Fish Passage Restoration and Habitat Enhancement

Atlantic salmon habitat restoration on the Fales River

Prepared By:

Rachel Walsh
December 2024

Clean Annapolis River Project
314 St. George Street, P.O. Box 395,
Annapolis Royal, NS, B0S 1A0
1-888-547-4344; 902 532 7533
carp@annapolisriver.ca, www.annapolisriver.ca

This page was intentionally left blank.

Fish Passage Restoration and Habitat Enhancement

Atlantic salmon habitat restoration on the Fales River

Nova Scotia Salmon Association
Adopt A Stream

This page was intentionally left blank.

Table of Contents

List of Figures

List of Tables

List of Acronyms

AAS	Adopt A Stream
CARP	Clean Annapolis River Project
cm	Centimetre
DFO	Fisheries and Oceans Canada
HSI	Habitat Suitability Index
km	Kilometre
l	Litre
m	Meter
m^2	Meters squared
mg	Milligram
mm	Millimeter
NSE	Nova Scotia Environment
NSFHAP	Nova Scotia Fish Habitat Assessment Protocol
µS/cm	microSiemens

Acknowledgements

Clean Annapolis River Project (CARP) would like to thank the following supporters for their contributions to the successful completion of the 2024 Fish Passage Restoration and Habitat Enhancement Project:

- Nova Scotia Salmon Association's *Adopt A Stream* program;
- Clean Foundation's *Clean Leadership* program;
- Nicholas MacInnis of *Adopt A Stream* for his invaluable in-field project support and guidance;
- CARP management staff, Susan Lane and Levi Cliche, for their in-office support and guidance;
- CARP field staff, including Grace Bowen-MacLean, Bethany Welch, Emma Walker, Ahniya Ustymenko, and Shauna Forrestall;
- CARP summer staff, Haelie Webber, Grace Thomas and Randy Fredericks;
- Volunteers, Joshua Reid, Pat Nixon, Wil Brunner, Katie McLean, Chad Creed, and Jack Morris, for their dedicated in-field assistance.

Thank you all for your efforts in advancing this important work!

Executive Summary

The degradation of freshwater habitats is one of the most significant threats to fish populations, contributing substantially to native species declines. Much of this habitat loss stems from modifications to the physical environment caused by human land use. The Fales River, like many other rivers in the Annapolis River watershed, has been heavily impacted by human activities and land-use changes within its sub-watershed. Consequently, ideal in-stream fish habitats have been lost due to channel modifications, sedimentation, and deteriorating water quality.

The Clean Annapolis River Project (CARP) has previously conducted habitat connectivity assessments and implemented restoration efforts on the Fales River. These initiatives included the installation of restoration structures and the evaluation of major road watercourse crossings for fish passage. In the late 1990s, CARP installed various structures, such as digger logs, deflectors, and log cribs, to enhance the river's physical characteristics, stabilize its banks, and promote the re-establishment of riparian buffer zones. These efforts were aimed at supporting salmonid spawning and rearing within the river.

In 2018, continued restoration and monitoring efforts confirmed the presence of two cohorts of Atlantic salmon, underscoring the importance of enhancing fish habitat in the Fales River. Habitat suitability assessments and consultations with stakeholders during restoration planning identified sedimentation and erosion from land-use changes as a leading threat to Atlantic salmon in the Fales River.

The 2024 project aimed to restore in-stream habitat, with a particular focus on rehabilitating spawning areas to reduce fine sediment in the streambed and improve overall fish habitat. Key activities included the installation of two rock sills, one double digger log, and one log crib to enhance rearing and migration habitats for salmonids while stabilizing eroding riverbanks. Monitoring efforts assessed pre- and post-restoration conditions to evaluate the impact of these activities. Overall, 2,601.4 m^2 of in-stream habitat was enhanced through these efforts. Additionally, eleven Atlantic salmon were captured via electrofishing in the Fales River, further validating the importance of in-stream restoration work.

1 Introduction

In Nova Scotia, the precipitous decline of fish populations that had historically widespread distributions is a well-documented dilemma (Parrish et al., 1998; Klemetsen et al., 2003; NSDAF, 2005; Ryan & MacMillan, 2016). While threats to fish populations are numerous and diverse, degradation of freshwater habitats resulting from human activities remains the most significant contributor to observed declines in native fish species, including sport fish that have provided valuable economic contributions to the province (Taylor et al., 2010; DFO, 2006; Bohn & Kershner, 2002; Bardonnet & Baglinière, 2000). Much of this habitat loss has been attributed to modifications of the physical environment by human land-uses. Human influences and land use changes surrounding a watercourse can lead to negative impacts such as erosion and sedimentation that damage aquatic ecosystems. Streams can become straightened and over widened which in turn can lead to greater erosion and sedimentation thus reducing the thermal capacity of the watercourse, in-stream cover and food availability from vegetation as well as appropriate flows for spawning (NSE, 2018).

Remediation actions involve the direct removal of fine sediments from the streambed to reveal the natural cobble and gravel substrate, as well as the installation of in-stream structures to redirect excess sand and silt while supporting natural stream processes. These efforts enhance the aquatic habitat for various species, including Atlantic salmon and brook trout.

Due to the region's history that includes the site of Canada's oldest existing European settlement, the rivers and streams of the Annapolis River watershed have a long history of human use, alteration and degradation, which has taken its toll on the freshwater ecosystems and the native aquatic species that inhabit them. In the early 1990's, the Clean Annapolis River Project (CARP) surveyed several tributaries to the Annapolis River, and in 2012 developed a list of seven priority sub-watersheds ideal for future fish habitat restoration work focused on the conservation of native fish populations, especially Atlantic salmon. As a historically known Atlantic salmon river, the Fales River watershed was identified as a priority sub-watershed based on historical water quality monitoring, past restoration activities and observations and experiences of local community members. In the late 1990's, digger logs, deflectors and log cribs were installed by CARP to enhance the physical characteristics of the watercourse, and stabilize the banks to allow for re-establishment of riparian buffer zones to encourage salmonid spawning and rearing within the river. In 2018, electrofishing practices verified the presence of two cohorts of Atlantic salmon on the Fales River supporting the value of in-stream habitat restoration on this system.

The Fish Passage Restoration and Habitat Enhancement Project, originally known as "Broken Brooks," was conceptualized and initialized by the Clean Annapolis River Project (CARP) in 2007. Fieldwork for the project has been ongoing since 2010, with the goal of assessing and restoring aquatic habitat and connectivity within the Annapolis River watershed. As part of the Broken Brooks program, CARP has been evaluating watercourse crossings in the watershed to identify barriers to fish passage and prioritize those that obstruct access to upstream habitats for remediation. In 2012, CARP adopted a sub-watershed assessment approach to improve watershed management and planning. In 2015, the project name was changed to reflect the inclusion of in-stream habitat remediation and sub-watershed planning within the project's scope.

In 2012, CARP began developing restoration plans for sub-watersheds, including those previously identified as suitable for salmonids (Wagner, 2013). The Fales River was a priority sub-watershed, having already received some restoration and enhancement work between 1999 and 2002. During that time, CARP installed digger logs, deflectors, log cribs, and low-flow barriers to add complexity and improve habitat quality in a long, flat stretch of the river, which had limited in-stream cover and severely eroding banks. In 2017, CARP initiated an extensive in-stream remediation project, involving the restoration of pre-existing digger logs, deflectors, and log cribs, along with the addition of new digger logs and deflectors and SandWanding in various stretches of the river. This work continued into 2019, through further SandWanding and the installation of in-stream structures aimed at improving spawning grounds and pool habitat for the spawning and rearing of salmonids and other native fish species.

Figure 1. Eroding bank on the Fales River.

Consultations with partners and experts helped identify additional activities for in-stream habitat enhancement. These consultations highlighted that much of the available spawning habitat in the accessible portions of the river was impacted by fine sediments, which likely impaired successful spawning. Over several decades, fine sediment accumulation, primarily from land-use impacts and bank erosion, had filled the river (Figure 1). Fine sediment accumulation (less than 2 mm in size; Louhi et al., 2008) is widely recognized as having detrimental effects on river ecosystems (Figure 2). Salmonid species, which prefer coarse gravel and stone bottoms for spawning, are particularly vulnerable to sediment buildup (Hendry & Cragg-Hine, 2003; Klemetsen et al., 2003). As a result, the 2024 restoration season focused on stabilizing eroding banks and improving spawning grounds and pool habitats for salmonids and other native fish species in the Fales River.

