Year 1 Monitoring Report

Pinevale Brook Aquatic Restoration & Monitoring

ANTIGONISH RIVERS ASSOCIATION

The Foundation for Conservation of Atlantic Salmon
La Fondation pour la conservation du saumon atlantique

adopt a stream

NOVA SCOTIA SALMON ASSOCIATION

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1.0 Introduction and Background

In 2022, The Antigonish Rivers Association (ARA) received funding from the Atlantic Salmon Conservation Foundation (ASCF), Nova Scotia Salmon Association (NSSA), and the NSSA Adopt-A-Stream program to carry out Phase 1 of *The South River Restoration and Conservation Plan*, to carry out in stream restoration of Pinevale Brook. Pinevale Brook was identified as a priority restoration site as it is the largest tributary to the South River main branch and contained degraded habitat characteristics. Habitat assessments within the watershed found that the absence of large woody debris (LWD) caused historical channel alterations and land clearing had resulted in degraded in stream habitat characteristics. The pre restoration assessments determined that spawning and juvenile habitat for Atlantic salmon was poor, and the absence of pool habitat was impacting adult Brook trout survival and adult Atlantic Salmon migration. In order to address these issues, a total of 25 in stream structures were installed and degraded riparian zones were replanted resulting in the restoration of 9000m^2 of fish habitat. To track the success of the instream restoration project, subsequent post-restoration monitoring is to be carried out in 2023 (year one post restoration), 2024 (year two), 2025 (year three), and 2026 (year four). The contents of this report document the findings of data collection from year one post-restoration.

Table 1: Information pertaining to the Pinevale Brook watershed.

Watershed Size (km^2)	Avg Calculated Bankfull Width	Stream Length	Estimated Habitat	Downstream Coordinates	Upstream Coordinates
33.38	8.62m	12607.75m	108678.81m^2	45.320015N -61.5528839W	45.2951525N -61.5948095W

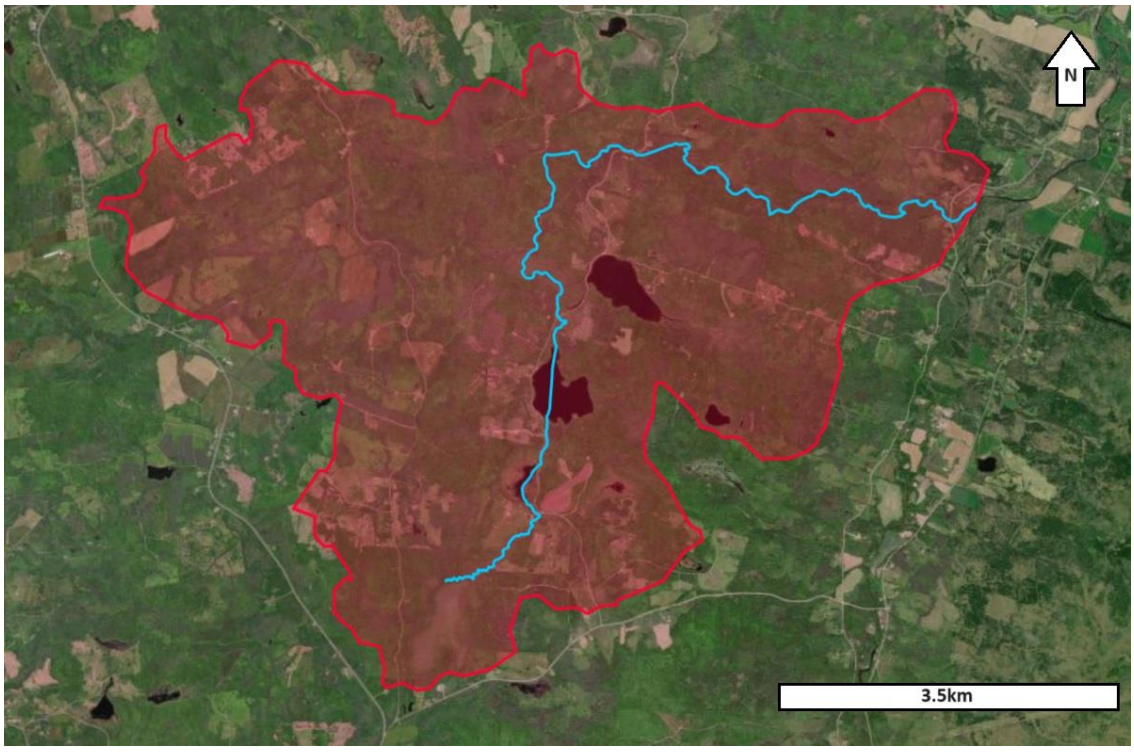

Figure 1: Pinevale Brook Watershed with main channel highlighted in blue.

2.0 Scope of Work

The downstream extent of this project is approximately 350m below the Dunmore Road Bridge that crosses Pinevale Brook (45.53170°N, -61.92831°W) with the upstream extent ending approximately 250m above the Pitchers Farm Road bridge that crosses Pinevale Brook (45.53792°N, -61.97093°W).

The success of this project is evaluated through the collection of baseline conditions (2022, pre-installation) and subsequent post-restoration conditions using the monitoring framework found in the proposal plan. Monitoring is structured to record and evaluate:

- Water temperature
- Physical habitat (i.e. pool quality meander sequences, etc.)
- Biological metrics:
  - Juvenile abundance
  - Spawning densities

Water temperature logger results can be found in Appendix A. Monitoring of physical habitat dimensions is completed using Habitat Suitability (HSI) surveys, which record metrics related to instream habitat such as thalweg depth, substrate composition and the quality of instream cover. The results of the HSI surveys can be found in Appendix B. Biological parameters were measured using electrofishing surveys (Appendix C), and Redd counts. All data collected will be compared to that of the previous year in order to monitor success of the instream structures.

An overview of Year 1 post restoration data can be found in the following sections.

3.0 Temperature Monitoring

Water temperatures were recorded using HOBOware Deployable loggers which are programmed to record water temperatures every fifteen minutes for a specific time frame which are typically set for June 1st to October 1st. Setting the temperature loggers to cover this specific time span will help identify trends in temperature ranges through the hottest months of the year. Issues for salmon begin when water temperatures exceed 23°C for periods of time greater than 24 hours. Atlantic salmon fry are more resilient to water temperatures and can withstand brief periods (less than 24 hours) of temperatures at or below 27° C.

In 2023, temperature probes in Pinevale Brook were destroyed during a high rainfall event in late August. Therefore, temperature probe data for 2023 is not available. It is worth noting that there was above average precipitation provincewide, contributing to stable water temperatures throughout Nova Scotia for Brook trout and Atlantic Salmon.

Moving forward, ARA will be adapting new temperate probe deployment methodology. In the past, the ARA has attached the probes to cinder blocks and placed them in the channel. With elevated levels of precipitation, this is no longer feasible.

Water temperature data can be found in Appendix A.

Table 2: Summary of temperature probe data collected from June 1 to September 30, 2022

Metric	Probe 1A (ID#20819832)	Probe 1B (ID#20990403)	Probe 2 (ID#20990413)	Probe 3A (ID#20676879)	Probe 3B (ID#20863369
Range (June 1 – Sept 30)	9.5°C-29.5 °C	9.3 °C -30.0 °C	11.6 °C -25.0 °C	10.7 °C -28.9 °C	10.3 °C -29.3 °C
Mean Daily Temp (June 1 – Sept 30)	19.7 °C	19.7 °C	19.1 °C	21.0 °C	21.0 °C
Mean June Temperature	18.1 °C	18.2 °C	18.0 °C	19.7 °C	19.7 °C
Mean July Temperature	21.8 °C	22.0 °C	20.5 °C	23.0 °C	23.0 °C
Mean August Temperature	21.9 °C	21.8 °C	20.9 °C	23.3 °C	23.2 °C
Mean September Temperature	16.6 °C	16.3 °C	16.6 °C	17.9 °C	17.8 °C

4.0 Physical Habitat Monitoring

The assessment of physical habitat was completed by the following protocols contained in the *Nova Scotia Fish Habitat Suitability Assessment: Field Manual* (Nova Scotia Salmon Association, 2019)

The Nova Scotia Fish Habitat Suitability Index Assessment (HSI) is intended to standardize freshwater fish habitat assessment while making use of habitat suitability variables and values specific to the rivers of Nova Scotia. This index standardizes field method assessments for variables such as site identification, water quality, channel cross-sections, substrate, cover, riverbanks, riparian areas, and benthic macroinvertebrates.

The field methods are based on a Habitat Suitability Index methodology developed by the U.S. Fish and Wildlife Department, specifically the Brook trout HSI and have been modified to represent the unique features of Nova Scotia watercourses. Additional HSI variables for Atlantic salmon have been drawn from the literature and used in the salmon habitat assessment. The methods are based on freshwater hydrology and geomorphology that develop the physical habitat and water quality that are commonly degraded by anthropogenic (human) impacts of fish habitat quality.

4.1 HSI Methodology

Channel width, in particular bankfull width and wetted width are both measured at each transect (Figure 2).

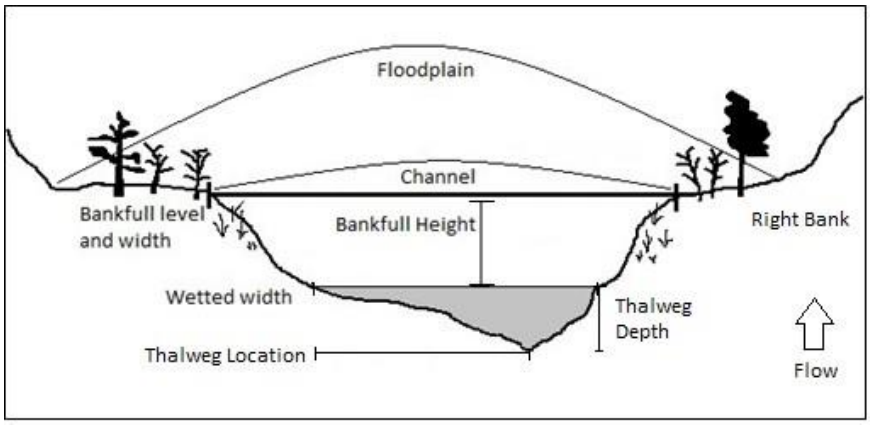

Figure 2: Visual guide for channel measurements.

The following steps for collecting bankfull width and bankfull height are found below (adapted from the NSHSI field assessment protocol):

- At each cross-section, a bankfull width and its height above the water level is taken
- Start measuring from the left bank looking downstream
- Pin the measuring tape into the banks or have a colleague hold the tape at the bankfull level and record the width on the field sheet

Using a meter stick or second measuring tape, measure the bankfull height from the water surface to the top of the bank and record it on the field sheet.

