Atlantic Salmon Habitat Management Plan

Prepared by Cornwall and Area Watershed Group

2022

Atlantic Salmon Habitat Management Plan for the North River Watershed

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1.0 Introduction

1.1 History of the watershed & Purpose of the project

Cornwall and Area Watershed Group

History

The Cornwall and Area Watershed Group has been an active non-profit community group since February 2009. It was founded by a group of Cornwall residents that wanted to play an active role in the conservation and rehabilitation of the Hyde Creek Watershed. In 2013, CAWG's boundaries expanded to encompass the North River Watershed, which was previously managed by Trout Unlimited Canada PEI.

Mandate

The Cornwall & Area Watershed Group is a non-profit community group whose goal is to enhance the water quality of our local waterways, to rehabilitate and protect fish and wildlife habitat, and improve outdoor active living through increased recreational opportunities. Our collaborative approach in watershed management integrates residents, farmers, fisherman, municipalities and government to actively work together for a sustainable future in our watershed communities.

Objectives

1. Assess

Collect information through mapping, surveying, assessments, and monitoring programs and evaluate the data to comprehensively understand the present conditions within the North River and Hyde Creek Watershed.

2. Rehabilitate

Initiate projects that will improve the habitat for stream, riparian and upland communities for fish and wildlife.

3. Conserve

Promote best land use strategies and engage in activities that will continue to protect and sustain our natural resources: water, top soil, trees and fish.

4. Monitor

Continue to monitor fish and wildlife populations, stream and upland habitat conditions, and land use practices to be able to evaluate long-term data and broaden our knowledge in understanding what best management practices in both land use and stream rehabilitation make a difference in the sustainability of natural resources within our watershed community.

5. Educate

Engage in community events and develop educational programs that promote sustainability and understanding of the environment and the impacts from human activities.

Contact Information

Watershed Coordinator:	**Mailing Address:**	**Website:**
Hannah MacLean	PO Box 430	www.cawgpei.com
(902) 218-8073	15 Mercedes Drive	**Email:**
	Cornwall, PE C0A 1H0	Info@cawgpei.com

What is a watershed?

Watershed boundaries form under geological and climatic processes that define the elevation of the landscape and direct water to fall on the land in one direction versus another. Therefore, the high peaks in the landscape encompass the area of land and the volume of water that drains down to a common point.

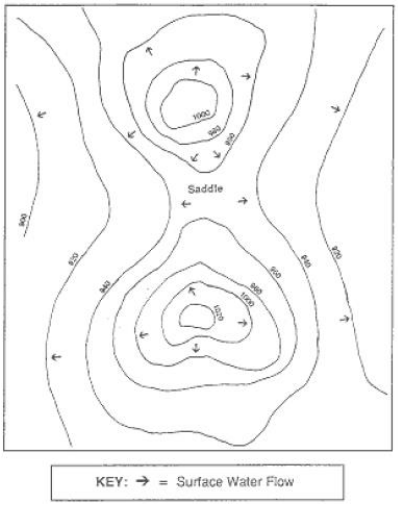

Figure 1. Water flowing downhill from a peak (the circle) in the landscape

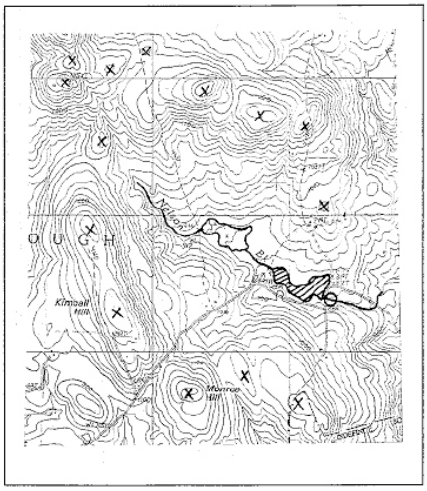

Figure 2. Peaks (x's) in the landscape define the watershed boundary; the contour lines show different elevations in the landscape.

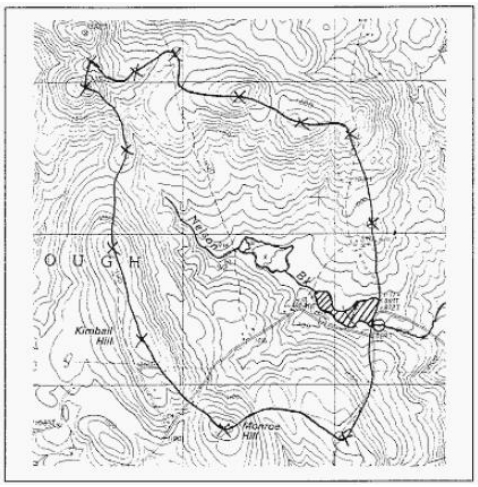

Figure 3. The watershed boundary encompasses the area of land and the volume of water that drains down to a common point.

Stream Hydrology

According to COSEWIC (2007) "Riffles are characterized by shallow water, fast currents and a turbulent surface with gravel or boulder bottom... Runs are deeper than riffles and with a moderate to fast current, the run's surface is not as turbulent as the riffle and bottom materials are smaller gravel/cobble...Pools are deep, slow-moving water with a flat surface and sand or small gravel bottoms." (see Fig: 4)

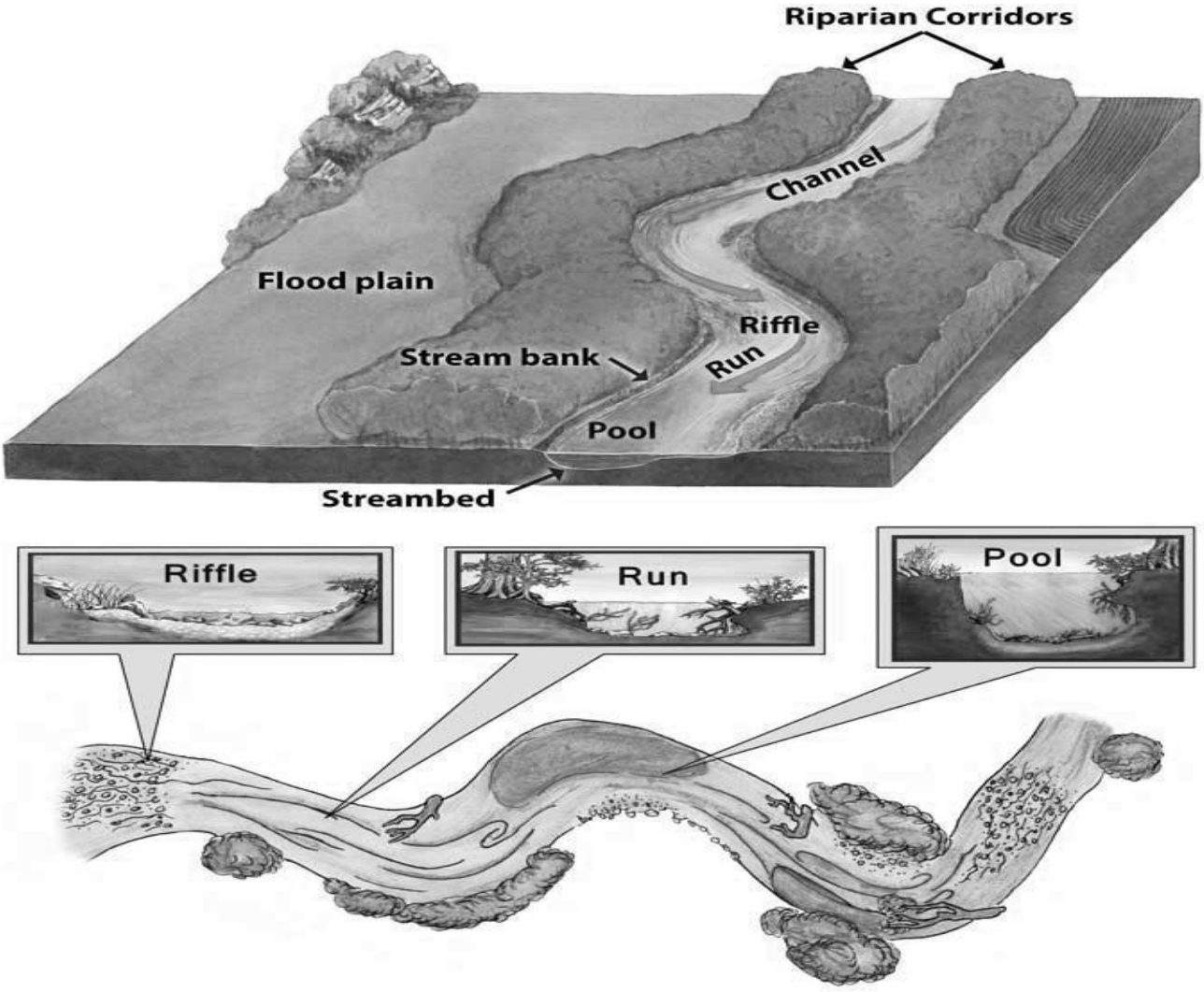

Figure 4. Run, riffle, pool diagram and cross-sectional diagrams.

Ecosystem

There are many ways to look at a watershed. Farmers, fisheries, engineers, biologists, ecologists, hydrologists, agronomists, transportation, families and communities all function within a watershed while utilising and benefitting from the resources it provides.