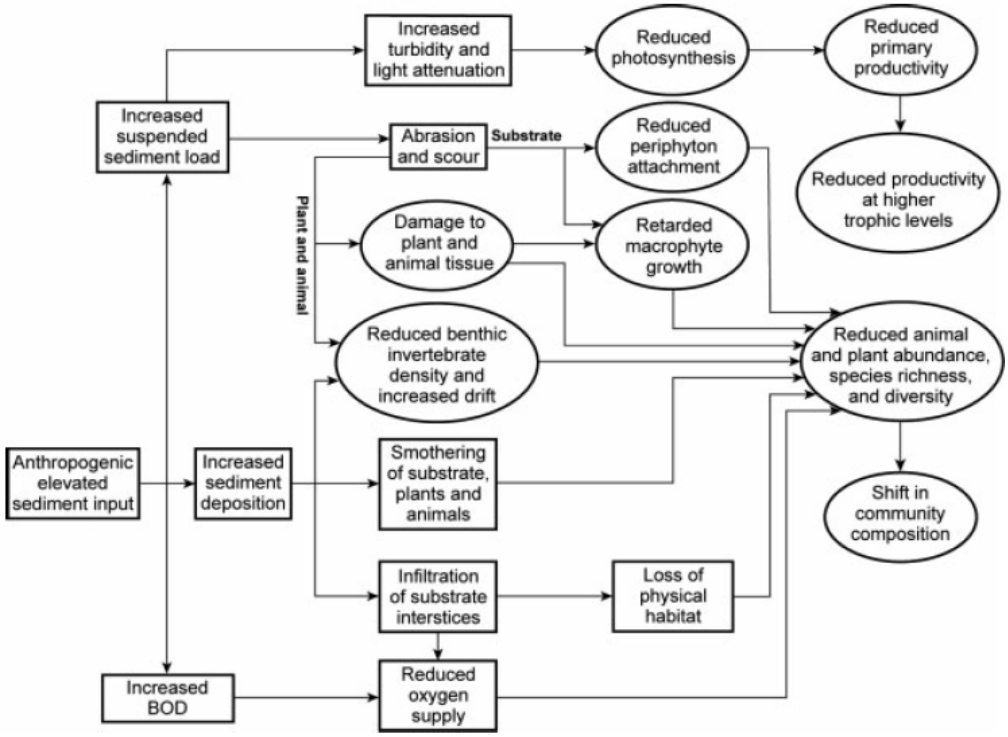

Figure 2. Negative impacts of anthropogenically enhanced sediment input (Kemp et al., 2011).

2 Methodology

The 2024 field season was built upon previous CARP projects aimed at enhancing physical habitat, improving water quality, and increasing habitat complexity in the Fales River, with a particular focus on improving spawning grounds and pool habitats. In-stream restoration actions addressed sedimentation in the Fales River through the installation of several in-stream structures designed to improve habitat conditions.

2.1 In-Stream Habitat Enhancement

Four in-stream structures were installed in the Fales River. Locations were selected through consultation with partners and experts and designed in accordance with Adopt-A-Stream protocols, adapted from the Ecological Restoration of Degraded Aquatic Habitat: A Watershed Approach (DFO, 2006). All materials used were sourced from the work sites, and installations were completed using hand tools such as saws, a pickaxe, log grabbers, a gas-powered drill, and an 8 lb sledgehammer.

2.1.1 Log Crib

Log cribs are commonly installed in areas prone to erosion or flooding to deflect water flow, narrow channels, and stabilize banks. On the Fales River, a log crib was constructed to address an eroding bank. Hardwood logs were tightly stacked against the bank and secured with rebar. Rocks were placed between the logs and the streambank to reinforce the structure and prevent water from flowing behind it. Cross-brace logs were added to enhance stability further.

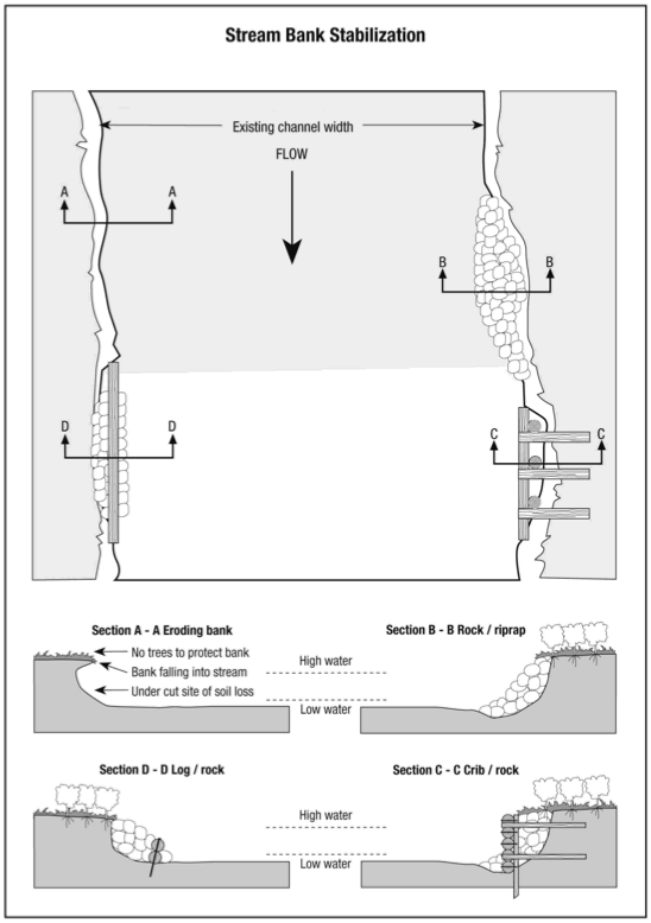

Figure 3. Conceptual drawings and guidelines of several types of stream and stabilization techniques (NSE, 2018).

2.1.2 Digger Log

Digger logs are restoration structures designed for rivers that lack natural meandering patterns with well-defined riffle-pool-run features. These logs are typically installed at the head of a pool or where a pool is planned. Given the large bankfull width (>6 m) of the Fales River, two hardwood logs were installed at a constant 30º angle between the stream banks, angled upstream toward the intended pool. Each log was set at a 5% vertical slope from the bank down to the pool's head, concentrating low flows on the pool side. A rock ramp was constructed upstream of the digger log, sloping the streambed toward the log. Large boulders were used to anchor the logs to the banks, and rebar was driven into the logs and substrate for added security.

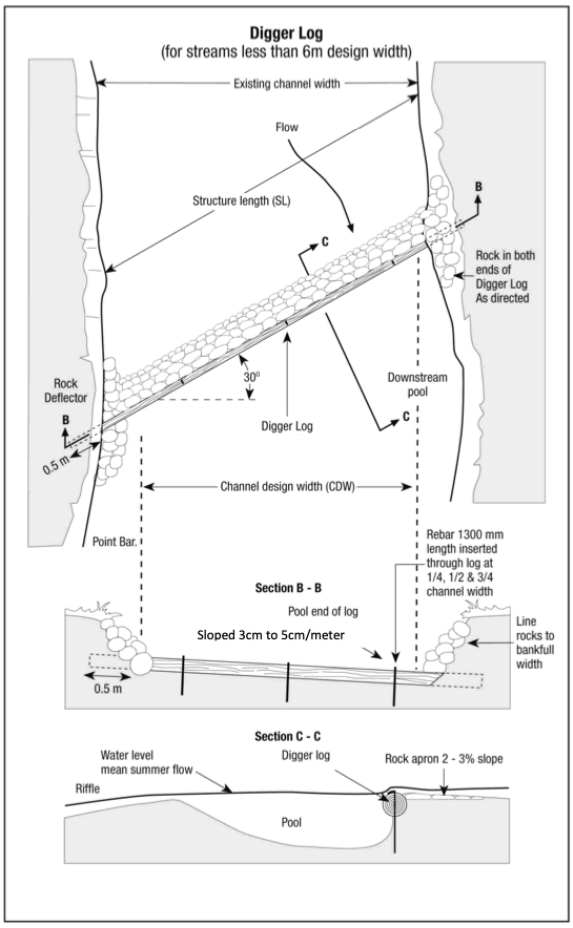

Figure 4. Conceptual drawing and guidelines of a digger log (Thaumas Environmental Consultants Ltd.).

2.1.3 Rock Sills

Rock sills were installed to support riffle sections upstream and create downstream pools, enhancing trout and salmon habitat while increasing habitat diversity. Rocks were arranged linearly across the river to a height of approximately 30 cm, with a ramp constructed upstream to direct water flow effectively.

