2020 NASHWAAK WATERSHED AQUATIC CONNECTIVITY REPORT

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2020 Aquatic Connectivity Report

Objectives

The objectives of the project were:
1) to increase the capacity of the NWAI to survey for aquatic connectivity;
2) to increase our knowledge of the aquatic connectivity and fragmentation of the watershed;
3) an overall decrease in habitat fragmentation within the Nashwaak watershed and an overall increase in habitat availability for fish; and
4) to communicate the connectivity of the river to the public.

Significant urbanization has occurred in the lower Nashwaak watershed in the last decade, leading to an increase in roads and associated stream crossings. Poorly designed, installed, or maintained culverts can restrict Endangered Atlantic salmon from reaching upriver spawning habitat, feeding grounds, or cold-water refuges, which can have significant impacts on their populations. A single culvert acting as a barrier can restrict fish from accessing several kilometres, or more, of important upstream habitat.

Additionally, culverts can change water velocity, river hydrology, and become blocked with debris causing flooding and costly damage to infrastructure. Habitat fragmentation is a prolific issue in the Maritimes. The Clean Annapolis River Foundation found that 70% of culverts they assessed were barriers to fish passage and 80% of the culverts surveyed by the Petitcodiac Watershed Alliance in 2015 were either partial or full barriers to fish passage.

Prior to 2017, the aquatic connectivity of the Nashwaak Watershed was unknown. Therefore, the NWAI requested funds to conduct multi-year project to assess, prioritize, and restore barrier culverts in the Nashwaak watershed from the mouth of the river working up, to re-establish salmon access to important upstream habitat. 2020 was our fourth field season.

Nashwaak River is an important salmon-producing tributary of the Saint John River and is one of DFO's priority rivers for restoration under their 2014 "Recovery Potential Assessment". This work is also in line with Atlantic Salmon Federation's 2013 "Recovery Strategy for Wild Atlantic Salmon". Habitat fragmentation and blocked access to cold-water or spawning habitats have been recognized as limiting factors for salmon populations.

Deliverables

The objectives of the project were:

1) Conduct a desktop survey of the remaining culverts to visit
2) Conduct a field survey of at least 50 culverts in the central watershed;
    a. clean-up all assessment sites of garbage and debris;
3) Map and prioritize them for remediation in terms of barriers to fish;
4) Conduct a hydraulic survey of the top barrier(s) with an engineering;
    a. Prepare stamped drawings
    b. Inform NBDTI, NBNRED, or other culvert owners and start conversation about remediation
5) Update our aquatic connectivity map of the watershed, which will be made public;
6) Remediate at least one culvert, using a local hydraulic engineering company's expertise as a guide;
    a. conduct electrofishing surveys to assess the remediation effort(s); and

7) Raise awareness about aquatic connectivity through outreach and social media

The end goals were to: 1) gain more knowledge about the health and connectivity of our watershed; 2) increase the amount of available upstream aquatic habitat for migratory fish, especially Species of Concern such as the Endangered Atlantic salmon, by facilitating fish passage through culverts assessed as barriers; and 3) communicate this information to the public through our outreach programs.

The long-term goals are to increase fish populations and biodiversity by improving access to high quality habitat.

Results

Over the course of the last four years, NWAI's capacity to survey the Nashwaak watershed has greatly increased, as has our knowledge about the connectivity and fragmentation of our watershed. We have been able to inform the public about habitat fragmentation via online and printed resources, we have developed a relationship with NB Department of Transportation and Infrastructure (NBDTI), and we have now completed four major remediation projects. There are approximately 985 stream-road crossings in the Nashwaak watershed. In May 2017, the NWAI began to map, assess, and improve these crossings. In our first field season we completed a full survey on 75 culverts and 70% were determined to be full or partial barriers to fish passage. In 2018, our second field season, we started by mapping out priority areas in the central watershed to survey, we then visited 114 sites and conducted a full survey of 67 crossings. We updated our survey form so that full surveys included collecting water temperature, pH, conductivity, DO, and total dissolved solids as well as some additional measurements and observations that were not included in 2017 surveys. For our third field season (2019), we visited 83 sites and conducted a full survey on 50 culverts. In 2020, we visited 50 sites and conducted a full survey on 24 culverts. We focused on culverts in the headwaters and on logging or forest service roads, which required more driving time. We cleaned all surveyed sites of debris and garbage. There were no major debris blockages encountered this year.