Integrated Ecosystems Management Approach

According to the 2005 Scientific Consensus Statement on Marine Ecosystem-based Management, the ecosystem management approach is a framework for the development of effective management plans based on an accepted set of guiding principles and should:

- Emphasize the health of the whole ecosystem ahead of the concerns of special interests;
- Be focused on a specific place, with boundaries that are scientifically defined;
- Account for the ways in which things or actions in that place affect each other;
- Consider the way things or actions in this place can influence or be influenced by things or actions on land (like dams or fertilizers in the watershed), in the air

(like air pollution), or in different parts of the ocean (like fishing or oil spills); and

- Integrate the concerns of the environment, society, the economy and our institution.

Our Watersheds

The Hyde Creek

The Hyde Creek watershed includes the residents, farmers, fisherman and businesses residing in the Town of Cornwall. Due to the urban development, residential and commercial concentration of this watershed, the ecological community requires us to consider our impact upon:

- ❑ Storm Water Management – improve natural and anthropogenic infrastructure to accommodate flash flooding during heavy precipitation and melting events due to impermeable surfaces.
- ❑ Stream, Shoreline and Roadside Cleanup – remove garbage refuse from ditches and waterways to improve water quality.
- ❑ Fish Passage, Fish and Wildlife Habitat & Connectivity – improve fish movement through road crossings and pond outlets while connecting sea-run trout to upstream spawning habitat

The North River

The North River watershed includes the residents, farmers, fisherman and businesses residing in the community of East Wiltshire, Milton, North Milton, Miltonvale Park, Warren Grove and North River. This area has a rural focus and consists mainly of agricultural land development. The ecological community requires us to consider our impact upon:

- ❑ Soil Conservation Structures – retain top soil on agricultural fields for farmers and reduce the risk of harmful chemicals leaching into the waterways during unexpected runoff events.
- ❑ River Corridor Reforestation – reduce erosion and impacts of runoff, improve water quality, enhance fish habitat and restore wildlife corridors.
- ❑ Fish Passage & Stream Connectivity – improve fish movement through road crossings and pond outlets while connecting sea-run salmon and trout to upstream spawning habit

1.2 Indigenous History to PEI

Indigenous people living on the land now known as Prince Edward Island are the Mi'kmaq, who have lived in Mi'kma’ki, traditional Mi'kmaq territory, for at least 12,000 years they are the only people Native to PEI. The Mi'kmaq originally named PEI as 'Epekwitk', meaning "lying in the water". The Mi'kmaq lived in an annual cycle of seasonal movement between living in dispersed interior winter camps and larger coastal communities during the summer **(Indigenous Canada)**. The name

‘Nemtaqaq’ is the traditional Mi’kmaq name of the North River, and it means “being able to see straight up or along until disappearing from view”. For more information, please visit the PEI Mi’kmaq Rights Initiative at lnuey.ca

1.3 Forming a Habitat Management Plan

When managing any species, the fundamentals for a species to thrive need to be understood and related to current and historical habitat usage within an area. The history and current habitat usage by a species will play a key role in identifying areas of habitat restoration efforts. To begin the planning process certain questions must be answered: how many salmon are returning during each spawning season, what is the juvenile survival rate/densities, what areas are currently being used to support certain life stage aspects, what is different about the current habitat usage compared to historical usage? The first step in improving or restoring local salmon populations must begin with identifying what the current situation is, recent watershed restoration efforts, ongoing issues, and current knowledge of species abundance. In this report, a structured approach will be implemented when all current and historical factors are considered to address certain life stage limiting factors that when relieved will help increase local populations in an efficient and effective manner.

2.0 Overview and Description of the Watershed

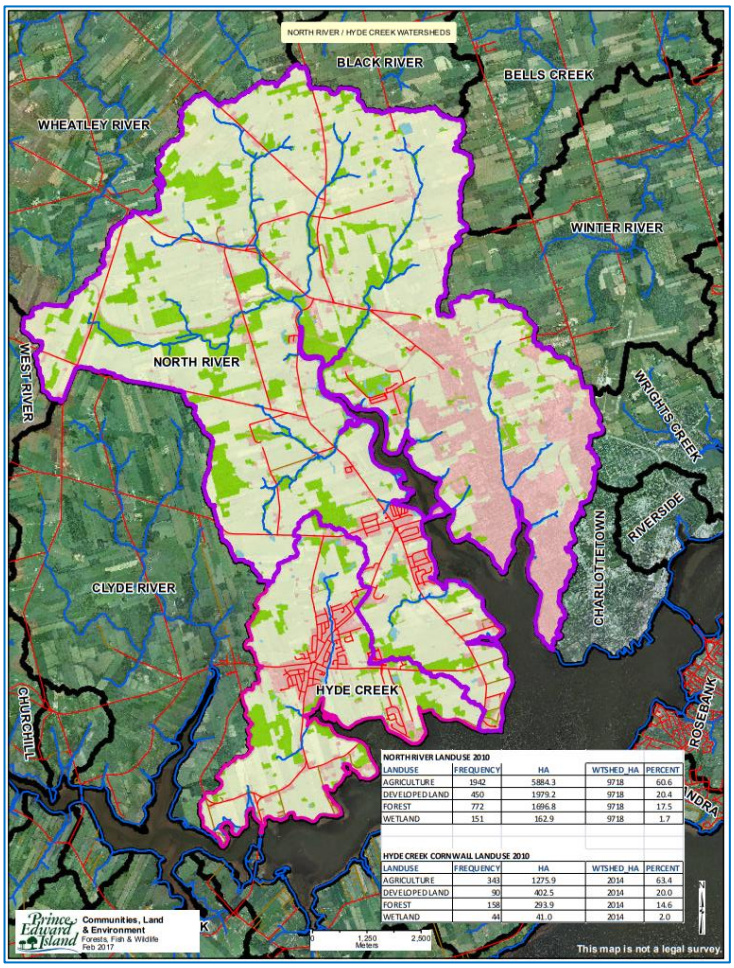

Figure 5. The watershed drainage area separated based on geographic orientation and major tributaries with 2010 land use.

The Hyde Creek and North River Watershed

In total, the Cornwall and Area Watershed Group encompasses 10,207 hectares and 52.5 km of freshwater streams. The Hyde Creek Watershed has a drainage area of approximately 2,009 hectares with 5.9 km of freshwater streams (Figure 4). The North River Watershed has a drainage area of approximately 9,695 hectares with 53.7 km of freshwater streams (Figure 4). However, the Cornwall and Area Watershed Group does not oversee management of Ellen's Creek within the City of Charlottetown, this portion is managed by the Ellen's Creek Watershed Group. Therefore, the management plan for this paper is only including the area within our boundary lines, for a total of 8,198 hectares and 46.6 km of freshwater streams.

North River Watershed

Cluster 4:

The West, Clyde and North Rivers all had historical runs of Atlantic salmon but currently, only the West maintains a consistent population. Salmon redd counts in the West River have been steadily increasing since habitat restoration work was resumed in 2010. It is anticipated that the 2018 run of salmon will be strong as the first salmon fry stocked from the Abegweit Biodiversity Enhancement Hatchery return to the river. Clyde River once had salmon in both branches, however in recent years it has experienced massive sediment run-off from exposed agricultural land. Redd numbers in North River were disappointingly low in 2017.

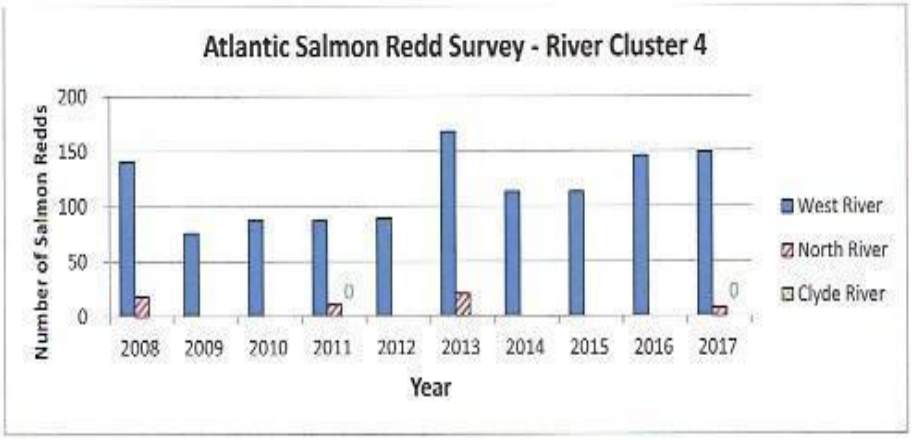

Figure 26. Number of salmon redds in Cluster 4 rivers from 2008 to 2017. Note: A '0' indicates that a survey was undertaken but no redds were recorded.

Figure 27. Massive runoff of sediment from a potato field alongside the Clyde River, April 2017. [Photo: D. Guignion]

Figure 6. Page from *A Renewed Conservation Strategy for Atlantic Salmon in PEI (2019)*.

The North River Watershed has documented populations of Atlantic Salmon for several years by way of annual redd survey and electrofishing survey. The populations at present appear to be low and declining due to habitat degradation. Redd surveying indicates the salmon spawning habitat to be at the footwaters of tributaries rather than the headwaters. This information relates to the quality of habitat and fish passage through the system.

Atlantic Salmon researcher, biologist and conservation advocate Daryl Guignon has developed an Atlantic Salmon Conservation Strategy and in his 2008 and 2019 publications he denoted the population on Atlantic Salmon abundance in three local watersheds, stating the salmon redd numbers in North River watershed for 2017 to be “disappointingly low”.