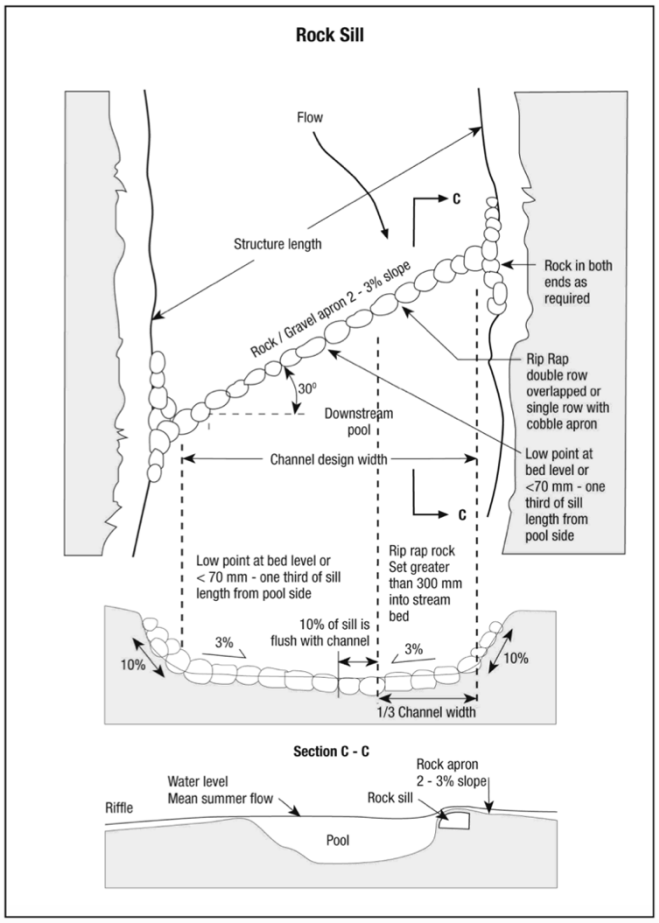

Figure 5. Conceptual drawing and guidelines of a rock sill (Thaumas Environmental Consultants Ltd.).

2.2 Restoration Monitoring

Restoration monitoring included the collection of in-stream data on habitat suitability, temperature profiles, and species abundance, both pre- and post-restoration, to evaluate the effectiveness of installed structures.

2.2.1 Habitat Suitability Index Assessments

The Habitat Suitability Index (HSI) is a widely used tool for evaluating stream and river characteristics based on the habitat requirements and limiting factors of key indicator species. During the 2024 field season, HSI surveys were conducted along the Fales River following the updated Nova Scotia Fish Habitat Enhancement Protocol (NSFHAP, 2019). These assessments were carried out before and after restoration efforts to evaluate changes in physical habitat and water quality, as well as the overall impact of restoration activities on fish habitats. Refer to Appendices 6.2 and 6.3 for examples of HSI data sheets and information on data collected during HSI assessments.

The collected data were entered into the Nova Scotia Fish Habitat Assessment Protocol (NSFHA) online data entry sheet, which evaluates the data based on habitat suitability models for brook trout and Atlantic salmon. The 15 features assessed in the field methods are primarily based on an HSI for brook trout (Raleigh, 1982), with adaptations for Atlantic salmon and local conditions in Nova Scotia. The program calculates important criteria for each species on a scale from 0 to 1 (Table 1). These scores offer a detailed overview of habitat conditions, highlighting areas requiring further restoration or protection.

Table 1. Habitat suitability index and quality rating values for brook trout and Atlantic salmon habitat (NSFHAP, 2018).

Suitability Value	Quality of Habitat	Result
0.00 – 0.39	Poor	Will support none or small numbers of Atlantic salmon or brook trout.
0.40 – 0.80	Moderate	Will support some Atlantic salmon or brook trout.
0.81 – 1.0	Good	Will support many Atlantic salmon or brook trout.
1.00	Optimal	Optimum habitat to support Atlantic salmon or brook trout.

During the 2024 field season, ten consecutive sites were assessed on the Fales River to identify limiting factors for both Atlantic salmon and brook trout, which naturally occur in the river system, and to quantify the impact of restoration activities. Surveys were conducted pre- and post-restoration to provide updated and comparable information on river conditions and salmonid habitats. For full details of the assessment procedure and habitat suitability variables for Atlantic salmon and brook trout, refer to "The Nova Scotia Fish Habitat Suitability Assessment: A Field Methods Manual" (NSFHAP, 2018).

2.2.2 Electrofishing

Electrofishing is a scientific survey method used to sample fish populations and evaluate species' health, abundance, and density. An electrical current is created between two submerged electrodes—a positive anode and a negative cathode. Galvanotaxis draws fish toward the anode, and once a fish is positioned between the two electrodes, a closed circuit forms, allowing current to flow through the fish's body. The fish are then netted and placed in a temporary holding tank where they can recover and be assessed, measured, and sampled for data collection.

During the 2024 field season, backpack electrofishing was conducted at three sites along the Fales River, each representing an open reach approximately 100 meters long. A single pass was executed at each site, documenting the captured fish species and recording their fork lengths. Electrofishing surveys were conducted pre- and post-restoration to provide comparative data on fish populations and restoration effectiveness. Refer to Appendices 6.5 and 6.6 for examples of electrofishing data sheets and the information collected during the surveys.

2.2.3 Temperature Monitoring

Temperature data loggers were deployed at five sites along the Fales River from May 24 to October 18, 2024, covering the crucial summer season. The loggers were programmed to record data at 30-minute intervals to track annual temperature trends, identify areas needing restoration to address thermal pollution and pinpoint critical thermal refuge areas for protection.

Loggers were placed in pools, which serve as cool-water refuges for fish. Each logger was secured to a brick and tethered to a nearby tree to ensure stability and prevent displacement, maintaining data accuracy throughout the monitoring period.

Figure 6. (Left) HOBO pendant temperature logger. (Right) Temperature logger deployed in the Fales River.

3 Results

Restoration efforts during the 2024 season significantly improved fish habitat along the Fales River. Habitat productivity increased across 2,601.4 m² of the river through the installation of one digger log, one log crib, and two rock sills.

