish, eels, shrimp, crab, etc.) can provide insight into current population trends and can alert of many possible environmental concerns depending on results.

**Objective:**

To further develop data and information available on the populations of various aquatic species.

**Actions:**

1. Perform Community Aquatic Monitoring Program (CAMP) sampling with DFO annually. CAMP is performed in the estuary portion of the watersheds, and gives insight on population trends of various estuarial species (e.g., fish, crab, shrimp, eel, etc.).

2. Perform electrofishing monitoring in freshwater to assess populations of various aquatic species (e.g., Blacknose dace, Brook trout, Atlantic salmon, Lamprey, Slimy sculpin, etc.). Species such as Blacknose dace are important as they may be host fish that help transport freshwater mussel glochidia (larvae) of Brook floater to different locations. Additionally, the overall health and diversity of the ecosystem is important for various reasons.

3. Perform trap-net monitoring within watersheds using smelt box-nets. Every species captured during trap-net fishing should be identified and counted, only Atlantic salmon and Brook Trout are measured, with additional sampling performed on the Atlantic salmon.

## 6.9 Action Plan 9: Monitor and Evaluate Bird Species and Associated Habitats

**Topic:**

Gaining an understanding of existing bird species along with associated habitats within the watersheds.

**Objective:**

To further develop data and information available on populations and associated habitats of various bird species. Habitat connectivity and availability is important for many bird species, especially rare ones that our watersheds are home to, such as: Olive-sided fly catcher, Wood duck, Barn swallow, etc.

**Actions:**

1. Conduct bird species identification and surveying – in the past TFK has contacted Ronald Chiasson from the Aster group to lead these surveys and educate the staff.

2. Record, photograph, document any sightings of interesting bird species when out in the field for other work.

3. Protect and maintain any significant habitats discovered when possible (must seek landowner permission and access if needed).

4. Compile data to be evaluated now and in the future. Share results and consult with relevant agencies (e.g., KNP, DFO, NBDNRED).

## 6.10 Action Plan 10: Education and Community Outreach

**Topic:**

TFK has been continuously working towards educating and spreading environmental awareness to community members (e.g., citizens, students, etc.) for over 20 years now; however, this is an issue that needs constant effort. An educated and aware population can be a very effective tool in enhancing and protecting the overall ecosystem; as those who live and play on the river can have the largest impact on its condition.

**Objective:**

Enhance the education and awareness level of the community members**.**

**Actions:**

1. Produce and distribute educational and informative material (e.g., videos, informative posts, etc.) online via social media and YouTube channel to reach a wide audience.

2. Organize and perform scholastic presentations and activities to educate future generations.

3. Attend and present information about TFK projects at various events and/or kiosk sessions at frequented local areas (e.g., St-Louis Co-op, KNP events, etc.).

4. Recruit watershed landowners to participate in property visit assessment program; TFK will assess environmental conditions present and provide management plan that includes: lists of recommended land practices; lists of plant species currently present; list of recommended plant species for planting/land restoration work; provide free trees/shrubs and offer planting assistance if required. This action also allows watershed residents who participate in program to share knowledge and experiences with other community members.

5. Share results and successes achieved through various projects performed by TFK (e.g., Atlantic salmon population results). This has a significant impact on community pride and passion; the community cares greatly about the ecological health and the quality of the river. Seeing results and effort instills hope in the area.

6. Encourage sustainable communities and lifestyles to help restore resiliency to community and combat climate change (e.g., composting, recycling waste, reduce water-waste, etc.).