The following steps (adapted from the NSHSI Protocol) are followed when measuring wetted width and wetted depths:

- At each cross-section, a wetted width and three wetted depths are taken at distances of ¼, ½, and ¾ across the wetted portion of the cross-section from left to right looking downstream.
- Pin the measuring tape into the banks or have a colleague hold the tape perpendicular to the banks at the edge of the water and record the width on the field sheet under wetted width.
- Divide the wetted width by 4 to determine the length of each quarter section
- Starting at the left bank use the meter stick to determine the depth of the water at distances of ¼, ½, and ¾ across the wetted portion of the cross-section
- Use the water level on the downstream side of the meter stick to determine depth as the level on the upstream side may be affected by stream velocity
- An estimated negative depth, or height above the water level, should be taken if a measurement is located with no water depth in the adjacent area (an island or section of riffle with no significant depth or flow). A measurement of zero can also be taken if the river bottom is approximately the same height as the water level
- A depth can be taken in a nearby representative area of the location if a depth location is on a rock or other feature that would misrepresent the cross-section (a boulder above the water level but with the adjacent area exhibiting depth)

Substrate composition is measured using a quadrant tool to calculate the composition of various substrate types (fines, cobble, gravels, boulders, and bedrock). Substrate size and embeddedness is measured using a random rock grab method, whereby three rocks are randomly selected from observed spawning areas and measure and record the diameter. Siltation lines are observable features on instream substrate that indicate the extent of siltation within the channel, the percentage of each rock that is below the silt line is recorded as a measure of embeddedness. The higher the percentage of rock that is covered by silt, the higher the level of embeddedness. The area of spawning habitat is calculated by recording the dimensions of each observed spawning area.

Cover was measured by using wooden dowels (10 cm and 30cm each) that are representative in size of juvenile fish and adult fish. These dowels were used to quantify the carrying capacity for juvenile Atlantic salmon and Brook trout and adult Brook trout based on the total cover available for each age-class of fish across each HSI transect. Each dowel is manually moved across each transact, where potential cover features are evaluated by physically moving the dowel underneath potential cover (e.g. large rock or embedded wood). If the potential cover is sufficient to provide complete cover for the dowel, it is counted towards the overall number of fish. Cover for fish can be provided by instream debris, over-hanging vegetation and either boulders substrate for adult fish and cobble substrate for fry and parr.

Spawning habitat was evaluated based on substrate composition, substrate size (diameter), the level of embeddedness) and the overall area of spawning habitat. Atlantic salmon and Brook trout require spawning habitat that is comprised primarily of gravel and cobble. The presence of fines, boulders and bedrock are known factors that contribute to increased egg mortality and therefore are calculated against the spawning score. In order to receive a very good score (<0.80) observed spawning habitat must have an average substrate size between 2cm and 9.5cm and the level of embeddedness must be >5%. Spawning habitat that does not meet one of these criteria receives a moderate score (0.60 to .79) and spawning habitat that does not meet either criteria will receive a poor score (>0.60).

4.2 HSI Excel Spreadsheet Evaluation and Interpretation

The NSHSI Excel spreadsheet evaluates data collected in the field based on suitability models so that limiting factors can be easily identified for both Atlantic salmon and Brook trout. The formula calculates 15 important criteria for each species in a range from 0-1, where poor quality is given a value of less than 0.4, moderate quality has a value between 0.4 and 0.8, and good quality has a value of greater than 0.8.

The criteria evaluated are:

- percent pools,
- pool class rating,
- percent instream cover for adults and juveniles,
- dominant substrate type in riffle run areas,
- vegetation along the streambank,
- rooted vegetation and stable rocky ground,
- water temperature, pH, size of substrate in spawning areas,
- Percent fines in spawning areas,

- percent fines in riffle-run areas,
- substrate size class for winter escape,
- thalweg depth during late growing season,
- percent stream shade

In 2022, as part of baseline data collection, and in 2023 a part of year one post-restoration monitoring. HSI surveys were completed to evaluate instream physical parameters at 19 sites over a 2km stretch of stream. HSI surveys will continue to be conducted at the same sites in 2024 (year two), 2025 (year three), and 2026 (year four).

Full survey results can be found in Appendix B.

4.3 Channel Width

Bankfull width is the distance between the start of bank vegetation on one side of the channel across to the start of vegetative growth on the opposite bank. Areas that are flooded during bankfull discharge events are typically bare of vegetation and therefore easily identifiable.

The channel through the two study areas of Pinevale Brook were found to be over-widened or within threatening distance should additional erosion take place. The calculated bankfull width for 8.62 meters. Bankfull widths were measured at 60 transects across 20 HSI sites. In Lower Pinevale, 16 out of 27 transects exceeded calculated bankfull width and an additional four were within 0.4 meters. In Upper Pinevale, 9 out of 30 transects exceeded calculated bankfull width, however, 16 were within 0.4 meters. The mean bankfull width measured through the HSI site was 9.07m, which is 5% over-widened compared to the calculated bankfull width of 8.62m. There are multiple stretches within the channel that are double, and even triple the calculated bankfull width. In these areas, the channel is disconnected from the floodplain during high flow events, resulting in a lack of dissipation of energy, thus enhance rates of erosion due to a lower stability of the riverbank. Over-widened channels result in severely degraded fish habitat, poorly sorted substrate that lacks sufficient spawning, and is frequently scoured to bedrock.

4.4 Channel Depth

Channel depth is measured by recording the thalweg (deepest section of the channel) and is important metric for assessing fish migration potential. For Atlantic salmon and Brook trout a thalweg depth greater than 15cm is an important requirement for upstream migration, therefore thalweg depth is measured and recorded at each transect throughout the HSI study site. Instream structures are installed to promote the narrowing of the channel, which will reconnect the floodplain, thus promoting the recovery of natural instream features.

Table 3: Channel depth summary for 2022-2023.

Year	0 transects 15cm or less (very good)	1 transect 15cm or less (moderate)	2 transects 15cm or less (poor)
2022	11	5	3
2023	18	0	0

4.4.1 Late Season Growing for Adult Brook Trout

This metric is used to assess overall depth of pool habitat. This is important for Brook trout parr and adults as they primarily feed in pool habitat. A lack of sufficient depth in theses areas increases the impacts of predation and mortality during feeding periods. A thalweg depth of 40cm or greater is required for a very good score, a depth of 20-40cm is required for a moderate score, and a depth less than 20cm is considered poor (Appendix B: Tables 23 & 25, Column L).

Table 4: Depth of pool habitat scores for 2022-23.

Year	Poor (<20cm)	Moderate (20-40cm)	Very Good (>40cm)
2022	5	8	6
2023	2	8	8

4.4.2 Fry Water Depth

This metric provides a score to the thalweg depth in riffle habitat, an important metric for both Atlantic salmon fry and Brook trout fry. A depth of 20cm or greater is required for a very good score, a depth of 10-20cm is required for a moderate score, and a depth less than 10cm is scored as poor. These values can be found in Appendix B: Tables 24 & 26, Column L.

Table 5: Fry water depth scores for 2022-23.

Year	Poor (<10cm)	Moderate (10-20cm)	Very Good (>20cm)
2022	0	0	19
2023	0	0	18

4.4.3 Parr Water Depth

This metric provides a score to the thalweg depth in run habitat, which is critical for Atlantic salmon parr rearing. A depth of 30cm or great is required for a very good score, a depth of 20-30cm is required for a moderate score, and a depth less than 20cm is scored as poor. This provided an overall score of very good. The values can be found in Appendix B: Tables 24 & 26, Column M.

Table 6: Parr water depth scores for 2022-23.

Year	Poor (<20cm)	Moderate (20-30cm)	Very Good (>30cm)
2022	0	2	17
2023	0	0	18

4.5 Pool Class Rating

Pool class rating is evaluated by measuring low flow pool depth and the amount of pool cover. The full results of this metric can be viewed in Appendix B: Tables 23, 24, 25 & 26, Column C.

Table 7: Pool class rating methodology (adapted from NS Fish Habitat Assessment 2019 Field Manual)

Pool Class	Low Flow Pool Depth	Amount of Cover
Very Good (A)	>1m, or >15% of width	>30%
Moderate (B)	$\leq$15% of width, and $\geq$15cm	5-30%
Poor (C)	<15cm	<5%

Low flow pool depth was measured by subtracting the depth of the tail-end control form the thalweg depth (deepest point of the pool). Percentage of instream cover was measured by calculating the percentage of the pool area that contains suitable cover for fish from birds of prey. Features such as embedded logs, over-hanging vegetation, and deep water that prevents bottom visibility were considered cover for pool habitat as they provide areas for fish to hide without exposure to predators.

Table 8: Pool class rating scores in 2022-23.

Year	Poor	Moderate	Very Good
2022	5	13	1
2023	0	18	0

4.6 Percent Pool Habitat

The total area in each HSI site that is considered pool habitat is an important metric for evaluating Atlantic salmon and brook trout habitat. Ideally for brook trout, each HSI site is comprise of >50% in pool habitat, while Atlantic salmon require >25%. Most of the Atlantic Salmon's adult life stage is spent in the marine environment, therefore less pool habitat is required for that species' survival. For brook trout, HSI sites with >50% pool area received a very good score, sites with 25-50% received a moderate score, and sites with <25% received a poor score. This resulted in an overall score of moderate. The results for percent pool habitat can be found in Appendix B: Tables 23, 24, 25 & 26, Column B.

Table 9: Results for percent pool habitat for Brook trout.

Year	Poor (<25%)	Moderate (25-50%)	Very Good (>50%)
2022	4	7	8
2023	0	11	7

For Atlantic Salmon, HSI sites with >25% pool habitat received a very good score, sites between 10-25% pool habitat received a moderate score, and anything less than 10% pool habitat was scored as poor.

Table 10: Results for percent pool habitat for Atlantic salmon.

Year	Poor (<10%)	Moderate (10-25%)	Very Good (>25%)
2022	7	5	7
2023	0	11	7

4.7 Substrate

To quantify substrate, each HSI site was divided into three transects, spaced at intervals equal to 2 widths the channel design width of 8.62m. Transects in this study were spaced at 15m. The substrate was evaluated at each transect using a $1m^2$ quadrant divided into 20 squares, each squares representing 5% of the substrate surface area. The quadrant is used at 3 points across each transect to measure substrate, providing a representation of the total cross section of the channel. Substrate material was classified as fines, gravels, cobbles, boulders, or bedrock.

4.7.1 Dominant Substrate Type in Riffle and Run Areas

Riffle and run habitat features should contain substrate of at least 50% cobble and the percentage of either boulders or gravel should not exceed 25% each. Furthermore, the presences of any fines or bedrock in either of these features is a sign of degradation and reduces the value for this metric, as the presence of fines in these areas can adversely affect survival, food production, and escape cover from predation (Raleigh, R.F., 1982).

The values for both Atlantic salmon and brook trout are based on the same conditions for this metric. The results for dominant substrate type in riffle and run areas can be found in Appendix B: Tables 23, 24, 25 & 26, Column H.

Table 11: Riffle and run habitat scores for 2022-23.

Year	Poor	Moderate	Very Good
2022	3	13	3
2023	0	11	7

4.8 Instream Cover

A score was generated based on the overall composition of each measured area and is dependant on the characterization of each transect (e.g., pool, riffle, or run). Riffle habitat should contain a mixture of cobbles and gravels while pool and run habitat should contain mostly cobble and boulders. Pools, riffles, and runs provide cover for different life cycles of Brook trout and Atlantic salmon. Riffle habitat provides cover for the Atlantic salmon fry, run habitat provides cover for Atlantic salmon parr and adult brook trout, and pools provide cover for adult Atlantic salmon. Scores are generated for each life stage based on their requirements for cover and the level of embeddedness at those sites.