3.1 In-Stream Habitat Enhancement

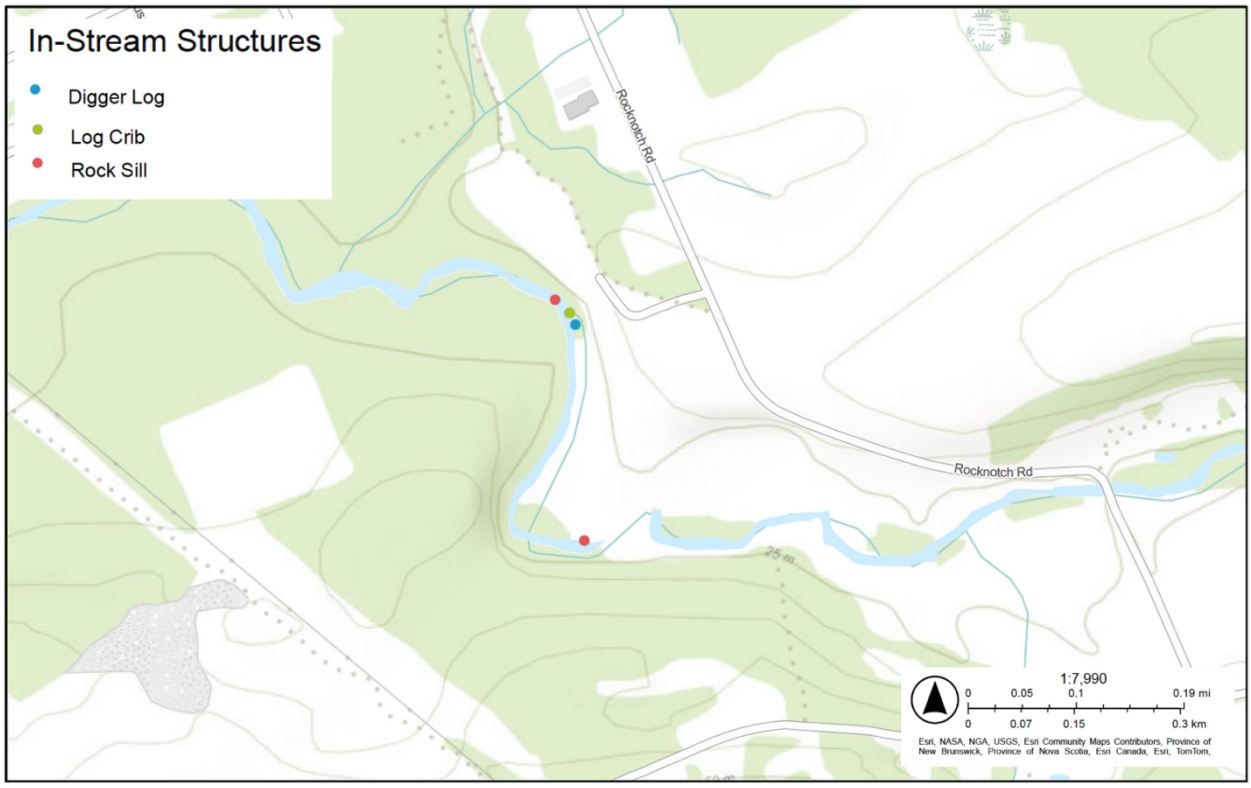

Figure 7. Map of 2024 in-stream structure locations

3.1.1 Log Crib

A log crib was installed to support an eroding bank on the Fales River. The logs of the crib were stacked two high and pushed up against the bank, and rock was used to fill the space behind the log wall. Due to the large size of the crib and the amount of rock needed to fill it in, a dump truck load of ~20 cm diameter basalt was delivered to the restoration site. Wheelbarrows and a paddleboard were used to float the rock down the river to efficiently fill in the structure. The completed log crib stabilized a 16-meter section of eroding bank, with a height of 0.45 meters.

Figure 8. Log crib installed to protect an eroding bank along the Fales River.

3.1.2 Digger Log

A double digger log was installed to enhance salmonid spawning, rearing and migration habitats while addressing fine sediment accumulation within the streambed. This structure was designed to support the riffle-pool-run sequence of the river by stabilizing the bottom of a riffle and creating a downstream pool. The double digger log spanned 14 m and consisted of two logs angled to meet at the low point on the right bank, focusing flows on the pool side of the stream. The in-stream area restored by the digger log totals 958.4 m^2.

Figure 9. Before (left) and after (right) digger log installation on the Fales River.

3.1.3 Rock Sills

Two rock sills were constructed at the heads of pools to enhance upstream riffle sections and downstream pool habitats. The downstream sill was built to a height of 30 cm, while the upstream sill reached 20 cm. Both structures spanned the width of the river and included 2 m rock ramps on their upstream sides. The two sills combined restored an in-stream area of 1,643 m^2.

Figure 10. Two rock sills installed along the Fales River.

3.2 Restoration Monitoring

Monitoring assessments were conducted to evaluate the quality of freshwater fish habitat and to identify the species within the river that would benefit from restoration and enhancement actions. Monitoring was conducted pre- and post-restoration to identify comparable measures and quantitatively assess the impact of restoration actions.

3.2.1 Habitat Suitability Index Assessments

HSI surveys were conducted to assess salmonid habitat quality before and after restoration. Ten sites were surveyed: six downstream of the restoration area, three upstream (unaffected by restoration), and one directly at the restoration site (Site 7). This was undertaken to identify comparable measures between the sites and to quantitatively assess the impact of restoration actions.

Figure 11. CARP staff conducting HSI survey measurements.

Results indicated minimal changes in HSI scores between pre- and post-restoration assessments for both brook trout and Atlantic salmon. This limited change is likely due to the timing of the post-restoration survey, conducted only one week after restoration activities concluded.

Notable improvements were observed at Site 7, where most restoration efforts were concentrated (Tables 2 and 3). The percentage of pools suitable for brook trout and Atlantic salmon increased, attributable to the rock sill and digger log installations, which created downstream pools and upstream spawning habitats. Additionally, the percentage of in-stream cover for juvenile fish showed significant improvement. The full pre- and post-restoration HSI results can be found in Appendix 6.4.

Table 2. Habitat suitability criteria for brook trout on the Fales River, before and after restoration activities.

	Percent Pools	Percent In-stream Cover (Juvenile)	Percent In-stream Cover (Adult)	Dominant Substrate Type in Riffle-Run Areas	Average Size of Substrate in Spawning Areas	Percent Fines in Spawning Areas	Percent Fines in Riffle-Run Areas	Percent Substrate Size Class for Winter Escape
Site 7 Pre-Restoration July 24, 2024	0.30	0.68	0.13	1.00	N/A	N/A	1.00	1.00
Site 7 Post-Restoration September 19, 2024	0.44	1.00	0.31	0.60	0.00	0.08	1.00	1.00

*Scores with results listed as N/A, contain data that was not documented during the time of assessment and therefore their scores could not be computed.

Table 3. Habitat suitability criteria for Atlantic salmon on the Fales River, before and after restoration activities.

	Percent Pools	Percent In-stream Cover (Juvenile)	Percent In-stream Cover (Adult)	Dominant Substrate Type in Riffle-Run Areas	Substrate for Spawning and Incubation	Percent Fines in Spawning Areas
Site 7 Pre-Restoration July 24, 2024	0.12	0.68	0.13	1.00	N/A	N/A
Site 7 Post-Restoration September 19, 2024	0.36	1.00	0.31	0.60	0.75	0.08

*Scores with results listed as N/A, contain data that was not documented during the time of assessment and therefore their scores could not be computed.

3.2.2 Electrofishing

Electrofishing surveys were conducted at three sites, revealing two cohorts of Atlantic salmon alongside eight other native fish species.

Pre-restoration assessments captured four Atlantic salmon: three at Site 2 and one at Site 3. Post-restoration assessments captured five Atlantic salmon: one at Site 2 and four at Site 3. However, post-restoration electrofishing could not be conducted at Site 1 due to unsafe conditions caused by a newly formed beaver dam downstream, which raised water levels.

Figure 12. Atlantic salmon caught on the Fales River.

3.2.3 Temperature Monitoring

Five temperature data loggers were deployed along the Fales River from May 24 to October 18, 2024, to track seasonal trends and assess their impact on aquatic species, particularly Atlantic salmon.

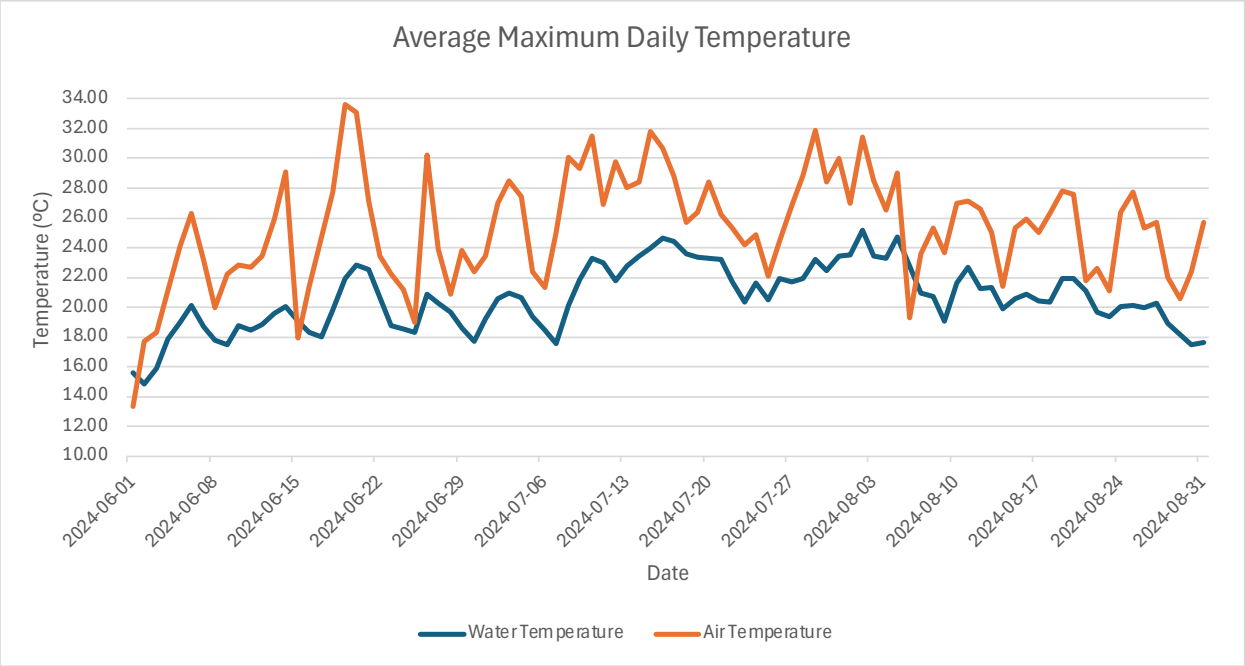

Figure 13. Comparison of daily maximum water and air temperatures recorded on the Fales River.

