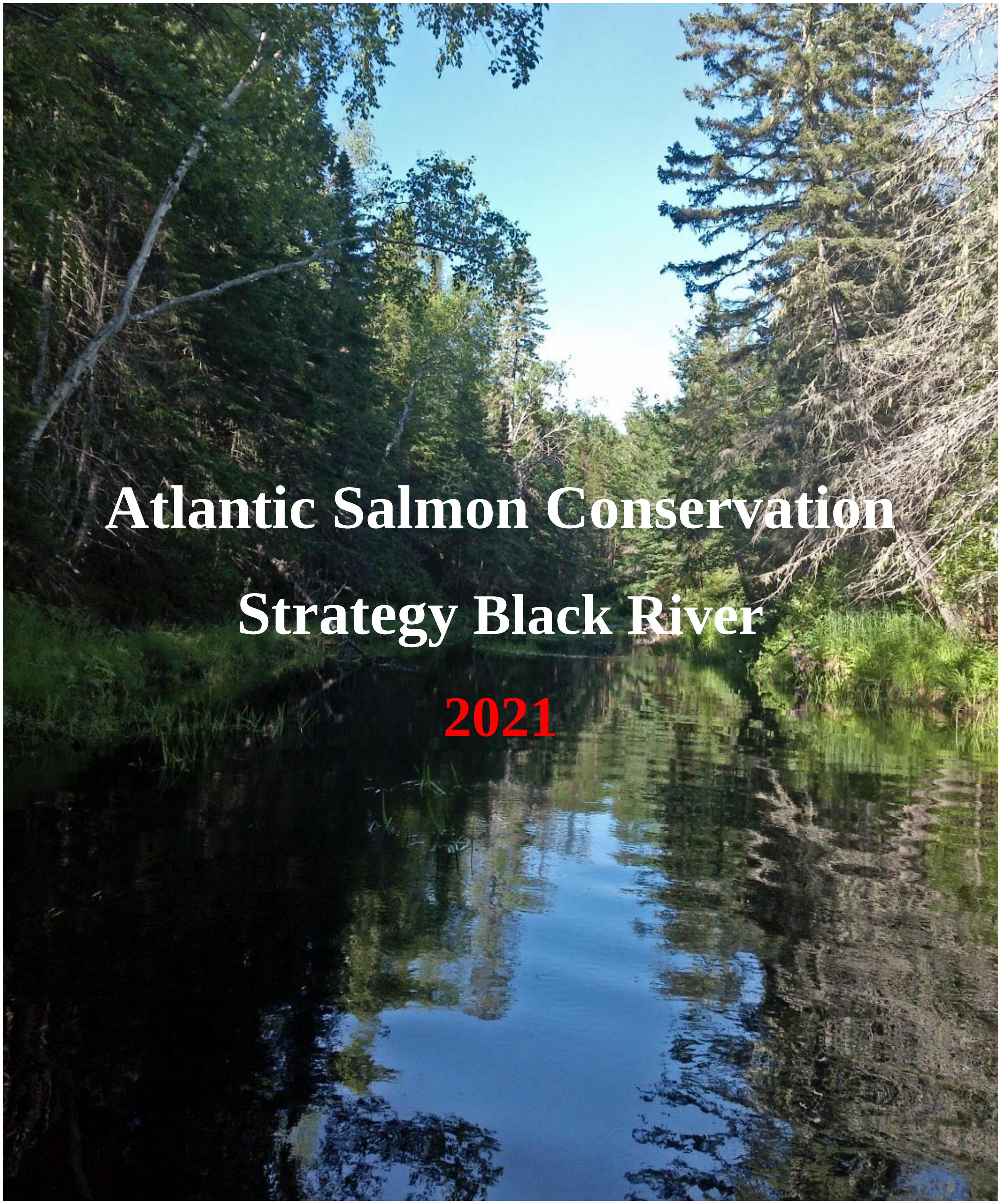
Atlantic Salmon Conservation Strategy Black River

2021



Acknowledgements

The Miramichi River Environmental Assessment Committee (MREAC) would like to thank the Atlantic Salmon Conservation Foundation (ASCF) for their funding support and this opportunity to work on Atlantic Salmon conservation on the Black River. MREAC volunteers, Quinn Cloud, Neil Collins, Bailee Fillmore, Tim Humes, Julie Lambert and Adam O'Connel also contributed to field work. Thank you all. Thanks also to NBCC-Miramichi instructor Linwood Dunham who assisted with the loan of hand-held field equipment.

Executive Summary

In 2021 MREAC was supported by the Atlantic Salmon Conservation Foundation to prepare an Atlantic Salmon conservation strategy on the Black River, tributary to Miramichi Inner Bay. MREAC staff and volunteers completed significant environmental monitoring and habitat assessment during the open water season of 2021 to contribute to the strategy. Little historic data was available on this watershed. Interviews with local recreational fishers were conducted when possible.

Based on available data, visual observations, river monitoring and communication with river stakeholders, the Black River does not appear to have habitat characteristics required to sustain a significant Atlantic salmon production. Limiting factors to Atlantic salmon production, where possible, should be addressed. Some natural limiting factors will be unsurmountable. Future efforts should concentrate on maintaining the existing ecological values that sustain the existing stock of Atlantic salmon and other indigenous fish species. This and other comparable sized tributaries in eastern New Brunswick should be assessed further to determine the actual size of the annual spawning population. Resource protection should be enhanced as human resources allow.

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1.0 Introduction

A Black River drainage basin conservation strategy was supported and completed by MREAC in 2021. Based on limited available survey data, recent monitoring efforts, other research and opportunistic interviews, we herein present the Black River Atlantic salmon conservation strategy.

The Black River sub-watershed covers an area of 277.4 km². It is known to have an Atlantic salmon population, but little is known about the size or sustainability of this population. It is not included among the scheduled rivers that limit angling to fly fishing during the annual fishing season.

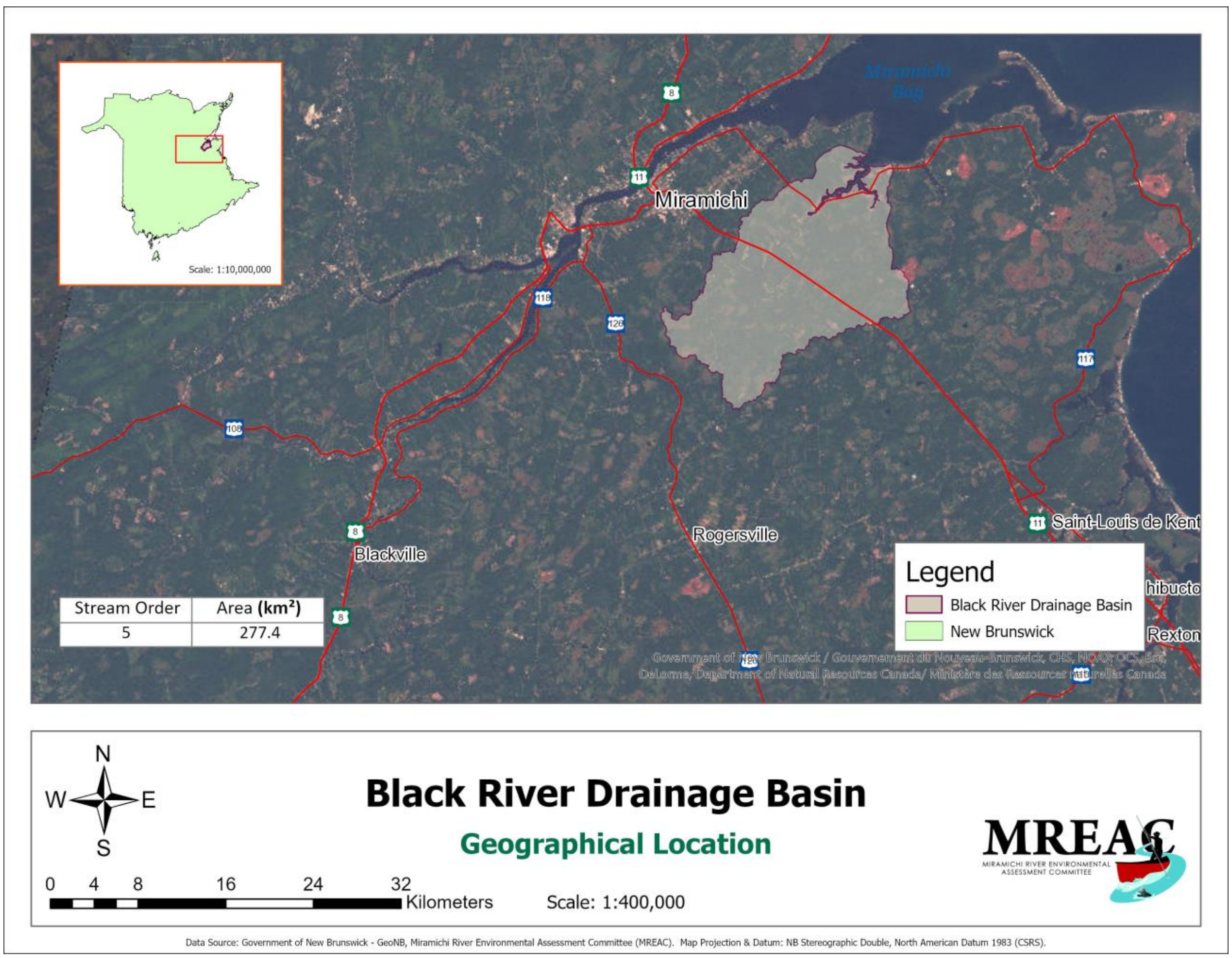

Figure 1 Black River Watershed

On the approximate 36-kilometre length of the main branch, 17 kilometres were travelled by canoe. Two one kilometer reaches, one on the Black River, main branch, and the other on the Little Black River were surveyed, applying the detailed fish habitat assessment protocol. Five temperature loggers were deployed at widely distributed locations, including locations on three tributary streams. Four of these five were successfully recovered and provide a four-month long temperature profile from each site. An electrofishing site was surveyed along a riffle reach of Sturgeon Creek. (Figure 12). This has contributed to the habitat assessment and to the overall conservation strategy.

The Miramichi River watershed with her many tributaries remains an important refuge for Atlantic salmon in New Brunswick, Canada. The Black River is among some orphan waterways within the much larger Miramichi drainage basin in the sense that it has not been adopted into the big picture of Miramichi River Atlantic salmon management. As such, relatively little is known about the level of salmon angling and the river's potential in producing Atlantic salmon. In 2021, with ASCF support, MREAC undertook the preparation of this Atlantic salmon conservation strategy on the Black River to bring it into the Miramichi family. Temperature monitoring, field surveys, habitat assessment, electro-fishing and opportunistic interviews were completed in 2021 to contribute to this strategy. A redd count on the Black River was not possible due to the dark colouration of the water that seriously limits visibility. The river name is appropriate. This 2021 work on the Black River cannot determine the current level of Atlantic salmon production. The report does consider the rivers limiting factors, approaches to sustain the existing level of salmon production, and the prospect of enhancing that production.

In discussions with recreational fishers, with New Brunswick Department of Energy and Resource Development staff and as confirmed by electrofishing, Black River does have resident Atlantic salmon. One trout fisherman complained about salmon parr persistent in stealing his trout bait.

Trout were the target species to the few local fishers we encountered on the freshwater reaches of the river. Sea trout fishing and Striped bass are the recreational fishing target on the Black River estuary. Like other rivers of this scale in eastern New Brunswick the Black has a fall run of spawning salmon. The relatively few camps and cottages on the Black River suggest the limited level of appeal to recreational angling.

During field surveys approximately 17 kms of the approximately 36 km length of Black River, main branch, was covered by canoe. Habitat assessment reaches and water quality sampling was completed by wading.

Figure 2 Black River Headwaters

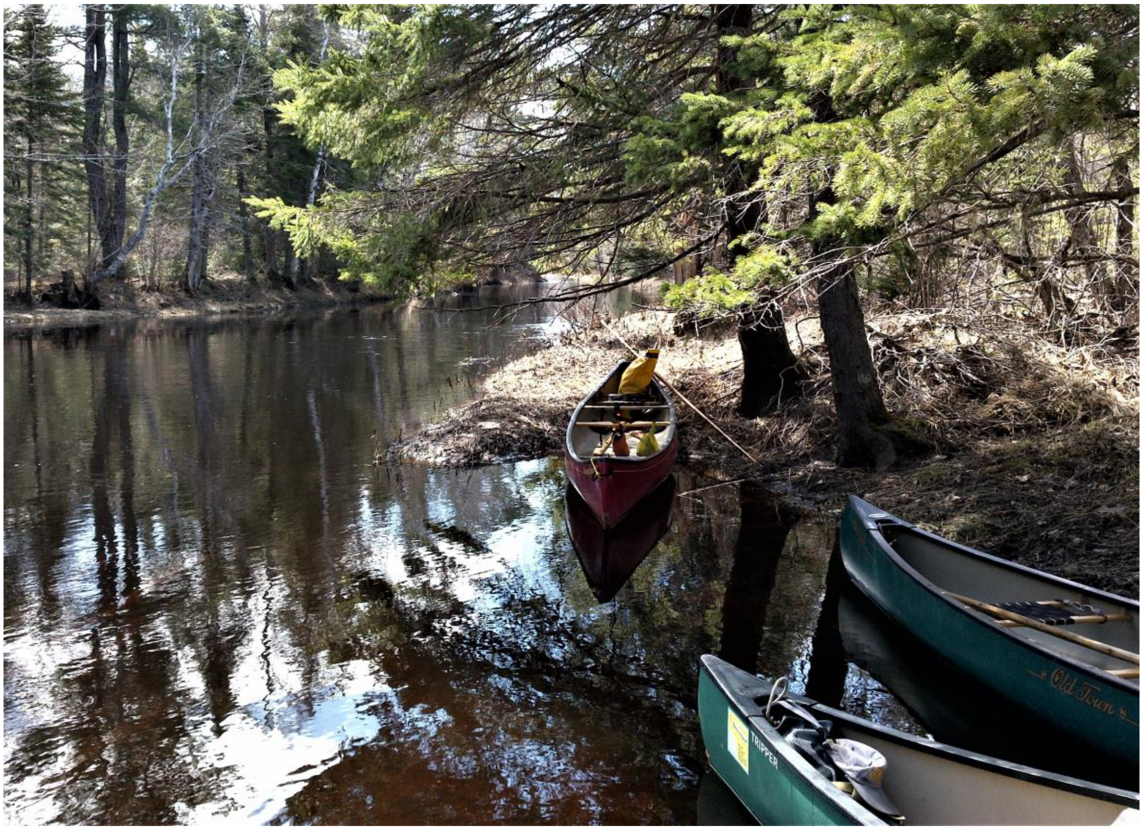

Figure 3 Black River - Middle Reach

2.0 Conservation Strategy Objectives for Atlantic Salmon on the Bay du Vin River

1. To maintain the ecological and recreational fishing values that the Black River currently possesses.
2. To conserve and protect existing recreational Atlantic salmon stocks and their habitat.
3. To maintain and ensure access to existing recreational fishing opportunities and experiences.
4. To contribute to existing environmental knowledge and tap into the existing traditional knowledge through monitoring and interviews of recreational fishers, respectively.