4.8.1 Instream Cover for Fry

High numbers of juvenile densities are associated with large, deep, low-velocity pools with abundant instream cover, overhanging vegetation, and gravel-cobble substrate (Raleigh, R.F., 1982). The full results for instream cover for Brook trout fry can be found in Appendix B: Tables 23 & 35, Column D.

Table 12: Scores for instream cover for Brook trout fry for 2022-23.

Year	Poor	Moderate	Very Good
2022	0	18	1
2023	0	4	14

The full results for instream cover for Atlantic salmon fry can be found in Appendix B: Tables 24 & 26, Column D.

Table 13: Scores for instream cover for Atlantic salmon fry for 2022-23.

Year	Poor	Moderate	Very Good
2022	1	18	0
2023	0	4	14

4.8.2 Instream Cover for Atlantic Salmon Parr

A high pool percentage and pool class rating is considered essential cover for salmon parr as they provide salmon the ability to successfully migrate, access suitable holding habitat, and the ability to survive and spawn successfully (Raleigh, R.F., 1982). Full results can be found in Appendix B: Tables 24 & 26, Column E.

Table 14: Scores for instream cover for Atlantic salmon parr in 2022-23.

Year	Poor	Moderate	Very Good
2022	18	1	0
2023	10	5	2

4.8.3 Instream Cover for Brook Trout Parr and Adults

Brook trout parr occupy the same habitat features as those of adult Brook Trout, therefore a single metric is used to score both life stages.

Table 15: Scores for instream cover for Brook trout Parr and Adults in 2022-23.

Year	Poor	Moderate	Very Good
2022	18	1	0
2023	11	6	1

4.9 Spawning Habitat

Spawning habitat is evaluated on two metrics: substrate size and embeddedness. A very good score contains substrate ranging form 2-9.5cm in size and is less than 5% embedded. A moderate score meets 1 of these 2 criteria, and a poor score does not meet either criterion.

Table 16: Spawning site summary for 2022-23.

Species	Total Spawning Sites		Poor		Moderate		Very Good	
	2022	2023	2022	2023	2022	2023	2022	2023
Brook Trout	14	15	0	0	1	2	13	13
Atlantic Salmon	14	16	0	0	0	0	14	16

4.10 Riparian Zone Vegetation

Riparian zone vegetation was evaluated by measuring the percentage of ground covered by trees, shrubs, grasses, and hedges, and bare ground within 10m from the bank's edge. The results for each HSI site can be found in Appendix B: Tables 23, 24, 25 & 26, Column G.

Table 17: Riparian zone vegetation scores for 2022-23.

Year	Poor	Moderate	Very Good
2022	0	4	15
2023	0	3	15

4.11 Riverbank Stability

The metric is evaluated by measuring the percentage of each streambank that is covered in stable rooted vegetation and the percentage of streambank that is actively eroding. The scores for both Brook trout and Atlantic Salmon are shared in this metric.

Table 18: Riverbank stability scores for 2022-23.

Year	Poor	Moderate	Very Good
2022	0	0	19
2023	0	1	17

5.0 Electrofishing

Electrofishing was conducted on September 25th, 2023, using a Halltech Aquatic Research Model HT2000B/MK5 Electrofisher. The electrofishing unit was set at a frequency of 60 hertz and the output voltage was set at 750 amps. Each electrofishing site was sectioned off with barrier nets at both the downstream and upstream extent of the survey site to ensure that fish were unable to exit or enter the site while the survey was being conducted.

Three sites were selected and electrofished to provide a baseline (pre-restoration) juvenile abundance estimate. Three sweeps of each survey site were conducted, with fish counted, identified, and measured after each sweep. Following each sweep, fish were measures to determine age class, and species was recorded. Fish were kept in holding tanks with aerators during the second and third sweeps to ensure fish were not captured and recorded twice. A field technician monitored each barrier net, and additional field technicians captures the shocked fish using small fishing nets in addition to the operator of the electrofishing unit.

In each of the electrofishing survey sites, the total number of fish captured declined with each subsequent sweep, therefore additional sweeps were not required. The decline in fish caught per sweep indicated that the electrofishing was successful at capturing a high percentage of the population of fish within each project site.

5.1 Electrofishing Results

Atlantic salmon numbers are up at both, indicates a great rate of fry and egg survival as a result of the instream structures. Another observed change in sampling was the presence of 2+ Atlantic Salmon, which were not observed during baseline data collection. A summary of the results can be found in table 19 and the full results can be viewed in Appendix C.

Table 19: Summary table results for raw electrofishing data

Site #	Total Area (m^2)	Total # of Fish	#0+ Brook Trout	#1+ Brook Trout	Density of 0+ Brook Trout	Density of 1+ Brook Trout	#0+ Atlantic Salmon	#1+ Atlantic Salmon	Density of 0+ Atlantic Salmon	Density of 1+ Atlantic Salmon
1 (2022)	260	59	0	0	0	0	19	26	$0.073/m^2$	$0.100/m^2$
1 (2023)	260	150	0	0	0	0	121	25 (4 2+)	0.465	0.112
2 (2022)	270	69	0	0	0	0	33	5	$0.122/m^2$	$0.019/m^2$
2 (2023)	270	72	0	0	0	0	74	1	0.274	0.004

5.2 Electrofishing: Using Zippin's Method to Estimate Populations

Based on the electrofishing data collected in August, population estimated were calculated using the Zippin's Method, also known as the total removal estimate (Zippin, 1958). "This is a multiple sweep method with 3 or more sweeps. It is based on the principle that a decrease in catch per effort (c/e) as the population is depleted bears a direct relationship to the extent of the population. Population size is derived by plotting a regression line of c/e on the cumulative catch" (UNB, 2003).

The linear regression technique to calculate population size first determines probability of capture (P):

$$P = \frac{-(K3Tx - 3T3x)}{K3x^2 - (3x)^2}$$

And then the population estimate (N)

$$N = \frac{3T + P3x}{KP}$$

Where:

K = number of sweeps completed

T= number of fish caught per sweep

x = cumulative number of fish removed in previous sweep(s)

Site #	Total Salmonid Population		0+ Brook		Estimated 1+ Brook Trout		Estimated 0+ Atlantic Salmon		Estimated 1+ Atlantic salmon	
	Est. Total	95% Confidence Interval Range	Est. Total	95% Confidence Interval Range	Est. Total	95% Confidence Interval Range	Est. Total	95% Confidence Interval Range	Est. Total	95% Confidence Interval Range
1 (2022) 1 (2023)	58 175	59-88 153-196	0 0	N/A N/A	0 0	N/A N/A	19 143	19-26 122-165	23 32	24-27 29-38
2 (2022) 2 (2023)	69 102	69-110 72-142	0 0	N/A N/A	0 0	N/A N/A	33 103	33-45 71-146	5 1	5-27 1-1

6.0 Biological Monitoring: Redd Counts

In November 2023, visual surveys were conducted to record the number and distribution of Atlantic Salmon redds throughout the entire restoration site. Monitoring of spawning (e.g., redd counts) focused only on Atlantic Salmon as observing and monitoring Brook trout redds can be difficult as they are smaller and not easily identified.

Redd surveys were conducted on November 16th, 2023, with the survey covering the entirety of the restored area in Pinevale Brook. In both the upper and lower sections, 4 redds were found, for a total of 8. Redd numbers were found to be lower than that found in 2022, and there are several factors playing into this. Approximately 150m upstream from the confluence of Pinevale Brook and South River, there was a significant debris jam that was restricting flow and causing a build up of fine sediments. In the upstream area, there was a large beaver dam approximately 500m downstream from the Pitcher's Farm Road bridge that was inhibiting fish passage. Due to the frequency of large rain events in the weeks leading up to salmon migration season, it was not possible to gain access to these sites to notch them. It is noted that the redds are significantly larger than those found in previous years. This is positive as it indicates the substrate is being clean of fines that have been deposited over the years from high amounts of beaver activity in the area.

Table 20: Summary of Redd Count data

Year	Number of Salmon Observed	Total Number of Redds Observed
2021 (Scoping)	3	11
2022 (Baseline)	12	43
2023 (Year One)	4	8

Figure 3: Lower survey area boundaries for Pinevale Brook

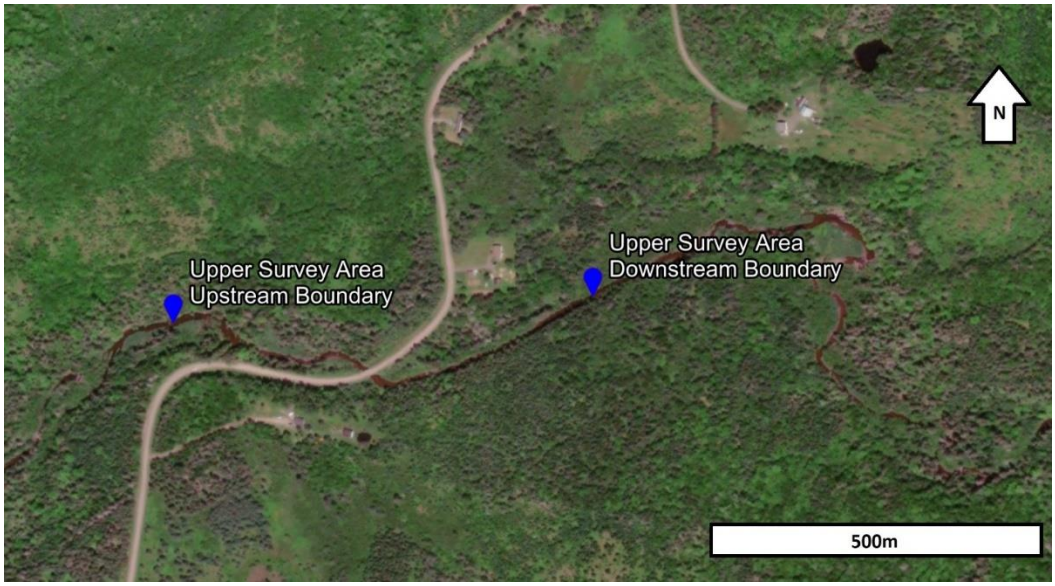

Figure 4: Upper survey area boundaries for Pinevale Brook

7.0 Structure Stability

Maintenance was carried out in June 2023, with minimal repairs being required. Structures were inspected during redd count surveys on November 16th, 2023, and all structures were found to have remained intact during the summer high flow events. A survey of structures will be completed in May 2024, with required maintenance being carried out in June 2024.

8.0 References

Breau, Cindy; Cunjak, Richard; and Stephan Peake. 2011. Behaviour during elevated water temperatures: can physiology explain movement of juvenile Atlantic salmon to cool water?. Journal of Animal Ecology. 80: 844-853.

Breau, Cindy; Cunjak, Richard A; and Bremset, G. 2007. Age-specific aggregation of wild juvenile Atlantic salmon Salmo salar at cool water sources during high temperature events. Journal of Fish Biology. 71: 1179-1191.

Corey, Emily; Linnansaari, Tommi; Cunjak, Richard and Currie, Suzanne. 2017. Physiological effects of environmentally relevant, multi-day thermal stress on wild juvenile Atlantic salmon (Salmo salar). Conservation Physiology. 5:1-13.