3.0 Monitoring Programs

North River Watershed Monitoring

3.1 Water temperature monitoring.

Data loggers were installed in two rivers in 2019 and 2021, for the purpose of monitoring the temperature conditions of salmon redds. Research suggests that colder water temperatures may impact juvenile survival. The optimal temperatures for the emergence of juvenile Atlantic Salmon occurs once the water reaches 10-12 degrees celsius consistently. So far, the data collected shows us that the temperature of the water is not optimal until mid-July, suggesting that our rivers stayed colder for a longer time than other PEI rivers.

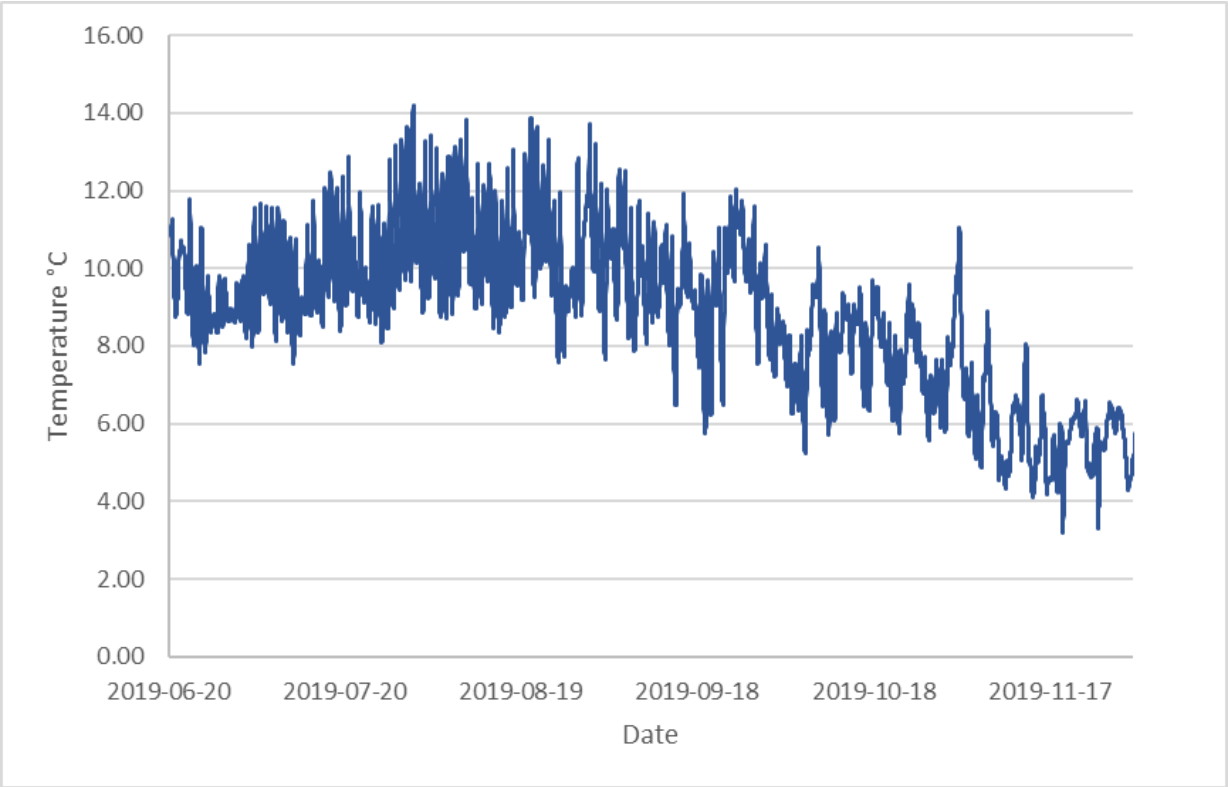

Figure 7. Watt’s Creek water temperature from June 20th to December 1st, 2019.

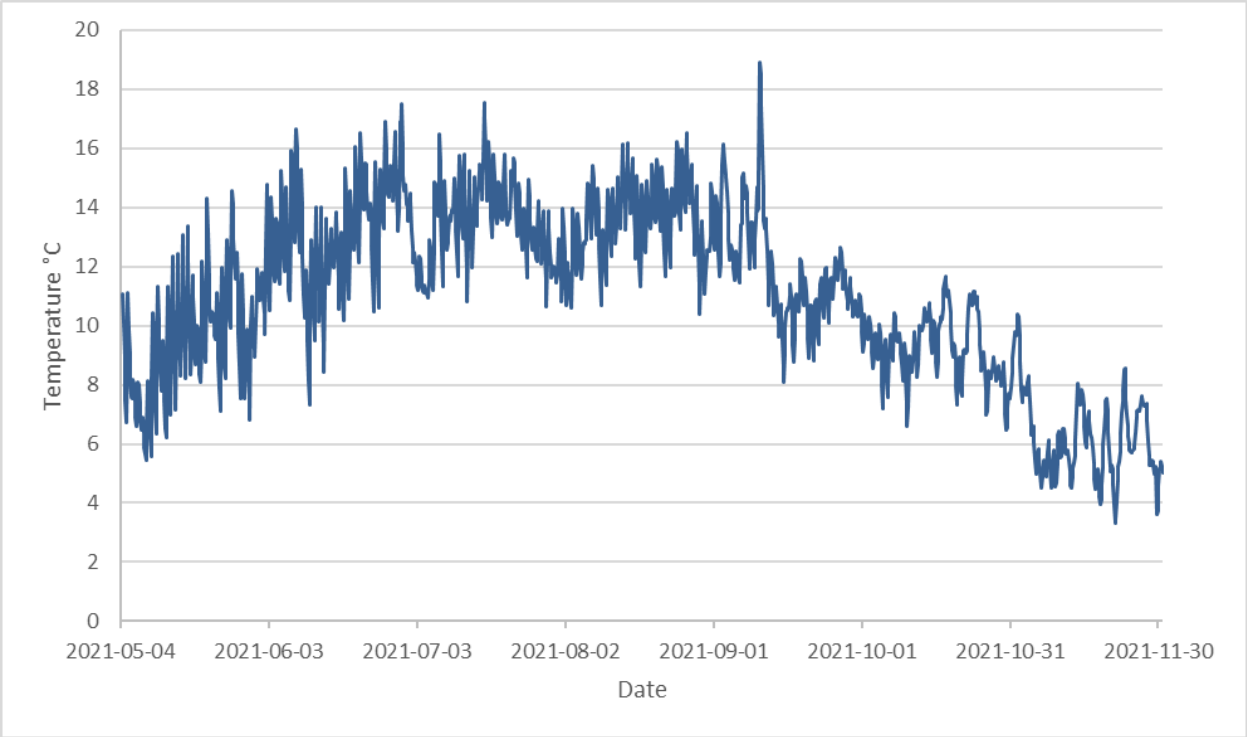

Figure 8: Lower Cole's Creek Water Temperature, May 4th to December 1st, 2021.

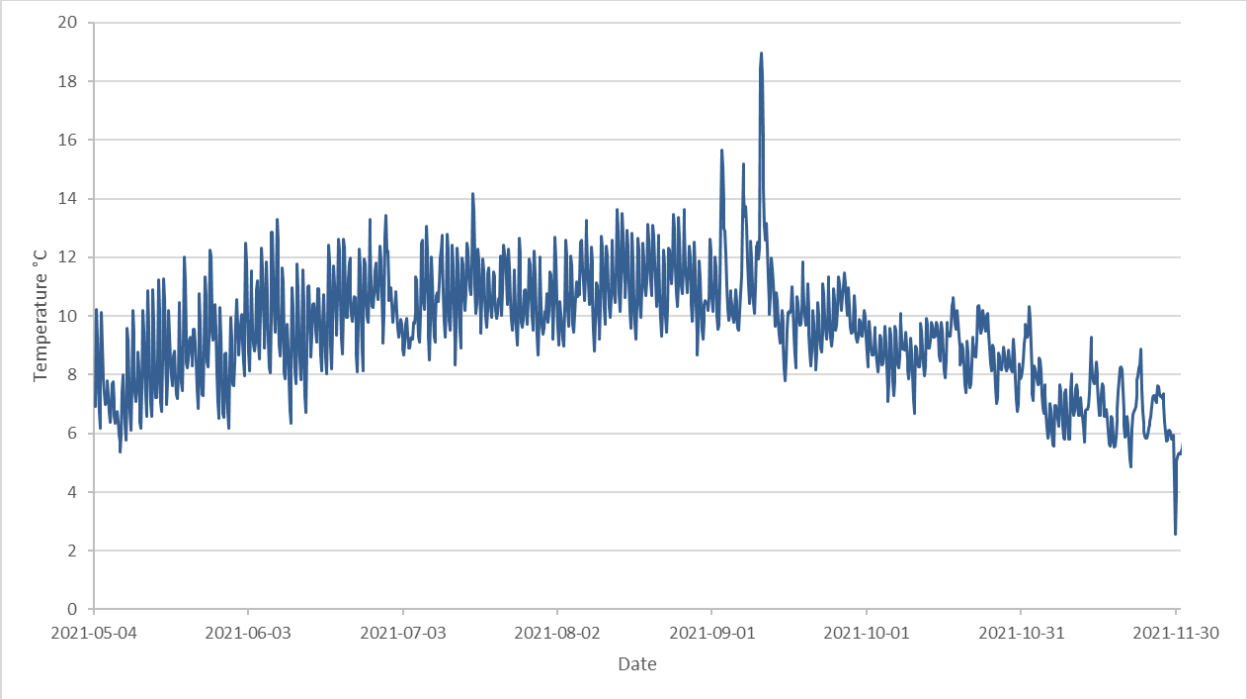

Figure 9: North River Water Temperature, May 4th to December 1st, 2021.