5. To promote the cooperation and support of residents, landowners, recreational users, and other interested parties to support effective management of the recreational fisheries resources.
6. To promote equity and fairness for all users in the application of management measures for the recreational fisheries.
7. To present a long-term strategy to conserve and maintain recreational fishes and their habitat.

Figure 4 Black River - Estuary

3.0 River Setting and Access

The Black River drainage basin lies in Northeastern New Brunswick and covers 277.4 km² (Figure 1). The basin contains the main branch Black River and an appropriately named tributary, Little Black River. Several named smaller tributary streams are included in the basin. Wells Brook and Sturgeon Creek were selected as monitoring streams to supplement the temperature monitoring data base. The basin runs in a southwest to northeast direction and empties into the Miramichi Inner Bay.

There is a close to even mix of crown and private lands on the Black River. In the lower reach, east of Hwy 11, private ownership is predominant. Crown land predominates west of Highway 11. Most of the public land is managed under lease to Chaleur Forest Products Ltd. (Figure 5). The Black River estuary extends for 8 kilometers before discharging into Miramichi Inner Bay. Along the tidal waters the shoreline is more developed with several year-round residents and farmlands. Some commercial fishing occurs along the estuary.

4.0 Physical Setting and Climate

In 2021 conditions were wetter and cooler than the record-breaking drought and heat of 2020. Climate Normals (1971-2000) show a mean July temperature of 19.2°C and a mean January temperature of -10.7°C. The mean annual precipitation is 1,115 mm and the drainage basin receives an annual 1993.4 total hours of sunshine (Environment Canada, 2013).

The past decade has shown that summer temperatures are on the rise, and this is in keeping with the expected climate change scenario. The rainfall amounts have been more erratic but have tended to be drier.

The Black River drainage basin is part of the Eastern Lowlands Ecoregion (Figure 6).
This makes the Black a low gradient river with an average drop of approximtely 1.4 meters per kilometer.

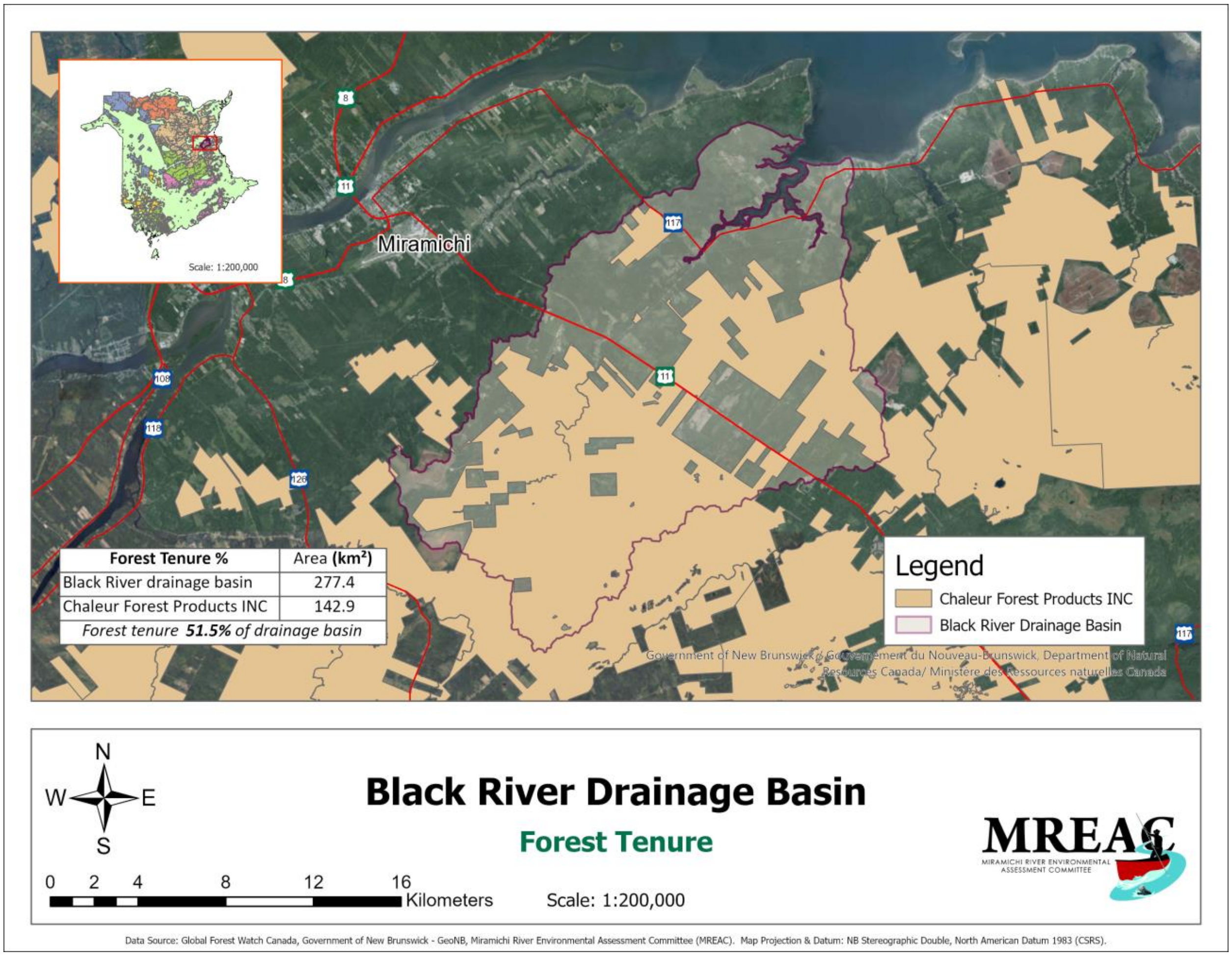

Figure 5 Black River Forest Tenure

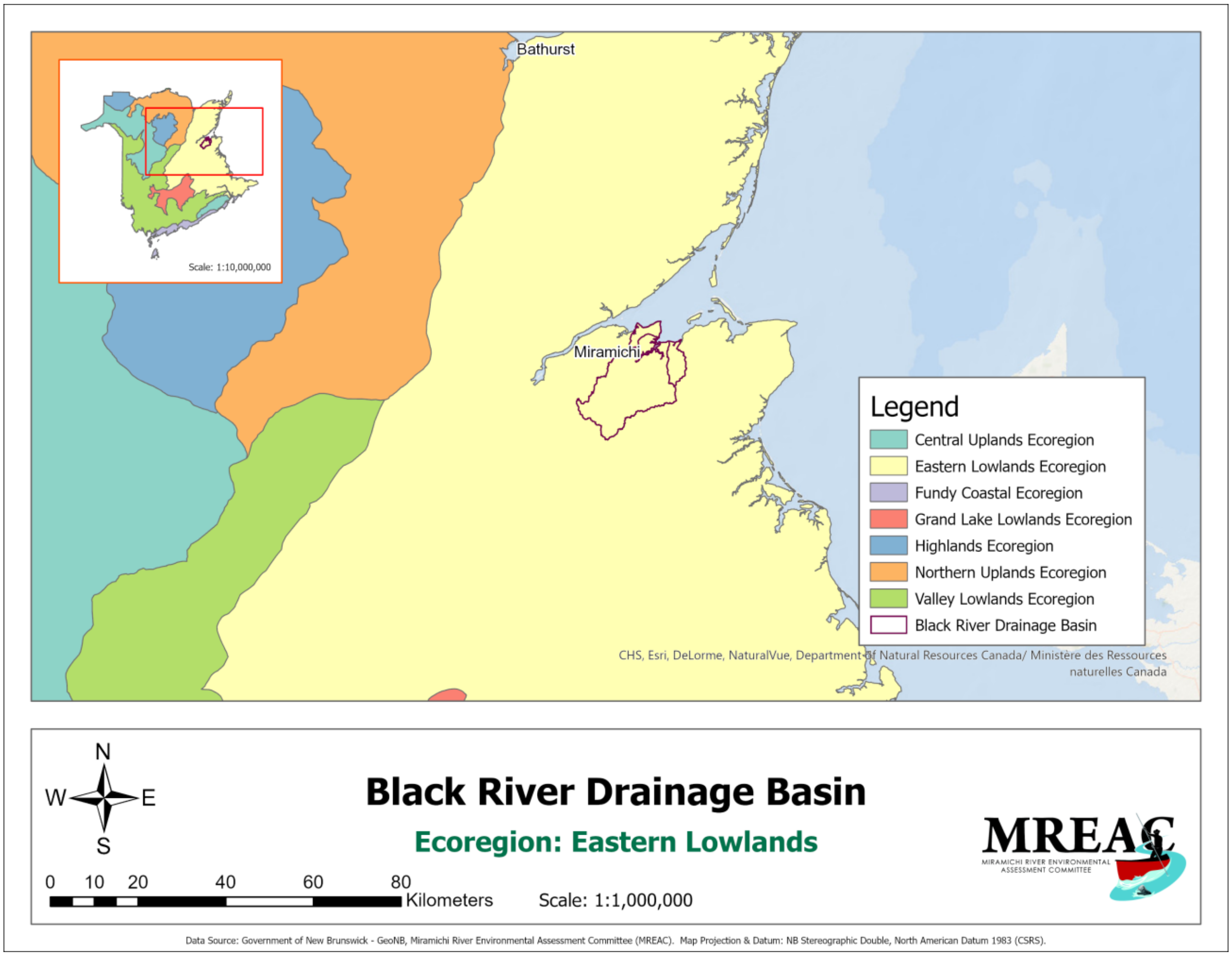

Figure 6 Black River within New Brunswick Ecoregions

5.0 Geology

The bedrock geology of the Black River drainage basin is typical to that of the eastern lowlands ecoregion which is generally composed of grey sandstone and red mudstone. The stratum is dating to the Carboniferous (Pennsylvanian) geologic era (Figure 7) (NBDNR, 2009). Exposed bedrock is a prominent feature of stretches of the river bottom with little other surficial material as a cover.

The surficial geology of the Black River drainage basin is primarily composed of silt, sand, gravel, rubble, loamy lodgement till, and minor ablation till. The organic sediments found in bogs or fens are typically 1 to 5 meters thick.

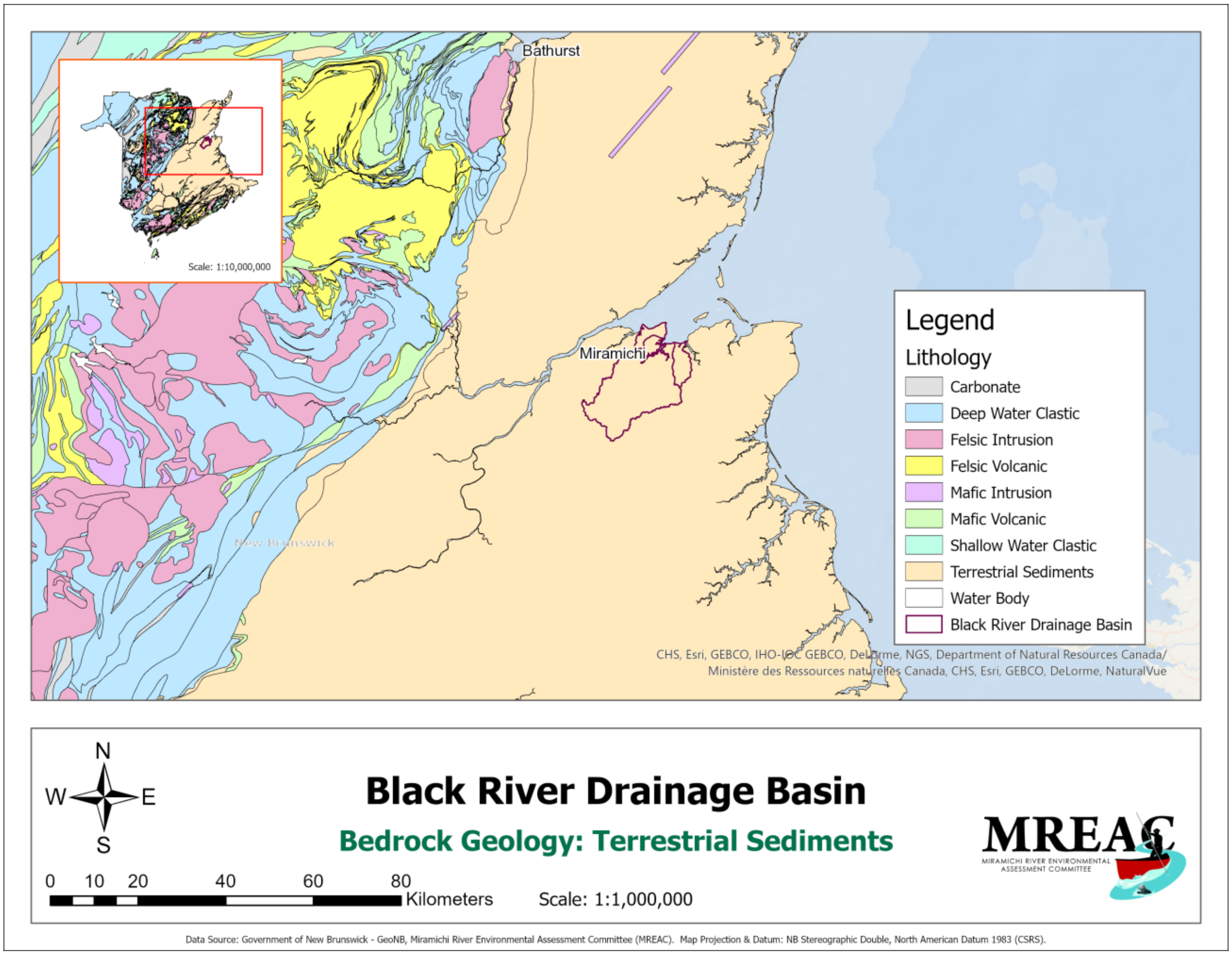

Figure 7 Black River Geology

6.0 Land Cover and Land Use

The predominant land cover within the Black River drainage basin is forest at 64.7%. Forestry is the main economic activity on the watershed and has the greatest anthropogenic impact on the watershed. Most of the forest harvesting is industrial scale work by Chaleur Forest Products Ltd. as the lease holder of the crown lands. Harvesting on private woodlots is also common. Forestry is followed by other activities as shown in Figure 8.