Floyd TA, MacInnis C, Taylor BR. 2008. Effects of artificial woody structures on Atlantic salmon habitat and populations in a Nova Scotia stream. Rivers Research and Applications 24: 272-282.

Government of Canada. (2019). Canadian Aquatic Biomonitoring Network. Retrieved from: https://www.canada.ca/en/environment-climate-change/services/canadian-aquatic-biomonitoring-network.html

Government of Canada. (2018). Science of Aquatic Biomonitoring. Retrieved from: https://www.canada.ca/en/environment-climate-change/services/canadian-aquatic-biomonitoring-network/science.html

Nova Scotia Salmon Association. (2019). The Nova Scotia fish habitat suitability assessment: a fields methods manual for Nova Scotia. Version 2.3. Retrieved from: http://www.adoptastream.ca/sites/default/files/The%20Nova%20Scotia%20Fish%20Habitat%20Assessment%20Protocol-%20June%202018.pdf

Raleigh, R. F. (1982). *Habitat Suitability Index Models: Brook trout.* U.S. Department of the Interior, Fish and Wildlife Service.

Ryther, John H. 1997. Anadromous brook trout: biology, status and enhancement. Woods Hole Oceanographic Institution.

Taylor BR, MacInnis C, and Floyd TA. 2009. Influence of rainfall and beaver dams on upstream movement of spawning Atlantic salmon in a restored brook in Nova Scotia, Canada. Rivers Research and Applications. 26:183-193.

University of New Brunswick. 2003. Field methods manual: fish population estimates. 14-28. Retrieved from: https://www.unb.ca/research/institutes/cri/_resources/downloads/nbaquaticdatawarehouse/manualanddoc/fishpopstreams.pdf

Zippin, C. (1958). The removal method of population estimation. Journal of Wildlife Management, 22, 82-90.

Appendix A: Temperature Probe Data

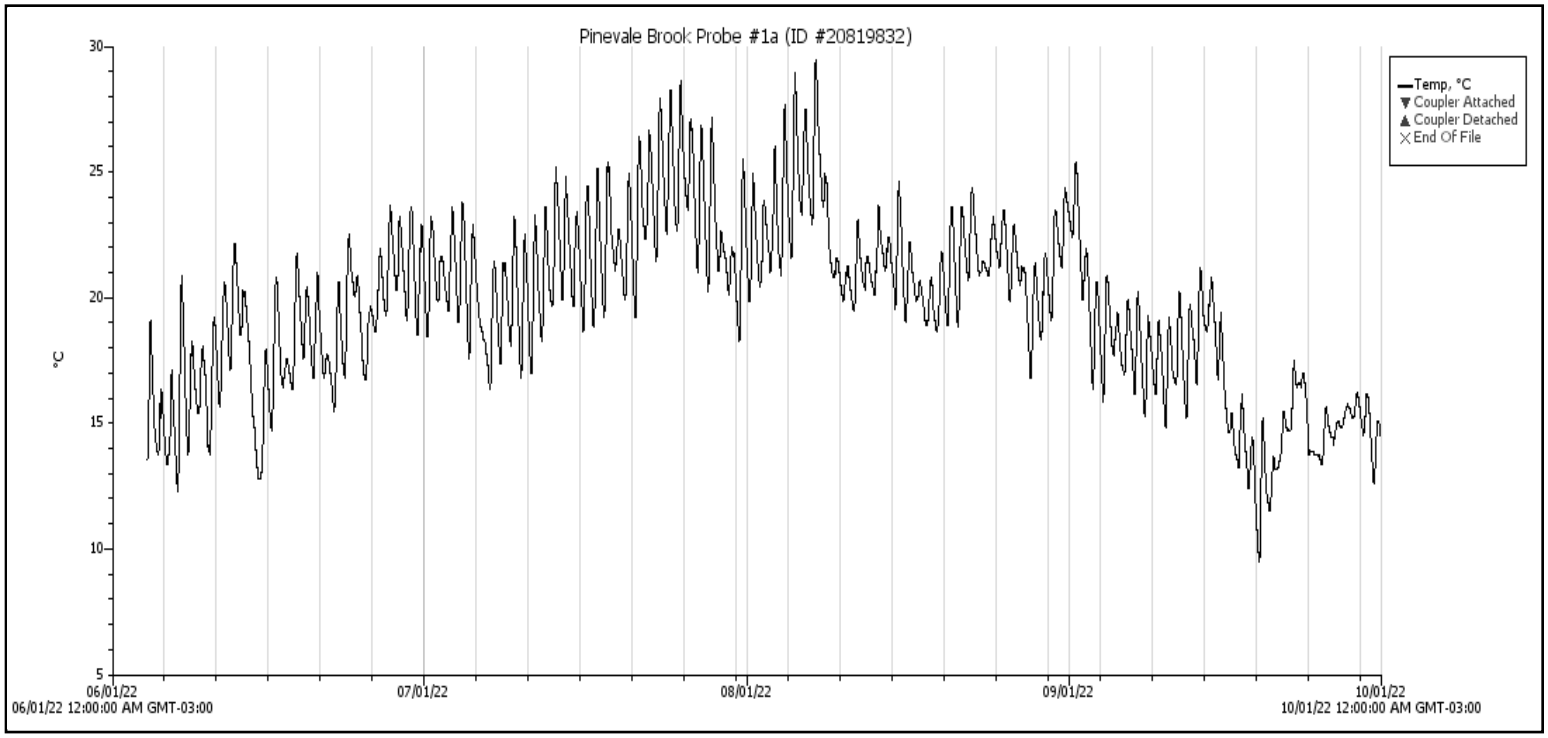

Table 21: 2022 Temperature Probe #1A (interior)

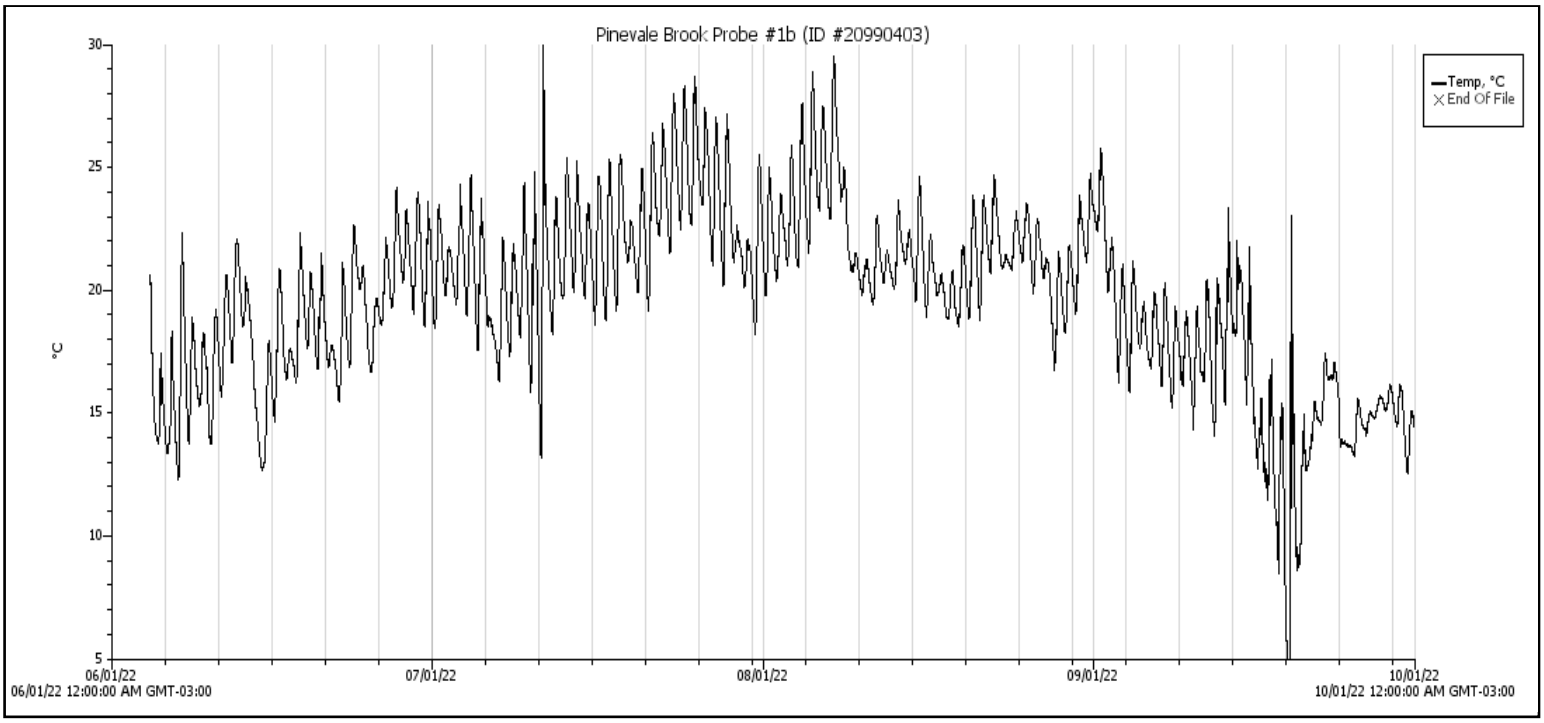

Table 22: 2022 Temperature Probe #1B (exterior)