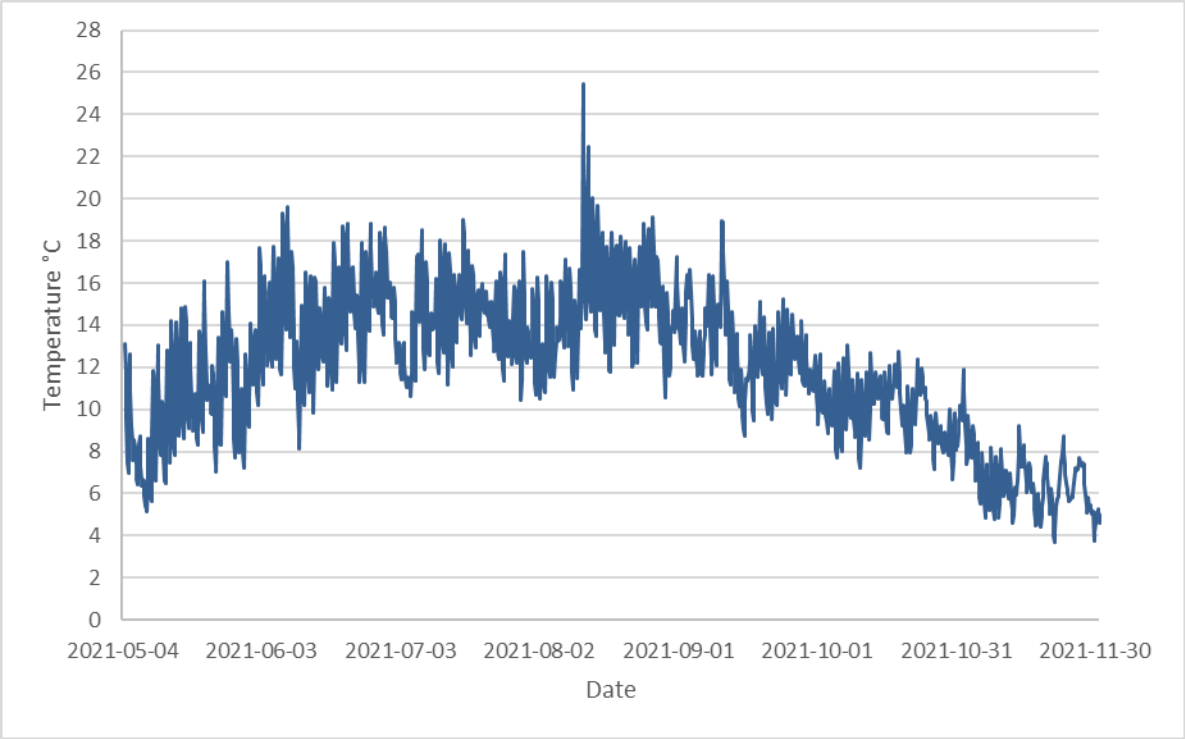

Figure 10: Upper Cole's Creek Water Temperature, May 4th to December 1st, 2021.

3.2 Nitrate monitoring.

There has not been official and strategic nitrate monitoring completed by CAWG. There is research indicating the North River watershed and the Hyde Creek watershed have excessive nitrate levels in the surface water, from the inputs of agricultural fields run off, which pose a threat to the ecosystem. Maps from the study by Pierre Grizard titled Modeling nitrate loading from watersheds to coastal waters of the Northumberland Strait.

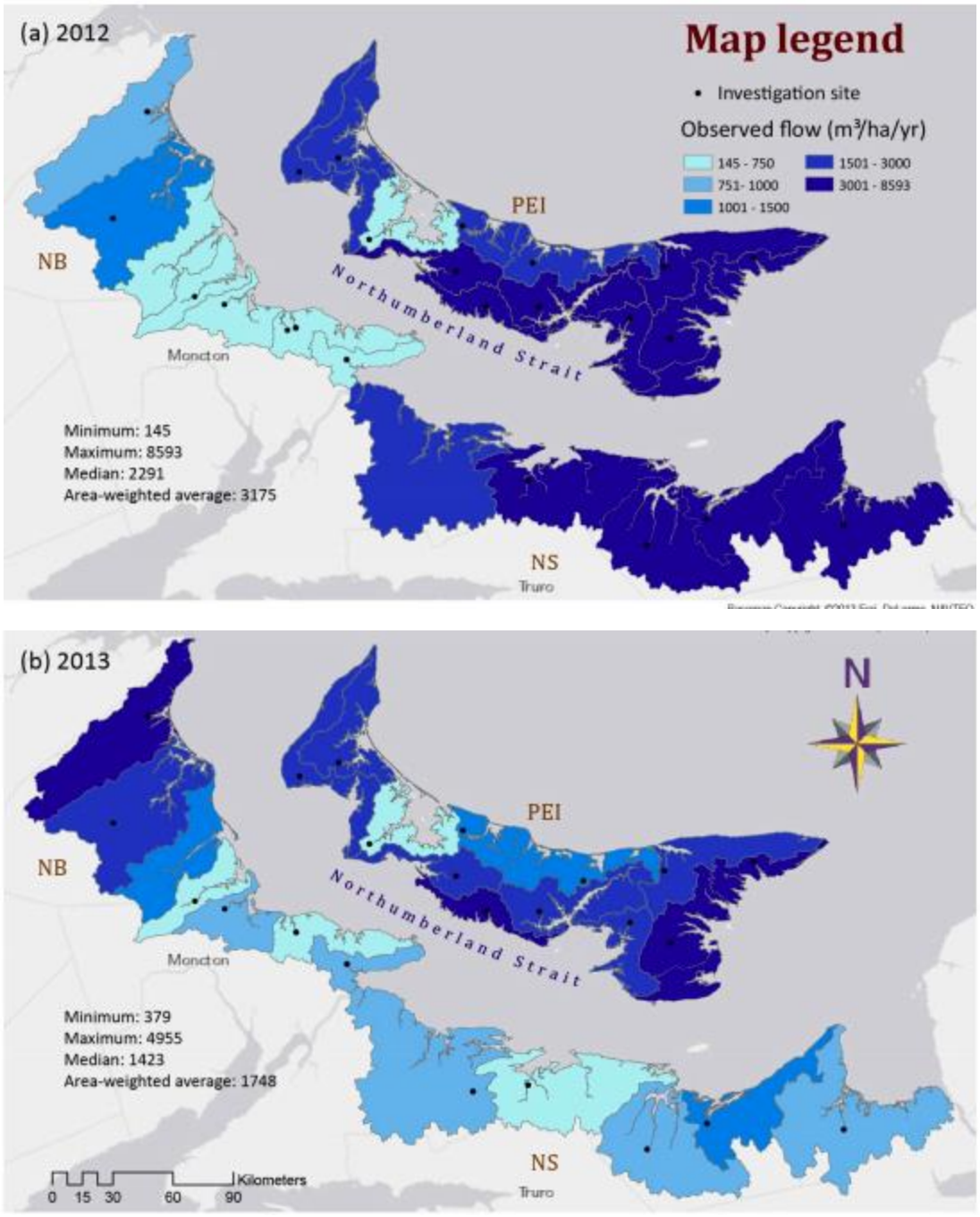

Figure 11. Observed surface water discharge around the Northumberland Strait: a) September/October 2012 and b) July/August 2013. The statistics are obtained from the set of 25 watersheds composing the study area. (Grizard, P. 2013)