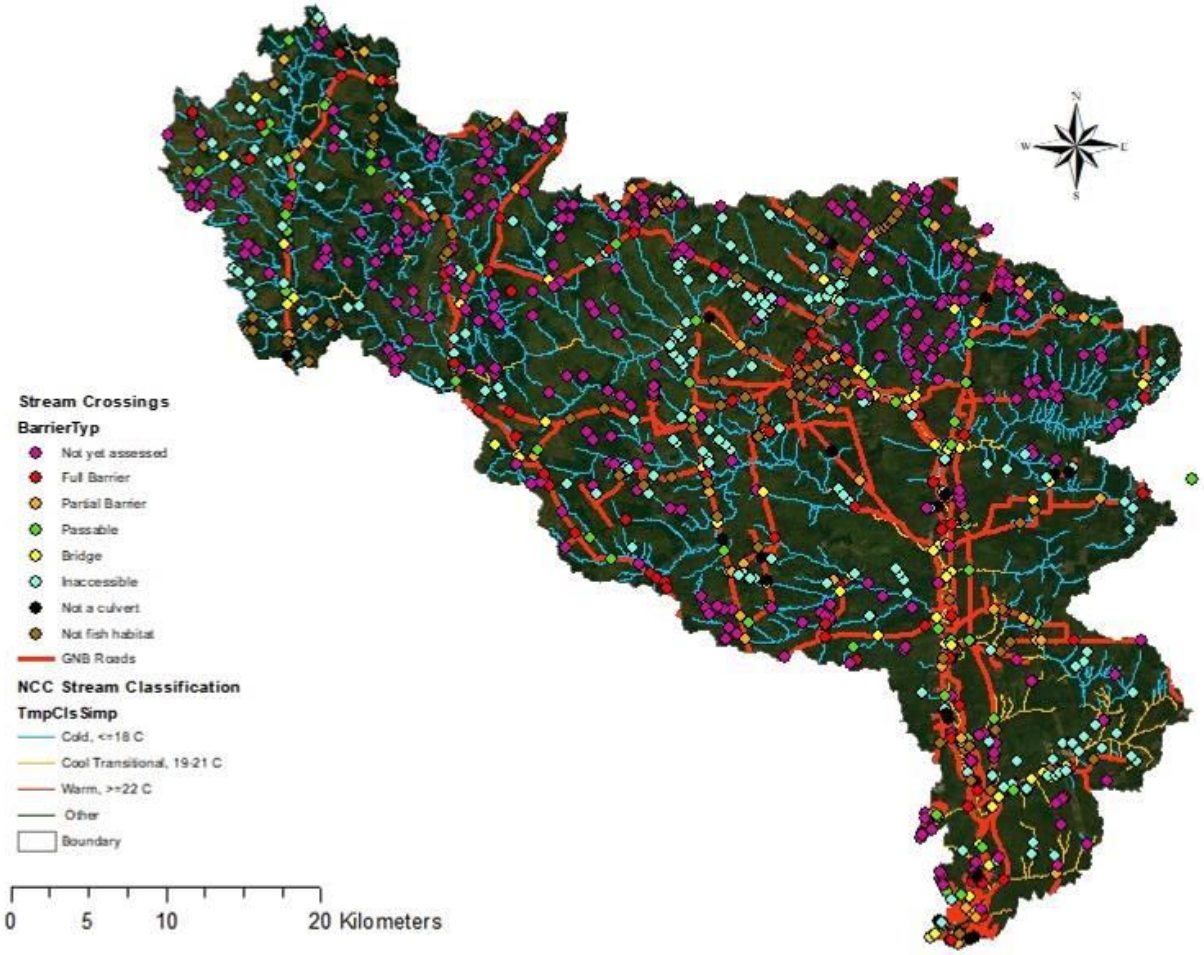

FIGURE 1. UPDATED GIS MAP WITH ALL CULVERTS SURVEYED TO DATE, CATEGORIZED IN TERMS OF PASSABILITY TO FISH

This survey information was entered into a central database and a GIS map, which will be shared with our partners at the end of the year. So far, we have visited 405 of the 985 crossings in the watershed (~40% complete) and we have done a full survey on 216 culverts. We have surveyed almost all the crossings on public paved roads and the main logging or forest roads. We have done at least 6 major debris removals and 14 smaller debris removals, which have improved flow and fish passage in those culverts and improved water quality in those streams. In September this year, we completed electrofishing above and below three barriers with the help of DFO, Kingsclear First Nation, and Woodstock First Nations. We also electrofished above and below our fish ladder on Manzer Brook.