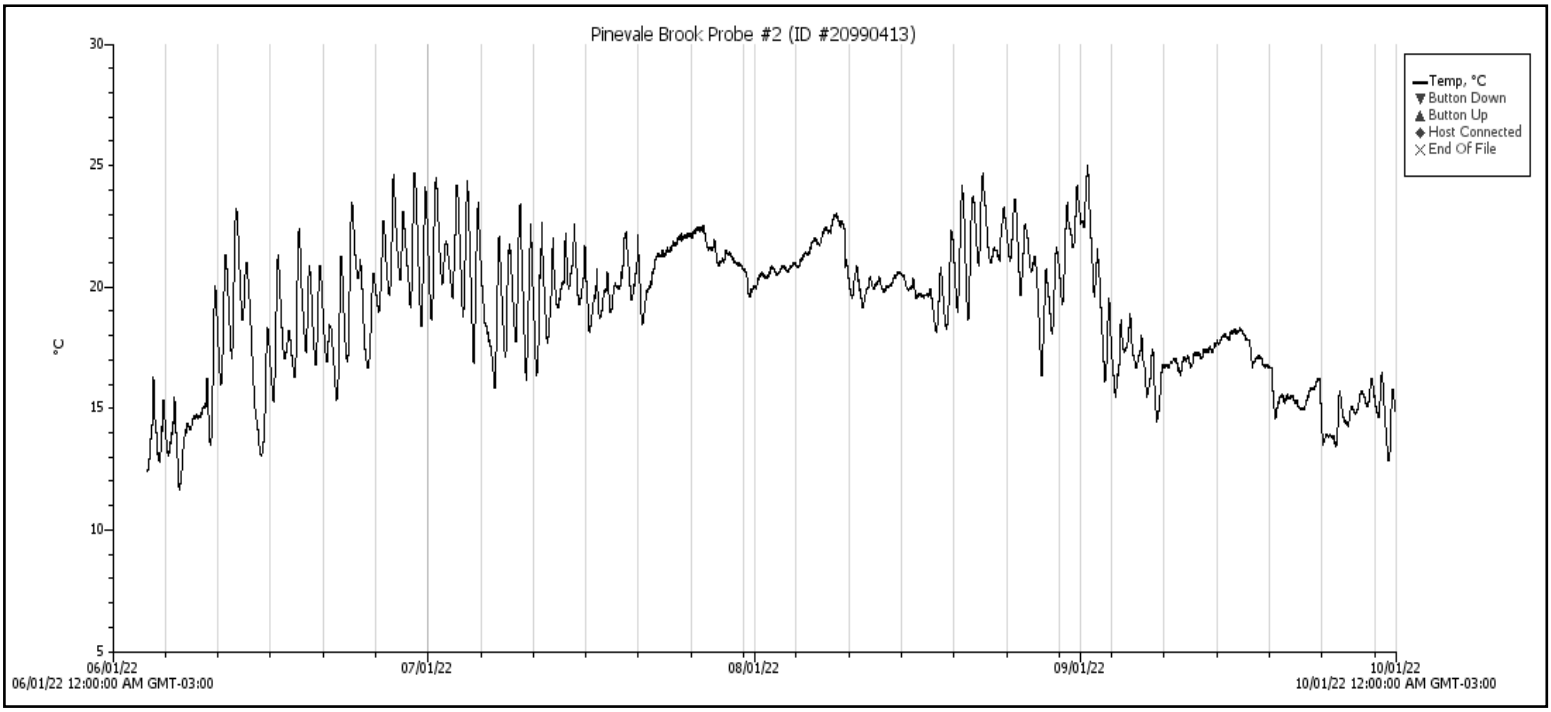

Table 23: 2022 Temperature Probe #2

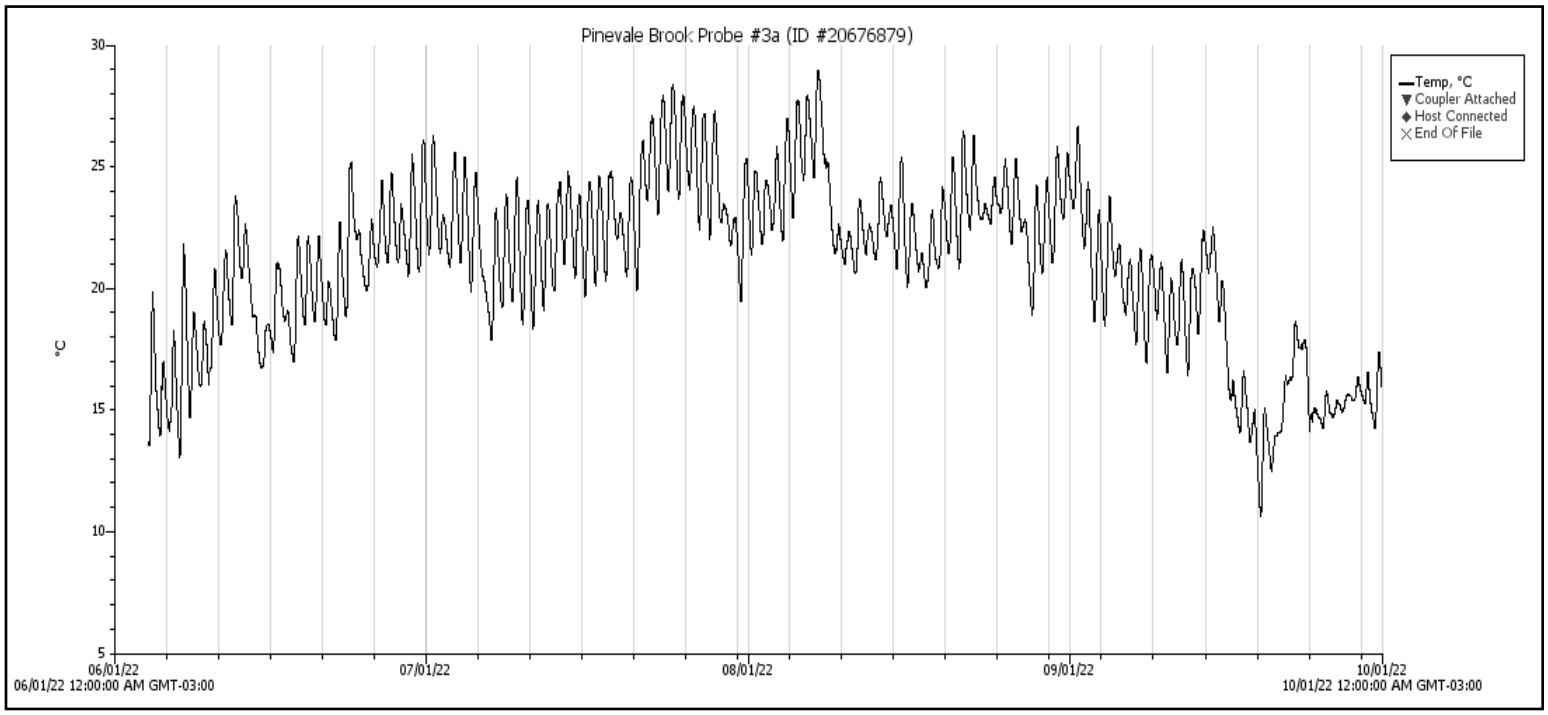

Table 24: 2022 Temperature Probe #3A (interior)

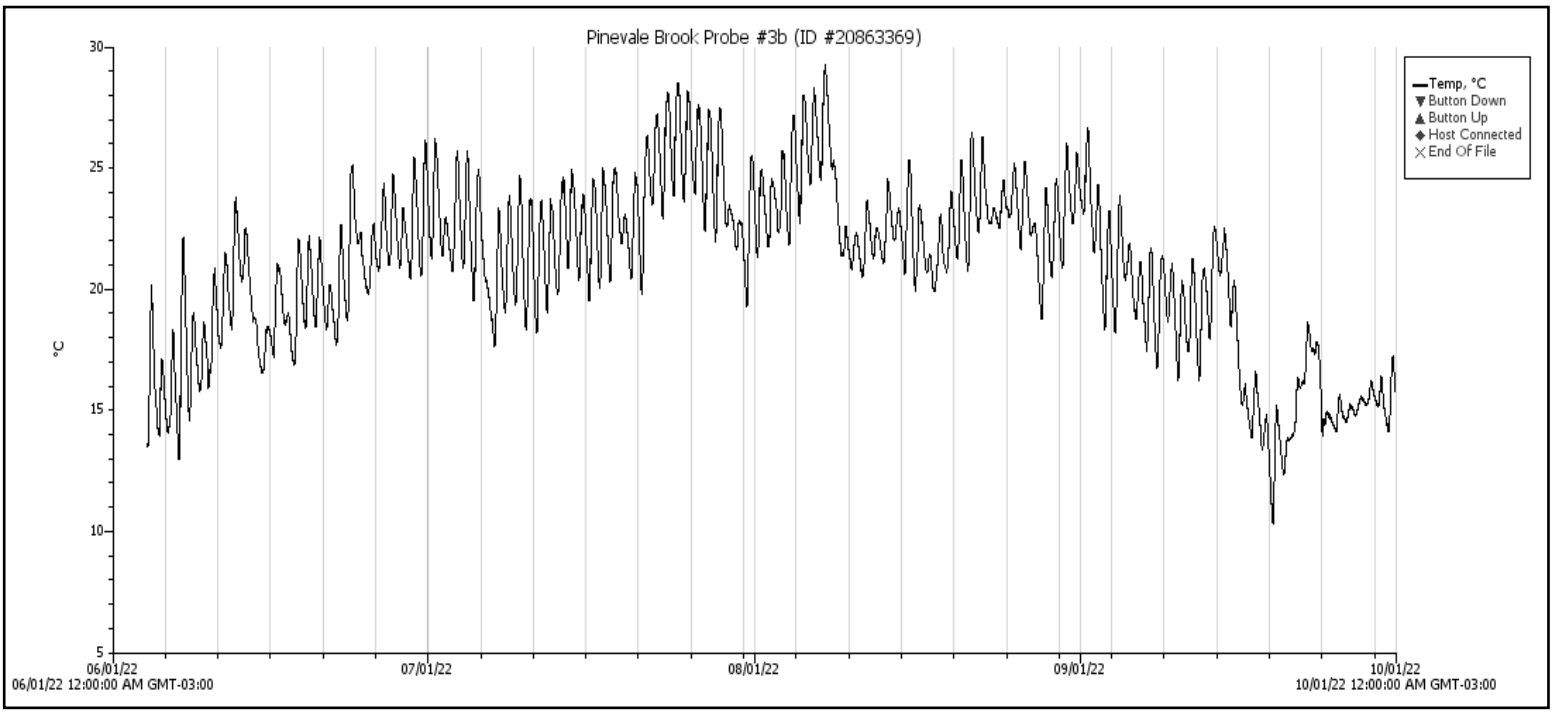

Table 25: 2022 Temperature Probe #3B (exterior)

Appendix B: Habitat Suitability Index

HSI Tables

	Downstream Boundary		Upstream Boundary	
HSI Site #	Latitude	Longitude	Latitude	Longitude
1	N45.533419	W61.924518	N45.533207	W61.925008
2	N45.533096	W61.925064	N45.532868	W61.925547
3	N45.532900	W61.925674	N45.532606	W61.926130
4	N45.532483	W61.926197	N45.532063	W61.926844
5	N45.531915	W61.926882	N45.531744	W61.927573
6	N45.531638	W61.927667	N45.531776	W61.928508
7	N45.531797	W61.928597	N45.531987	W61.929211
8	N45.531046	W61.929720	N45.532607	N61.929239
9	N45.532690	W61.929218	N45.533116	N61.929510
10				
11	N45.538829	W61.964242	N45.538843	W61.964793
12	N45.538892	W61.964941	N45.538990	W61.965566
13	N45.538981	W61.965694	N45.538776	W61.966220
14	N45.538742	W61.966305	N45.538608	W61.966935
15	N45.538601	W61.967065	N45.538458	W61.967676
16	N45.538420	W61.967862	N45.538161	W61.968433
17	N45.538139	W61.968631	N45.537976	W61.969170
18	N45.537940	W61.969357	N45.537796	W61.969939
19	N45.537817	W61.970310	N45.537867	W61.970873
20	N45.538078	W61.971097	N45.538163	W61.971755