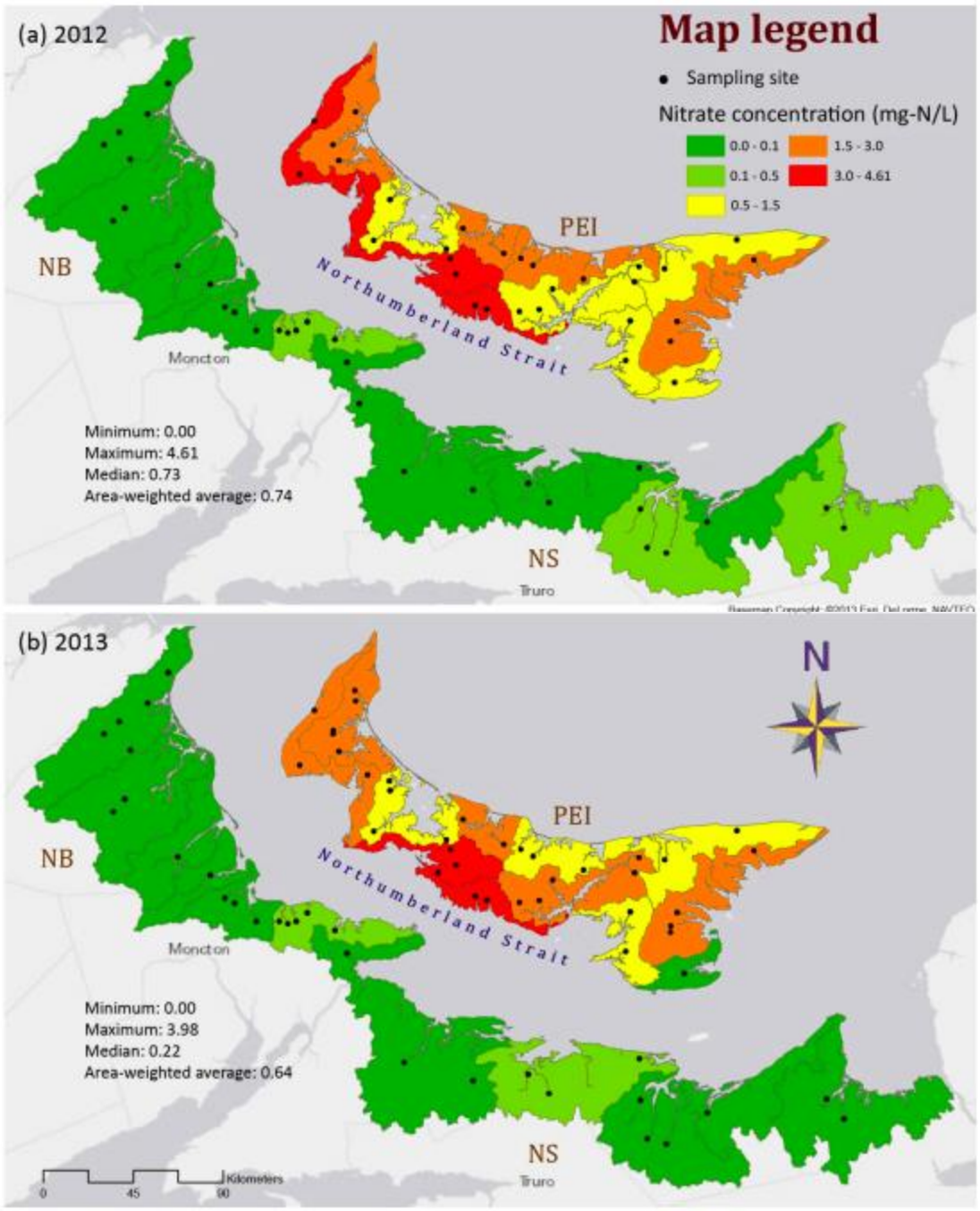

Figure 12. Nitrate concentration measured in fresh surface waters around the Northumberland Strait: a) September/October 2012 and b) July/August 2013. The statistics are obtained from the set of 25 watersheds composing the study area. (Grizard, P. 2013)

3.3 Electrofishing.

Annually, the Department of Forest, Fish, and Wildlife have performed electrofishing at 3 index sites within the North River watershed. The goal of using annual electrofishing is to identify the species composition of a reach, confirm juvenile Salmon habitat and estimate population density.

Table 1. Electrofishing data from Dept. index sites the North River watershed, showing salmonid density (number fish/100 m2) and Atlantic salmon redds for the North River. Note that the 2018 electrofishing locations are not identical to historical sites. (Guignon, Gaudet & MacFarlane, 2019).

Site	*Water temperature (^{0}C)	Salmonid density				[5]AS redds	
North River		BT	RT	AS	year	year	number
Rt 2 (Coles Brook)	5.3	87.6	22.5	**0** Yes	**2018**[1] 2008[3]	2008 2011 2013	18 11 21
Loyalist Road	6.8	48.6	1.4	**0** 0 No 0	**2018**[1] 2002[3] 2008[3] 2017[2]	2017	8
Springvale (Rt 2)				47.4 6.7 0	2007[3] 2016[4] 2017[2]		

1- 2018 electrofishing survey; **2**- Forests, Fish and Wildlife 2017 survey; **3-** Guignion and Oak Meadows (2009); **4**- Forests, Fish and Wildlife 2016 survey**; 5**- Oak Meadows (2018); BT- brook trout; RT – rainbow trout; AS- Atlantic salmon; Yes/ No – present /absent in spot check; *water temperature from 2018 electrofishing survey

Figure 13. Map of Forests, Fish and Wildlife electrofishing sites.

CAWG's Electrofishing Surveys
In July 2021, CAWG electro-fished a total of 20 thirty-meter sites with known redding activity to determine where juvenile salmon densities were highest. Redd sites on Watt's Creek and North River demonstrated the strongest juvenile population densities.

Table 2. Sites with Atlantic Salmon Juveniles within the North River Drainage Basin

Site #	Watershed	Number of AS	Density (#/m^2)
1	Lower North River	3	0.002
2	Lower North River	10	0.056
3	Watt's Creek	11	0.102
4	Watt's Creek	5	0.048
5	Watt's Creek	8	0.078
6	Upper North River	6	0.036

Figure 14. Map of Sites with Atlantic Salmon Juveniles within the North River Drainage Basin.

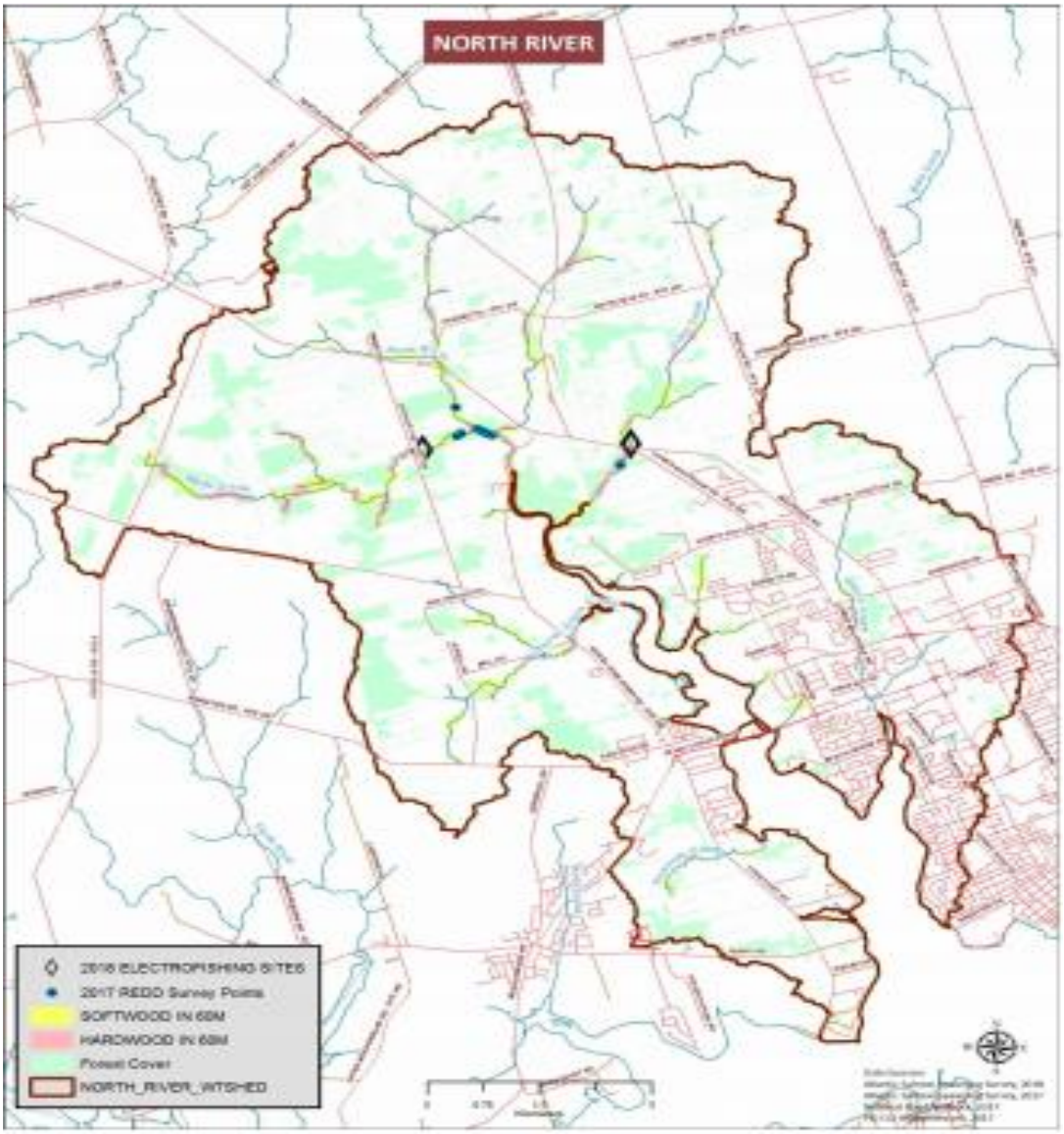

Figure 14. North River watershed showing location of 2018 electrofishing sites and 2017 redds.

3.4 Redd Surveys. The goal of performing annual redd surveys is to obtain a measurement of the mature spawning adults in a salmonid population. This data is quantitative, recorded by a GPS or the Watershed App, and it can be used to suggest the status of the population. Timing of the redd surveys occurs usually from mid- November to mid- December. Checking the rivers every three days, weather permitting. Water conditions on a high flow event, or a rainy/snowy day, are poor for redd surveying. Wearing polarized glasses allows the surveyor to omit the reflection of the water and obtain a good visual on the redd below the water's surface.

Table 3. Salmon redd count surveys on the North River Watershed (Cornwall and Area Watershed Group).

Year/# of Redds	2008	2011	2013	2016	2017	2018	2019	2020	2021
North River	18	11	21	3	8	1	5	0	7
Watt's Creek	*	*	*	0	1	5	5	2	5
Milton Brook	*	*	*	3	0	0	1	0	2
Cole's Creek	*	*	*	1	0	0	2	1	*

*****Surveys not completed due to extenuating circumstances

Figure 15. Map of North River Watershed where Salmon redds are commonly found.