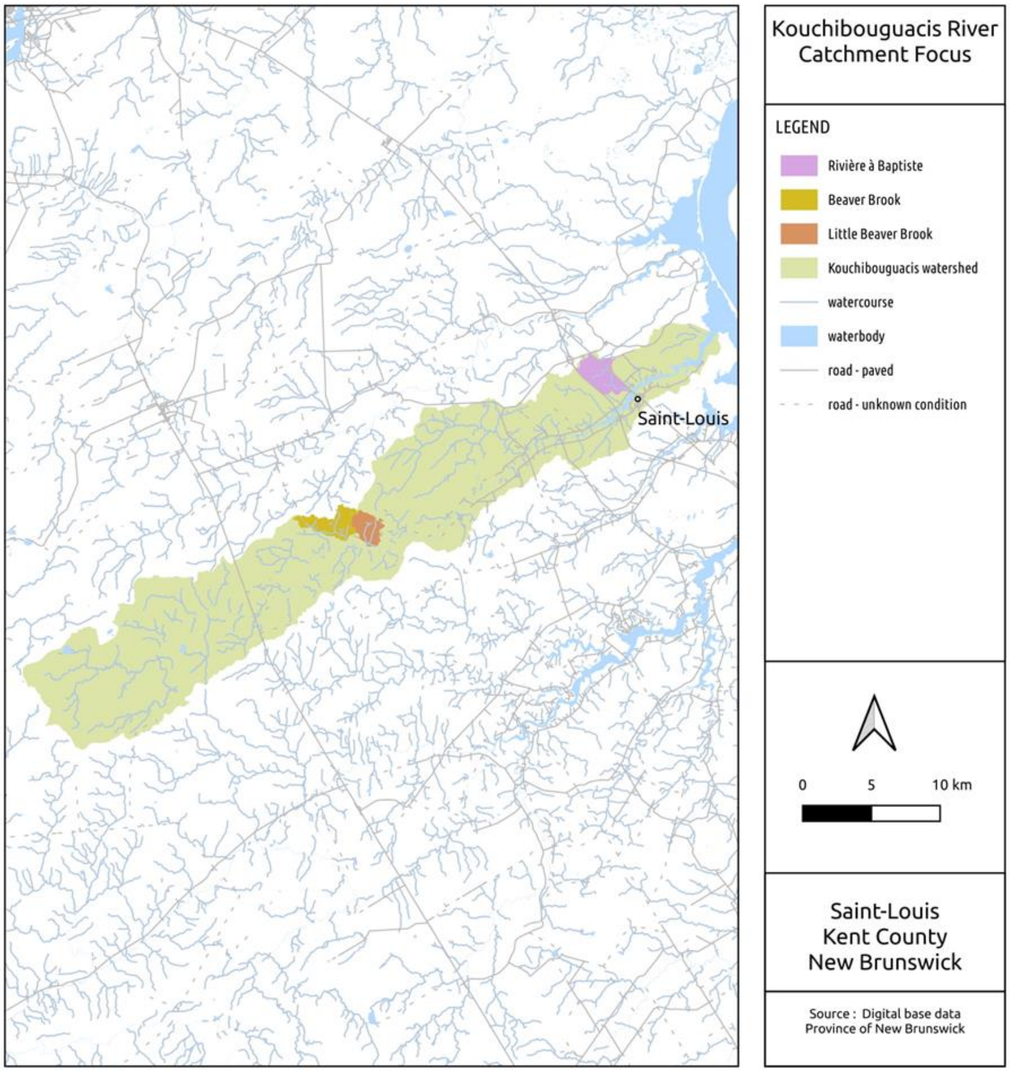
7. Initiate or assist in constructing surface water/pollution management systems such as bio-swales and/or rain gardens to help decrease strain on infrastructure.