Table 26: HSI Site Boundaries

A	B	C	D	E	F	G	H	I	J	K	L	M
Field Sheet Number	% Pools	Pool Class Rating	% Instream Cover (fry)	% Instream Cover (parr)	Dominant Substrate Type in Riffle Run Areas	Avg % Veg Along Stream Bank	Avg % Rooted Veg and Stable Rocky Ground Cover	Spawning Present	Avg Size of Substrate in Spawning Areas	% Fines in Spawning Areas	Avg Thalweg Depth During Late Growing Season	% Stream Shade
HSI #1	0.91	0.60	0.52	0.44	0.60	0.73	1.00	No	0.00	0.00	1.00	0.51
HSI #2	1.00	0.60	0.77	0.23	0.60	0.88	1.00	Yes	1.00	0.90	0.74	0.65
HSI #3	0.64	0.60	0.45	0.05	0.60	0.68	1.00	Yes	1.00	0.90	0.70	0.44
HSI #4	0.30	0.30	0.43	0.00	0.60	0.89	1.00	Yes	1.00	0.00	0.70	0.37
HSI #5	0.91	0.60	0.71	0.23	0.60	0.80	1.00	No	0.00	0.00	1.00	0.58
HSI #6	0.84	0.60	0.47	0.00	0.30	0.50	0.97	No	0.00	0.00	0.87	0.51
HSI #7	0.97	0.60	0.52	0.06	0.30	0.96	1.00	Yes	1.00	0.00	0.94	0.30
HSI #8	0.43	1.00	0.60	0.10	0.60	0.96	1.00	Yes	0.90	0.00	0.50	0.58
HSI #9	0.30	0.30	0.61	0.09	0.60	0.87	1.00	Yes	1.00	0.08	0.64	0.51
HSI #10												
HSI #11	0.87	0.60	0.76	0.15	0.60	0.63	1.00	Yes	1.00	0.81	0.88	1.00
HSI #12	0.54	0.60	0.60	0.09	0.60	0.82	1.00	Yes	1.00	0.81	0.77	1.00
HSI #13	1.00	0.60	0.48	0.08	0.60	0.80	1.00	Yes	0.93	0.81	0.35	0.72
HSI #14	0.60	0.60	0.56	0.07	1.00	0.89	1.00	No	0.00	0.00	0.44	0.58
HSI #15	0.30	0.30	0.44	0.05	1.00	0.89	1.00	Yes	1.00	0.81	0.21	0.58
HSI #16	0.30	0.30	0.43	0.02	0.60	0.92	1.00	Yes	1.00	0.81`	0.28	0.93
HSI #17	0.45	0.60	0.54	0.06	0.60	0.99	1.00	Yes	0.99	0.81	0.55	0.86
HSI #18	0.30	0.30	0.14	0.00	0.60	0.92	1.00	Yes	1.00	0.81	0.15	0.79
HSI #19	0.95	0.60	0.55	0.06	0.30	1.00	1.00	Yes	0.77	0.81	0.95	0.79
HSI #20	0.72	0.60	0.54	0.06	1.00	0.95	0.97	No	0.00	0.00	0.32	0.44

Table 27: 2022 Brook Trout HSI Results

A	B	C	D	E	F	G	H	I	J	K	L	M	N
Field Sheet Number	% Pools	Pool Class Rating	% Instream Cover (fry)	% Instream Cover (parr)	Dominant Substrate Type in Riffle Run Area	Avg % Vegetation Along Streambank	Avg % Rooted Vegetation and Stable Rocky Ground Cover	Spawning Present	Substrate for Spawning and Incubation	% Fines in Spawning Area	Fry Water Depth	Parr Water Depth	% Stream Shade
HSI #1	0.98	0.60	0.52	0.44	0.60	0.73	1.00	No	0.00	0.00	1.00	1.00	0.51
HSI #2	0.55	0.60	0.77	0.23	0.60	0.88	1.00	Yes	1.00	0.90	1.00	0.86	0.65
HSI #3	0.74	0.60	0.45	0.05	0.60	0.68	1.00	Yes	1.00	0.90	1.00	0.51	0.44
HSI #4	0.12	0.30	0.43	0.00	0.60	0.89	1.00	Yes	1.00	0.00	1.00	0.86	0.37
HSI #5	0.98	0.60	0.71	0.23	0.60	0.80	1.00	No	0.00	0.00	1.00	1.00	0.58
HSI #6	0.99	0.60	0.47	0.00	0.30	0.50	0.97	No	0.00	0.00	1.00	1.00	0.51
HSI #7	0.86	0.60	0.52	0.06	0.30	0.96	1.00	Yes	1.00	0.00	1.00	0.90	0.30
HSI #8	0.33	1.00	0.60	0.10	0.60	0.96	1.00	Yes	0.88	0.00	0.91	0.46	0.58
HSI #9	0.12	0.30	0.61	0.09	0.60	0.87	1.00	Yes	1.00	0.08	1.00	0.83	0.51
HSI #10													
HSI #11	1.00	0.60	0.76	0.15	0.60	0.63	1.00	Yes	1.00	0.81	1.00	1.00	1.00
HSI #12	0.56	0.60	0.60	0.09	0.60	0.82	1.00	Yes	1.00	0.81	1.00	0.99	1.00
HSI #13	0.69	0.60	0.48	0.08	0.60	0.80	1.00	Yes	1.00	0.81	1.00	1.00	0.72
HSI #14	0.66	0.60	0.56	0.07	1.00	0.89	1.00	No	0.00	0.00	1.00	0.99	0.58
HSI #15	0.12	0.30	0.44	0.05	1.00	0.89	1.00	Yes	1.00	0.81	1.00	0.95	0.58
HSI #16	0.12	0.30	0.43	0.02	0.60	0.93	1.00	Yes	1.00	0.81	1.00	1.00	0.93
HSI #17	0.37	0.60	0.54	0.06	0.60	0.99	1.00	Yes	1.00	0.81	1.00	1.00	0.86
HSI #18	0.12	0.30	0.14	0.00	0.60	0.92	1.00	Yes	1.00	0.81	1.00	0.86	0.79
HSI #19	0.92	0.60	0.55	0.06	0.30	1.00	1.00	Yes	0.96	0.81	1.00	1.00	0.79
HSI #20	0.87	0.60	0.54	0.06	1.00	0.95	0.97	No	0.00	0.00	1.00	1.00	0.44

Table 28: 2022 Atlantic Salmon HSI Results

A	B	C	D	E	H	G	H	I	J	K	L	M
Field Sheet Number	% Pools	Pool Class Rating	% Instream Cover (fry)	% Instream Cover (parr)	Dominant Substrate Type in Riffle Run Area	Avg % Vegetation Along Streambank	Avg % Rooted Vegetation and Stable Rocky Ground Cover	Spawning Present	Substrate for Spawning and Incubation	% Fines in Spawning Area	Avg Thalweg Depth During Late Growing Season	% Stream Shade
HSI #1	0.92	0.60	1.00	0.40	0.60	0.93	0.93	No	0.00	0.00	0.90	0.58
HSI #2												
HSI #3	0.58	0.60	0.81	0.26	1.00	1.00	0.75	Yes	1.00	0.81	0.75	0.51
HSI #4	0.57	0.60	0.86	0.27	1.00	1.00	0.90	Yes	1.00	0.81	0.71	0.44
HSI #5	0.66	0.60	0.59	0.17	0.60	0.60	0.98	Yes	1.00	0.54	0.83	0.58
HSI #6	0.89	0.60	1.00	0.68	1.00	1.00	0.88	Yes	1.00	0.94	0.96	0.65
HSI #7	1.00	0.60	1.00	0.44	0.60	0.60	0.89	Yes	1.00	1.00	0.81	0.51
HSI #8	0.56	0.60	0.74	0.24	0.60	0.60	0.96	Yes	0.72	0.88	0.69	1.00
HSI #9	0.91	0.60	0.97	0.33	0.60	0.60	0.95	Yes	1.00	0.81	0.82	1.00
HSI #10												
HSI #11	0.93	0.60	0.92	0.29	0.60	0.90	1.00	Yes	1.00	0.81	0.89	1.00
HSI #12	0.72	0.60	0.89	0.27	0.60	0.92	1.00	Yes	1.00	0.94	0.61	0.65
HSI #13	0.79	0.60	0.77	0.29	0.60	0.96	1.00	Yes	1.00	0.94	0.94	1.00
HSI #14	0.67	0.60	1.00	0.49	1.00	0.96	1.00	No	0.00	0.00	0.51	1.00
HSI #15	0.62	0.60	0.80	0.30	1.00	1.00	1.00	Yes	0.93	0.94	0.35	1.00
HSI #16	0.62	0.60	0.55	0.14	1.00	0.91	1.00	Yes	0.99	0.94	0.64	1.00
HSI #17	0.74	0.60	1.00	0.44	0.60	0.77	1.00	Yes	0.93	0.81	0.44	1.00
HSI #18	0.47	0.60	0.90	0.42	0.60	0.67	1.00	Yes	0.99	0.94	0.47	1.00
HSI #19	1.00	0.60	1.00	1.00	0.60	0.99	1.00	Yes	0.93	0.94	0.97	1.00
HSI #20	0.87	0.60	1.00	0.57	1.00	0.93	0.97	No	0.00	0.00	0.32	0.65

Table 29: 2023 Brook Trout HSI Results

A	B	C	D	E	H	G	H	I	J	K	L	M	N
Field Sheet Number	% Pools	Pool Class Rating	% Instream Cover (fry)	% Instream Cover (parr)	Dominant Substrate Type in Riffle Run Area	Avg % Vegetation Along Streambank	Avg % Rooted Vegetation and Stable Rocky Ground Cover	Spawning Present	Substrate for Spawning and Incubation	% Fines in Spawning Area	Fry Water Depth	Parr Water Depth	% Stream Shade
HSI #1	0.97	0.60	1.00	0.40	0.60	0.93	1.00	No	0.00	0.00	1.00	1.00	0.58
HSI #2													
HSI #3	0.63	0.60	0.81	0.26	1.00	0.75	0.75	Yes	1.00	0.81	0.89	1.00	0.51
HSI #4	0.62	0.60	0.86	0.27	1.00	0.90	1.00	Yes	1.00	0.81	1.00	1.00	0.44
HSI #5	0.78	0.60	0.59	0.17	0.60	0.98	1.00	Yes	1.00	0.54	1.00	1.00	0.58
HSI #6	0.99	0.60	1.00	0.68	1.00	0.88	1.00	Yes	1.00	0.94	0.96	1.00	0.65
HSI #7	0.64	0.60	1.00	0.44	0.60	0.89	1.00	Yes	1.00	1.00	0.83	1.00	0.51
HSI #8	0.59	0.60	0.74	0.24	0.60	0.96	1.00	Yes	0.95	0.88	1.00	1.00	1.00
HSI #9	0.98	0.60	0.97	0.33	0.60	0.95	1.00	Yes	1.00	0.81	1.00	1.00	1.00
HSI #10													
HSI #11	0.96	0.60	0.92	0.29	0.60	0.90	01.00	Yes	1.00	0.81	1.00	1.00	1.00
HSI #12	0.87	0.60	0.89	0.27	0.60	0.92	1.00	Yes	1.00	0.94	1.00	1.00	0.65
HSI #13	0.96	0.60	0.77	0.29	0.60	0.96	1.00	Yes	1.00	0.94	1.00	1.00	1.00
HSI #14	0.80	0.60	1.00	0.49	1.00	0.96	1.00	No	0.00	0.00	1.00	1.00	1.00
HSI #15	0.71	0.60	0.80	0.30	1.00	1.00	1.00	Yes	1.00	0.94	1.00	1.00	1.00
HSI #16	0.71	0.60	0.55	0.14	1.00	0.91	1.00	Yes	1.00	0.94	1.00	1.00	1.00
HSI #17	0.89	0.60	1.00	0.44	0.60	0.77	1.00	Yes	1.00	0.81	1.00	1.00	1.00
HSI #18	0.41	0.60	0.90	0.42	0.60	0.67	1.00	Yes	1.00	0.94	1.00	1.00	1.00
HSI #19	0.48	0.60	1.00	1.00	0.60	0.99	1.00	Yes	1.00	0.94	1.00	1.00	1.00
HSI #20	0.48	0.60	1.00	1.00	0.60	0.99	1.00	Yes	1.00	0.94	1.00	1.00	1.00