We have been regularly checking on the Manzer Brook fish ladder, installed in 2018. It survived the last two winters well and has not been catching debris. Electrofishing in August 2018 prior to the install of the remediation found seven species downstream and five species upstream (a total of 54 fish downstream and 55 fish upstream). Electrofishing in September 2020 found six species downstream and five species upstream (a total of 154 fish downstream and 104 fish upstream). Unfortunately, no new species were found upstream that were not present there before; however, higher numbers of fish were found upstream after the remediation.

FIGURE 2. THE MANZER BROOK FISH LADDER, INSTALLED IN AUGUST 2018

TABLE 1. ELECTROFISHING RESULTS FROM 2018, BEFORE THE MANZER BROOK FISH LADDER WAS INSTALLED

Site	American eel	Atlantic salmon	Black nose dace	Brook trout	Burbot	Creek chub	Sea lamprey	Slimy sculpin	White sucker	Grand Total
Manzer downstream	5	1	25	3	1			18	1	54
Manzer upstream			16	3		4	5	27		55
Grand Total	**5**	**1**	**41**	**6**	**1**	**4**	**5**	**45**	**1**	**109**

TABLE 2. ELECTROFISHING RESULTS FROM 2020 (POST-REMEDIATION)

Site	American eel	Black Nose dace	Brook trout	Common shiner	Sea lamprey	Slimy sculpin	Grand Total
Manzer downstream	1	67	11	69	2	4	154
Manzer upstream		43	11	32	8	14	108
Grand Total	**5**	**133**	**119**	**101**	**10**	**33**	**411**

2020 remediation projects

Through last fall and winter, we worked with NBDTI and HILCON Ltd. on the design of fish passage structures involving baffles and chutes for three barrier culverts, which were built and installed by Tek Steel. The East Ryan Brook fish passage project was completed in July and the Limekiln and McGivney Brook fish passage projects were completed in October (thanks to an extension on our Watercourse and Wetland Alteration Permit).

At East Ryan Brook, a cast in place 2,750 x 1,800 mm concrete box installed in the 1950s on Rte 107 was too steep (2.3% over 20 m) and had a 30 cm step at the outlet, preventing fish passage through the pipe. Water in the pipe was very shallow due to its wide, flat bottom. Electrofishing in 2019 showed that there were many brook trout using this cold-water stream along with a single American eel.

The remediation took place in two phases: First, a baffle was placed at the end of the enclosed pipe and another just before the drop (Fig 3). Baffle height was 350 mm and notch width and depth were 200 mm and 150 mm, respectively for both. These allowed the water in the pipe to back-flood and velocity to decrease. A short chute was installed over the drop at the end of the structure. The chute contained roughness bars to prevent sheet flow. The second baffle was fitted with a small slide to allow fish to swim up and over. The second phase, installed a few weeks later, involved three shorter baffles that extended 4/5ths of the way across the pipe (Fig 4). We alternated what side of the baffle was opened to create a sinuous channel through the pipe. These helped back-flood the remainder of the pipe. Large rocks were placed throughout the pipe to create microhabitat. Water will eddy behind the rocks and they will provide protection for small fish.

This project opened 1.8 km^2 of habitat and 800 m of stream length above it. Electrofishing results pre- and post-remediation showed similar numbers of the same species (mainly brook trout and a few American eel). We hope that electrofishing in 2021 during higher water conditions will yield higher numbers upstream and perhaps the presence of other species. A temperature logger installed over the summer of 2020 gave an average temperature between 21 June and 21 September of only 13.33°C and a peak temperature of 18.7°C, indicating that this brook is an excellent thermal refuge for salmonids in the summer.

FIGURE 3. BEFORE (LEFT) AND AFTER (RIGHT) OF THE EAST RYAN BROOK FISH PASSAGE PROJECT.

FIGURE 4. DETAILS OF THE EAST RYAN BROOK FISH PASSAGE PROJECT SHOWING THE CHUTE AND FIRST TWO BAFFLES (LEFT) AND THE UPPER THREE PARTIAL BAFFLES (RIGHT) AS WELL AS THE LARGE ROCKS PLACED TO PROVIDE MICROHABITAT IN THE PIPE.

TABLE 3. ELECTROFISHING RESULTS FROM 2019, BEFORE THE REMEDIATION STRUCTURES WERE INSTALLED.

Site	American Eel	Brook Trout	Grand Total
East Ryan downstream	1	50	51
East Ryan upstream		23	23
Grand Total	**1**	**73**	**74**

TABLE 4. ELECTROFISHING RESULTS FROM 2020, POST-REMEDIATION.

