DEVELOP HABITAT CONSERVATION PLANS AND RESTORATION FOR RIVERS IN BAY ST. GEORGE
2019



Habitat Restoration

FLAT BAY BROOK
LITTLE BARACHOIS BROOK
MIDDLE BARACHOIS BROOK

BAY ST. GEORGE SOUTH AREA DEVELOPMENT ASSOCIATION

ACKNOWLEDGEMENTS

Funding for this project was provided by the Atlantic Salmon Conservation Foundation (ASCF) to the Bay St. George South Area Development Association (BSGSADA). Additional support was provided by the BSGSADA, Flat Bay Band Group, Qalipu First Nation, Intervale Associates, Conservation Corps of Newfoundland and Labrador (CCNL), and the Newfoundland and Labrador Department of Fisheries and Oceans (DFO).

Further acknowledgements are extended to Rex Porter, retired biologist with the Department of Fisheries and Oceans Canada, Richard Van Ingen, Senior Coastal Restoration Fund Biologist Fisheries and Oceans Canada, as well as Keith Clarke, Fisheries and Oceans Canada, for their logistics and training support. We are very grateful to the field staff who worked long hours on the rivers in rough terrain removing obstructions, and in office inputting data for analysis. Members include Field Supervisor Jonah Hulan (BSGSADA), CCNL Green Team members Shane Whalen, Jayden Harris, Ashtin King, Dawn Quilty, and BSGSADA Fisheries Chairman Eric Legge.

Staff wishes to express their appreciation to all groups for the collaborative planning and engagement of who are dedicated to the conservation of Atlantic salmon and salmon habitat in rivers of Bay St. George. In addition to the partners listed above, they include local businesses, outfitters, non-profit organizations, and other federal and provincial government departments.

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1.0 INTRODUCTION

Habitat assessment was conducted during the summer months of 2018.

This report presents the results of habitat restoration conducted on each of these three (3) rivers as they contain important habitat for wild Atlantic salmon (*Salmo salar*).

Atlantic salmon stocks in rivers of Bay St. George are considered very important for biological and socio-economic reasons. This stock contains multi-sea winter large salmon, which are uncommon in most other rivers in Newfoundland. The salmon populations in these rivers declined over several decades prior to 2002; in spite of a number of management measures put in place by DFO to restore these. A conservation and stock recovery strategy recommended by local stewardship groups was implemented by DFO in 2004. This strategy seemed to improve the abundance of salmon in some rivers, but not to the extent expected. On other rivers, according to local knowledge, the numbers of salmon did not appear to increase and may have declined. Meetings of stakeholders and DFO indicated that a variety of factors may be inhibiting recovery and contributing to the decline on some rivers. These factors includes illegal fishing and excessive harvest, degradation of habitat due to barriers to upstream salmon migration, siltation and pollution.

The Atlantic Salmon Conservation Foundation (ASCF) provided funding to the Bay St. George Area Development Association (BSGSADA) in 2018 and 2019 to identify any natural and/or manmade barriers that could affect salmon passage and other habitat disturbances that could have a negative impact on salmon production. In 2018, habitat surveys were conducted on three (3) river systems of Bay St. George: namely: Flat Bay Brook, Little Barachois Brook, and Middle Barachois Brook. Data was collected on obstructions such as large woody debris, deteriorating stream bank conditions, siltation, and possible sources of pollution. Recommendations were made to the obstructions on these brooks that should be removed.

The 2019 project funded by ASCF had three (3) objectives:

1) *Engineering design to improve fish passage at the falls at approximately 30 km on Middle Barachois Brook.*
2) *Removal of barriers and habitat improvement on Middle Barachois, Little Barachois, and Flat Bay Brook.*
3) *Develop an inventory of habitat factors affecting salmon production on Robinsons River and Crabbes River.*

2.0 METHODS

Objective 1: *Engineering design to improve fish passage at the falls at approximately 30 km on Middle Barachois Brook.*

A contract was issued in September to Anderson Engineering Consultants, Corner Brook, for the following work:

1) Place rocks in the constriction at the downstream end of the pool below the falls to raise the water level in the pool by 0.75 to 1.0 m (Fig 1). Rocks must be strategically placed such that they do not cause a barrier to upstream migrating salmon. Also, the rocks must be large enough so that they do not wash out.

2) Remove some small rock outcroppings at the base of the falls, on the right looking downstream; these may cause problems for salmon jumping the falls (Fig 2).

3) Place sandbags or a wooden diversion dam at the top of the falls to divert water to the right side of the falls (looking downstream) at low water levels (Fig 3).