# 7.0 Conclusion

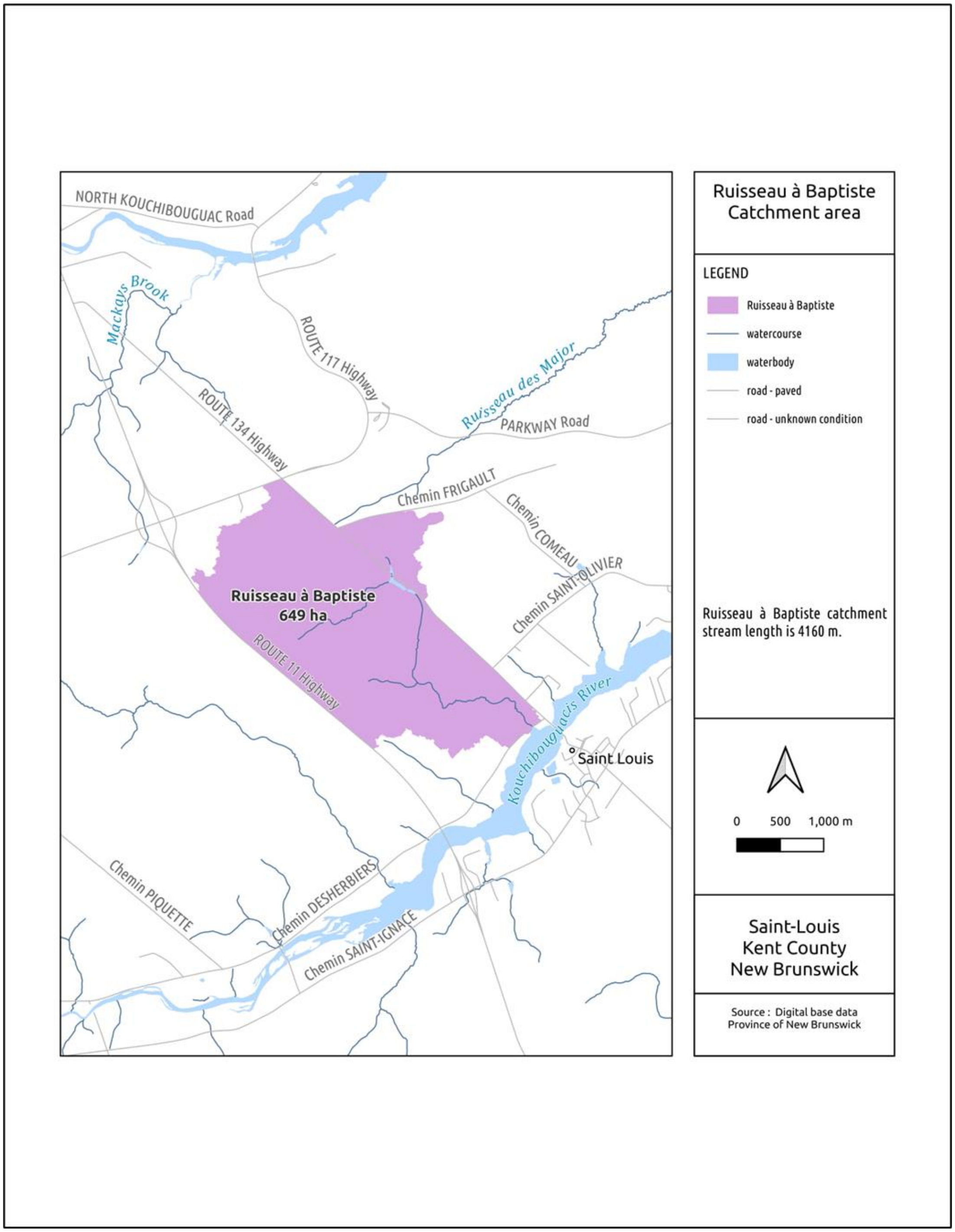
Based upon the review all of the included data and information within this management plan, the three issues of largest priority that TFK identifies as requiring attention within the Kouchibouguacis and Kouchibouguac watersheds include: sedimentation, land management, and water quality. Mitigating the effects of sedimentation and poor land management (e.g., restoring eroding streambanks, protecting and revegetating deforested land and riparian zones, restoring proper water flow, etc.), while improving water quality conducive to suiting aquatic species needs (e.g., increasing cold water inputs, reducing pollution inputs, protecting cold water fish refuges from in-filling, etc.) using the action plans and recommendations laid out within this management plan will provide the strongest foundation for TFK and the community to build off of for a healthy ecosystem now and in the future.

This document should serve as a living document, being updated annually with new information, reviewing past efforts, and to act as a guide for future work to maintain a consistent mission of restoring the cultural, social, and ecological health of the local region for generations to come.