Wetlands comprise 14.6% of the landscape and are concentrated toward the headwaters but are otherwise widely distributed   These areas lack good substrate for spawning with alder choked, slow moving, organic rich river bottom. Drainage from the wetlands is also proven quite acidic and dark colored due to tannins and the humic acid generated in this environment.
This high proportion of wetland also has a significant impact on water quality and by extension reduces the quality of fish habitat. One peat bog in the headwaters is situated on the divide, adjacent to the Napan River watershed. Peat harvesting is operated by Sun Gro Horticulture Canada Ltd. Most of the agricultural lands (3.7%) are concentrated along the tidal waters or near the Northumberland Strait.

There is no active tracking of the level of recreational fishing activity and no resource data available on Atlantic salmon (Pers Comm: Mr. Bernie Dubee, provincial fish biologist {retired} and Rod McEasheron, NBDERD). One particularly active angler on the Black River was encountered and willing to offer local insights.

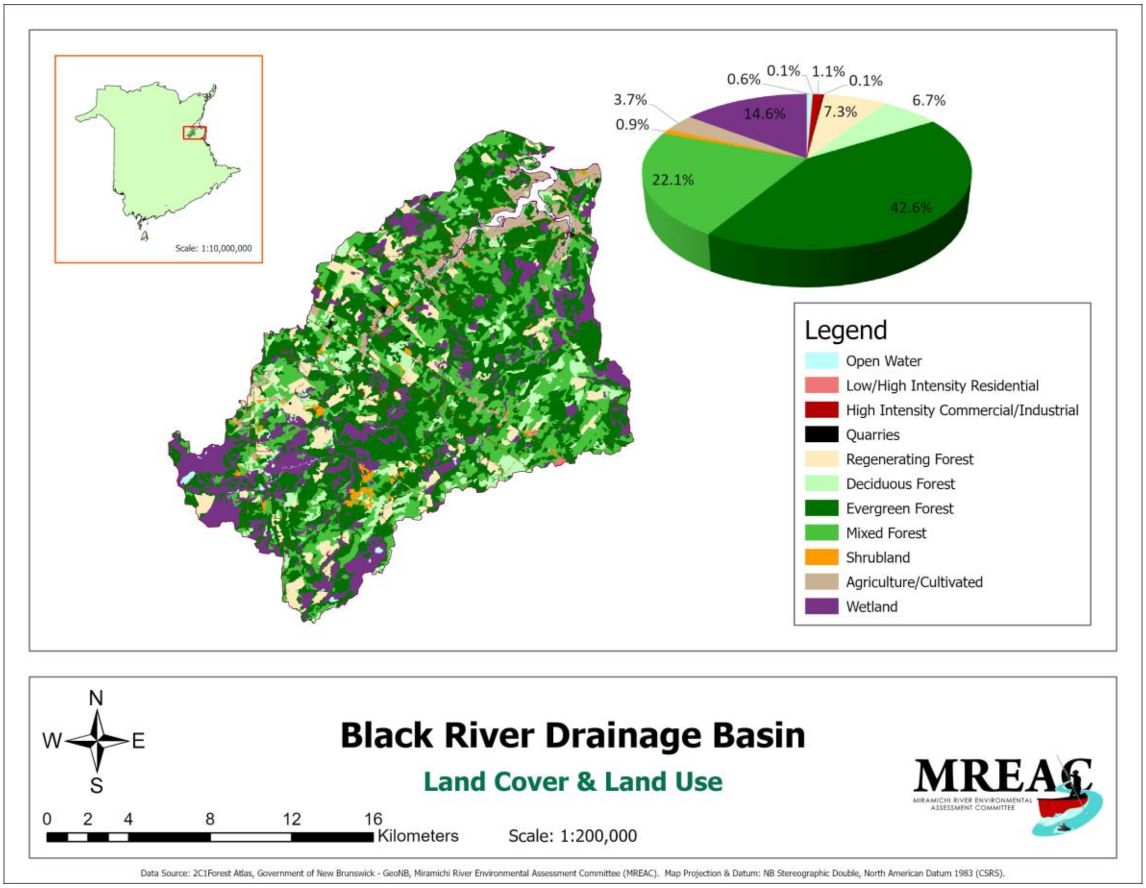

Figure 8 - Black River Watershed - Land Cover and Land Use

7.0 Beaver Dams

Based on available maps, much of the headwaters on the Black River appear accessible to Atlantic salmon spawning. However, the road access to these headwaters is limited and beaver activity may be more of a factor than realized. Additionally, the topography, land type (i.e. wetlands) and physical factors (i.e. water quality) suggest poor Atlantic salmon spawning and rearing habitat in the headwaters. Beaver dams were not a prominent feature on the lower reaches of the Black River or Little Black, but lack of accessibility may again be a factor. No other impoundments or barriers that would impede spawning were encountered in 2021.

8.0 Habitat Assessment

Considerable effort was applied to assess habitat conditions. The detailed results of these efforts are found in the appendices. These include an electrofishing report by R.A Currie Limited (Appendix 1). In 2016 a site on the Black River was assessed using the Canadian Aquatic Biomonitoring Network or CABIN (Appendix 2). Four of five temperature loggers disbursed through the watershed were successfully retrieved and these results displayed in Appendix 3. Appendix 4 contains the field sheets of a provincially and federally accepted protocol, the DNR&E / DFO – New Brunswick Stream Habitat Inventory. Finally, habitat conditions as reflected in a general chemistry of river water are found in Appendix 5.

The two stream habitat surveys were completed on the main branch of the Black River and on the Little Black River (Figure 12). These reaches were chosen based on their accessibility and distribution and offer representative sections of these waterways. Both reaches covered a distance of one kilometer. The results showed in-stream physical conditions conducive to rearing Atlantic salmon. The DNR&E / DFO – New Brunswick S field forms (Appendix 5) indicate that the overall physical characteristics show favorable conditions in the number and depth of pools, available shade, potential cover with woody debris, bank stability, and vegetation along banks. Outstanding however is the dark colour of the water in “Black River”. Fish biologist Rod Currie suggests that this may be a significant problem for fish foraging when visibility is poor (see Appendix 1).

The water temperatures at the four logger sites indicate that the temperature reached or exceeded a 23°C salmonid thermal stress level at all sites. The temperatures at the upper logger, main branch was the warmest and Sturgeon Creek was the coolest. A composite display of these logger results in shown in Figure 13. The four temperature logger graphs are shown in Appendix 4. High temperatures are now common on most tributaries of the Miramichi watershed. Extended periods of these stress level temperatures are of greatest concern. As a fall run river, adult salmon are not at risk. Resident juvenile salmon will seek out cold water pools to wait out these conditions. The temperature profiles extend for over four months with deployment of loggers in the spring and extraction in the fall. The Black River with a smaller and shallow watercourse will get warmer quicker during the hot days and get colder quicker when the ambient temperature drops. Warm and shallow conditions relegate the Black River to a fall run river.

Figure 9 Fish Habitat Assessment

The electrofishing site was fished by Mr. Rod Currie, fish biologist, on September 21 (Figure 12). Rod was supported by Kate Currie, one MREAC staff, and two student volunteers (NBCC-Miramichi). The results, were disappointing and produced only juvenile salmon fry. These salmon fry were undersized for their age based on the time of sampling. Rod's full report, **"**Results of Fish Population Survey on Sturgeon Creek September 20, 2021" is included as Appendix 1. The author, Rod Currie, makes an informed comment on the status of Atlantic salmon on the creek as follows:

> "It is believed that the quality of the water was less than optimal for ideal fish production. The dark, tea coloured water indicates an abundance of tannins and humic compounds which usually indicates acidic water. The reduced visibility in the dark water also likely impacts the feeding efficiency of fish that depend on sight to find food items." (pg. 4).

Also noteworthy, the CABIN protocol as applied in 2016, indicated a strong diversity of macroinvertebrates but low abundance,

The major economic activities in the watershed, lumber harvesting, a peat production operation and limited agriculture production do not appear to pose any significant threat to fish habitat. Poaching on the river was identified as an issue by a recreational fisherman.

Figure 10 Electrofishing Team - Sturgeon Creek

9.0 Water Quality

Water quality monitoring on the Black River in 2021 indicated that most parameters show conditions are acceptable to support fish populations, including Atlantic salmon. Appendix 6 shows the general chemistry results taken in 2021. The general chemistry sample was processed by the RPC Laboratory (Fredericton). These results were compared to the Canadian Council of Ministers of the Environment's (CCME) Water Quality Guidelines for the Protection of Aquatic Life. No issues were noted.

Water temperature, however, is a water quality issue that has increasingly become a limiting factor for Atlantic salmon on the Black River, and elsewhere. As a smaller scale shallow river, water temperatures, especially those in recent years, have resulted in temperatures above the stress threshold of salmonids. River management on the Miramichi main branches use a sustained threshold above 20°C as a trigger for the “warm water protocol”. Twenty-eight of the better-known Miramichi pools were closed to fishing later in the summer of 2021 due to the hot weather conditions that directly impact water temperatures. Water quantity is another limiting factor, and between water temperature and water quantity the Atlantic salmon spawning run on the Black River is limited to more favorable conditions in the fall.

Dissolved oxygen levels have been acceptable in repeated monitoring over multiple visits during 2021. The river’s pH values are generally withing an acceptable range but tend toward being acidic. The wetlands, mostly bog and fen, are acidic environments and drainage from these would contribute to this supressed pH. The dark colour of “Black River” is felt to be a significant limiting factor. The electrofishing report (Appendix 1) suggested that as trout and Atlantic salmon depend on sight to forage, the poor visibility is likely an issue.

Sedimentation issues appear to be minimal. Some river fording sites were noted in the spring river reconnaissance but none seemed to contribute significant sediment to the watercourse. There is no delta at the river mouth to suggest the river deposits large amounts of sediment.

Recommendation: The Black River should be included in a comprehensive monitoring program of water temperature in eastern New Brunswick rivers to monitor long-term trends with the intent of providing special protection of colder water streams and pools as fish refuges.

Recommendation: Monitoring of the Black River Hwy 11 site for pH levels should continue annually in late winter and spring.

Figure 11 Black River Fording Site

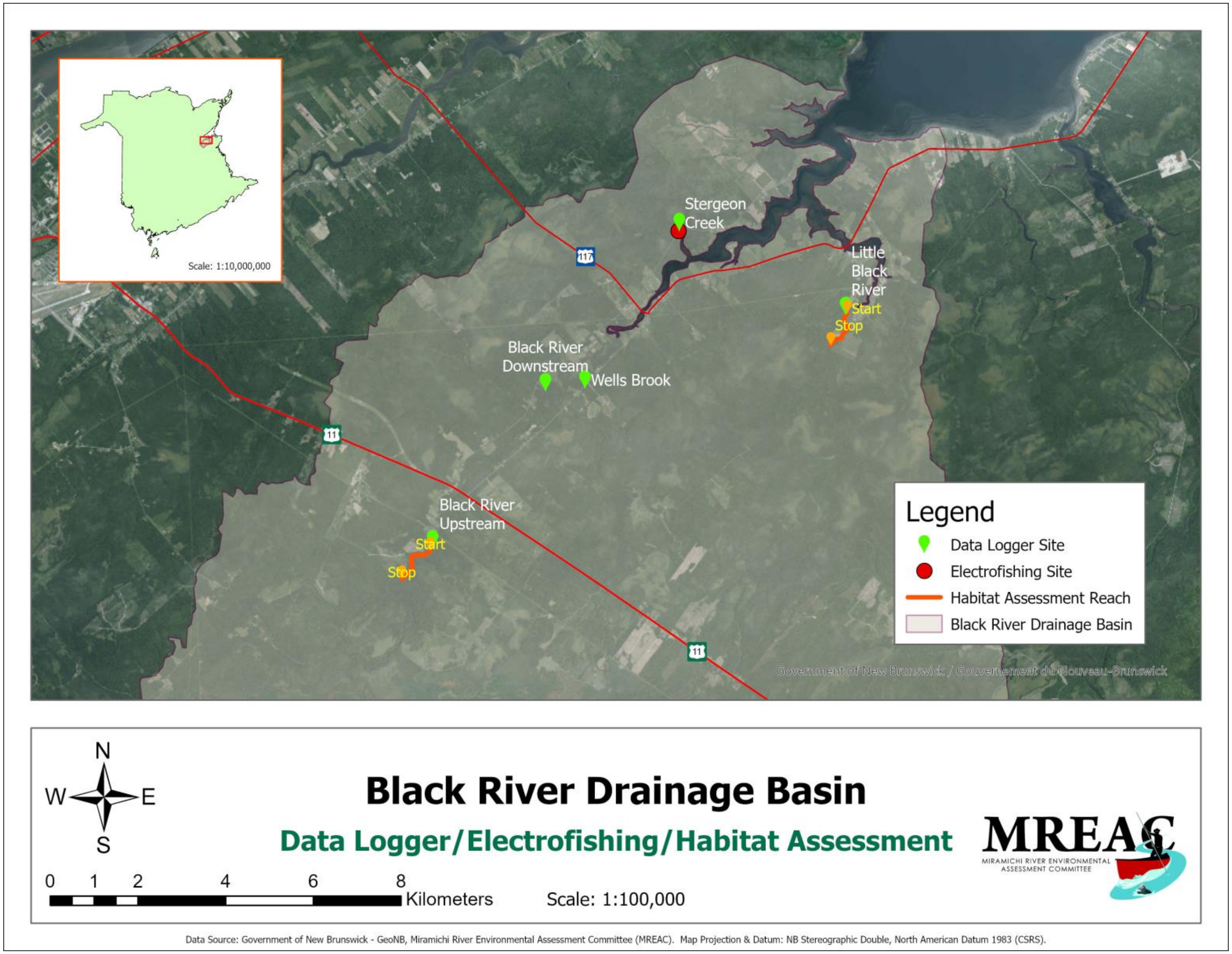

Figure 12 Black Rive Temperature Logger Sites / Habitat Assessment Reaches

The following Figure 11 represents a water temperatures composite from the four Black River watershed sites from 2021 monitoring. (Profiles from each of the individual sites is presented in Appendix 4). The data loggers were deployed for 19 to 20 weeks from May to September 2021 to capture the warmest summer days and fish angling season. The smaller waterways, Sturgeon Brook and Wells Brook contained the cooler conditions while the wider river sites on the Black River main branch were warmer. The warmest was found at the upper Black River site about midway in the watershed.