4.0 Habitat Requirements

Each life stage of salmon utilizes unique habitat components with an array of requirements and pressing limiting factors. Life stage requirements can be broken down into three general habitat components that should be targeted to improve early life stage success and productivity in streams. The three are: **spawning habitat**, **juvenile rearing habitat**, and **migratory areas**. When managing a section of river these three general habitat components should be identified to gauge the level of productivity and also have limiting factors associated with the degradation of said areas identified. Limiting factors that negatively affect local salmon populations usually target one of these general habitat components. For example, severe sedimentation negatively impacts spawning habitat quality and juvenile rearing habitat which

will ultimately lead to reduced productivity and local population declines. By addressing sources of sediment, the spawning habitat and rearing habitat should be easier to enhance and re-establish with additional restoration tactics. The historic usage of said identified habitat components is important when moving forward with habitat management. The current situation of salmon and habitat usage may be the result of many decades of habitat degradation and may not always be the most ideal or productive area for salmon production. The following categorizes the life stage requirements into three general habitat components used during the salmon freshwater residency.

4.1 Spawning and Egg Incubation

The first task is to conduct annual redd surveys to identify which areas are currently being used for spawning activity. Talking to anyone who has historic knowledge on the area is also key in this step as some local experts may have prior knowledge of historic areas salmon used for spawning, which should be considered in management implications. Once ideal spawning areas are identified for targeting, the quality of spawning habitat can be improved via reducing instream sediment bedload, un-imbedding spawning substrate by manually breaking up substrate, and adding desired fist sized spawning substrate to identified areas. Salmon chose the placement of redds in a location with accelerating water velocity and decreasing depth (means of providing eggs with oxygen) in the transition area from pool to riffle and an area with coarse spawning substrate to ensure high egg survival. Other factors that should be considered in spawning habitat quality include nearby pools for salmon to stage in with adequate cover (under banks or Large Woody Debris), quality of spawning substrate (round, fist sized rock is preferred with minimal fine sediments), and chronic sources of sediment sources upstream of spawning areas. Woody debris can also be positioned in-stream to help create areas with ideal water velocities to increase available spawning habitat.

4.2 Juvenile Rearing Habitat

Young salmon prefer occupying riffle areas (<15cm in depth with coarse streambed) while depth preference for coarse substrate increases with body size. Juvenile salmon are territorial, and higher densities can be found in riffle/run areas when coarse substrate and ideal flow are present. The first step in improving this habitat component is relating juvenile rearing habitat to spawning areas. Juvenile salmon will migrate downstream over time so rearing habitat should be located directly below spawning areas and progress down to the estuary. If it is identified that rearing habitat areas are lacking or are impaired, coarseness of the streambed can be improved upon. Using local rock sources (i.e. bedrock slabs or embedded boulders) to create boulder clusters in riffle/run areas is a way to increase hydraulic roughness and also increase interstitial spacing between rocks. It is important to remember that juvenile salmon have preferred dietary items (mayflies and stoneflies) so improving habitat requirements for desired invertebrates also improves the quality of habitat for juvenile salmon (i.e. leave woody debris in stream channel, rocks with interstitial spacing also improve habitat for invertebrates, etc).

4.3 Migratory corridor

To complete the salmon life cycle adults must return from sea to the freshwater environment to spawn and begin the life cycle again. The most important aspect of this stage is to ensure the adult fish can reach spawning areas. Annual monitoring of migratory corridors is required to ensure any major blockages (beaver dams, log jams etc) are removed before spawning season. It is also important to consider that adult fish are anadromous and require a transition period when leaving the saltwater environment and entering the freshwater. This requires adequate holding areas in the head-of-tide region to allow the salmon to slowly adjust to the changing environment. Another factor to consider is the frequency of adequate holding pools that an adult fish can comfortably stage in while migrating upriver. When attempting to encourage adult fish to enter into major tributaries the frequency of holding pools should be every 200-500m. Ideally holding areas should be situated nearby spawning areas. If class A pools cannot be achieved large cover structures can be installed (e.g. full-length cover logs or multi-log structures) near spawning areas to encourage them to stage nearby prior to spawning. Also, an avoidance of stretches with low water should be resolved, if possible, by resolving any braids and narrowing the stream channel in over widened areas.

When considering all life stage components, the current areas used by salmon should be targeted for enhancement and future restoration efforts should be targeted on areas that had historical significance for range expansion. The following will discuss important historic areas utilized by Atlantic salmon, identified limiting factors, and possible restoration techniques that could be utilized to improve habitat components.

5.0 Threats to Salmon

5.1 Climate Change

A changing climate has posed a range of challenges to salmon survival during the freshwater portion of their lifecycle. During the spring of 2015, record breaking snowfall resulted in a massive spring freshet, which would have had severe negative effectives on egg survival. Redds could have been washed away and/or buried in sediment. If there is an increase in dramatic flooding events like experienced in 2014/2015 this may result in an increase of sedimentation and reduced egg survival.

A prediction with climate change is an increase in rainfall events during the winter months, which may result in a “super cooling” event as water runs off the land at near freezing temperatures. This may result in a hypothermic shock to the eggs resulting in a reduced egg survival. On the other end of the spectrum during 2020 there were drought-like conditions experienced resulting in low water levels during the spawning season. Salmon redds were not recorded up any major tributary and were recorded in abnormal areas resulting in eggs placed in lower quality habitat. Another note with low water conditions was the increase in sightings of salmonids with fungal infections. A graduate study was ongoing during 2020 and resulted in multiple adult salmon captured with a fungal infection. During low water fish are concentrated in pools and springs. This allows the rate of infection spread to increase, which has unknown

consequences to the broodstock population. During the same period dozens of adult brook trout were found dead covered in the same fungal infection.

5.2 Sedimentation

Sediment is the biggest threat to salmon on PEI. It reduces habitat quality in multiple aspects. It reduces egg survival by infiltrating the spawning substrate which reduces the oxygen supply to the eggs during the incubation period. When the salmon fry emerge, they require a coarse stream bed bottom for cover. After the fry emerge, they become territorial, and the size of the territories are directly related to the habitat quality. A coarse streambed bottom can support a higher number of individuals compared to a homogenous streambed bottom with no interstitial spaces. Another factor that can affect the growth of juveniles is the available dietary items present. Ideal dietary items are benthic macroinvertebrates, such as mayflies and stoneflies, and are usually found in high quality habitat with rocky streambed bottom opposed to a silt dominated stream, which would contain lower quality food items (midges, worms, etc). Sediment runoff enters the stream from a range of sources, the main sources are secondary roads and agricultural fields. CAWG has been actively working with local landowners and the Department of Transportation Infrastructure and energy to resolve problematic areas.

5.3 Fish Kill Events

Sadly, fish kills happen far too often and are recurring events here on PEI. Fish kill events devastate local populations as the young age classes are typically completely wiped out having detrimental long-term effects. Agricultural fish kill event impacts are also likely to intensify as a result of climate change.

In 2017, the North River Watershed's Atlantic Salmon population was considered 'disappointingly low' due to several factors which include agricultural contaminants, barriers to fish passage, changes in environmental conditions and depressed population phenomena. When populations of salmonids are critically in decline, we have what is known as 'depressed population phenomena', where there becomes a lack of recruits to form effective schools of fish that protect each other and offer a food source for larger predators. There was a fish kill in 2014 on the North River, and another in 2017 on Hyde Creek, both were investigated and pesticide run off was determined to be the cause.

By confronting the interaction and providing advocacy for our salmonid species we can mitigate future challenges and rehabilitate the population. One further step would be to see provincial regulations set up to accommodate protection on the native salmonid species we have. By mitigating these challenges head on we can sustain some standard level of conservation for salmonids.

Immediate Challenges

- Changes in environmental conditions
- Contaminants
- Barriers to fish passage
- Depressed population phenomena

Long Term Challenges

- Interactions with farmed and hatchery salmon – competition with escapees for food, infestations of parasites, disease outbreaks, and modified predator interactions
- Ecological community shifts- increased predator abundance, and lack of or reduced forage species
- Environmental shifts- temperature shifts, depressing ocean productivity, altered migration routes, decreasing survival rates
- Fisheries- excessive illegal and/or incidental catch
- Depressed population phenomena

5.4 Barriers to Migration

Beaver issues arise from time to time on PEI watersheds. With their low densities they are considered more of an annoyance with minimal effort to manage when compared to other watersheds. Culverts problems as well as impoundments have drastic effects on the North River Watershed. Issues such as hung culverts, low water, and speed of water in culvert structures can prevent salmonids from accessing headwater spawning areas. Impoundments cause a warming effect on downstream waters and allow for algal blooms which can create anoxic conditions. This is especially important in the Coles and Milton Creeks where numerous impoundments change the temperature regime for the rivers.

5.5 Invasive Species

Rainbow trout can be found throughout the entire North River watershed drainage basin and have been an ongoing problem for decades. Intraspecific competition for spawning area, food, as well as cover and space have created issues for native salmonid populations. While brook trout and salmon both spawn in late autumn, rainbow trout spawn in April.

On the North River, rainbow trout can excavate their redds on top of Atlantic salmon spawning sites from the previous fall. Rainbow trout are known to be aggressive and fast growing and their impacts on salmon in PEI streams is not fully understood. Recent studies in PEI suggest that because of habitat separation between the three salmonid species, the impacts of rainbow trout may not be the most significant threat to native salmonid populations.