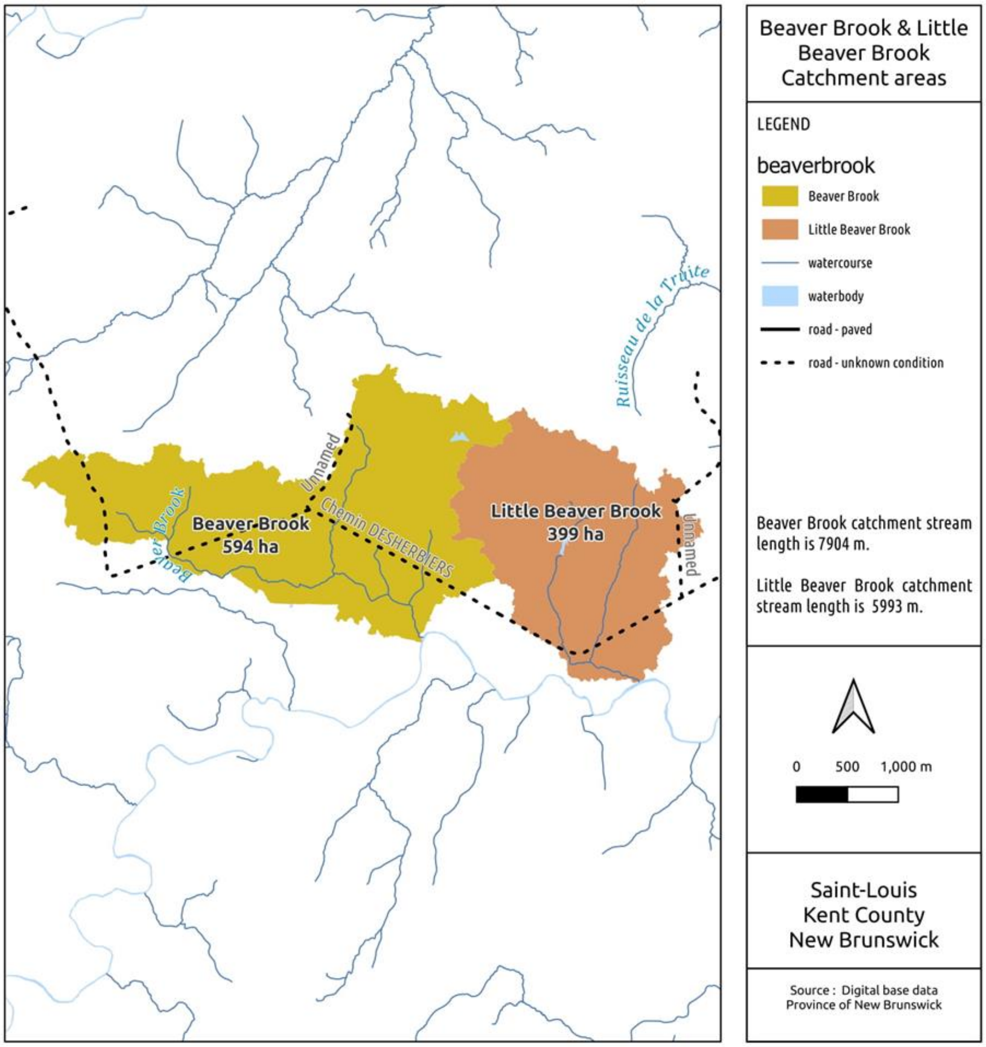
# Annexe A




**Map above displays Kouchibouguacis Watershed with three watersheds of interest**

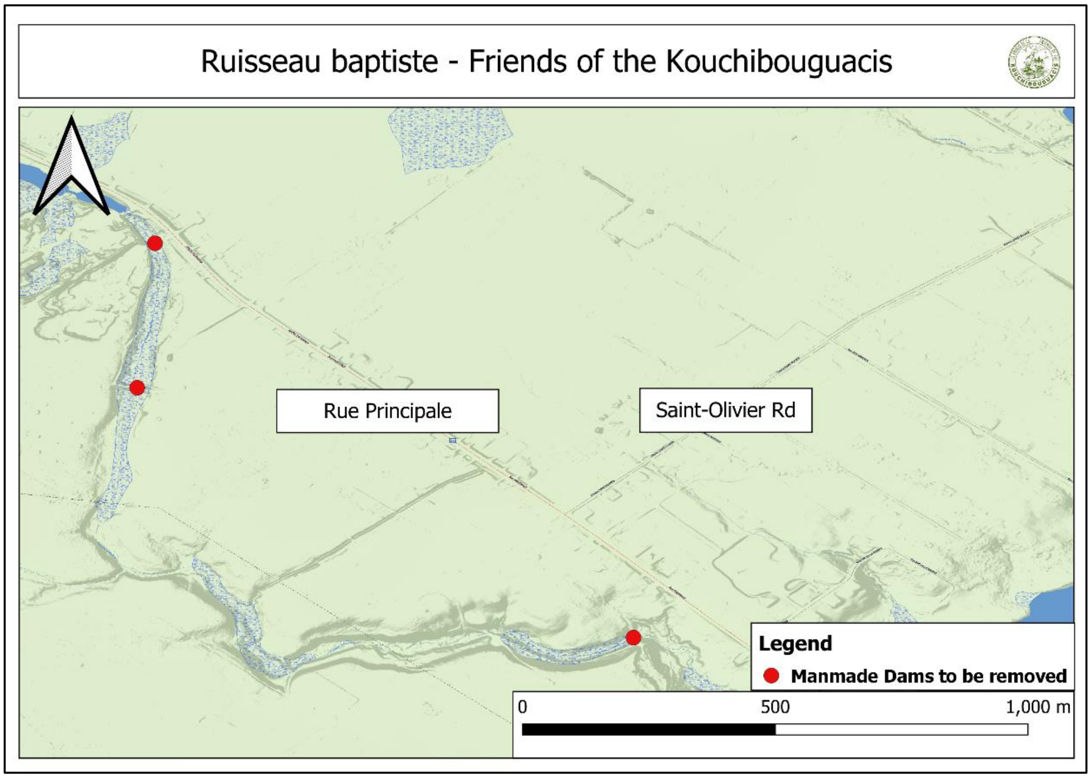