10.0 Land Tenure

A review of private land holdings along the Black River (GeoNB) show some sizable freehold properties that exceed 25 acres. These properties are concentrated toward the east end of the watershed and the tidal waters near the river mouth. Navigating the river revealed no lumbering that cause sedimentation or significantly removed canopy cover. The risks remain among these properties for poor management of these woodlots that could lead to siltation and increased heating of the waterway. By working with the Northumberland Woodlot Owners Association, best management practices on these properties can be promoted.

> **Recommendation**: Strategies to promote the use of best management practices among private woodlot owners should be promoted through the woodlot owners' association**.**

> **Recommendation**: Strategies to promote shoreline protection and river stewardship should include full time residents along with camp and cottage owners.

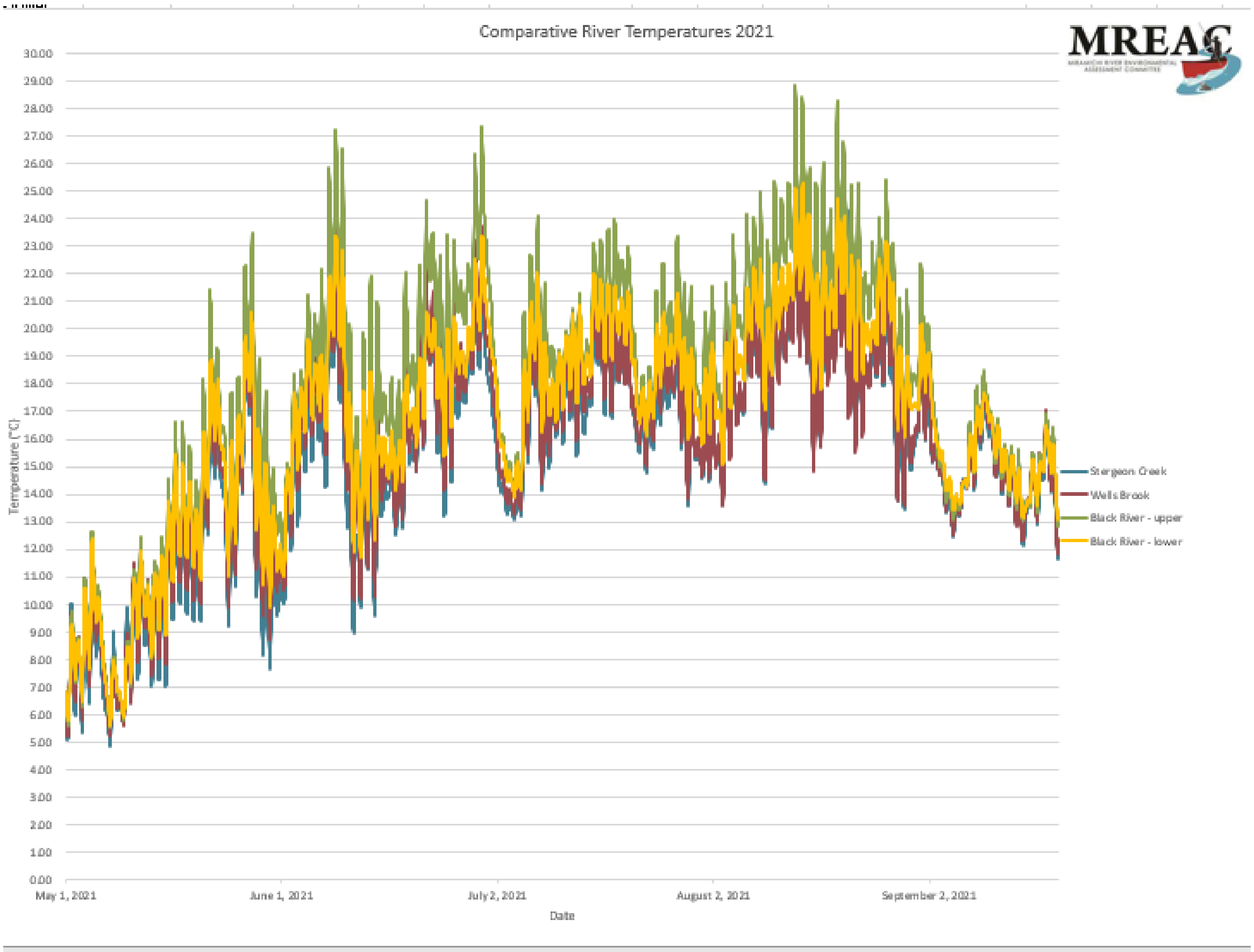

Figure 13 Temperature Loggers - Composite of Four Sites

11.0 Conclusion

The Black River is a relatively small, intact waterway with an extant Atlantic salmon population. The watercourse is protected in part by its relatively low profile, small scale, and remoteness amid the higher profile tributaries on the Miramichi. Atlantic salmon apparently receive limited attention from recreational fishers. The threat of poaching was flagged as an issue but its impact is unknown. The limited fishing pressure on this waterway suggest the Atlantic salmon stock, albeit small, is not in peril.

MREAC monitoring and research on the Black River in 2021 was important to the development of this strategy as little historic information was available on this waterway.

Climate change impacts, as they increase, will be problematic on this waterway. Already suffering high temperatures during the peak of summer, the habitat for juvenile salmon seems limited at best and will not likely improve in face of warming conditions. Apart from temperature, the water clarity and somewhat suppressed pH level are the other environmental parameters that limit fish production.

Industrial forestry, as the major industrial use on the Black River and most of New Brunswick, continues to be blamed for the "flashy" nature of quickly raising and quickly falling water levels, with negative impacts on salmon habitat conditions. Despite forestry, the largely intact riparian zone and relatively narrow channel on the Black River allows for good shading.

The waterfront properties that have camps, cottages or full-time residents are relatively few.

Based on the data analyzed, visual observations recorded, and personal communications with landowners and stakeholders, the Black River does not appear to have significant production of Atlantic salmon. However, the current limited pressure from recreational fishers suggest that the existing salmon stock is currently secure. Increasing impacts from a warming climate suggest the future of a sustainable salmon stock on the Black River, over the long term, is in question. In the interim, finding ways to implement the recommendations from this conservation strategy will stabilize the Atlantic salmon stock over the shorter term.

All this considered, the future of Atlantic salmon on Miramichi waterways, including the Black River, seems more likely to be determined by far reaching global factors than local limiting conditions.

12.0 Summary of Recommendations

Recommendation: The Black River should be included in a comprehensive monitoring program of water temperature in eastern New Brunswick rivers to monitor long-term trends with the intent of providing special protection of colder water streams and pools as fish refuges.

Recommendation: Monitoring of the Black River Hwy 11 site for pH levels should continue annually in late winter and spring.

Recommendation: The CABIN protocol site on the Black River should be included in a regular monitoring by ECCC to track the ecological condition of the macroinvertebrate population on this waterway.

Recommendation: Strategies to promote the use of best management practices among private woodlot owners should be promoted**.**

Recommendation: Strategies to promote shoreline protection and river stewardship should include full time residents along with camp and cottage owners.

Recommendation: When feasible. the Black River (and other smaller waterways) should be assessed using ‘Aris Sonar Population Tracking’ to determine the actual size of annual spawning population.

References

Dubee, B., 2021 (Personal Communications) Fish Biologist (retired)

Environment Canada. (2013). National Climate Data and Information Archive, Canadian Climate Normals 1971 – 2000, Miramichi. Retrieved October 8, 2013, from http://www.climate.weatheroffice.gc.ca/climate_normals/results_e.html?stnID=6140&prov=&lang=e&dCode=1&dispBack=1&StationName=miramichi&SearchType=Contains&province=ALL&provBut=&month1=0&month2=12

GeoNB Map Viewer GeoNB Map Viewer (arcgis.com)

Government of New Brunswick, Fish 2021 - a part of our heritage. 2020

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Rampton, V.N. (1984). *Generalized Surficial Geology Map of New Brunswick*. Department of Natural Resources and Energy, Minerals. Policy and Planning Division. NR-8 (scale 1: 500 000).

Appendix 1 – Electrofishing Report by R.A Currie Ltd.

R. A. CURRIE LTD.
BIOLOGICAL CONSULTANT

2 November, 2021

Mr. Harry Collins
Miramichi River Environmental Assessment
P. O. Box 85
Miramichi, NB E1V 3M2

Dear Mr. Collins;

Re: Results of Fish Population Survey for Sturgeon Creek on 20 Sept. 2021

We are pleased to provide you with these results for the fish population survey that was conducted on Sturgeon Creek, a tributary of Black River, on 20 September, 2021.

The survey found low densities of brook trout, Atlantic salmon and creek chub inhabiting riffle habitat near the mouth of the brook. In addition to the low numbers, it is important to note that only one age class of salmon was found in this area. The salmon were represented by the capture of two fry (0+ age class), and no older age classes (parr) were captured or observed.

The reason for the low species diversity, and population density, of fish is attributed to the low pH of the water. Additionally, the dark, tea-coloured water likely restricts fish from finding food and feeding efficiently.

If you have any questions or comments concerning this project, please do not hesitate to contact me.

Sincerely,

Rod Currie

R. A. Currie
Biological Consultant

P.O. Box 1484, Fredericton, NB E3B 5E3 Tel: 506-458-5643 Fax: 506-458-9183

Fish Population Survey for Sturgeon Creek on 20 September, 2021

INTRODUCTION

In the summer of 2021, R. A. Currie was asked by the Miramichi River Environmental Assessment Committee (MREAC) to conduct a fish population survey on Sturgeon Creek, a tributary of Black River. The following is a summary of the results of that survey.

LOCATION

Black River is located on the east coast of New Brunswick where it drains into the south side of Miramichi Bay. Sturgeon Creek is a first order tributary of the lower section of Black River. It flows from the north and drains into the estuary of Black River near the community of Black River Bridge. The sampling location on Sturgeon Creek is located a short distance upstream of North Black River Road crossing of this watercourse, and is defined by the coordinates 47⁰ 01' 15.37" N and 65⁰ 15' 40.05" W.

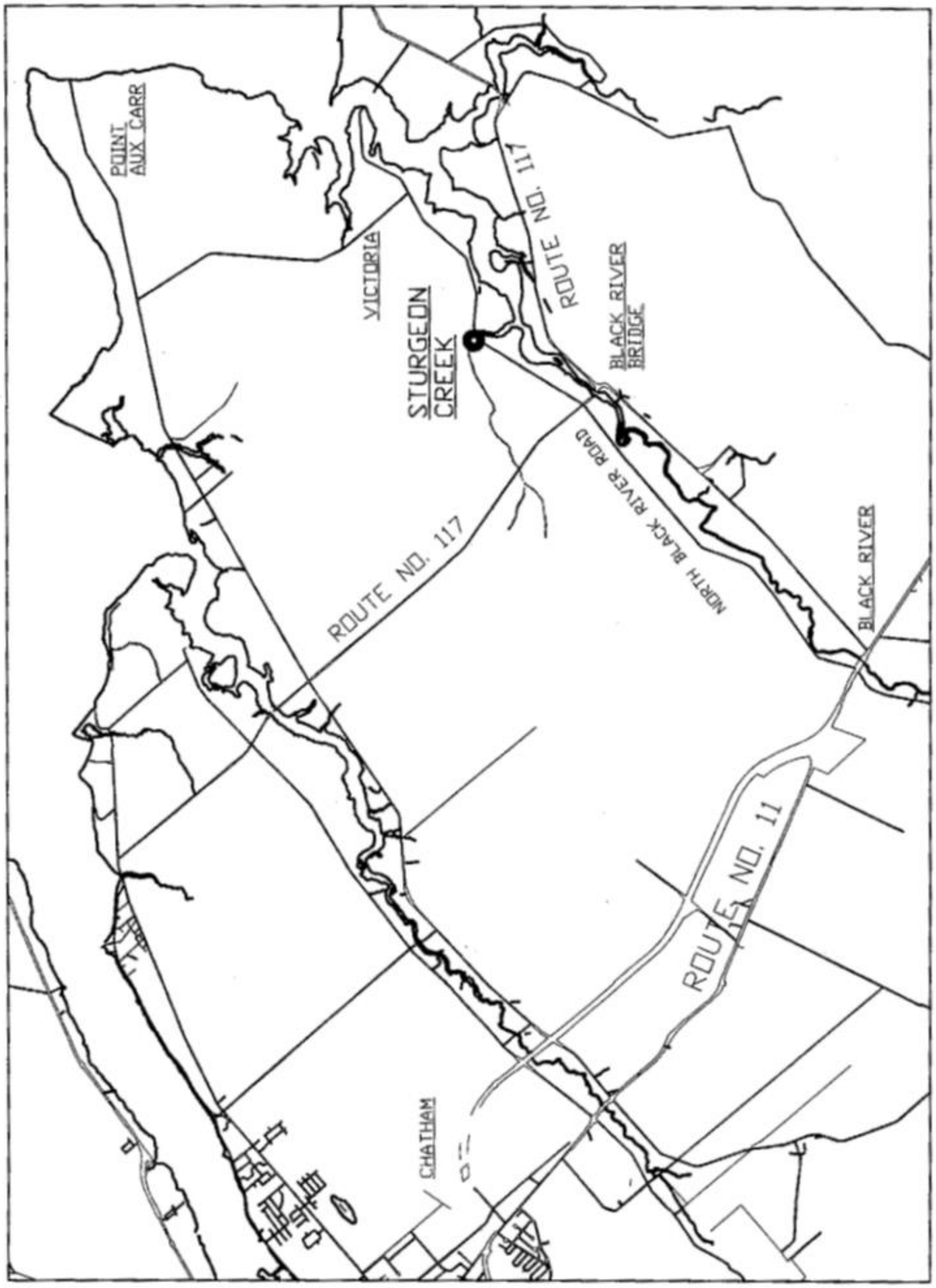
The location of Sturgeon Brook, as well as the location of the fish survey site, is provided in Figure 1.