Table 30: 2023 Atlantic Salmon HSI Results

2023 HSI Photos

Figure 5: Site 1 Downstream

Figure 6: Site 1 Upstream

Figure 7: Site 2 Upstream (Inaccessible)

Figure 8: Site 2 Downstream

Figure 9: Site 3 Downstream

Figure 10: Site 3 Upstream

Figure 11: Site 4 Upstream

Figure 12: Site 4 Downstream

Figure 13: Site 5 Upstream

Figure 14: Site 5 Downstream

Figure 15: Site 6 Upstream

Figure 16: Site 6 Downstream

Figure 17: Site 7 Downstream

Figure 18: Site 7 Upstream

Figure 19: Site 8 Upstream

Figure 20: Site 8 Downstream

Figure 21: Site 9 Upstream

Figure 22: Site 9 Downstream

Figure 23: Site 11 Downstream

Figure 24: Site 11 Upstream

Figure 25: Site 12 Downstream

Figure 26: Site 12 Upstream

Figure 27: Site 13 Upstream

Figure 28: Site 13 Downstream

Figure 29: Site 14 Upstream

Figure 30: Site 14 Downstream

Figure 31: Site 15 Upstream

Figure 32: Site 15 Downstream

Figure 33: Site 16 Downstream

Figure 34: Site 16 Upstream

Figure 35: Site 17 Downstream

Figure 36: Site 17 Upstream

Figure 37: Site 18 Upstream

Figure 38: Site 18 Downstream

Figure 39: Site 19 Downstream

Figure 40: Site 19 Upstream

Figure 41: Site 20 Upstream

Figure 42: Site 20 Downstream

Appendix C: Electrofishing

Survey Site Details & Measurements

Date	**August 29th, 2022**
Crew	Nicholas MacInnis, Victoria Maxwell, Bruce Wheadon, Bailey Randall, Andrew Grace, Greg Shields
Survey Site #	1
Upstream Limit	45.53201°N
	61.92681°W
Downstream Limit	45.53253°N
	61.92623°W
Site Length (m)	40m
Wetted Widths (m)	6.5m
Area (m^2)	260m^2
Temperature (°C)	21.1°C
Acidity (pH)	7.38

Sweep #1

- Duration: 13 minutes

Table 31: 2022 Site 1 Sweep 1

#	Species	Size (cm)	Age
1	Atlantic Salmon Fry	6	0+
2	Atlantic Salmon Parr	10.5	1+
3	Atlantic Salmon Fry	5.5	0+
4	Atlantic Salmon Parr	12	1+
5	Atlantic Salmon Parr	9	1+
6	Atlantic Salmon Parr	10	1+
7	Atlantic Salmon Fry	6	0+
8	Atlantic Salmon Parr	10.5	1+
9	Atlantic Salmon Parr	9	1+
10	Atlantic Salmon Parr	9.5	1+
11	Atlantic Salmon Fry	6	0+
12	Atlantic Salmon Parr	10	1+
13	Atlantic Salmon Parr	10	1+
14	Atlantic Salmon Parr	10	1+
15	Atlantic Salmon Parr	9.5	1+
16	Atlantic Salmon Parr	10.5	1+
17	Atlantic Salmon Parr	10	1+
18	Atlantic Salmon Fry	6	0+
19	Atlantic Salmon Parr	9	1+

20	Atlantic Salmon Fry	7	0+
21	Atlantic Salmon Fry	6	0+
22	Atlantic Salmon Parr	10	1+
23	Atlantic Salmon Parr	9.5	1+
24	Atlantic Salmon Fry	6.5	0+
25	Atlantic Salmon Fry	6	0+
26	Atlantic Salmon Parr	10	1+
27	Atlantic Salmon Fry	6.5	0+
28	Atlantic Salmon Fry	5.5	0+
29	Atlantic Salmon Fry	6	0+
30	White Sucker	12.5	1+
31	White Sucker	9.5	1+

Sweep #2

- Duration: 13 minutes

Table 32: 2022 Site 1 Sweep 2

#	Species	Size (cm)	Age
1	Atlantic Salmon Fry	5.5	0+
2	Atlantic Salmon Fry	5.5	0+
3	Atlantic Salmon Parr	11	1+
4	Atlantic Salmon Parr	10	1+
5	Atlantic Salmon Parr	10.5	1+
6	Atlantic Salmon Parr	9.5	1+
7	Atlantic Salmon Parr	10	1+
8	Atlantic Salmon Fry	5	0+
9	Atlantic Salmon Fry	6	0+
10	Creek Chub	4.5	0+
11	Creek Chub	7	0+
12	Creek Chub	3.5	0+
13	Creek Chub	9	1+
14	Creek Chub	4	0+
15	Creek Chub	5.5	0+
16	White Sucker	15	1+
17	White Sucker	5.5	0+
18	White Sucker	5.5	0+
19	Stickleback	4.5	0+

Sweep #3

- Duration: 12 minutes

Table 33: 2022 Site 1 Sweep 3

#	Species	Size (cm)	Age
1	Atlantic Salmon Fry	7	0+
2	Atlantic Salmon Parr	12	1+
3	Atlantic Salmon Parr	10.5	1+
4	Atlantic Salmon Fry	6	0+
5	Atlantic Salmon Fry	6	0+
6	White Sucker	9.5	1+
7	White Sucker	10	1+
8	White Sucker	5	0+
9	Creek Chub	6	0+

Survey Site Details & Measurements

Date	**August 29th, 2022**
Crew	Nicholas MacInnis, Victoria Maxwell, Bruce Wheadon, Bailey Randall, Andrew Grace, Greg Shields
Survey Site #	2
Upstream Limit	45.53252°N
	61.92923°W
Downstream Limit	45.53203°N
	61.92924°W
Site Length (m)	40m
Wetted Widths (m)	6.8m
Area (m^2)	270m^2
Temperature (°C)	18.7°C
Acidity (pH)	7.47

Sweep #1

- Duration: 10 minutes

Table 34: 2022 Site 2 Sweep 1

#	Species	Size (cm)	Age
1	Creek Chub	4	0+
2	Creek Chub	4.5	0+
3	Creek Chub	3.5	0+

4	Creek Chub	6	0+
5	Creek Chub	6.5	0+
6	Creek Chub	4	0+
7	Creek Chub	3.5	0+
8	Creek Chub	3	0+
9	Creek Chub	4	0+
10	Creek Chub	4	0+
11	Creek Chub	4.5	0+
12	Creek Chub	4	0+
13	Creek Chub	3.5	0+
14	Creek Chub	4	0+
15	Atlantic Salmon Fry	6	0+
16	Atlantic Salmon Fry	5.5	0+
17	Atlantic Salmon Fry	5.5	0+
18	Atlantic Salmon Fry	5.5	0+
19	Atlantic Salmon Fry	6	0+
20	Atlantic Salmon Fry	6	0+
21	Atlantic Salmon Fry	5.5	0+
22	Atlantic Salmon Fry	6	0+
23	Atlantic Salmon Fry	6.5	0+
24	Atlantic Salmon Fry	6	0+
25	Atlantic Salmon Fry	6.5	0+
26	Atlantic Salmon Fry	5	0+
27	Atlantic Salmon Fry	6	0+
28	Atlantic Salmon Fry	6.5	0+
29	Atlantic Salmon Fry	5.5	0+
30	Atlantic Salmon Parr	9	1+
31	Atlantic Salmon Fry	5.5	0+
32	Atlantic Salmon Fry	5.5	0+
33	Atlantic Salmon Fry	6	0+
34	Atlantic Salmon Fry	5.5	0+
35	Stickleback	3	0+
36	Stickleback	3.5	0+
37	Golden Shiner	5.5	

Sweep #2

- Duration: 10 Minutes

Table 35: 2022 Site 2 Sweep 2

#	Species	Size (cm)	Age
1	Atlantic Salmon Fry	5.5	0+
2	Atlantic Salmon Fry	5.5	0+
3	Atlantic Salmon Fry	6	0+
4	Atlantic Salmon Fry	5.5	0+
5	Atlantic Salmon Fry	5.5	0+
6	Atlantic Salmon Parr	9.5	1+
7	Atlantic Salmon Fry	6	0+
8	Atlantic Salmon Parr	8.5	1+
9	Atlantic Salmon Fry	6	0+
10	Atlantic Salmon Fry	5.5	0+
11	Atlantic Salmon Fry	6.5	0+
12	Atlantic Salmon Fry	5.5	0+
13	Creek Chub	3.5	0+
14	Creek Chub	3.5	0+
15	Creek Chub	3.5	0+
16	Creek Chub	3.5	0+
17	Creek Chub	4	0+
18	Creek Chub	3.5	0+

Sweep #3

- Duration: 11 minutes

Table 36: 2022 Site 2 Sweep 3

#	Species	Size (cm)	Age
1	Atlantic Salmon Parr	11	1+
2	Atlantic Salmon Fry	6	0+
3	Atlantic Salmon Parr	11.5	1+
4	Atlantic Salmon Fry	5	0+
5	Atlantic Salmon Fry	5.5	0+
6	Atlantic Salmon Fry	6.5	0+
7	White Sucker	5	0+
8	White Sucker	5.5	0+
9	Creek Chub	3.5	0+
10	Creek Chub	3.5	0+
11	Creek Chub	3.5	0+
12	Creek Chub	3	0+
13	Creek Chub	4	0+
14	Creek Chub	3.5	0+

Survey Site Details & Measurements

Date	**September 25th, 2023**
Crew	Charles MacInnis, Bruce Wheadon, Allison White, Bailey Randall, Emma Purdy, Thomas Sweeney
Survey Site #	1
Upstream Limit	45.53201°N
	61.92681°W
Downstream Limit	45.53253°N
	61.92623°W
Site Length (m)	40m
Wetted Widths (m)	6.5m
Area (m^2)	260m^2

Table 37: 2023 Site 1 Sweep 1

#	Species	Size (cm)	Age
1	Atlantic Salmon Fry	5	0+
2	Atlantic Salmon Fry	7	0+
3	Atlantic Salmon Fry	5.5	0+
4	Atlantic Salmon Fry	7	0+
5	Atlantic Salmon Fry	6.5	0+
6	Atlantic Salmon Fry	6.5	0+
7	Atlantic Salmon Fry	6	0+
8	Atlantic Salmon Fry	6.5	0+
9	Atlantic Salmon Fry	6.5	0+
10	Atlantic Salmon Fry	6.5	0+
11	Atlantic Salmon Fry	6	0+
12	Atlantic Salmon Fry	7	0+
13	Atlantic Salmon Fry	6.5	0+
14	Atlantic Salmon Fry	7	0+
15	Atlantic Salmon Fry	7	0+
16	Atlantic Salmon Fry	7	0+
17	Atlantic Salmon Fry	6	0+
18	Atlantic Salmon Fry	5.5	0+
19	Atlantic Salmon Fry	6	0+
20	Atlantic Salmon Fry	6	0+
21	Atlantic Salmon Fry	5.5	0+
22	Atlantic Salmon Fry	6	0+
23	Atlantic Salmon Fry	5	0+
24	Atlantic Salmon Fry	7	0+
25	Atlantic Salmon Fry	7	0+
26	Atlantic Salmon Fry	6.5	0+
27	Atlantic Salmon Fry	6.5	0+
28	Atlantic Salmon Fry	6	0+