From June to August 2024, the average water temperature was 20.6°C, with values ranging from a low of 14.9°C in early June to a peak of 25.2°C in early August. While water temperatures showed moderate variability, the majority of readings fell between 19.0°C and 22.1°C, indicating stable yet warming conditions as the summer progressed. In comparison, air temperatures were significantly higher, averaging 25.3°C, and fluctuated widely from a minimum of 13.3°C to a maximum of 33.6°C, reflecting typical summer weather patterns (Figure 13).

The rising water temperatures observed in late July and early August are particularly noteworthy given their implications for Atlantic salmon, a species known to be sensitive to temperature. Atlantic salmon thrive in water temperatures ranging between 12°C and 20°C, and temperatures above 23°C can induce thermal stress. Prolonged exposure to temperatures exceeding 25°C can be lethal for this species, potentially disrupting feeding and growth while forcing them to seek cooler refuges in deeper waters or tributaries. During the monitoring period, several instances of water temperature surpassing 23°C were recorded, suggesting that Atlantic salmon in the Fales River may have faced stressful conditions during peak summer heat.

These findings highlight the importance of continuous temperature monitoring in the watershed, especially as climate change may increase the frequency of warm periods, potentially threatening the habitat quality for temperature-sensitive species. Understanding these trends is crucial for informing conservation measures aimed at protecting Atlantic salmon and maintaining the ecological health of the river system.

4 Recommendations

The following recommendations are based on observations from the 2024 field season and previous work conducted under the Fish Passage Restoration and Habitat Enhancement Program:

I. Revisit the 2024 installed structures (digger log, log crib, and rock sills) on the Fales River. Perform maintenance as necessary to ensure the integrity of these structures.

II. The removal of half of a digger log and the installation of a log deflector were scheduled for 2024 but were not completed due to time constraints. These tasks should be included in the 2025 work plan.

III. Conduct post-restoration Habitat Suitability Index (HSI) assessments in subsequent years to monitor potential long-term impacts of the in-stream structures on substrate composition and habitat quality within the Fales River.

IV. Perform maintenance on previously installed structures along the Fales River, including replenishing any washed-out rock.

V. Identify additional opportunities for enhancement activities or new structure installations further upstream for future project implementation.

5 References

Bardonnet, A., & Baglinière, J.-L. (2000). Freshwater habitat of Atlantic salmon (*Salmo salar*). *Canadian Journal of Fisheries and Aquatic Sciences,* 57, 497-506.

Bohn, B. A., & Kershner, J. L. (2002). Establishing aquatic restoration priorities using a watershed approach. *Journal of Environmental Management,* 64, 1-9.

Environment and Climate Change Canada. (2024, June 1). *Daily data report for June 2024*. Retrieved from https://climate.weather.gc.ca/climate_data/daily_data_e.html.

Environment and Climate Change Canada. (2024, July 1). *Daily data report for July 2024*. Retrieved from https://climate.weather.gc.ca/climate_data/daily_data_e.html.

Environment and Climate Change Canada. (2024, August 1). *Daily data report for August 2024*. Retrieved from https://climate.weather.gc.ca/climate_data/daily_data_e.html.

Fisheries and Oceans Canada [DFO]. (2006). *Ecological restoration of degraded aquatic habitats: A watershed approach*. Gulf Region. CAT# Fs104-4/2006E.

Kemp, P., Sear, D., Collins, A., Naden, P., & Jones, I. (2011). The impacts of fine sediment on riverine fish. *Hydrological Processes,* 25(11), 1800-1821.

Klemetsen, A., Amundsen, P.-A., Dempson, J. B., Jonsson, B., Jonsson, N., O'Connell, M. F., & Mortensen, E. (2003). Atlantic salmon *Salmo salar* L., brown trout *Salmo trutta* L., and Arctic charr *Salvelinus alpinus* (L.): A review of aspects of their life histories. *Ecology of Freshwater Fish,* 12, 1-59.

Louhi, P., Mäki-Petäys, A., & Erkinaro, J. (2008). Spawning habitat of Atlantic salmon and brown trout: General criteria and intragravel factors. *River Restoration and Applications,* 24, 330-339.

Nova Scotia Department of Fisheries and Aquaculture [NSDAF]. (2005). *Nova Scotia trout management plan*. Inland Fisheries Division. Available online: http://novascotia.ca/fish/documents/special-management-areas-reports/NSTroutManplandraft05.pdf.

Nova Scotia Environment [NSE]. (2018). *Certification manual for aquatic habitat restoration installers*. Province of Nova Scotia.

Nova Scotia Salmon Association [NSFHAP]. (2018). *A field methods manual: Nova Scotia freshwater fish habitat suitability index assessment* (Version 1.5). NSLC Adopt A Stream.

Parrish, D. L., Behnke, R. J., Gephard, S. R., McCormick, S. D., & Reeves, G. H. (1998). Why aren't there more Atlantic salmon (*Salmo salar*)? *Canadian Journal of Fisheries and Aquatic Sciences,* 55(S1), 281-287.

Raleigh, R. F. (1982). *Habitat suitability index models: Brook trout* (FWS/OBS-82/10.24). U.S. Department of the Interior, Fish and Wildlife Service.

Ryan, A., & MacMillan, J. L. (2016). Speckled trout population parameters, habitat conditions, and management strategies in lakes in Nova Scotia, Canada. *Proceedings of the Nova Scotian Institute of Science,* 48(2), 189-210.

Sepulveda, A. J., Juddson, S., & Marczak, L. B. (2014). Testing ecological trade-offs of a new tool for removing fine sediment in a spring-fed stream. *Ecological Restoration,* 32(1), 68-77.

Taylor, B. R., MacInnes, C., & Floyd, T. A. (2010). Influence of rainfall and beaver dams on upstream movement of spawning Atlantic salmon in a restored brook in Nova Scotia, Canada. *River Research and Applications*, 26, 183-193.

Wagner, K. (2013). *Broken Brooks 2012: Salmonidae outreach, accessibility, and restoration*. Clean Annapolis River Project, Annapolis Royal, Nova Scotia.