**Map above displays Ruisseau a baptiste watershed**

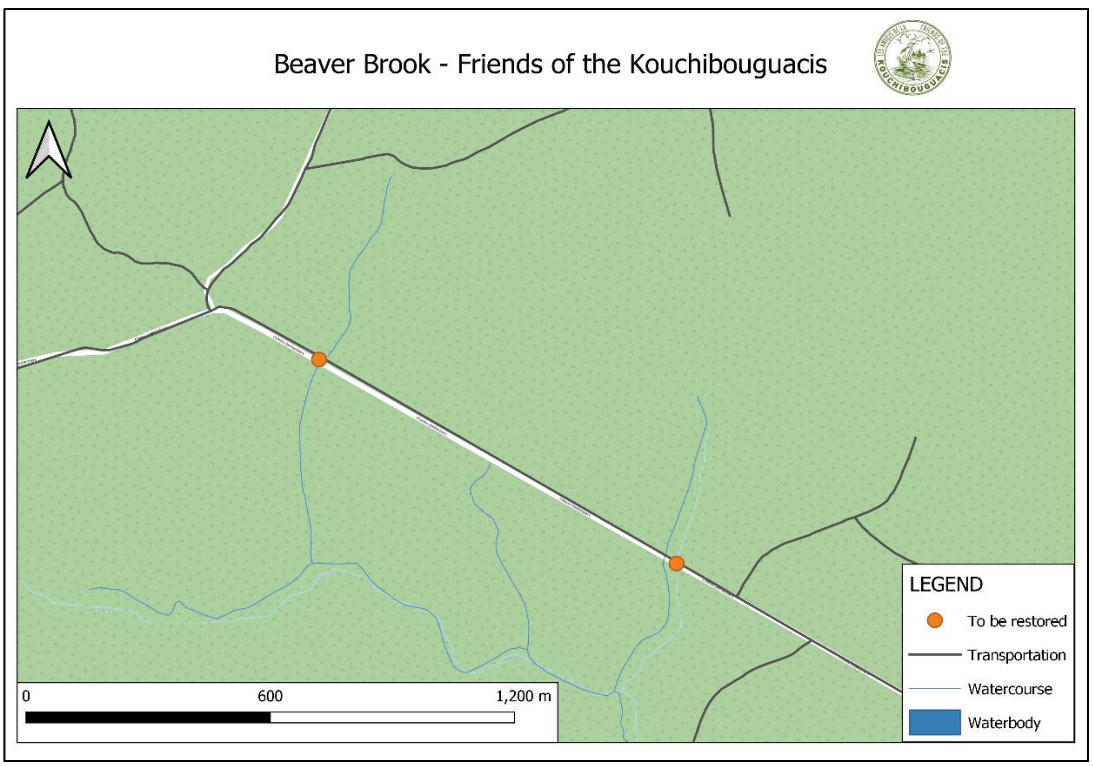



**Map above displays Beaver brook and Little Beaver brook watersheds**

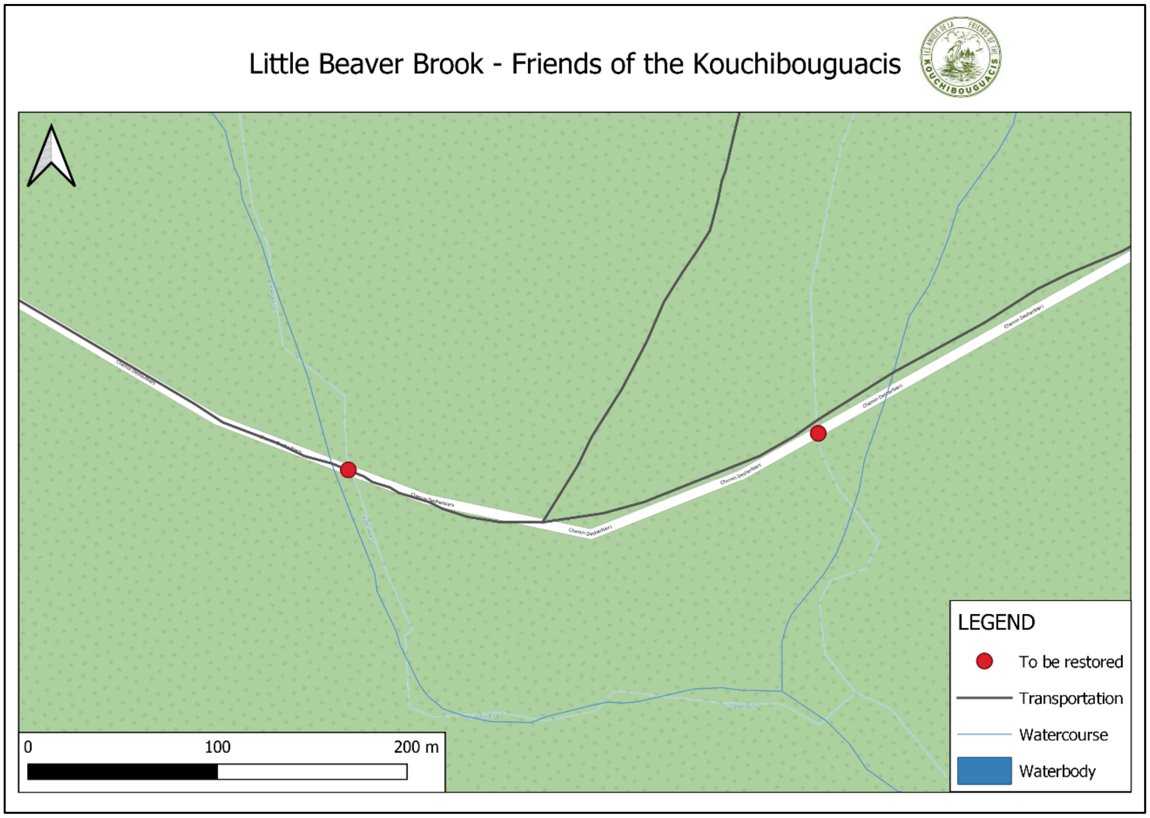