6.0 Watershed-specific Action Plans

6.1 Watt's Creek

Watt's creek can be described as a Westward branch of the North River Drainage Basin that enters at the "forks" of the North River. It runs to its outlet at the forks, from its headwater at Colville Road, and contains a major tributary that starts near the Kinkora road. Watt's creek is a 3rd order river and has the most forested area of all tributaries of the North River watershed. It contains the greatest concentrations of juvenile salmon as determined by recent electrofishing surveys and contains the best spawning habitat. Some of the recent restoration achievements CAWG has completed include the following:

- Installed a large sediment trap to reduce sediment loads in the area above Loyalist Road to the "Faithworks Bridge"
- Conducted Rapid Geomorphic Assessment and Cross-Sectional surveys in areas above and below the sediment trap to monitor sediment load, riparian habitat, and substrate changes
- Repeat areas used for spawning have been identified and are enhanced annually via raking
- Major restoration work has been conducted, with the installation of 200+ brush mats over the past 3 years
- ~5 km of stream has been cleared of blockages and alder overgrowth. This area is annually maintained
- A HOBO temperature logger was installed in 2019 to monitor water temperatures and to determine if temperatures negatively impact emergence

Major limiting factors that threaten Atlantic salmon populations include the following:

- Sedimentation (mainly from agricultural fields)
- Poor spawning habitat quality in areas due to riffle embeddedness
- Reduced juvenile rearing habitat due to sedimentation
- Poor riparian forest health due to deforestation/alder overgrowth

Sources of sedimentation are a factor that affects spawning habitat quality (embeds spawning substrate and reduces oxygen supply to eggs) and affects juvenile rearing habitat by reducing the streambed interstitial spacing and limiting insect productivity (food sources and cover for juvenile). To resolve this issue the upstream sources of sediment must be addressed, and in-stream sediment must be removed. Riparian health can be improved by selective cutting and planting practices.

Recommendations

The following are objectives to help further improve local populations of salmon along the Watt's Creek section:

- On an annual basis, survey for redds and monitor areas that are repeatedly used for spawning. Then, use information for future enhancement activities
- Work with local landowners to address run-off issues (especially in First and Second Order streams)
- Maintain stream connectivity by ensuring the migratory corridor from sea to spawning areas remains clear of blockages.
- Work with TIE to address connectivity issues caused by the Loyalist Road culvert, and any confederation trail river crossings with issue.
- Monitor agricultural fields for sediment input
- Enhance current spawning areas by loosening substrate (up to 30cm deep) with rakes and removing fine sediments to ensure future spawning efforts have ideal substrate to create high quality redds. Addition of preferred substrate (fist sized rock) can be added in areas where non-preferred substrate is dominant (especially below Loyalist Road)

- Continue stream enhancement activities such as cover log installation and brush matting
- Concentrate work in areas identified by 2021 electrofishing surveys to have high juvenile salmon populations to ensure survivability and restore juvenile habitat
- Continue to improve juvenile rearing habitat in riffle/run areas below Loyalist Road by flipping rock, raking
- Monitor sediment trap for future re-excavation
- Plant trees throughout Kinkora Road headwater to preserve cold water habitat
- Remove beaver dam below Colville Road to ensure headwater access
- Identify landowners who support riparian management

Table 4. Management recommendations for the Watt's creek section

Annual To-Do Checklist	Long Term (5+ years)	Short Term (1-5 years)	Cost/Benefit	Priority
Area: Watt's Creek				
Redd surveys	X		Low/Medium	1
Address run-off issues	X		Medium/High	1
Walk section to ensure no barriers to fish passage		X	Low/Medium	1
Work with TIE to resolve Loyalist Road culvert	X		Low/High	1
Monitor agricultural fields for sediment input	X		Low/High	1
Rake spawning areas identified via redd surveys		X	Low/Medium	2
Addition of preferred substrate to spawning areas where non-preferred substrate is dominant		X	Low/Medium	1
Continue stream enhancement activities (brush mats, cover logs)		X	Low/Medium	2
Increase/improve juvenile rearing habitat (esp. identified by electrofishing surveys)		X	Low/Medium	2
Monitor sediment level in trap for future re-excavation		X	High/high	1
Plant trees throughout Kinkora Road headwater	X		Low/high	2
Remove beaver dam below Colville Road		X	Low	3

6.2 North River (Above Forks)

North River (above forks) can be described as the branch of the North River drainage basin that enters at the "forks" of the North River. It runs to its outlet at the forks, from its headwater at the New Glasgow Road, and contains a major tributary that starts near the Route 2 highway (Springvale). The Above Forks section of the North River contains the most potential

salmon habitat of all tributaries of the North River watershed. Some of the recent restoration achievements CAWG has made include the following:

- Installed 200+ brush mats to mitigate sedimentation issues and restore banks
- Repeat areas used for spawning have been identified and are annually enhanced via raking
- Restored/Improved ~2km of juvenile rearing habitat
- 6 km of stream has been cleared of blockages and alder overgrowth.
- A HOBO temperature logger was installed in 2019 to monitor water temperatures to determine if they negatively impact emergence

Major limiting factors that threaten Atlantic salmon populations include the following:

- Poor connectivity between areas of quality habitat
- Lack of holding pools for staging
- Sedimentation (mainly from agricultural fields)
- Poor spawning habitat quality in areas due to riffle embeddedness
- Reduced juvenile rearing habitat due to sedimentation
- Poor riparian forest health due to deforestation/alder overgrowth

To allow for salmon to reach headwater spawning areas, connectivity issues arising from decommissioned stream crossings and silt-laden areas must be addressed.

Recommendations

The following are objectives to help further improve local populations of salmon along the North River (Above Forks) section:

- On an annual basis survey for redds to monitor areas that are repeatedly used for spawning and use information for future enhancement activities
- Work with local landowners to address run-off issues (especially in First and Second Order streams)
- Maintain stream connectivity by ensuring the migratory corridor from sea to spawning areas remains clear of blockages.
- Remove a conglomeration of old cars, tires and a decommissioned stream crossing known as the “car wreck”
- Monitor agricultural fields for sediment input
- Enhance current spawning areas by loosening substrate (up to 30cm deep) with rakes and removing fine sediments to ensure future spawning efforts have ideal substrate to create high quality redds. Addition of preferred substrate (fist sized rock) can be added in areas where non-preferred substrate is dominant (especially below the Confederation Trail)
- Continue stream enhancement activities such as cover log installation and brush matting
- Use structures such as gap-notches, pinch-points, deflectors to create desirable flow characteristics in areas with little pool habitat for staging
- Continue to improve juvenile rearing habitat in riffle/run areas below Route 2 by flipping rock, raking

- Plant native trees/shrubs throughout the New Glasgow and Springvale headwaters to preserve cold water habitat and reduce runoff
- Remove a decommissioned crossing near Crabbe Road to ensure headwater access
- Address poor riparian health and sedimentation issues above the "Car Wreck" by planting trees, brush-matting and potentially reconnecting the floodplain via bank reconstruction.

Table 5. Management recommendations for the Above Forks section of the North River

Annual To-Do Checklist	Long Term (5+ years)	Short Term (1-5 years)	Cost/Benefit	Priority
Area: North River (Above Forks)				
Redd surveys	X		Low/Medium	1
Address run-off issues	X		Medium/High	1
Walk section to ensure no barriers to fish passage		X	Low/Medium	2
Remove decommissioned crossing near Crabbe Rd		X	Low/High	1
Monitor agricultural fields for sediment input	X		Low/High	1
Rake spawning areas identified via redd surveys		X	Low/Medium	2
Addition of preferred substrate to spawning areas where non-preferred substrate is dominant		X	Low/Medium	1
Continue stream enhancement activities (brush mats, cover logs)		X	Low/Medium	3
Install pinch points/deflectors		X	Low/Medium	3
Increase/improve juvenile rearing habitat		X	Low/Medium	2
Address poor riparian conditions above "car wreck"	X		Medium/High	1
Plant trees throughout Springvale and New Glasgow Road Headwaters	X		Low/high	1
Remove "Car Wreck"		X	Low/high	1

6.3 North River (Below Forks)

North River (Below Forks) can be described as the main branch of the North River drainage basin below the "forks" of the North River. It runs from its inlet at the forks to its confluence with the West River in the Charlottetown Harbor. The Below Forks section of the North River is mostly tidal, this area acts a buffer for sea-run fish where they acclimate to fresh water before spawning. Some of the recent restoration achievements CAWG has made include the following:

- Installed several large brush mats to mitigate sedimentation issues and address widening

- Repeat areas used for spawning have been identified and are annually enhanced via raking
- Installed several large cover logs to provide fish cover and desirable flow characteristics
- Installed a large Rock Deflector which will be used to create a large holding pool for salmon and help restore natural meander
- Conducted several patch cuts to increase the speed of natural succession and address alder overgrowth
- Planted ~100 Black Spruce, Tamarack, Red Maple, and Yellow Birch trees to create shade, diversity, and buffer bank erosion due to rising tides and sea level rise.

Major limiting factors that threaten Atlantic Salmon populations include the following:

- Lack of holding pools
- Excessive human activity causing bank erosion, litter accumulation and destruction of riparian vegetation
- Sedimentation (mainly from agricultural fields)
- Poor spawning habitat quality due to riffle embeddedness
- Reduced juvenile rearing habitat due to sedimentation
- Poor riparian forest health due to deforestation/alder overgrowth
- Sea Level Rise (Climate Change)

The creation of deep holding pools will benefit salmonids giving them cover and refuge while they acclimate to fresh water. Pools could be restored with structures that both create deep water and restore natural river meander. Human activity is a challenge that must be met with trail creation and the planting of shrubs and trees to reduce bank erosion. Regular garbage clean ups could help eliminate litter and improve water quality.