6 Appendices

6.1 Fales River Sub-Watershed

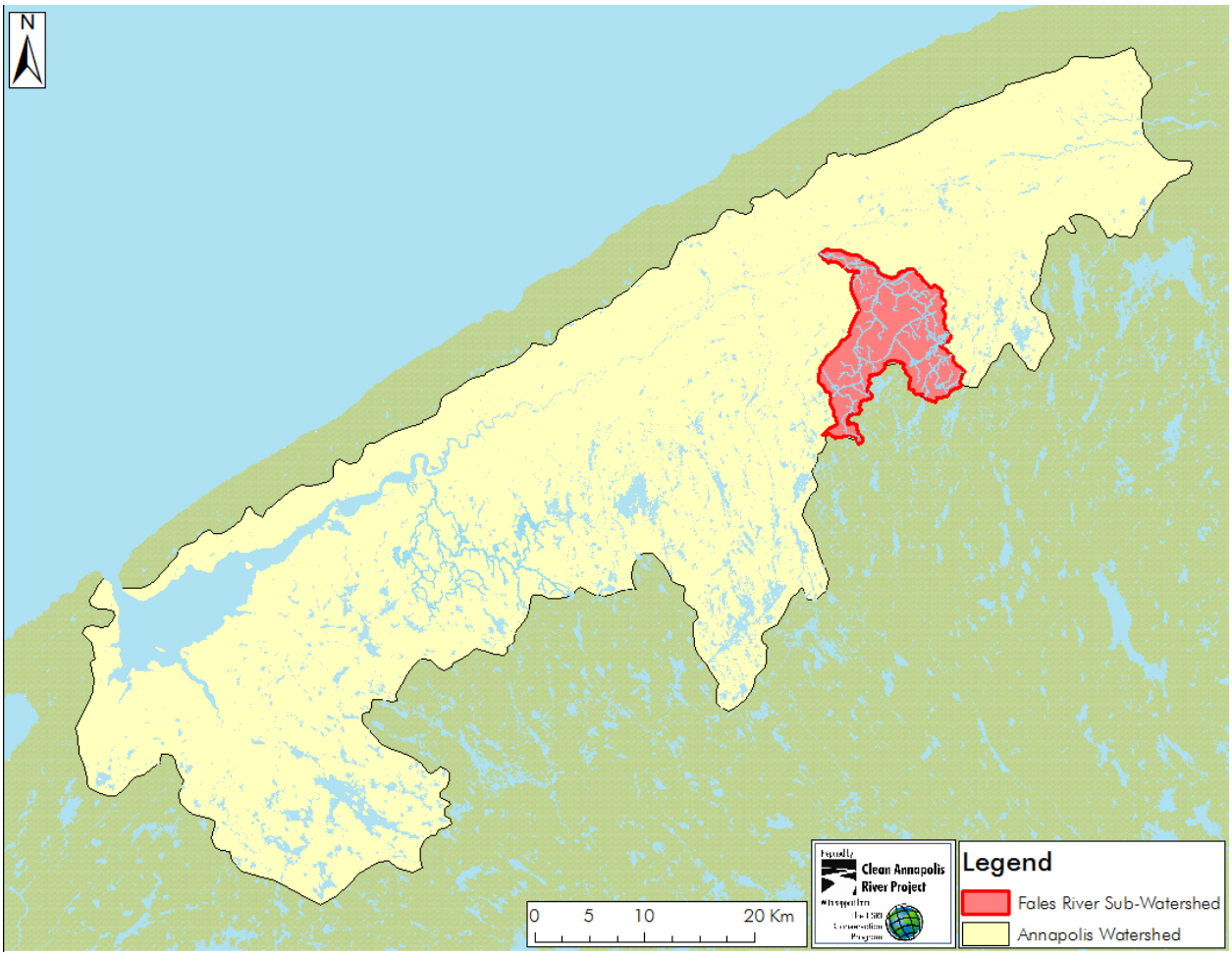

Figure 14. Location of the Fales River sub-watershed within the greater Annapolis River watershed.

6.2 Habitat Suitability Index (HSI) Data Sheet – NSFHAP

NSFHAP Field Sheet #:

River Name: _____ Watershed Code: _____ Date: _____ Time: _____ Crew: _____

Site Boundary Coordinates: D/S _____ _____ U/S _____ _____

Site Bankfull Width: _____ Site Length: _____ Transect Spacing: _____ Stream Order: _____

Air Temp: _____ Water Temp: _____ pH: _____ Conductivity: _____ TDS: _____ DO: _____

Channel Cross-sections

	Floodplains		Height and Widths			Wetted Depths				
	Average Left Width	Average Right Width	Bankfull Width (m)	Bankfull Height (m)	Wetted Width (m)	1/4 of Width (cm)	2/4 of Width (cm)	3/4 of Width (cm)	Thalweg (cm)	Thalweg Location (m)
T1										
T2										
T3										

Substrate and Cover

				¼ Width					1/2 Width					¾ Width							
	GPS Coordinates		Habitat Type	Fines	Gravel	Cobble	Boulder	Bedrock	Fines	Gravel	Cobble	Boulder	Bedrock	Fines	Gravel	Cobble	Boulder	Bedrock	% Embedded	Instream Cover for Juveniles (# of fish)	Instream Cover for Adults (# of fish)
T1																					
T2																					
T3																					

Riverbanks and Riparian Area

	% Trees	% Shrubs	% Grass	% Bare Soil	% Eroding	% Stable Ground	% Stream Shade	Ice Scar Height
Left Bank								
Right Bank								
Vegetation Index:					Avg:	Avg:		

Pool Measurements									
Transect #	Max Depth (cm)	Depth of Pool Tail (cm)	Est. Low Flow Max Depth (cm)	Average Length (m)	Average Width (m)	Final Pool Area (m^2)	% Pool Cover	Percentage of Pools	Pool Class Rating

Pictures	
#	Description

Avg. Substrate Size in Spawning Areas (*Brook trout*) (cm): _____

Avg. Substrate Size in Spawning Areas (*Atlantic salmon*) (cm): _____

% Fines (*Brook trout Spawning*): _____

% Fines (*Salmon Spawning*): _____

Point Bar Presence/Condition: _____

Rock Grab: □ 3 Minute Kick: □

Net Type/Mesh Size: _____ /____

% EPT: __ __ %Chironomids: _ _

Common Name				Tally
Midges				
Snails, Limpets				
Sow Bugs				
Aquatic Earthworm				
Beetles				
Mayflies				
Fishflies, Alderflies				
Stoneflies				
Caddisflies				

Notes and Section Sketch: Indicate right and left banks, tributaries and inflows, flow direction, and general river form description

6.3 Habitat Suitability Index (HSI) Assessment Parameters – NSFHAP

Table 2. Variables assessed during Habitat Suitability Index assessments.

Variable	Units	Description
Air Temperature	Celcius	The temperature of the air on the day of the assessment
Average Pool Length	m	Length of pool parallel to the flow
Average Pool Width	m	Width of pool perpendicular to flow
Bankfull Height	m	Height of elevation of the bankfull above the water surface
Bankfull Width	m	Horizontal distance between banks on opposite sides of the stream
Bedrock	%	Hard, solid rock often beneath surface materials such as soil and sediment
Boulder	%	Substrate measuring >25.6 cm
Channel		Area of the river within the bankfull, including potentially dry areas during low water and riverbanks, but not the floodplain
Cobble	%	Substrate measuring 6.4-25.6 cm
Conductivity	µS/cm	The ability of a solution (water) to carry an electrical current
Crest of Riffle		Area at the most downstream end of a pool or most upstream end of a riffle where a slow, deep section of river becomes a shallow and fast section. See also 'tail of pool'.
Date		The date on which the assessment was completed
Depth of Pool	cm	Depth of pool at the deepest section
Depth of Pool Tail	cm	Depth of water on the pool tail
Design Width	m	See also 'site bankfull width'
DO	mg/L	The amount of oxygen dissolved in the water
Embeddedness	%	Degree that boulder, cobble and gravel substrate is surrounded by finer sand and silt. Measured as percentage of fines underneath rocks.
Estimated Low Flow Max Depth	cm	How much of the pool will be covered in low flows
Final Pool Area	m^2	Total area of pool measured during the assessment
Floodplain	m	Relatively flat area of land adjacent to a river channel which gets submerged when water levels are high.
Field Crew		The assessors collecting the data
Fines	%	Sand or silt measuring <0.2 cm
Gravel	%	Substrate measuring 0.2-6.4 cm
Ice Scarring	m	Signs of damaging ice movement observed as scarring on riparian trees and shrubs
In-stream Cover (Adults)		Unembedded cover (substrate, aquatic vegetation, large woody debris, undercut banks, etc.) below the water surface that can shelter/hide a 10 cm long dowel (representing a juvenile fish)
In-stream Cover (Juveniles)		Unembedded cover (substrate, aquatic vegetation, large woody debris, undercut banks, etc.) below the water surface that can shelter/hide a 20 cm long dowel (representing an adult fish)
Meander Sequence (Full)		The meandering or sinuous pattern many rivers follow that feature steps, pools, riffles, and runs. A full meander sequence usually has two pool, riffle, and run areas in low gradient rivers and steps, pools and runs in higher gradient rivers.
Percentage of Pools	%	Calculated by determining the total area of each transect covered by pools
pH		The acidity of the water in the watercourse
Photos		The photos taken of the assessment site
Pool		Deep, slow section of river used by salmonids for cover and resting
Pool Class Rating		Pools can be classified as having an A, B or C rating based on depth and amount of cover
Pool Cover	%	Amount of pool bottom that is hidden by water colour, depth, or high surface velocities

Riffle		A shallow (<10 cm) and fast section of river that occurs between pools
Riparian Vegetation	%	Percentage of ground covered by trees, shrubs, grasses and sedges, and bare ground within 10 m of the banks edge
Riverbank Stability	%	Percentage of rooted vegetation and stable rocky substrate that protect riverbanks from erosion
Rock Grab Sampling		Cobble sized rock from a riffle is selected from the stream and the invertebrates/organisms on the bottom of the rock are counted and identified
Run		A moderately deep section, somewhat slower than a riffle, that occurs in varying locations in a river pattern
Site Bankfull Width	m	Proper stream width determined mathematically before entering the field. The formula is based on watershed area and annual precipitation. See also 'design width'
Site Length	m	6 channel width lengths or site bankfull width x 6
Spawning Areas (Brook Trout)		Spawning occurs in areas of groundwater upwelling which contains 2.5-6 cm gravel substrate
Spawning Areas (Atlantic Salmon)		Spawning occurs in areas of downwelling, such as the tail of pools or above a digger log which contains 2-9.5 cm g-cobble substrate
Step-Pool		Series of staircase-like pools, which usually occur in steeper channels
Stream Name		The name of the watercourse where the assessment is taking place
Stream Order		Measure of the relative size of a stream. The smallest streams in a watershed have the lowest numbers and the largest streams closest to the ocean have the highest numbers.
Stream Shade	%	Canopy cover created by riparian vegetation
Tail of pool		Area at the most downstream end of a pool or most upstream end of a riffle where a slow, deep section of river becomes a shallow and fast section. See also 'crest of riffle'.
TDS	mg/l	Total dissolved solids, the measurement of the combined content of all inorganic and organic substances in its suspended form
Thalweg	Depth: cm Location: m	Deepest section in a channel cross-section, and the area where the water will be found during low water events
Three-Minute Kick Sampling		Kick/disturbing the substrate for three minutes while a partner collects the invertebrates/organisms that are dislodged with a fine mesh net
Time		The time that the assessment began
Transect		Every two calculated bankfull widths
Transect Spacing	m	Site bankfull width x 2
UTM Coordinates		GPS position of the HSI assessment location, described with Northings and Eastings, using a NAD83 projection
Vegetation Index		Multiplication factors are used for each vegetation type and added together to obtain an index value
Water Temperature	Celcius	Downstream water temperature
Watershed Code		Obtained through the Nova Scotia environment and allows sites in the same watershed to be grouped together
Wetted Width	m	Width of the river that contains water at the time of the measurement

6.4 Habitat Suitability Index (HSI) Scores – NSFHAP

Table 3. Pre-restoration HSI scores for brook trout.