## 4.3 Land Reforestation



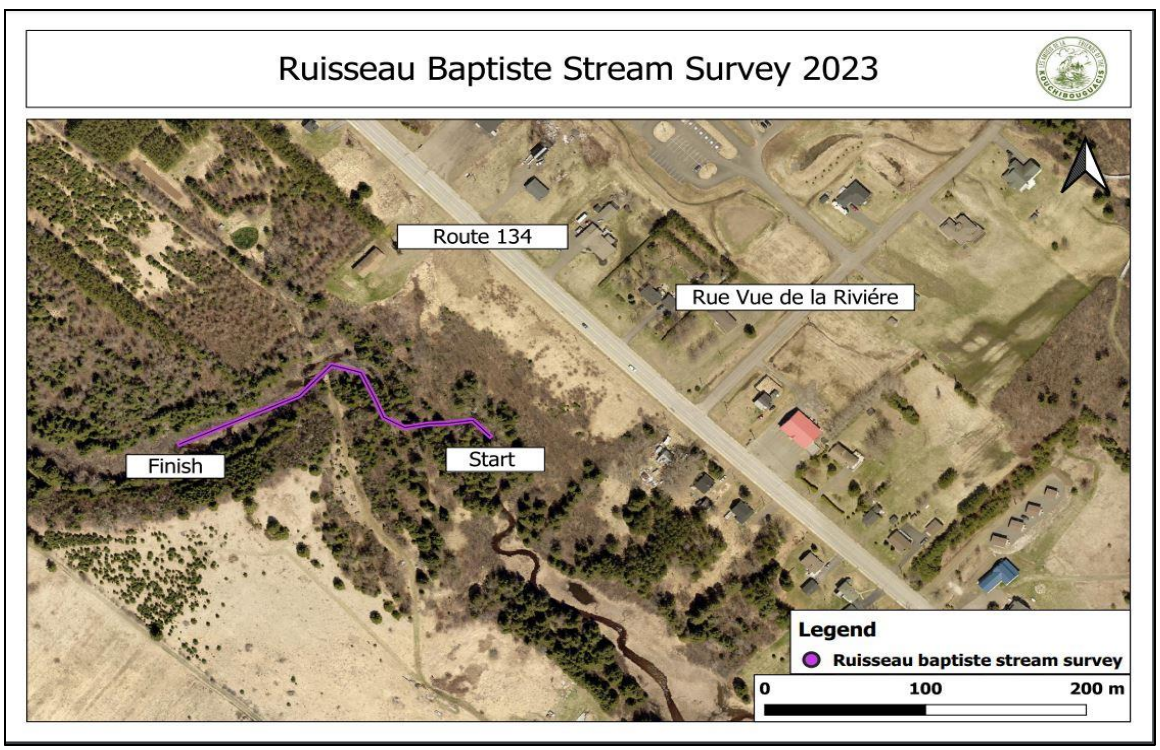

**Map above displays restoration sites on ruisseau baptiste indicated in red**



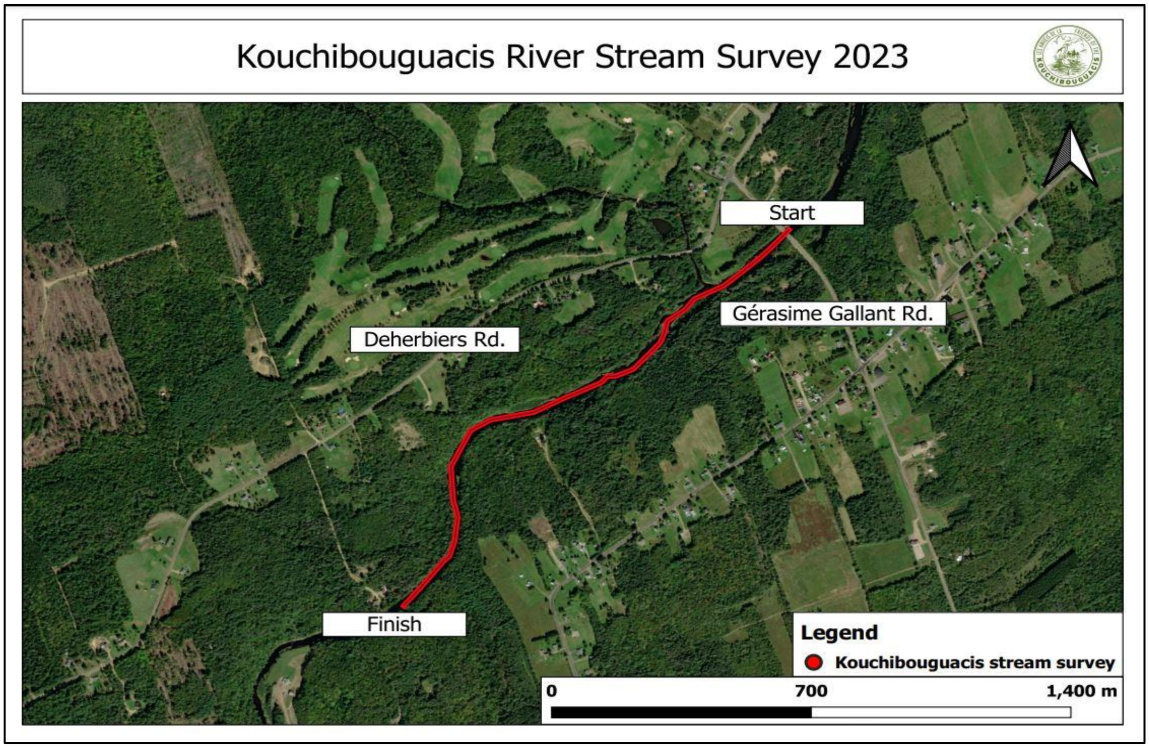