Site	American Eel	Brook Trout	Grand Total
East Ryan downstream	2	40	42
East Ryan upstream		19	19
Grand Total	**2**	**59**	**61**

The McGivney Brook pipe is a cast in place concrete box (4,580 x 1,260 mm) on route 625. The remediation work at this site was completed in October 2020. This culvert was slightly too steep (0.9% over 9.8 m) to allow for fish passage. Its wide, flat bottom meant that there were only a few millimetres of water depth during low flow. Pre-remediation electrofishing found three species downstream and four species upstream (American eel was found upstream but not downstream). Similar numbers of brook trout were found up and downstream but higher numbers of black nose dace and slimy sculpin were found downstream compared to upstream. A total of 43 fish were found downstream versus 25 upstream. Post-remediation electrofishing will be completed in 2021. A temperature logger installed over the summer of 2020 gave an average temperature between 21 June and 21 September of only 15.04°C and a peak temperature of 20.6°C, indicating that this brook is an excellent thermal refuge for salmonids in the summer.

Remediation work involved the installation of one aluminum baffle and chute at the outlet of the pipe. The baffle was 300 mm high with a notch width and depth of 400 mm and 300 mm, respectively. The chute was 400 mm wide and 615 mm long. The baffle allows water to back-flood in the culvert, becoming deeper and slower (and easier for fish to swim in). The chute allows fish to swim into the culvert during low flow and it was fitted with roughness bars to prevent sheet flow. This project opened 10.2 km^2 of habitat and 8,913 m of stream length above it.

FIGURE 5. BEFORE AND AFTER OF THE MCGIVNEY BROOK FISH PASSAGE PROJECT

TABLE 5. ELECTROFISHING RESULTS FROM SEPTEMBER 2020 (PRE-REMEDIATION)

Site	American Eel	Black Nose Dace	Brook Trout	Slimy sculpin	Grand Total
McGivney downstream		16	13	14	43
McGivney upstream	1	5	18	1	25
Grand Total	**1**	**21**	**31**	**15**	**68**

The Limekiln Brook pipe is a cast in place concrete box (3,000 x 2,400 mm) on route 620. The remediation work at this site was completed in October 2020. This culvert was too steep (2.11% over 28 m) to allow for fish passage. Its wide, flat bottom meant that there were only a few millimetres of water depth during low flow. Pre-remediation electrofishing found 4 species downstream and 2 species upstream. American eel and black nose dace were not found above the pipe. A total of 14 fish were found downstream versus 6 fish upstream. Post-remediation electrofishing will be completed in 2021. A temperature logger installed over the summer of 2020 gave an average temperature between 21 June and 21 September of 18.41°C and a peak temperature of 24.73°C, indicating that this brook would be an excellent thermal refuge for salmonids in early/late summer. However, in peak summer, it may be too warm (temperature exceeded 23°C on 20 days this summer).

The remediation involved the installation of 4 fish weirs spaced 7 m apart throughout the pipe. The baffles were 500 mm high with a notch width and depth of 300 mm and 200 mm, respectively. This project opened 7.25 km^2 of habitat and 10,732 m of stream length above it.

FIGURE 6. BEFORE (LEFT) AND AFTER (RIGHT, BELOW) OF THE LIMEKILN BROOK FISH PASSAGE PROJECT.

FIGURE 7. A CLOSE-UP SHOT SHOWING THE WEIRS INSTALLED FOR THE LIMEKILN BROOK FISH PASSAGE PROJECT. THE WEIRS WERE NOT FULLY INSTALLED AT THIS POINT, SO WATER WAS JUST STARTING TO FLOW OVER THE CHUTE.

TABLE 6 ELECTROFISHING RESULTS FROM SEPTEMBER 2020 (PRE-REMEDIATION)

Site	American Eel	Black Nose Dace	Brook Trout	Creek Chub	Grand Total
Limekiln downstream	1	2	5	6	14
Limekiln upstream			2	4	6
Grand Total	**5**	**133**	**119**	**10**	**411**

Next Projects

We have met with the engineering company to go over our short-listed culverts. We narrowed down what culverts to focus on by choosing culverts that had no barriers downstream, were at least 1 m wide, and were properly sized to handle increasing flows. We discussed three projects with DTI and chose to survey two in November (the third is due to be removed in future and is a larger project requiring significant funding). Surveys for Sands Brook (Giant's Glen Road) and unnamed brook on Mclean Flats Road are now complete. The survey for Porters Brook (Nashwaak West Road) will be completed before the end of 2020. Together these three projects will open around 9 km^2 of previously inaccessible habitat.