MATERIALS AND METHODS

The timing of the fish population survey was delayed until the month of September to avoid the possibility of stress to fish as a result of high temperatures and lower levels of dissolved oxygen. Sampling at this time of year has the added benefit of allowing more growth of salmon and trout fry to ensure they are retained by the barrier nets, as well as allowing more time for more even distribution in the stream of this youngest age class of these species.

The fish sampling methodology involved standard procedures associated with the removal method for enclosed populations. This procedure began with selecting a section of stream with riffle habitat, then erecting barrier nets across the stream at the upstream and downstream boundaries to prevent immigration and emigration of fish within the sample site. Fish were collected from within the site by the use of a Smith-Root Model LR24 backpack electrofisher. This unit automatically selected the optimum power setting for the stream, and for Sturgeon Creek, the unit selected 280 volts as the optimum output current, and this power setting was maintained throughout this project. Electrofishing began at the downstream barrier net and was conducted in the upstream direction to the upper barrier net. Stunned fish were captured by two technicians with dip nets and placed in a pail that was partially filled with water. When the sweep through the site was completed, those fish were identified to species, counted. Additionally, captured salmonids were anesthetized using tricane methane sulonate (TMS) and measured for fork length. The fish from each sweep were held in a cage in the water outside the site until the final sweep was completed. For the fish survey in Sturgeon Creek, four (4)

FIGURE 1.



LOCATION OF FISH POPULATION SITE ON STURGEON CREEK consecutive sweeps were made through the site. Following the final sweep, all of the captured fish were released unharmed back into the stream.

When the fish data from the final sweep was collected, the total length, and average width, of the enclosed stream section was determined with a 30 m tape measure. These dimensions were used to determine the area of the sample site. Also, a certified pocket thermometer was used to measure the midday water temperature of the stream.

Following the collection of the field data, age classes were assigned to individual salmon and trout based on their respective lengths. The fish numbers for each sweep were then processed through a computer program, *Microfish 3.0* (Van Deventer and Platts, 1989), to determine population densities for each species of fish, as well as for each age class of salmonid. The density estimates were then adjusted based on the area of the sampling site to a standard unit area to reflect the number of fish/100 m^2.

RESULTS AND DISCUSSION

The results of the fish population survey that was conducted on Sturgeon Creek on 20 September, 2021 are presented in Table 1.

TABLE 1

Fish Population Estimates for One Site on Sturgeon Creek
on 20 September, 2021

Species	Age Class	No. of Fish/100 m^2
Brook trout	0+	1.4
"	1+	2.7
"	2+	0.9
"	Total	5.6
Atlantic salmon	0+	0.9
Creek chub		0.4
Total fish		6.9

Fish population estimates are based on the *Microfish 3.0* formula (Van Deventer and Platts, 1989)

A review of the data presented in Table 1 shows only three species of fish were captured in the survey on Sturgeon Creek, and the population density of each of those species is very low. It is important to note, that although the flow volume, habitat characteristics (riffle habitat and abundant cover) and water temperature for this stream section appeared favorable for fish, the water had a very distinct tea colour. Tea-coloured water is indicative of bog drainage and is commonly observed in streams that drain peat lands and black spruce swamps, features that are very common in this area. The reddish brown colour reflects the influence of humic soils in these drainage areas.

The unusually low diversity of fish, as well as the very low density of those species, is likely a direct result of humic water conditions. Humic waters usually reflect low pH, and a field measurement of the pH of Sturgeon Creek on 20 September showed a pH level of 5.42. This measurement represents definite acidic conditions and acidic waters have been shown to negatively affect fish survival through several means. In extreme cases, acidic water can reduce the survival of fish eggs and alevins, the most sensitive fish life stages, as well as cause damage to delicate structures such as gills on older fish. Even a slight drop in pH can significantly increase the solubility of toxic metals such as aluminum and copper from riparian soils and stream bottom substrates. Additionally, acidic water can erode shell cases of aquatic invertebrates which could reduce the numbers of these organisms that represent a major food component of many fish species. Water high in tannins and humic acids can negatively impact fish populations due to the associated dark tea colour. All of the species that were captured (brook trout, Atlantic salmon and creek chub) are primarily sight feeders – they observe and select individual food items. The turbidity of the water in Sturgeon Creek is extremely high, and it is likely that the resident fish are not feeding efficiently. This theory may be supported by the unusually small size of the salmon fry that were captured. Only two fry were captured and both of these fish were less than 50 mm fork length. In other river systems at this time of year, salmon fry have generally achieved a fork length of 75-85 mm by mid September.

SUMMARY

The fish population survey of Sturgeon Creek on 20 September, 2021 found only three species of fish (brook trout, Atlantic salmon and creek chub) and these occurred in very low densities. Although the brook was well shaded and provided riffle habitat with a variety of substrate sizes and an abundance of cover for fish, it is believed that the quality of the water was less than optimal for ideal fish production. The dark, tea-coloured water indicates an abundance of tannins and humic compounds which usually indicates acidic water. A field measurement found the water to have a pH of 5.42, indicating a distinctly acidic state. The reduced visibility in this dark water also likely impacts the feeding efficiency of fish that depend on sight to find food items.

In summary, the water of Sturgeon Creek appears to provide only marginal quality fish habitat as evidenced by the low variety and numbers of fish it supports.

Appendix 2 – CABIN Protocol Assessment – Black River

As developed by Environment and Climate Change Canada (ECCC), the Canadian Aquatic Biomonitoring Network (CABIN) protocol is now a nationally applied technique for assessing the biological condition of freshwater systems. The Miramichi River Environmental Assessment Committee (MREAC) has been engaged in this protocol since 2004 and the Miramichi watershed has 28 established reference and test sites that are found on major tributaries within the drainage basin. As part of a larger Atlantic Canada wide project - the Atlantic CABIN Collaborative 2015 - this protocol was implemented at the Black River (BLK-DS) site on October 14, 2015.

The Reference Condition Approach (RCA) assessment and running of the Atlantic Reference Model (ARM) allowed for a comparison of the "Observed vs. Expected" benthic macroinvertebrate community at the BLK-DS CABIN site.

The RCA Model Assessment – Observed vs. Expected Richness results for site BLK-DS is illustrated in Figure 1.

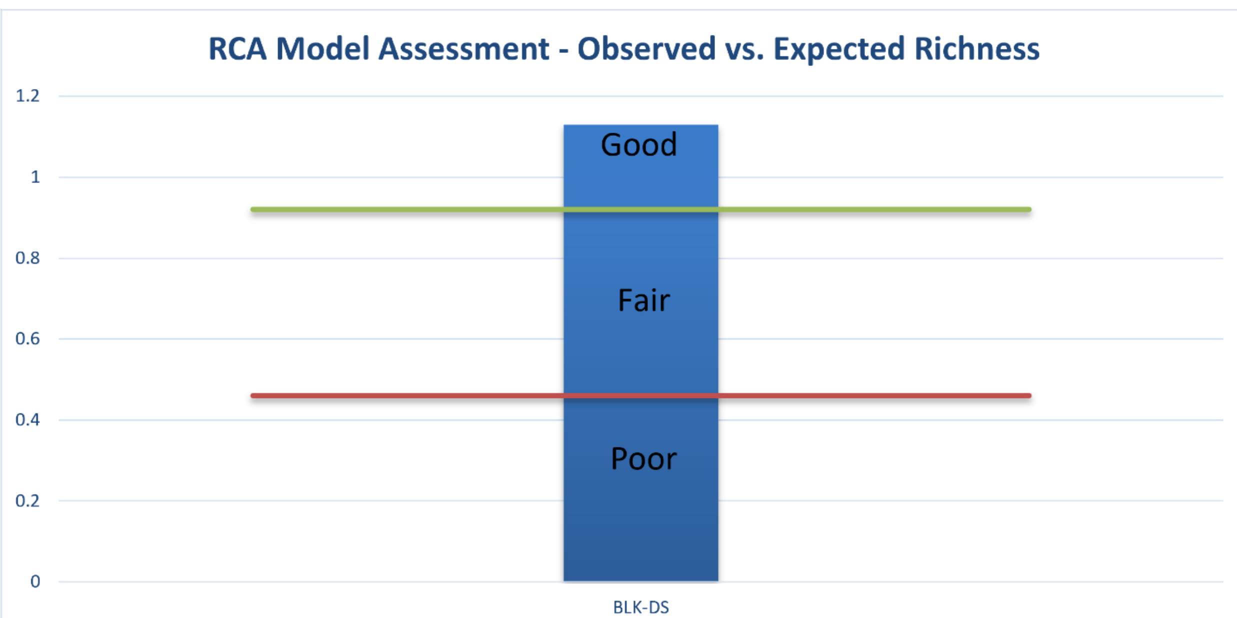
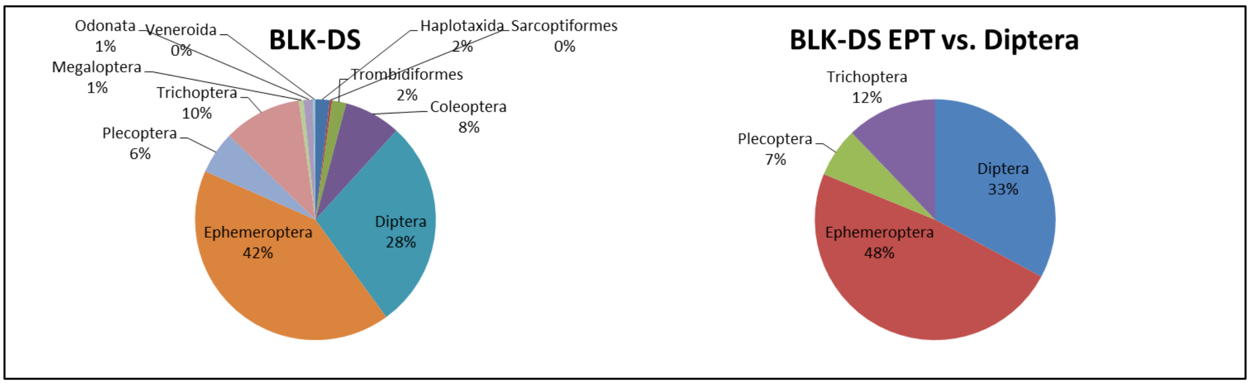


Figure 1: RCA Assessment Using ARM for Site BLK-DS

Note: MREAC was trained by EC staff on how to extract habitat variables using QGIS and GRASS computer software program/plugin, and how to format the CABIN benthic data set in order to run ARM in GenGIS and R computer software program/plugin.

The RCA model assessment of taxa observed (what is there) vs. expected (what should be there) richness (number of taxa at family level) for site BLK-DS indicates that it is in the "Good" range and that it is not divergent from normal.

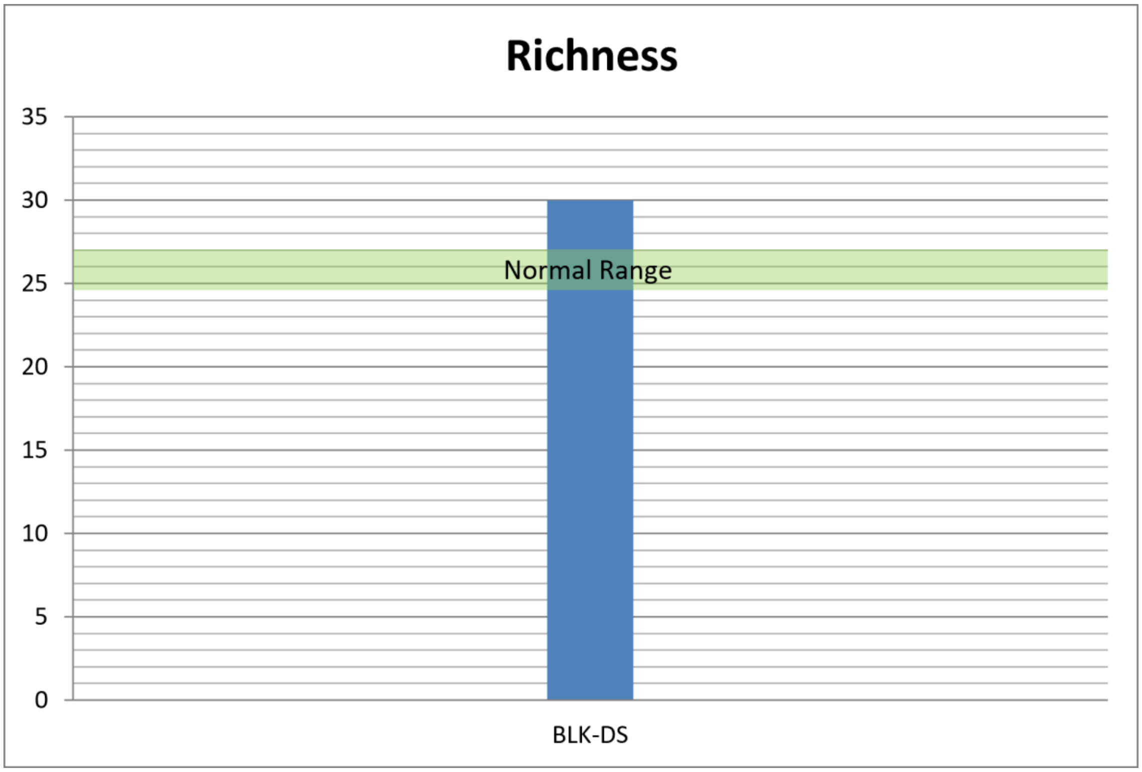
Illustrated in Figure 2 is the taxonomic composition of the benthic macroinvertebrate community, and it also examines the proportion of non-tolerant to pollution taxa [Ephemeroptera, Plecoptera, and Trichoptera (EPT)] to tolerant to pollution taxa (Diptera).