Recommendations

The following are objectives to help further improve local populations of salmon along the North River (Below Forks) section:

- On an annual basis survey for redds to monitor areas that are repeatedly used for spawning and use information for future enhancement activities
- Install brush mats/deflectors to restore natural meander patterns
- Continue brush matting to address widening and sedimentation issues
- Continue additional patch cuts and tree planting to increase succession
- Enhance current spawning areas by loosening substrate (up to 30cm deep) with rakes and removing fine sediments to ensure future spawning efforts have ideal substrate to create high quality redds. Addition of preferred substrate (fist sized rock) can be added in areas where non-preferred substrate is dominant (especially below the forks)
- Create angling trails away from the riverbank to reduce erosion and preserve crucial vegetation, then stabilize the bank.

- Continue to improve juvenile rearing habitat in riffle/run areas below the forks by flipping rock
- Plant native trees/shrubs in strategic areas to create tree cover and reduce runoff
- Address steep bank angles by potentially reconnecting the floodplain via bank reconstruction
- Monitor where the head of tide is affected by SLR

Table 6. Management recommendations for the Below Forks section of the North River

Annual To-Do Checklist	Long Term (5+ years)	Short Term (1-5 years)	Cost/Benefit	Priority
Area: North River (Below Forks)				
Redd surveys	X		Low/Medium	1
Restore natural meander/create holding pools	X		Low/High	3
Brush mat to mitigate widening/sedimentation		X	Low/Medium	2
Continue patch cuts	X		Low/High	2
Rake spawning areas identified via redd surveys		X	Low/Medium	3
Addition of preferred substrate to spawning areas where non-preferred substrate is dominant		X	Low/Medium	1
Increase/improve juvenile rearing habitat		X	Low/Medium	2
Create angling trails		X	Low/High	1
Plant native trees/shrubs	X		Low/high	1
Reduce steep bank angles	X		Low/high	2

6.4 Milton Creek

Milton Creek can be described as a major tributary of the North River. It runs to its outlet upriver from North York River Road to its headwater near the North Rustico Road. Some of the recent restoration achievements CAWG has made include the following:

- Installed 200+ brush mats to mitigate sedimentation issues
- Installed 100+ cover logs for salmonid habitat
- Improved ~1km of juvenile rearing habitat
- ~4 km of stream has been cleared of blockages and alder overgrowth.
- ~ 200 Oak, Birch, Serviceberry and Spruce planted to fix issues with runoff, fish cover, and poor riparian health

Major limiting factors that threaten Atlantic salmon populations include the following:

- Poor connectivity between areas of quality habitat
- Sedimentation (mainly from agricultural fields)

- Poor spawning habitat quality in areas due to riffle embeddedness
- Reduced juvenile rearing habitat due to sedimentation
- Poor riparian forest health due to deforestation/alder overgrowth

Recommendations

The following are objectives to help further improve local populations of salmon along the Milton Creek section:

- On an annual basis survey for redds to monitor areas that are repeatedly used for spawning and use information for future enhancement activities
- Work with local landowners to address run-off issues (especially in First and Second Order streams)
- Maintain stream connectivity by ensuring the migratory corridor from sea to spawning areas remains clear of blockages.
- Monitor agricultural fields for sediment input
- Enhance current spawning areas by loosening substrate (up to 30cm deep) with rakes and removing fine sediments to ensure future spawning efforts have ideal substrate to create high quality redds.
- Continue stream enhancement activities such as cover log installation and brush matting above Milton Creek Pond
- Excavate Milton Creek Pond to reduce sediment loads
- Continue to improve juvenile rearing habitat in riffle/run areas below Route 2 by flipping rock, raking
- Plant native trees/shrubs in select headwaters and above Milton Creek Pond to preserve cold water habitat and reduce runoff

Table 7. Management recommendations for the Milton Creek section.

Annual To-Do Checklist	Long Term (5+ years)	Short Term (1-5 years)	Cost/Benefit	Priority
Area: Milton Creek				
Redd surveys	X		Low/Medium	1
Address run-off issues	X		Medium/High	1
Walk section to ensure no barriers to fish passage		X	Low/Medium	2
Monitor agricultural fields for sediment input		X	Low/High	1
Rake spawning areas identified via redd surveys		X	Low/Medium	2
Excavate Milton Creek Pond	X		Low/Medium	1
Continue stream enhancement activities (brush mats, cover logs)	X		Low/Medium	3
Increase/improve juvenile rearing habitat		X	Low/Medium	2

Plant trees in headwaters and above Milton Creek Pond	X		Low/high	1

6.5 Coles Creek

Coles Creek can be described as a major tributary of the North River Watershed. It runs to its outlet below the Confederation Trail, from its headwater at the Winsloe Road, and contains several smaller tributaries. Some of the recent restoration achievements CAWG has made include the following:

- Installed 50+ brush mats to mitigate sedimentation issues
- Repeat areas used for spawning have been identified and are annually enhanced via raking
- Planted ~200 trees in headwater areas for fish cover and to reduce warm water conditions
- Restored/Improved ~1km of juvenile rearing habitat
- ~ km of stream has been cleared of blockages and alder overgrowth.
- 2 HOBO temperature loggers were installed in 2021 to monitor water temperatures and if they negatively impact emergence

Major limiting factors that threaten Atlantic salmon populations include the following:

- Warm water conditions
- Lack of holding pools for staging
- Poor connectivity between areas of quality habitat
- Sedimentation (mainly from agricultural fields)
- Poor spawning habitat quality in areas due to riffle embeddedness
- Reduced juvenile rearing habitat due to sedimentation
- Poor riparian forest health due to deforestation/alder overgrowth
- Capitol City (Charlottetown) water supply connected to aquifer via Wellfield below pond. Warm water conditions on Cole's Creek have mainly been observed in the past 3 years and are arising due to the City of Charlottetown wellfield that draws water from the Cole's Creek watershed. Cole's creek also has the most impoundments out of any stretch of the North River watershed, and lacks tree cover in much of its headwaters.

Recommendations

The following are objectives to help further improve local populations of salmon along the Coles Creek section:

- On an annual basis survey for redds to monitor areas that are repeatedly used for spawning and use information for future enhancement activities
- Work with local landowners to address run-off issues (especially in First and Second Order streams)
- Maintain stream connectivity by ensuring the migratory corridor from sea to spawning areas remains clear of blockages.
- Monitor beaver activity and take corrective actions if necessary
- Monitor agricultural fields for sediment input

- Enhance current spawning areas by loosening substrate (up to 30cm deep) with rakes and removing fine sediments to ensure future spawning efforts have ideal substrate to create high quality redds.
- Continue stream enhancement activities such as cover log installation and brush matting
- Continue to improve juvenile rearing habitat in riffle/run areas below Route 2 by flipping rock, raking
- Plant native trees/shrubs throughout the Coles Creek headwaters to preserve cold water habitat and reduce runoff
- Excavate impoundments such as Cole's pond, Upper Cole's Pond and Cole's Tributary Pond to reduce sediment loads
- Excavate springs to allow for greater groundwater flows during the summer months
- Address poor riparian health and sedimentation issues in the old mill pond basin above Route 2 by planting trees, brush-matting and potentially reconnecting the floodplain via bank reconstruction.

Table 8. Management recommendations for the Coles Creek section of the North River

Annual To-Do Checklist	Long Term (5+ years)	Short Term (1-5 years)	Cost/Benefit	Priority
Area: Cole's Creek				
Redd surveys	X		Low/Medium	1
Address run-off issues	X		Medium/High	1
Walk section to ensure no barriers to fish passage		X	Low/Medium	2
Monitor and manage beaver activity	X		Low/High	1
Monitor agricultural fields for sediment input		X	Low/High	1
Rake spawning areas identified via redd surveys		X	Low/Medium	2
Rehabilitate fish habitat in the old mill pond above Route 2	X		Low/High	2
Continue stream enhancement activities (brush mats, cover logs)		X	Low/Medium	3
Increase/improve juvenile rearing habitat		X	Low/Medium	2
Excavate impoundments to reduce sediment loads	X		Medium/High	1
Plant trees throughout Coles Creek headwaters	X		Low/High	1
Excavate springs		X	Low/Medium	1
Monitor water temps	X		Low/High	1

7.0 Potential Sources of Funding for Atlantic salmon projects

- HSP (https://www.dfo-mpo.gc.ca/species-especes/sara-lep/hsp-pih/index-eng.html)
- ASCF (https://www.salmonconservation.ca/)
- WCF (https://www.peiwcf.ca/)
- WMF (https://www.princeedwardisland.ca/en/information/environment-water-and-climate-change/watershed-management-fund)
- Canada Nature Fund for Aquatic Species at Risk (https://www.canada.ca/en/fisheries-oceans/news/2020/11/canada-nature-fund-for-aquatic-species-at-risk--projects-in-atlantic-provinces.html)

8.0 References/Technical documents

Visit: https://peiwatershedalliance.org/?page_id=26319 to find the following documents:

- West River WMP
- Watershed Technical Manual
- 2019 renewed conservation strategy
- Native Plants and Watersheds: A Natural Combination

Canada, Department of Fisheries and Oceans. (n.d.). *Atlantic Salmon Integrated Management Plan 2008-2012 Gulf Region* (https://waves-vagues.dfo-mpo.gc.ca/Library/332473e.pdf).

Leblanc-Poirier, N., Comeau, C., & Maillet, M. (2014, February). Stewardship Plan to Protect and Restore the Atlantic Salmon (Salmo salar) Habitat in the Cocagne River. Retrieved December 22, 2020, from https://ecopaysdecocagne.ca/images/publications-bassin-versant/salmon-habtiat-cocagne.pdf

https://indigenoustourism.ca/regions/prince-edward-island/