29	Atlantic Salmon Fry	7.5	0+
30	Atlantic Salmon Fry	7	0+
31	Atlantic Salmon Fry	6.5	0+
32	Atlantic Salmon Fry	4	0+
33	Atlantic Salmon Fry	5.5	0+
34	Atlantic Salmon Fry	7	0+
35	Atlantic Salmon Fry	6.5	0+
36	Atlantic Salmon Fry	5.5	0+
37	Atlantic Salmon Fry	6	0+
38	Atlantic Salmon Fry	6.5	0+
39	Atlantic Salmon Fry	6	0+
40	Atlantic Salmon Fry	6	0+
41	Atlantic Salmon Fry	6.5	0+
42	Atlantic Salmon Fry	5.5	0+
43	Atlantic Salmon Fry	7	0+
44	Atlantic Salmon Fry	7	0+
45	Atlantic Salmon Fry	7	0+
46	Atlantic Salmon Fry	7	0+
47	Atlantic Salmon Fry	7	0+
48	Atlantic Salmon Fry	6.5	0+
49	Atlantic Salmon Fry	7	0+
50	Atlantic Salmon Fry	6.5	0+
51	Atlantic Salmon Fry	7	0+
52	Atlantic Salmon Fry	7	0+
53	Atlantic Salmon Fry	7	0+
54	Atlantic Salmon Fry	6	0+
55	Atlantic Salmon Fry	6.5	0+
56	Atlantic Salmon Fry	6.5	0+
57	Atlantic Salmon Fry	6	0+
58	Atlantic Salmon Fry	7	0+
59	Atlantic Salmon Fry	7	0+
60	Atlantic Salmon Fry	5	0+
61	Atlantic Salmon Fry	7	0+
62	Atlantic Salmon Fry	7.5	0+
63	Atlantic Salmon Fry	6.5	0+
64	Atlantic Salmon Fry	6	0+
65	Atlantic Salmon Fry	7	0+
66	Atlantic Salmon Fry	6	0+
67	Atlantic Salmon Fry	6	0+
68	Atlantic Salmon Fry	6.5	0+
69	Atlantic Salmon Fry	6.5	0+
70	Atlantic Salmon Fry	6	0+
71	Atlantic Salmon Parr	12	1+
72	Atlantic Salmon Parr	9.5	1+
73	Atlantic Salmon Parr	12	1+
74	Atlantic Salmon Parr	11.5	1+

75	Atlantic Salmon Parr	12	1+
76	Atlantic Salmon Parr	12	1+
77	Atlantic Salmon Parr	10.5	1+
78	Atlantic Salmon Parr	10.5	1+
79	Atlantic Salmon Parr	8	1+
80	Atlantic Salmon Parr	8	1+
81	Atlantic Salmon Parr	8.5	1+
82	Atlantic Salmon Parr	9	1+
83	Atlantic Salmon Parr	8.5	1+
84	Atlantic Salmon Parr	8	1+
85	Atlantic Salmon Parr	14	2+
86	Atlantic Salmon Parr	13.5	2+
87	Atlantic Salmon Parr	14.5	2+

Table 38: 2023 Site 1 Sweep 2

#	Species	Size (cm)	Age
1	Atlantic Salmon Fry	7.5	0+
2	Atlantic Salmon Fry	7.5	0+
3	Atlantic Salmon Fry	7	0+
4	Atlantic Salmon Fry	6	0+
5	Atlantic Salmon Fry	7	0+
6	Atlantic Salmon Fry	5.5	0+
7	Atlantic Salmon Fry	7.5	0+
8	Atlantic Salmon Fry	7	0+
9	Atlantic Salmon Fry	7	0+
10	Atlantic Salmon Fry	6.5	0+
11	Atlantic Salmon Fry	4.5	0+
12	Atlantic Salmon Fry	5.5	0+
13	Atlantic Salmon Fry	7.5	0+
14	Atlantic Salmon Fry	6.5	0+
15	Atlantic Salmon Fry	7	0+
16	Atlantic Salmon Fry	5.5	0+
17	Atlantic Salmon Fry	6.5	0+
18	Atlantic Salmon Fry	6	0+
19	Atlantic Salmon Fry	7.5	0+
20	Atlantic Salmon Fry	7	0+
21	Atlantic Salmon Fry	7	0+
22	Atlantic Salmon Fry	5	0+
23	Atlantic Salmon Fry	6.5	0+
24	Atlantic Salmon Fry	7	0+
25	Atlantic Salmon Fry	7	0+
26	Atlantic Salmon Fry	6.5	0+
27	Atlantic Salmon Fry	7	0+
28	Atlantic Salmon Fry	7	0+
29	Atlantic Salmon Parr	11.5	1+

30	Atlantic Salmon Parr	11	1+
31	Atlantic Salmon Parr	12	1+
32	Atlantic Salmon Parr	11.5	1+
33	Atlantic Salmon Parr	9	1+
34	Atlantic Salmon Parr	9	1+
35	Atlantic Salmon Parr	8	1+
36	Atlantic Salmon Parr	13	2+
37	Atlantic Salmon Parr	8	1+

Table 39: 2023 Site 1 Sweep 3

#	Species	Size (cm)	Age
1	Atlantic Salmon Fry	7.5	1+
2	Atlantic Salmon Fry	6.5	0+
3	Atlantic Salmon Fry	6.5	0+
4	Atlantic Salmon Fry	5.5	0+
5	Atlantic Salmon Fry	7	0+
6	Atlantic Salmon Fry	7.5	0+
7	Atlantic Salmon Fry	5.5	0+
8	Atlantic Salmon Fry	6.5	0+
9	Atlantic Salmon Fry	6.5	0+
10	Atlantic Salmon Fry	7	0+
11	Atlantic Salmon Fry	7.5	0+
12	Atlantic Salmon Fry	6.5	0+
13	Atlantic Salmon Fry	6	0+
14	Atlantic Salmon Fry	5.5	0+
15	Atlantic Salmon Fry	6.5	0+
16	Atlantic Salmon Fry	6.5	0+
17	Atlantic Salmon Fry	5.5	0+
18	Atlantic Salmon Fry	6	0+
19	Atlantic Salmon Fry	6	0+
20	Atlantic Salmon Fry	6.5	0+
21	Atlantic Salmon Fry	7	0+
22	Atlantic Salmon Fry	6.5	0+
23	Atlantic Salmon Fry	6	0+
24	Atlantic Salmon Parr	12.5	2+
25	Atlantic Salmon Parr	12	2+
26	Atlantic Salmon Parr	8	1+

Survey Site Details & Measurements

Date	**September 25th, 2023**
Crew	Charles MacInnis, Bruce Wheadon, Allison White, Bailey Randall, Emma Purdy, Thomas Sweeney
Survey Site #	2
Upstream Limit	45.53252°N
	61.92923°W
Downstream Limit	45.53203°N
	61.92924°W
Site Length (m)	40m
Wetted Widths (m)	6.8m
Area (m^2)	270m^2

Table 40: 2023 Site 22 Sweep 1

#	Species	Size	Age
1	Atlantic Salmon Fry	6	0+
2	Atlantic Salmon Fry	6	0+
3	Atlantic Salmon Fry	6.5	0+
4	Atlantic Salmon Fry	6.5	0+
5	Atlantic Salmon Fry	7.5	0+
6	Atlantic Salmon Fry	6.5	0+
7	Atlantic Salmon Fry	7.5	0+
8	Atlantic Salmon Fry	5	0+
9	Atlantic Salmon Fry	6	0+
10	Atlantic Salmon Fry	7	0+
11	Atlantic Salmon Fry	5.5	0+
12	Atlantic Salmon Fry	6.5	0+
13	Atlantic Salmon Fry	5	0+
14	Atlantic Salmon Fry	6	0+
15	Atlantic Salmon Fry	5.5	0+
16	Atlantic Salmon Fry	6	0+
17	Atlantic Salmon Fry	7	0+
18	Atlantic Salmon Fry	6	0+
19	Atlantic Salmon Fry	6	0+
20	Atlantic Salmon Fry	6.5	0+
21	Atlantic Salmon Fry	6	0+
22	Atlantic Salmon Fry	5.5	0+
23	Atlantic Salmon Fry	6.5	0+
24	Atlantic Salmon Fry	6.5	0+
25	Atlantic Salmon Fry	6	0+
26	Atlantic Salmon Fry	5.5	0+
27	Atlantic Salmon Fry	7.5	0+
28	Atlantic Salmon Fry	7.5	0+

29	Atlantic Salmon Fry	6	0+
30	Atlantic Salmon Fry	7	0+
31	Atlantic Salmon Fry	7.5	0+
32	Atlantic Salmon Fry	6.5	0+
33	Atlantic Salmon Fry	6	0+
34	Atlantic Salmon Fry	6.5	0+
35	Atlantic Salmon Parr	11.5	1+

Table 41: 2023 Site 2 Sweep 2

#	Species	Size	Age
1	Atlantic Salmon Fry	6	0+
2	Atlantic Salmon Fry	5.5	0+
3	Atlantic Salmon Fry	5.5	0+
4	Atlantic Salmon Fry	6.5	0+
5	Atlantic Salmon Fry	6.5	0+
6	Atlantic Salmon Fry	6.5	0+
7	Atlantic Salmon Fry	7	0+
8	Atlantic Salmon Fry	6	0+
9	Atlantic Salmon Fry	6	0+
10	Atlantic Salmon Fry	4.5	0+
11	Atlantic Salmon Fry	7.5	0+
12	Atlantic Salmon Fry	6	0+
13	Atlantic Salmon Fry	6	0+
14	Atlantic Salmon Fry	6	0+
15	Atlantic Salmon Fry	6.5	0+
16	Atlantic Salmon Fry	6.5	0+
17	Atlantic Salmon Fry	5	0+
18	Atlantic Salmon Fry	6	0+
19	Atlantic Salmon Fry	6.5	0+
20	Atlantic Salmon Fry	6.5	0+
21	Atlantic Salmon Fry	6.5	0+

Table 42: 2023 Site 2 Sweep 3

#	Species	Size	Age
1	Atlantic Salmon Fry	6	0+
2	Atlantic Salmon Fry	6.5	0+
3	Atlantic Salmon Fry	6.5	0+
4	Atlantic Salmon Fry	5.5	0+
5	Atlantic Salmon Fry	5.5	0+
6	Atlantic Salmon Fry	7	0+
7	Atlantic Salmon Fry	5.5	0+
8	Atlantic Salmon Fry	5	0+
9	Atlantic Salmon Fry	7.5	0+

10	Atlantic Salmon Fry	5.5	0+
11	Atlantic Salmon Fry	6	0+
12	Atlantic Salmon Fry	6	0+
13	Atlantic Salmon Fry	5	0+
14	Atlantic Salmon Fry	6	0+
15	Atlantic Salmon Fry	4	0+
16	Atlantic Salmon Fry	7	0+

Appendix D: List of Tables and Figures

List of Tables

List of Figures