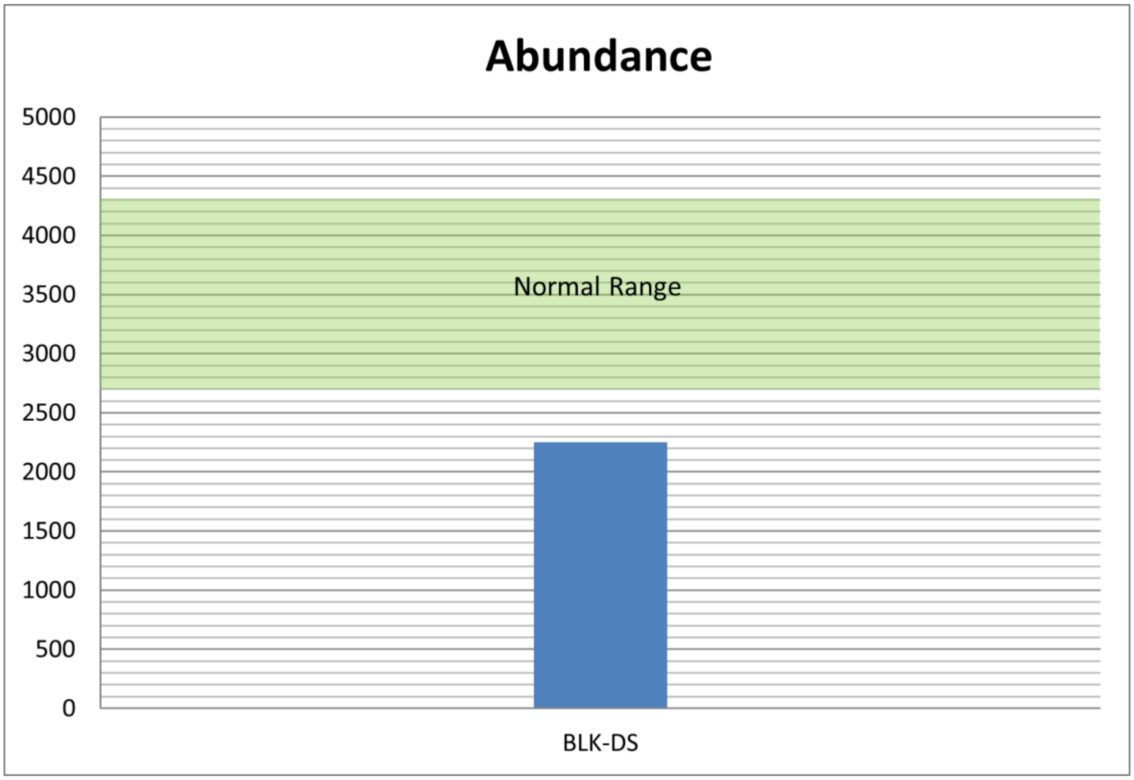
Taxonomic Composition & EPT vs. Diptera for Site BLK-DS

At site BLK-DS, the benthic macroinvertebrate taxa appear somewhat in proportion, but slightly favouring the Ephemeroptera taxon. The higher EPT percentage seems to indicate a good aquatic environment favouring the non-tolerant to pollution taxa.

The BLK-DS CABIN site richness and abundance, as illustrated in Figure 3 and Figure 4, were also calculated directly from the taxonomic data/counts. The results were compared to the "Normal Range" as determined from the 25th to 75th percentiles.



Richness Assessment for Site BLK-DS



Abundance Assessment for Site BLK-DS

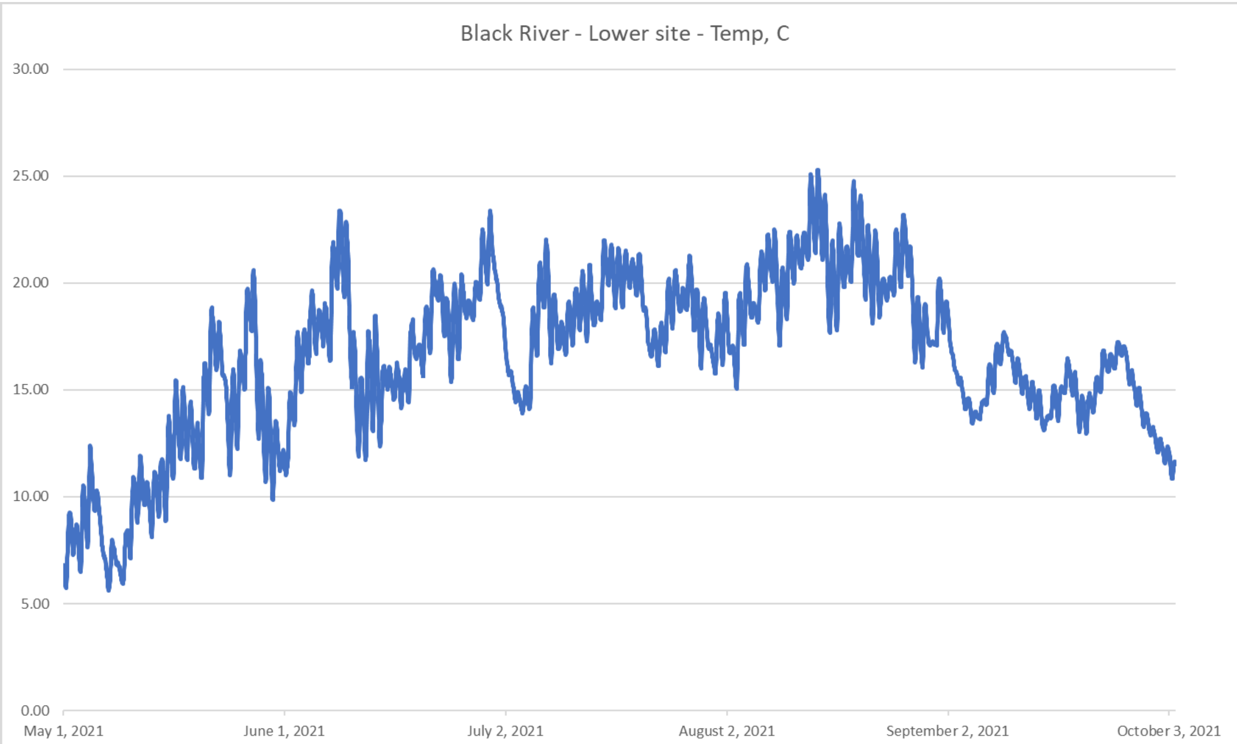
As calculated directly from the taxonomic data/counts, the richness result for site BLK-DS indicates that is just above the normal range and has a slightly elevated taxa richness.

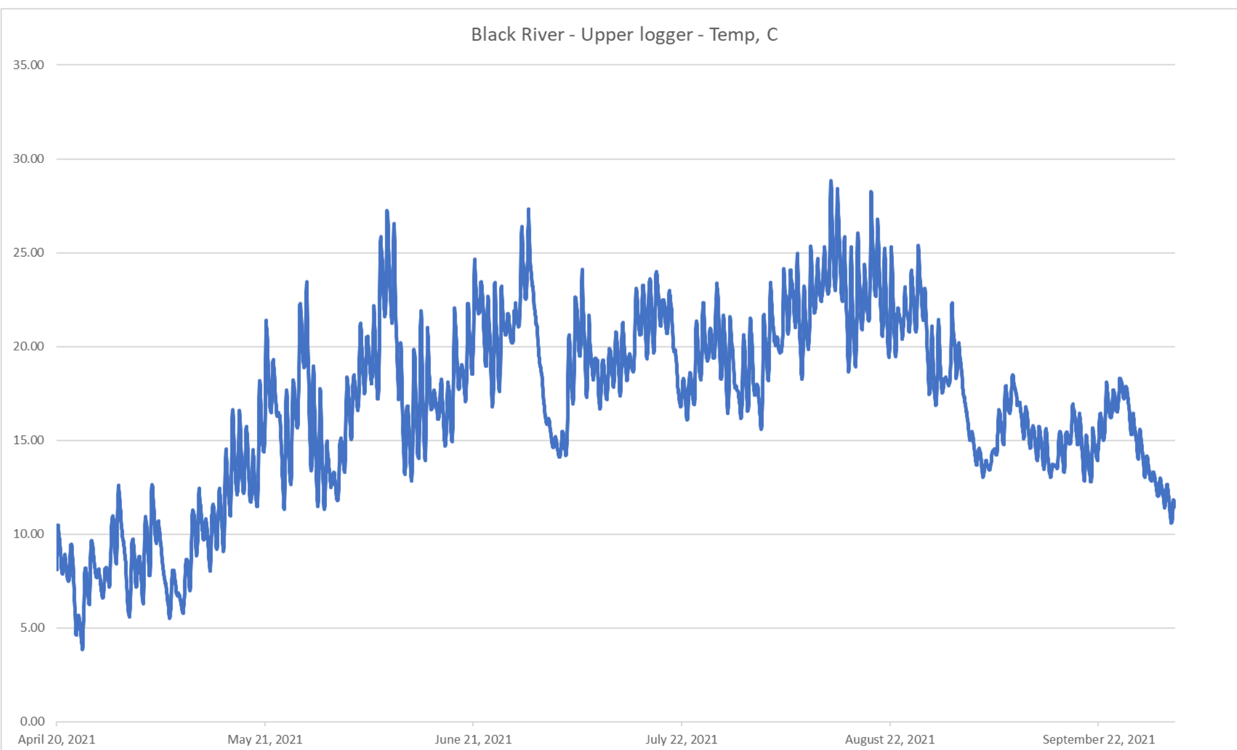
For total taxa abundance, site BLK-DS was below the normal range. This could be the result of a low macroinvertebrate biomass productivity in the river.

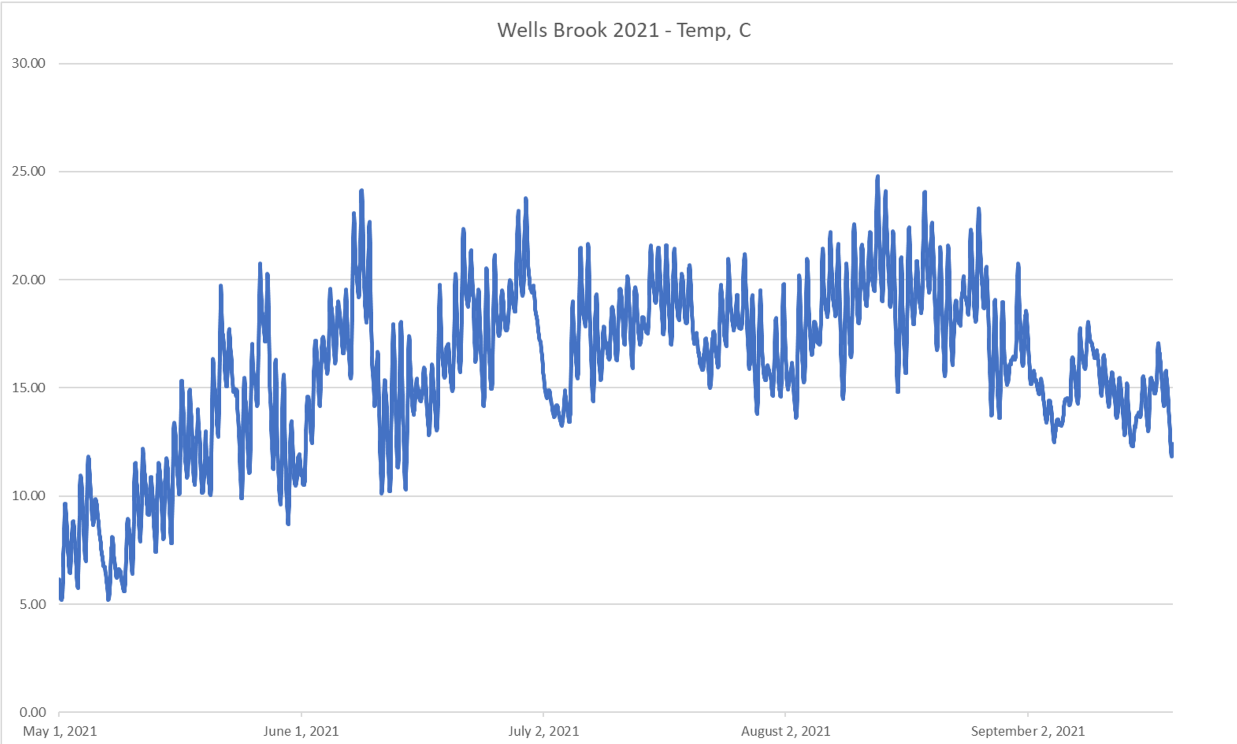
Recommendation: In order to get a more accurate picture of the number of taxa families commonly present at site BLK-DS, and given that this site is below the "Normal Range" in taxa abundance, further periodic sampling and analysis of the benthic macroinvertebrates community is suggested.