**Map above displays Beaver brook proposed restoration sites (culverts) indicated in orange.**



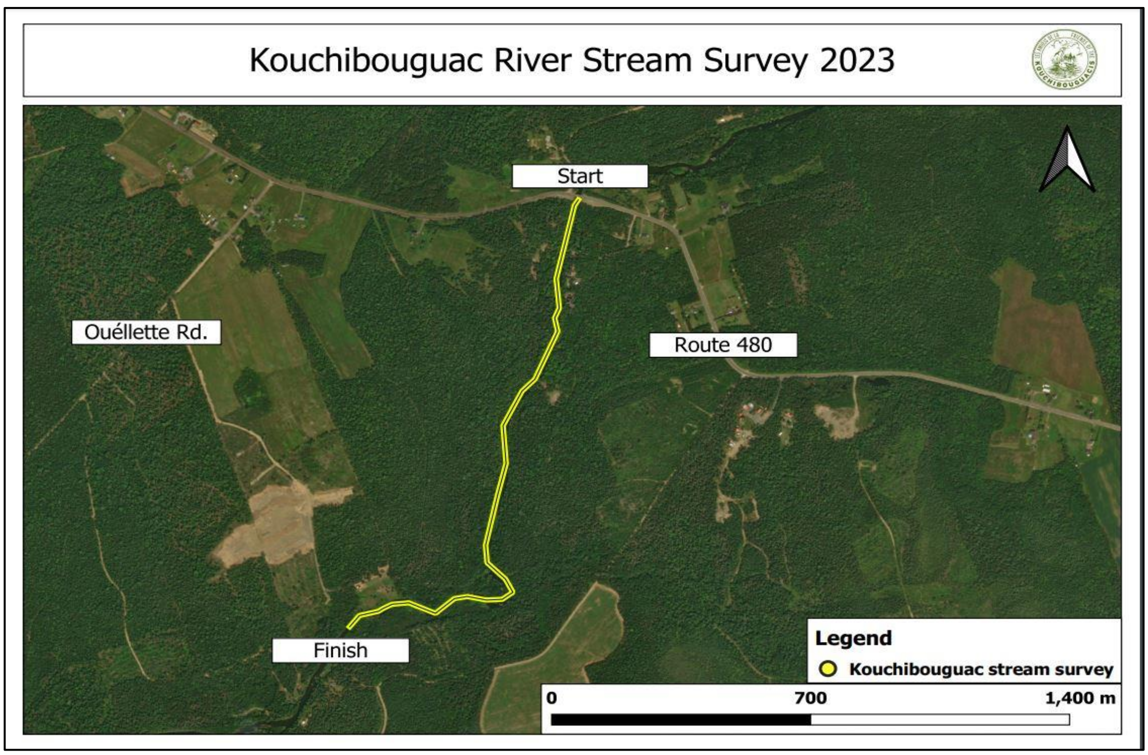

**Map above displays proposed restoration sites (culverts) on Little beaver brook.**




**Map above displays Ruisseau baptiste stream survey**




**Map above displays Kouchibouguacis River stream survey**




**Map above displays Kouchibouguac River stream survey**