Site Date	Downstream Site Boundary	Percent Pools	Pool Class Rating	Percent In-stream Cover Juvenile	Percent In-stream Cover During Late Growing Season Adult	Dominant Substrate Type in Riffle-Run Areas	Average Percent Vegetation Along the Streambank	Average Percent Rooted Vegetation and Stable Rocky Ground Cover	Average Maximum Water Temperature	pH	Average Size of Substrate in Spawning Areas	Percent Fines in Spawning Areas	Percent Fines in Riffle-Run Areas	Percent Substrate Size Class for Winter Escape	Average Thalweg Depth During the Late Growing Season	Percent Stream Shade
Site 1 2024/07/23	44°57′43″ N 64°55′30″ W	0.59	0.30	0.64	0.11	1.00	0.97	0.88	0.85	0.94	0.00	0.00	0.97	1.00	0.78	1.00
Site 2 2024/07/23	44°57′39″ N 64°55′28″ W	0.77	0.60	0.83	0.15	1.00	0.47	0.77	0.83	0.80	N/A	N/A	1.00	1.00	0.63	1.00
Site 3 2024/07/23	44°57′39″ N 64°55′25″ W	0.77	0.60	0.87	0.30	0.60	1.00	1.00	0.77	0.85	0.37	0.00	1.00	1.00	0.91	0.93
Site 4 2024/07/23	44°57′40″ N 64°55′23″ W	0.96	0.60	1.00	0.84	1.00	1.00	1.00	0.73	0.86	N/A	N/A	0.87	1.00	0.97	0.72
Site 5 2024/07/24	44°57′41″ N 64°55′19″ W	0.63	0.60	0.77	0.17	0.60	0.97	0.81	0.76	0.94	0.93	0.00	1.00	1.00	0.37	1.00
Site 6 2024/07/24	44°57′40″ N 64°55′17″ W	0.67	0.60	1.00	0.40	1.00	0.99	0.85	0.73	0.90	N/A	N/A	1.00	1.00	0.83	1.00
Site 7 2024/07/24	44°57′39″ N 64°55′14″ W	0.30	0.30	0.68	0.13	1.00	0.88	0.57	0.64	0.91	N/A	N/A	1.00	1.00	0.93	1.00
Site 8 2024/07/25	44°57′37″ N 64°55′13″ W	0.34	0.30	1.00	0.19	0.60	0.86	0.77	0.81	0.93	N/A	N/A	1.00	1.00	0.81	1.00
Site 9 2024/07/25	44°57′34″ N 64°55′13″ W	0.34	0.60	0.85	0.18	1.00	0.92	1.00	0.79	0.88	0.24	0.00	1.00	1.00	0.46	1.00
Site 10 2024/07/25	44°57′31″ N 64°55′16″ W	0.64	0.60	1.00	0.26	1.00	0.73	0.73	0.75	0.87	N/A	N/A	1.00	1.00	0.68	1.00

*Scores with results listed as N/A, contain data that was not documented during the time of assessment and therefore their scores could not be computed.

Table 4. Pre-restoration HSI scores for Atlantic salmon.

Site Date	Downstream Site Boundary	Percent Pools	Pool Class Rating	Percent In-stream Cover (Juveniles)	Percent In-stream Cover (Adults)	Dominant Substrate Type in Riffle-Run Areas	Average Percent Vegetation Along the Streambank	Average Percent Rooted Vegetation and Stable Rocky Ground Cover	Summer Rearing Temperature During Growing Season	pH	Substrate for Spawning and Incubation	% Fines in Spawning Areas	Fry Water Depth	Parr Water Depth	Stream Order	Percent Stream Shade
Site 1 2024/07/23	44°57′43″ N 64°55′30″ W	0.66	0.30	0.64	0.11	1.00	0.97	0.88	0.86	0.98	0.72	0.00	1.00	1.00	0.90	1.00
Site 2 2024/07/23	44°57′39″ N 64°55′28″ W	0.94	0.60	0.83	0.15	1.00	0.47	0.77	0.83	0.86	N/A	N/A	1.00	1.00	0.90	1.00
Site 3 2024/07/23	44°57′39″ N 64°55′25″ W	0.93	0.60	0.87	0.30	0.60	1.00	1.00	0.76	0.91	0.86	0.00	1.00	1.00	0.90	0.93
Site 4 2024/07/23	44°57′40″ N 64°55′23″ W	0.91	0.60	1.00	0.84	1.00	1.00	1.00	0.70	0.92	N/A	N/A	0.87	1.00	0.90	0.72
Site 5 2024/07/24	44°57′41″ N 64°55′19″ W	0.71	0.60	0.77	0.17	0.60	0.97	0.81	0.74	0.98	1.00	0.00	1.00	1.00	0.90	1.00
Site 6 2024/07/24	44°57′40″ N 64°55′17″ W	0.80	0.60	1.00	0.40	1.00	0.99	0.85	0.70	0.95	N/A	N/A	1.00	1.00	0.90	1.00
Site 7 2024/07/24	44°57′39″ N 64°55′14″ W	0.12	0.30	0.68	0.13	1.00	0.88	0.57	0.61	0.96	N/A	N/A	1.00	1.00	0.90	1.00
Site 8 2024/07/25	44°57′37″ N 64°55′13″ W	0.17	0.30	1.00	0.19	0.60	0.86	0.77	0.81	0.98	N/A	N/A	1.00	1.00	0.90	1.00
Site 9 2024/07/25	44°57′34″ N 64°55′13″ W	0.18	0.60	0.85	0.18	1.00	0.92	1.00	0.78	0.94	0.83	0.00	1.00	0.91	0.90	1.00
Site 10 2024/07/25	44°57′31″ N 64°55′16″ W	0.73	0.60	1.00	0.26	1.00	0.73	0.73	0.73	0.93	N/A	N/A	0.98	1.00	0.90	1.00

*Scores with results listed as N/A, contain data that was not documented during the time of assessment and therefore their scores could not be computed.

Table 5. Post-restoration HSI scores for brook trout.