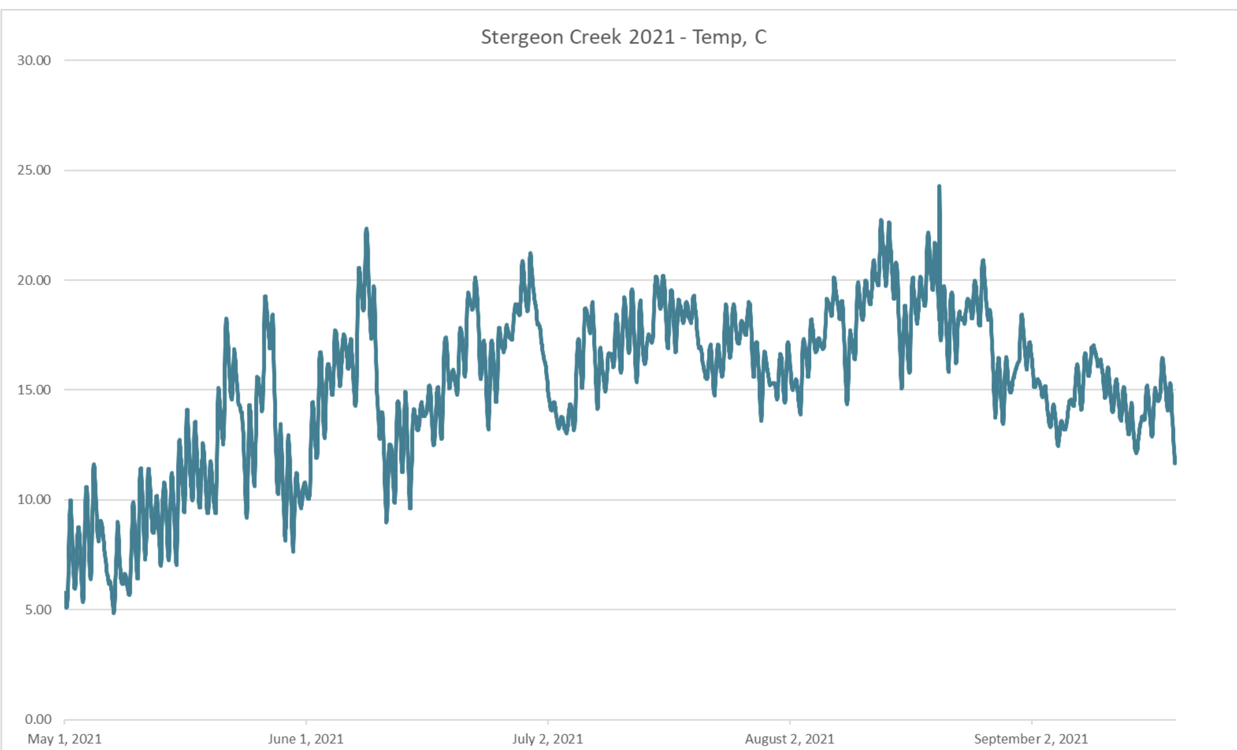
The benthic macroinvertebrate sampled in applying the Canadian Biomonitoring Network (CABIN) protocol show that the EPT (bug families) and Total Taxa Richness on the Black River show a reference quality site. This is based on the benthic community at the collection site just downstream of the Hwy 11bridge, sampled in 2016.

Appendix 3 – Temperature Profiles from Four Watershed Sites






Wells Brook 2021 - Temp, C
30.00
25.00
20.00
15.00
10.00
5.00
0.00
May 1, 2021
June 1, 2021
July 2, 2021
August 2, 2021
September 2, 2021


Stergeon Creek 2021 - Temp, C
30.00
25.00
20.00
15.00
10.00
5.00
0.00
May 1, 2021
June 1, 2021
July 2, 2021
August 2, 2021
September 2, 2021

Appendix 4 – Fish Habitat Assessment Field Sheets (Black and Little Black Rivers)

04-98 Datum - WGS ...

DNR&E / DFO - NEW BRUNSWICK
STREAM HABITAT INVENTORY

1 of ____

River: Black
No. 4
Personnel: Harry, Vlad, Bailee, Julia
No. ____

Start Point: N46.95624 W65.53696 End Point: N46.95079 W65.34515

Drainage Code: ☐☐ ☐☐ ☐☐ ☐☐ ☐☐

Trib 15.8 °C
Main 17.9 °C

Date: July 8/21 GIS Map No. ____ Drainage Name: Black River watershed

REACH NO. *	UNIT NO.	STREAM TYPE	CHANNEL TYPE	LENGTH (m) *	AVG WIDTH (m) * WET	AVG WIDTH BANK CHANNEL	SUBSTRATE (%) * BED-ROCK	BOULDER	ROCK	RUBBLE	GRAVEL	SAND	FINES	AVG DEPTH WET WIDTH (cm) *	0-50% UNDERCUT BANK L	0-50% UNDERCUT BANK R	0-50% OVERHANGING VEGETATION L	0-50% OVERHANGING VEGETATION R	LARGE WOODY DEBRIS IN STREAM (m) *	FLOWS * TYPE	FLOW (cms) m/s	TIME	TEMP (°C) W	TEMP (°C) A	EMBEDDEDNESS (CRITERIA) 1: ≤ 20% 2: 20% - 35% 3: 35% - 50% 4: ≥ 50%	COMMENTS 1.2 m dep
1		8	1	508.5	12 m	1.__ 14.m	1	1.30 1	70	15	5	5	3	[illegible]	0	0	15	15	62	1	0.17		17.9	14	1	107 m pool
2		8	1	306	13.9	17.6	1	1	70	20	5	3	1		0	0	10	10	9.5	1	0.18		18.7	19	1	
3		8	1	200	13	16.3	2	0	70	20	3	3	2		0	0	10	10	4.8	1	0.2		18.9	20	3	12:35

CHECKLIST OF LAND USE ATTRIBUTES (COMMENTS)

1. ACTIVE BEAVER DAM
2. INACTIVE BEAVER DAM ✓
3. WOODY DEBRIS (OBSTRUCTION) ✓
4. MAN-MADE DAM OBSTRUCTION
5. ROCK DAM (SWIMMING POOL)
6. BRAIDED STREAM CHANNELS
7. OBSTRUCTION IN STREAM
8. ROAD FORD

POLLUTION CAUSED BY:

9. FOOD PROCESSING INDUSTRY
10. FOREST INDUSTRY
11. CAMPSITES OR RESIDENTIAL
12. MINING
13. LITTER
14. OIL
15. AGRICULTURE WASTE
16. HEALTH HAZARD

17. CLEAR CUT TO STREAM EDGE
18. SELECTIVE CUT
19. BUFFER STRIP PRESENT

20. CATTLE CROSSING
21. EROSION FROM AGRICULTURE
22. SUSPENDED SILT NOTED
23. UNUSUAL STREAM SCOURING
24. LARGE BEDLOAD DEPOSIT
25. BANK EROSION - MODERATE
26. BANK EROSION - EXCESSIVE
27. STREAM DREDGING/BULLDOZING
28. GRAVEL REMOVAL
29. CHANNELIZATION (RIPRAP, ETC)
30. STREAM DIVERSION

31. WATER WITHDRAWAL
32. REGULATED STREAM FLOW
33. CAMP/COTTAGE PRESENT
34. RESIDENTIAL AREA
35. ACCESS - ATV'S
36. ACCESS - TRAILS ✓
37. ACCESS - TRUCK/CAR
38. ACCESS - BOAT

39. ROAD CROSSING (BRIDGE)
40. ROAD CROSSING (CULVERT)
41. BOAT LANDING

42. ORGANIC LITTER
43. AQUATIC PLANTS ABUNDANT ✓

44. GOOD SPAWNING
45. GOOD NURSERY
46. ATLANTIC SALMON OBSERVED
47. BROOK TROUT OBSERVED

STREAM TYPE *

FASTWATER		POOLS			
1. Fall	6. Sheet (ledge)	10. Midchannel	14. Trench	18. Eddy	22. Wood Debris
2. Cascade	7. Chute	11. Convergence	15. Plunge	19. Gabion	23. Man-Made Dam
3. Riffle (GR/RB)	8. Run	12. Lateral	16.	20. Log Structure	24. Natural Deadwater
4. Riffle (R/B)	9. Rapid	13. Beaver	17. Bogan	21. Road Crossing	
Riffle (Sand)					

CHANNEL TYPE

1. Main (if measurement refers to main area of river)
* 2. Side Channel (water diverted by islands)
* 3. Split (if river is split into various different stream types)
* 4. Bogan

*Specify Left (L), Right (R) or Middle (M)

SUBSTRATE

1. Bedrock, Ledge		
2. Boulder	=	> 461 mm
3. Rock	=	180 – 460 mm
4. Rubble	=	54 – 179 mm
5. Gravel	=	2.6 - 53 mm
6. Sand	=	0.06 - 2.5 mm
7. Fines	=	0.0005 - 0.05 mm

FLOW TYPE

1. Survey stream
2. Spring
3. Brook/River Tributary
4. Spring Seep

POOL RATING (reverse side)

CRITERIA NO.	% OF POOLS IN SITE (LETTER)
POOL DEPTH ≥ 1.5m 1 - Instream Cover ≥ 30% 2 - Instream Cover < 30%	a - ≥ 30% b - ≥ 10 to 30% c - < 10%
POOL DEPTH .5 - 1.5m 3. Instream cover 5-30% 4 - Instream Cover > 30%	a - ≥ 50% b - < 50%

Black River Pg 2

REACH NO.	SITE (50m - interval)	% SITE: RIFFLE/ RUN	% SITE: POOLS	SHADE (%)	STREAM BANKS: VEGETATION (%): BARE GROUND	VEGETATION (%): GRASSES	VEGETATION (%): SHRUBS	VEGETATION (%): TREES	EROSION (%): LEFT BANK (0 - 50%): STABLE	LEFT BANK: BARE STABLE	LEFT BANK: ERODING	EROSION (%): RIGHT BANK (0 - 50%): STABLE	RIGHT BANK: BARE STABLE	RIGHT BANK: ERODING	O_2 (mg/l)	pH	DEPTH: ¼ (m): Wet	¼ (m): CHANNEL	DEPTH: ½ (m): Wet	½ (m): CHANNEL	DEPTH: ¾ (m): Wet	¾ (m): CHANNEL	POOL RATING (CRITERIA ON OTHER SIDE): NO.	POOL RATING: LETTER	POOL TAIL: EMBEDDEDNESS (CRITERIA) 1: ≤ 20% 2: 20% - 35% 3: 35% - 50% 4: ≥ 50%	POOL TAIL: MEAN SUBSTRATE SIZE (cm)	POOL TAIL: % FINE	% TURBU-LENCE
1		95	5	30	15	15	30	40	80	10	10	80	15	5	7.5	6.54	0.3	1.30	0.42	1.42	0.25	1.25			2	2	20	10
2		100	–	25	10	20	50	20	80	15	5	80	15	5	7.9	6.79	0.2	1.20	0.25	1.25	0.25	1.25			2	9	10	
3		100	–	25	10	30	40	10	80	15	5	85	10	5	9.6	6.62	0.2	1.23	0.51	1.37	0.45	1.45			2	7	20	

REACH NO.	UNIT NO.	STREAM TYPE	WET WIDTH (m)	DEPTH (cm): ¼ WAY	DEPTH (cm): ½ WAY	DEPTH (cm): ¾ WAY	AVERAGE DEPTH SUM/4: CENTIMETERS (cm)	AVERAGE DEPTH SUM/4: METERS (m)	COEFFICIENT (0.9 - SMOOTH) (0.8 - ROUGH)	LENGTH (3m)	FLOAT TIME (sec): ¼ WAY	FLOAT TIME (sec): ½ WAY	FLOAT TIME (sec): ¾ WAY	FLOAT TIME (sec): AVERAGE	COMMENTS (LOCATION)

FORMULA (CMS) = W ____ (m) x D ____ (m) x A ____ x L ____ (m) / T ____ (sec)   Where: W = width, D = depth, L = length, A is coefficient for the stream bottom

04-98

DNR&E / DFO - NEW BRUNSWICK
STREAM HABITAT INVENTORY

River: Little Black
No.
Personnel: Adam, Bailee, Julia, Harry
No.

Start Point: N47°0218 W065°12629
End Point: N46°59805 W065°12919
Date: July 21/2021
GIS Map No.