FIGURE 8. THE PORTER'S BROOK CULVERT ON NASHWAAK WEST ROAD IS A SEVERE BARRIER TO FISH. THE POOL AT THE MOUTH OF THIS BROOK IS AN IMPORTANT SALMON HOLDING POOL THAT DFO CLOSES ANNUALLY ON JUNE 15. NASHWAAK WEST ROAD HAS BEEN CLOSED FOR MANY YEARS AND WILL NOT REOPEN. IF THIS CULVERT BLOWS OUT IN A STORM, THE BROOK, THE POOL AT THE MOUTH OF THE BROOK, AND DOWNSTREAM HABITAT IN THE NASHWAAK RIVER WILL BE IRREVERSIBLY DAMAGED.

FIGURE 9. THIS PIPE ON MCLEAN FLATS ROADS IS IN VERY POOR SHAPE AND FILLS WITH GRAVELS ANNUALLY DURING THE FRESHET. THESE PIPES NEED TO BE REPLACED. LOCAL RESIDENTS DESCRIBED MANY FISH INCLUDING ATLANTIC SALMON USING THIS STREAM IN PREVIOUS YEARS.

FIGURE 10. THIS PIPE ON SANDS BROOK ON GIANT'S GLEN ROAD HAS EXPERIENCED MAJOR DETERIORATION OF THE SUBSTRATE IN THE LAST FEW YEARS. THOUGH IT HAS OPEN BOTTOM IT APPEARS AS THOUGH THIS CULVERT IS NO LONGER PASSABLE TO FISH. BLACK SEDIMENT CONTROL FABRIC IS SHOWN EXPOSED IN THE PHOTO ABOVE.

We have updated our GIS aquatic connectivity map. We will share this information with our partners this fall and winter and carry out our "Healthy Nashwaak" social media campaign to further inform the public about the importance of connected stream habitats. This winter we will also continue to prioritize barriers for remediation using the Nature Conservancy's GIS Barrier Assessment Tool. We are working hard to communicate the importance of connectivity of the river to the public via our social media channels, our annual newsletter, and conversations with landowners.

Evaluation and assessment of the project so far

The first four years of our aquatic connectivity project have been a huge success for NWAI. We surpassed our goal for number of culverts to map and survey. So far, we have trained five staff, three board members, four summer students, and five volunteers on the survey protocol. This has increased our capacity of our organization to survey the aquatic connectivity of the watershed, as well as our knowledge about the fragmentation of the rivers in the Nashwaak watershed.

In 2020, we were able to complete three restoration projects, opening a total of 19.3 km^2 of upstream habitat area, and 20.4 km in stream length that was previously inaccessible to fish. We partnered with the DFO Aboriginal Fisheries Strategies teams from St Marys, Woodstock, Oromocto, and Kingsclear First Nations to complete electrofishing up and downstream of these barriers.

NBDTI has been generous with their time for reviewing drawings and answering questions.

The Barrier Assessment Tool is a GIS add-on developed by The Nature Conservancy to prioritize culverts for assessment and remediation and quickly calculate upstream habitat gain, land use information, and other parameters. This is an extremely useful tool to have when approaching DTI and other culvert owners. This partnership has turned into a pilot project, where NWAI's culvert data was combined with NCC's newly released Freshwater Ecological Classification and Aquatic Blueprint. This partnership will eventually allow us to contribute our data to an international effort focused on restoring connectivity for both ecological and climate change adaptation (flooding – emergency services provisioning- risk to culverts) purposes: the North Atlantic Aquatic Connectivity Collaborative.

Problems encountered & solutions:

We are still learning about the aquatic connectivity of the watershed, the scale or budgets of remediations that might be needed, how many culverts we can remediate in a year, and the timeline of getting DTI's approval to move forward on projects. The results of our surveys showed that remediation of the most severe barriers will be bigger, higher budget projects than expected. We also realized that most of the existing barrier culverts cannot be remediated to provide fish passage (for example, a collapsing wooden box culvert or one with a drop of >60 cm); they simply need to be replaced with new, properly designed and sized infrastructure. We have communicated these barriers to DTI, DNRED, and other owners. It has been challenging to find suitable projects that are within our budget, on structurally sound culverts, down accessible roads, and which have the potential to open sufficient upstream habitat to warrant remediation. With continued surveys we hope to find more potential project candidates.

Communications with DTI have improved, and we have now also started conversations with DNRED about culverts on woods roads. However, timelines for approval of projects and remediation remain long.