Site Date	Downstream Site Boundary	Percent Pools	Pool Class Rating	Percent In-stream Cover Juvenile	Percent In-stream Cover During Late Growing Season Adult	Dominant Substrate Type in Riffle-Run Areas	Average Percent Vegetation Along the Streambank	Average Percent Rooted Vegetation and Stable Rocky Ground Cover	Average Maximum Water Temperature	pH	Average Size of Substrate in Spawning Areas	Percent Fines in Spawning Areas	Percent Fines in Riffle-Run Areas	Percent Substrate Size Class for Winter Escape	Average Thalweg Depth During the Late Growing Season	Percent Stream Shade
Site 1 2024/09/18	44°57′43″ N 64°55′30″ W	0.54	0.60	1.00	0.24	0.60	0.92	0.69	1.00	1.00	0.00	0.00	1.00	1.00	0.68	1.00
Site 2 2024/09/18	44°57′39″ N 64°55′28″ W	0.46	0.60	0.70	0.15	1.00	0.53	0.53	1.00	1.00	N/A	N/A	1.00	1.00	0.49	1.00
Site 3 2024/09/18	44°57′39″ N 64°55′25″ W	0.48	0.60	0.97	0.30	0.60	0.99	1.00	1.00	1.00	0.46	0.08	1.00	1.00	0.88	0.86
Site 4 2024/09/18	44°57′40″ N 64°55′23″ W	0.64	0.60	1.00	1.00	1.00	1.00	0.97	0.98	1.00	N/A	N/A	1.00	1.00	0.77	1.00
Site 5 2024/09/18	44°57′41″ N 64°55′19″ W	0.35	0.30	0.46	0.02	1.00	0.99	0.69	0.92	0.95	1.00	0.00	1.00	1.00	0.24	0.93
Site 6 2024/09/19	44°57′40″ N 64°55′17″ W	0.49	0.60	1.00	0.30	1.00	1.00	0.53	1.00	1.00	N/A	N/A	1.00	1.00	0.91	1.00
Site 7 2024/09/19	44°57′39″ N 64°55′14″ W	0.44	0.60	1.00	0.31	0.60	1.00	0.65	1.00	1.00	0.00	0.08	1.00	1.00	0.81	1.00
Site 8 2024/09/19	44°57′37″ N 64°55′13″ W	0.30	0.30	1.00	0.48	0.60	1.00	1.00	1.00	0.98	N/A	N/A	1.00	1.00	0.61	1.00
Site 9 2024/09/19	44°57′34″ N 64°55′13″ W	0.42	0.60	1.00	0.27	1.00	1.00	0.92	1.00	0.97	0.12	0.00	1.00	1.00	0.97	0.72
Site 10 2024/09/19	44°57′31″ N 64°55′16″ W	0.30	0.30	0.78	0.16	0.60	0.96	0.85	0.98	0.96	N/A	N/A	1.00	1.00	0.69	1.00

*Scores with results listed as N/A, contain data that was not documented during the time of assessment and therefore their scores could not be computed.

Table 6. Post-restoration HSI scores for Atlantic salmon.

Site Date	Downstream Site Boundary	Percent Pools	Pool Class Rating	Percent In-stream Cover (Juveniles)	Percent In-stream Cover (Adults)	Dominant Substrate Type in Riffle-Run Areas	Average Percent Vegetation Along the Streambank	Average Percent Rooted Vegetation and Stable Rocky Ground Cover	Summer Rearing Temperature During Growing Season	pH	Substrate for Spawning and Incubation	% Fines in Spawning Areas	Fry Water Depth	Parr Water Depth	Stream Order	Percent Stream Shade
Site 1 2024/09/18	44°57′43″ N 64°55′30″ W	0.55	0.60	1.00	0.24	0.60	0.92	0.69	1.00	0.86	0.73	0.00	1.00	1.00	0.90	1.00
Site 2 2024/09/18	44°57′39″ N 64°55′28″ W	0.40	0.60	0.70	0.15	1.00	0.53	0.53	1.00	1.00	N/A	N/A	1.00	1.00	0.90	1.00
Site 3 2024/09/18	44°57′39″ N 64°55′25″ W	0.43	0.60	0.97	0.30	0.60	0.99	1.00	1.00	1.00	0.88	0.08	1.00	1.00	0.90	0.86
Site 4 2024/09/18	44°57′40″ N 64°55′23″ W	0.73	0.60	1.00	1.00	1.00	1.00	0.97	1.00	1.00	N/A	N/A	1.00	1.00	0.90	1.00
Site 5 2024/09/18	44°57′41″ N 64°55′19″ W	0.19	0.30	0.46	0.02	1.00	0.99	0.69	0.94	0.99	1.00	0.00	1.00	0.79	0.90	0.93
Site 6 2024/09/19	44°57′40″ N 64°55′17″ W	0.46	0.60	1.00	0.30	1.00	1.00	0.53	1.00	1.00	N/A	N/A	1.00	1.00	0.90	1.00
Site 7 2024/09/19	44°57′39″ N 64°55′14″ W	0.36	0.60	1.00	0.31	0.60	1.00	0.65	1.00	1.00	0.75	0.08	1.00	1.00	0.90	1.00
Site 8 2024/09/19	44°57′37″ N 64°55′13″ W	0.12	0.30	1.00	0.48	0.60	1.00	1.00	1.00	1.00	N/A	N/A	1.00	0.54	0.90	1.00
Site 9 2024/09/19	44°57′34″ N 64°55′13″ W	0.31	0.60	1.00	0.27	1.00	1.00	0.92	1.00	1.00	0.79	0.00	1.00	1.00	0.90	0.72
Site 10 2024/09/19	44°57′31″ N 64°55′16″ W	0.12	0.60	0.78	0.16	0.60	0.96	0.85	1.00	1.00	N/A	N/A	1.00	1.00	0.90	1.00

*Scores with results listed as N/A, contain data that was not documented during the time of assessment and therefore their scores could not be computed.

6.5 Electrofishing Data Sheet

Electrofishing Field Sheet #:

Crew:

Site Information			
Site Name		Date (dd/mm/yyyy)	
Stream Name		Time	
Wetted Width (m)		UTM Easting (m)	
Reach Length (m)		UTM Nothing (m)	
Depth (m)	*D1*:	*D2*:	*D3*:	*Average*:

Water Quality							
pH		DO (mg/L)		Conductivity (µS/cm)		Salinity (g/L)	
Water Temp (°C)		DO (% SAT)		Turbidity (NTU)		TDS (mg/L)	

Pass Information							
Pass Number	Time Start	Time End	Total Time	Pulse Width (ms)	Pulse Frequency (Hz)	Duty Cycle (%)	Volts

Species Information					
Pass Number	Species	Fork Length (cm)	Pass Number	Species	Fork Length (cm)

6.6 Electrofishing Survey Parameters

Table 7. Variables collected during electrofishing surveys.

Variable	Units	Description
Air Temperature	Celcius	The temperature of the air on the day of the assessment
Turbidity	NTU	Transparency of the water due to the presence of suspended particles
Salinity	g/L	The amount of dissolved salts in the water
Pass Number		Sample number
Time Start		Time recorded from the Electrofishing unit before the start of a pass
Time End		Time recorded from the Electrofishing unit at the end/completion of a pass
Total Time		Time End – Time Start using the numbers recorded from the Electrofishing unit (See 'Time Start' and 'Time End')
Pulse Width	ms	Duration of each individual pulse of electricity
Pulse Frequency	Hz	Number of pulses per second
Conductivity	mS/cm	The ability of a solution (water) to carry an electrical current
Duty Cycle	%	Frequency or pulse rate is
Date		The date on which the assessment was completed
Depth	cm	Depth measured at 3 locations that is representative of the survey site. Taken within the reach length.
Volts	V	Electrical pressure
DO	% SAT	The amount of oxygen dissolved in the water
DO	mg/L	The amount of oxygen dissolved in the water
Species		Identity of fish captured.
Fork Length	cm	Length of fish measured from the tip of the snout to the end of the middle caudal fin rays.
Field Crew		The assessors collecting the data
pH		The acidity of the water in the watercourse
Reach Length	m	Linear distance of area being surveyed
Site Name		The name of the site where the survey is taking place. Usually 'Test' or 'Control'
Stream Name		The name of the watercourse where the survey is taking place
TDS	mg/l	Total dissolved solids, the measurement of the combined content of all inorganic and organic substances in its suspended form
Time		The time that the assessment began
UTM Coordinates		GPS position of the HSI assessment location, described with Northings and Eastings, using a NAD83 projection
Water Temperature	Celcius	Downstream water temperature
Wetted Width	m	Width of the river that contains water at the time of the measurement

6.7 Pre-Restoration and Post-Restoration Electrofishing Results

Table 8. Electrofishing results for the Fales River.

	Site Date	Downstream Site Boundary	Reach Length (m)	Pass	Total Time of Pass (seconds)	Pulse Frequency (Hz)	Volts (V)	Species Count Information									
								Atlantic Salmon	Brook Trout	Creek Chub	Lake Chub	White Sucker	Threespine Stickleback	Ninespine Stickleback	American Eel	Sea Lamprey	Total
Pre-Restoration	Site 1 2024/07/04	44°57′45″ N 64°55′58″ W	80	1	869.8	80	250	0	5	12	10	2	7	0	8	5	49
	Site 2 2024/06/13	44°57′44″ N 64°55′33″ W	105	1	25471.4	80	350	3	5	21	0	3	0	0	52	2	86
	Site 3 2024/07/05	44°57′35″ N 64°55′13″ W	110	1	1333.1	80	350	1	3	16	2	3	0	0	21	0	46
Post-Restoration	Site 2 2024/09/24	44°57′35″ N 64°55′13″ W	85	1	1755	30	370	1	0	15	26	3	6	1	12	1	64
	Site 3 2024/09/24	44°57′44″ N 64°55′33″ W	80	1	1398	30	370	4	0	5	11	5	0	0	16	0	41