Drainage Code: □□ □□ □□ □□ □□
Drainage Name: Little Black River

REACH NO.	UNIT NO.	STREAM TYPE	CHANNEL TYPE	LENGTH (m)	AVG WIDTH (m) WET	AVG WIDTH (m) BANK CHANNEL	SUBSTRATE (%) BED-ROCK	BOULDER	ROCK	RUBBLE	GRAVEL	SAND	FINES	AVG DEPTH WET WIDTH (cm)	0-50% UNDERCUT BANK L	R	0-50% OVERHANGING VEGETATION L	R	LARGE WOODY DEBRIS IN STREAM (m)	FLOWS TYPE	FLOW m/sec	TIME	TEMP (C) W	TEMP (C) A	EMBEDDEDNESS	COMMENTS
1		3	1	300	12.7	13.3	4	4	10	70	10	2	0	12.7	10	25	25	25	179	1	0.75 m/sec	13.2 sec	17.3	20	1	
2		3	1	100	8.2	11.4	25	5	15	40	10	5	0		10	25	25	25	14	1	0.23 m/sec	42 sec	17.3	20	1	
3		3	1	121	9.2	11.7	2	2	15	65	10	1	0	12.7	20	20	35	35	47	1	0.26 m/sec	38 sec	17.4	20	2	
4		3	1	120	8.2	11.7	25	5	15	40	10	5	0		20	20	35	35	41	1	0.23 m/sec	42 sec	17.3		1	
5		3	1	224	10.4	17.6	40	5	5	35	10	0	0	10.4	20	20	35	35	765	1	0.07 m/sec	146 sec	17.5		1	
6		3	1	100 50	11.0	13.3	5	15	15	25	10	0	0	11.9	30	30	35	35	25	1	0.75 m/sec	13.3 sec	17.3		1	

FLOWS*

EMBEDDEDNESS (CRITERIA)
1: ≤ 20%
2: 20% - 35%
3: 35% - 50%
4: ≥ 50%

CHECKLIST OF LAND USE ATTRIBUTES (COMMENTS)

1. ACTIVE BEAVER DAM
2. INACTIVE BEAVER DAM
3. WOODY DEBRIS (OBSTRUCTION)
4. MAN-MADE DAM OBSTRUCTION
5. ROCK DAM (SWIMMING POOL)
6. BRAIDED STREAM CHANNELS
7. OBSTRUCTION IN STREAM
8. ROAD FORD

POLLUTION CAUSED BY:

9. FOOD PROCESSING INDUSTRY
10. FOREST INDUSTRY
11. CAMPSITES OR RESIDENTIAL
12. MINING
13. LITTER
14. OIL
15. AGRICULTURE WASTE
16. HEALTH HAZARD

17. CLEAR CUT TO STREAM EDGE
18. SELECTIVE CUT
19. BUFFER STRIP PRESENT

20. CATTLE CROSSING
21. EROSION FROM AGRICULTURE
22. SUSPENDED SILT NOTED
23. UNUSUAL STREAM SCOURING
24. LARGE BEDLOAD DEPOSIT
25. BANK EROSION - MODERATE
26. BANK EROSION - EXCESSIVE
27. STREAM DREDGING/BULLDOZING
28. GRAVEL REMOVAL
29. CHANNELIZATION (RIPRAP, ETC)
30. STREAM DIVERSION

31. WATER WITHDRAWAL
32. REGULATED STREAM FLOW
33. CAMP/COTTAGE PRESENT
34. RESIDENTIAL AREA
35. ACCESS - ATV'S
36. ACCESS - TRAILS
37. ACCESS - TRUCK/CAR
38. ACCESS - BOAT

39. ROAD CROSSING (BRIDGE)
40. ROAD CROSSING (CULVERT)
41. BOAT LANDING

42. ORGANIC LITTER
43. AQUATIC PLANTS ABUNDANT

44. GOOD SPAWNING
45. GOOD NURSERY
46. ATLANTIC SALMON OBSERVED
47. BROOK TROUT OBSERVED

STREAM TYPE

FASTWATER		POOLS			
1. Fall	6. Shoot (ledge)	10. Midchannel	14. Trench	18. Eddy	22. Wood Debris
2. Cascade	7. Chute	11. Convergence	15. Plunge	19. Gabion	23. Man-Made Dam
3. Riffle (GR/BR)	8. Run	12. Lateral	16.	20. Log Structure	24. Natural Deadwater
4. Riffle (S/B)	9. Rapid	13. Beaver	17. Bogan	21. Road Crossing	
5. Riffle (Sand)					

CHANNEL TYPE

1. Main (if measurement refers to main area of river)
* 2. Side Channel (water diverted by islands)
* 3. Split (if river is split into various different stream types)
* 4. Bogan

*Specify Left (L), Right (R) or Middle (M)

SUBSTRATE

1. Bedrock, Ledge		
2. Boulder	=	> 460 mm
3. Rock	=	180 - 460 mm
4. Rubble	=	54 - 179 mm
5. Gravel	=	2.6 - 53 mm
6. Sand	=	0.06 - 2.5 mm
7. Fines	=	0.0005 - 0.05 mm

FLOW TYPE

1. Survey stream
2. Spring
3. Brook/River Tributary
4. Spring Seep

POOL RATING (reverse side)

CRITERIA NO.	% OF POOLS IN SITE (LETTER)
POOL DEPTH ≥ 1.0m 1 - Instream Cover ≥ 30% 2 - Instream Cover < 30%	a - ≥ 30% b - ≥ 10 to 30% c - < 10%
POOL DEPTH .5 - 1.0m 3. Instream cover 5-30% 4 - Instream Cover > 30%	a - ≥ 30% b - < 30%

12.1

REACH NO.	SITE (20m-interval)	% SITE: RIFFLE/RUN	% SITE: POOLS	SHADE (%)	STREAM BANKS – VEGETATION (%): BARE GROUND	GRASSES	SHRUBS	TREES	EROSION (%) – LEFT BANK (0-50%): STABLE	BARE STABLE	ERODING	RIGHT BANK (0-50%): STABLE	BARE STABLE	ERODING	O2 (mg/l)	pH	DEPTH cm – ¼ (m) cm: Wet	CHANNEL	½ (m) cm: Wet	CHANNEL	¾ (m) cm: Wet	CHANNEL	POOL RATING (CRITERIA ON OTHER SIDE): NO.	LETTER	POOL TAIL – EMBEDDEDNESS (CRITERIA) 1: ≤ 20% 2: 20%-35% 3: 35%-50% 4: ≥ 50%	MEAN SUBSTRATE SIZE (cm)	% FINE	% TURBULENCE
		50	4	50	5	20	40	35	25	15	10	14	1	35	9.02	7.43	122	110	120	110	120	110			1	10	1	10
		80	0	50		35	55	10	–	10	40	45	5	0	8.9	7.35	121	110	159	110	123	110			1	5	1	
		70	+	60	5	35	35	20	10	5	35	10	5	35	8.9	7.45	110	90	115	90	112	90			1	5	1	
		90	0	60	5	35	35	20	10	5	35	10	5	35	8.9	7.40	110	90	115	90	112	90			1	5	1	
		70	2	60	5	35	35	20	10	5	35	10	5	35	9.07	7.39	104	80	103	80	92	80			2	5	1	
			0	50	10	25	45	20	20	5	25	15	5	30	8.9	7.59	93	70	81	70	77	70			1	7	1	

REACH NO.	UNIT NO.	STREAM TYPE	WET WIDTH (m)	DEPTH (cm): ¼ WAY	½ WAY	¾ WAY	AVERAGE DEPTH SUMS: CENTIMETERS (cm)	METERS (m)	COEFFICIENT (0.8 - SMOOTH) (0.8 - ROUGH)	LENGTH (m)	FLOAT TIME (sec): ¼ WAY	½ WAY	¾ WAY	AVERAGE	COMMENTS (LOCATION)

FORMULA (CMS) = W (m) x D (m) x A x L (m) / T (sec)   Where: W = width, D = depth, L = length, A is coefficient for the stream bottom

13.3

Appendix 5 – Black River Water Chemistry Results 2021

Report ID: 408717-IAS
Report Date: 27-Aug-21
Date Received: 17-Aug-21

CERTIFICATE OF ANALYSIS
for
Miramichi River Environmental
Assessment Committee
21 Cove Road
Miramichi, NB E1V 0A6

rpc
921 College Hill Rd
Fredericton NB
Canada E3B 6Z9
Tel: 506.452.1212
Fax: 506.452.0594
www.rpc.ca

Attention: Harry Collins
Project #: Not Available
Location: Black River
Analysis of Surface Water

RPC Sample ID:			408717-1
Client Sample ID:			17/21/03000
Date Sampled:			16-Aug-21
Analytes	**Units**	**RL**	
Sodium	mg/L	0.05	5.33
Potassium	mg/L	0.02	0.46
Calcium	mg/L	0.05	9.89
Magnesium	mg/L	0.01	1.81
Alkalinity (as $CaCO_3$)	mg/L	2	35
Chloride	mg/L	0.5	5.9
Fluoride	mg/L	0.05	0.36
Sulfate	mg/L	1	3
Bromine	mg/L	0.01	0.02
Ammonia (as N)	mg/L	0.05	< 0.05
Un-ionized @ 20°C	mg/L	-	< 0.001
Nitrate + Nitrite (as N)	mg/L	0.05	< 0.05
Nitrite (as N)	mg/L	0.05	< 0.05
Nitrate (as N)	mg/L	0.05	< 0.05
Nitrogen - Total	mg/L	0.2	0.7
Phosphorus - Total	mg/L	0.002	0.029
Carbon - Total Organic	mg/L	0.5	19.9
Colour	TCU	5	192
Conductivity	µS/cm	1	86
pH	units	-	7.4
Turbidity	NTU	0.1	1.4
Calculated Parameters			
Bicarbonate (as $CaCO_3$)	mg/L	-	34.9
Carbonate (as $CaCO_3$)	mg/L	-	0.082
Hardness (as $CaCO_3$)	mg/L	0.2	32.1
TDS (calc)	mg/L	-	49
Saturation pH (20°C)	units	-	8.8
Langelier Index (20°C)	-	-	-1.38

This report relates only to the sample(s) and information provided to the laboratory.
RL = Reporting Limit

Peter Crowhurst, B.Sc., C.Chem.
Director
Inorganic Analytical Chemistry

SURFACE WATER CHEM
Page 1 of 3

Matthew Norman
Senior Chemist
Inorganic Analytical Chemistry

Report ID: 408717-IAS
Report Date: 27-Aug-21
Date Received: 17-Aug-21

CERTIFICATE OF ANALYSIS

for
Miramichi River Environmental
Assessment Committee
21 Cove Road
Miramichi, NB E1V 0A6

rpc
921 College Hill Rd
Fredericton NB
Canada E3B 6Z9
Tel: 506.452.1212
Fax: 506.452.0594
www.rpc.ca

Attention: Harry Collins
Project #: Not Available
Location: Black River

Analysis of Surface Water

RPC Sample ID:			408717-1
Client Sample ID:			17/21/03000
Date Sampled:			16-Aug-21
Analytes	**Units**	**RL**	
Aluminum	mg/L	0.001	0.175
Antimony	mg/L	0.0001	< 0.0001
Arsenic	mg/L	0.001	0.001
Barium	mg/L	0.001	0.057
Beryllium	mg/L	0.0001	< 0.0001
Bismuth	mg/L	0.001	< 0.001
Boron	mg/L	0.001	0.007
Cadmium	mg/L	0.00001	0.00011
Calcium	mg/L	0.05	9.89
Chromium	mg/L	0.001	< 0.001
Cobalt	mg/L	0.0001	0.0002
Copper	mg/L	0.001	0.003
Iron	mg/L	0.02	0.73
Lead	mg/L	0.0001	0.0016
Lithium	mg/L	0.0001	0.0011
Magnesium	mg/L	0.01	1.81
Manganese	mg/L	0.001	0.051
Molybdenum	mg/L	0.0001	0.0001
Nickel	mg/L	0.001	0.007
Potassium	mg/L	0.02	0.46
Rubidium	mg/L	0.0001	0.0014
Selenium	mg/L	0.001	< 0.001
Silver	mg/L	0.0001	< 0.0001
Sodium	mg/L	0.05	5.33
Strontium	mg/L	0.001	0.057
Tellurium	mg/L	0.0001	< 0.0001
Thallium	mg/L	0.0001	< 0.0001
Tin	mg/L	0.0001	< 0.0001
Uranium	mg/L	0.0001	< 0.0001
Vanadium	mg/L	0.001	< 0.001
Zinc	mg/L	0.001	0.028

Report ID:	408717-IAS
Report Date:	27-Aug-21
Date Received:	17-Aug-21

CERTIFICATE OF ANALYSIS
for
Miramichi River Environmental
Assessment Committee
21 Cove Road
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Methods

Analyte	RPC SOP #	Method Reference	Method Principle
Ammonia	IAS-M47	APHA 4500-NH_3 G	Phenate Colourimetry
pH	IAS-M03	APHA 4500-H^+ B	pH Electrode - Electrometric
Alkalinity (as $CaCO_3$)	IAS-M43	EPA 310.2	Methyl Orange Colourimetry
Chloride	IAS-M44	APHA 4500-CL E	Ferricyanide Colourimetry
Fluoride	IAS-M30	APHA 4500-F- D	SPADNS Colourimetry
Sulfate	IAS-M45	APHA 4500-SO_4 E	Turbidimetry
Nitrate + Nitrite (as N)	IAS-M48	APHA 4500-NO_3 H	Hydrazine Red., Derivitization, Colourimetry
Nitrite (as N)	IAS-M49	APHA 4500-NO2- B	Ferrous Ammonium Sulfate Colourimetry
Nitrogen - Total	IAS-M57	ASTM D8083-16	Combustion/Chemiluminescence
Phosphorus - Total	IAS-M17	APHA 4500-P E	Digestion, Manual Colourimetry
Carbon - Total Organic	IAS-M38	APHA 5310 C	UV-Persulfate Digestion, NDIR Detection
Turbidity	IAS-M06	APHA 2130 B	Nephelometry
Colour	IAS-M55	APHA 2120 Color (A,C)	Single Wavelength Spectrophotometry
Conductivity	IAS-M04	APHA 2510 B	Conductivity Meter - Electrode
Trace Metals	IAS-M01/IAS-M29	EPA 200.8/EPA 200.7	ICP-MS/ICP-ES

Report/Rapport: 408717-ML-W1
Date: 18-Aug-21
Date Received/Reçu: 17-Aug-21

CERTIFICATE OF ANALYSIS / CERTIFICAT D'ANALYSE

for/pour
Miramichi River Environmental
Assessment Committee
21 Cove Road
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Attention: Harry Collins

Client Location: Black River

Microbiological Examination of Water/Qualité microbiologique de l'eau potable

RPC Sample ID/No. d'échantillon de RPC:				408717-1
Client Sample ID/ID d'échantillon du client:				17/21/03000
Date collected/Date du prélèvement				16-Aug-21
Time sampled/Heure du prélèvement				11:00:00 AM
Analytes/Paramètre(s)	**Method/Méthode**	**Date Analyzed Date Analysé**	**Units Unités**	
Total Coliforms/Coliformes totaux	FFA01	17-Aug-21	MPN/100mL	>2,419.6
E. coli	FFA01	17-Aug-21	MPN/100mL	44.8

This report relates only to the sample(s) and information provided to the laboratory.

Le présent rapport ne s'applique qu'aux échantillons et à l'information transmis au laboratoire.

Corrie Maston
Acting Micro Supervisor
Applied and Experimental Bioscience

Adrienne Fortin
Microbiology Technician
Applied and Experimental Bioscience