Objective 2: *Removal of barriers and habitat improvement on Middle Barachois, Little Barachois, and Flat Bay Brook.*

Habitat removal was completed throughout the months of July, August, and September of 2019. Before conducting obstruction removal, a review of the 2018 Habitat Conservation/Improvement Plan was conducted to outline and identify the exact coordinates and recommendations to prepare for the removal. Once the information from the 2018 report was reviewed the field supervisors would then break the rivers in to sections to maximize the amount of obstructions removed without having to back track. Obstruction/barrier removal was first conducted on tributaries of Flat Bay Brook and then Middle Barachois Brook.

Equipment used by field crews mainly included a GPS, waterproof camera, measuring tape, thermometer, chainsaw, axe and bucksaw. Field crews were also geared with waterproof binders, data sheets and chest waders. Proper safety gear was used by the Supervisor who was operating the chainsaw when it was required.

In addition to conducting the actual removal, crew members also photographed obstructions being removed, where the debris was diverted and after photos, showing improved habitat. When an obstruction was removed, the distance to previous obstruction was recorded. This would allow the calculation of habitat improved after the obstruction was removed.

3.0 RESULTS AND DISCUSSION

Objective 1: *Engineering design to improve fish passage at the falls at approximately 30 km on Middle Barachois Brook*

A report was received from Anderson Engineering and the estimated cost of doing the proposed remedial work is $163,271.25 (Appendix A). Upon further discussion with the consultant, DFO, WWF and others, the cost of doing the work at this remote location is expected to be higher than estimated, possibly in the range of $200,000.00 to $250,000.00.

The diversion structure at the top of falls will have to be monitored on regular bases in order to adjust for changes in water levels and preference of salmon. It is desirable for the person responsible for the flow adjustments be familiar with the requirements of salmon to jump the falls.

An evaluation of the effectiveness of the remedial work should carry out. One suggestion would be to place a salmon counting fence upstream from the falls as early as possible in 2020 and continue until late fall to monitor salmon migrating upstream. This evaluation could be carried out by the Bay St. George Area South Development Association.

Based on the evaluation of the work done in year one and knowledge gained on how and when salmon jump the falls, modifications could be made to the falls and a more permanent diversion dam constructed at the top of the falls.

Objective 2: *Removal of barriers and habitat improvement on Middle Barachois, Little Barachois, and Flat Bay Brook*

3.1 Flat Bay Brook

3.1.1 Main Stem

In 2018 a total of 46 km was surveyed along sections of Flat Bay Brook and tributaries including Sheep Brook, St. Georges Dribble, and Coal Brook. On the main stem, 23 km were surveyed, and no obstructions were observed. There was also minimal bank erosion reported and no other observations negatively impacting salmon habitat.

In 2019, 13 obstructions were removed: one (1) on Sheep Brook, seven (7) on St. Georges Dribble, and five (5) on Coal Brook. A description of the obstructions removed are described in Table 1.

3.1.2 Sheep Brook

Sheep Brook is located 1.5 km along Flat Bay Brook road, off the Trans-Canada Highway (N 48.382859, W -58.429587) (Fig 4.). During the survey of 7.5 km Sheep Brook, in 2018, 12 obstructions were identified. All obstructions were mainly classified as large woody debris (LWD), with branches impeding water flow. Eleven (11) of the 12 obstructions were considered partial barriers that potentially could in the future cause barriers to upstream salmon migration. These were not removed since they were beneficial to fish habitat, providing cover for salmonids, habitat for invertebrates, shade, and stabilized stream flow and banks.

The removal of obstructions in Sheep Brook in 2019 took place in July when water levels were low and the air temperature was approximately 22 degrees Celsius. The initial plan for 2019 was to remove the one (1) obstruction that was identified as a complete barrier to salmon migration. However, one obstruction, identified as Obstruction #7 in the 2018 survey report, was not a barrier to salmon passage in 2019: therefore, it was not removed. The reason that the obstruction was no longer a barrier was most likely due to the effects of high-water discharge in the spring of 2019. The second complete obstruction identified in the 2019 survey was Obstruction 2 (N 48.38337, W -58.42922) (Fig.5). This obstruction was not recommended for removal from the 2018 report but was removed due to the fact that it had become a greater obstruction over time. This obstruction was partially removed providing unimpeded upstream salmon migration (Figs. 6-8).

3.1.3 St. Georges Dribble

St. Georges Dribble is located 2 km along Flat Bay Gypsum Road, off route 403 (N 48.413269, W -58.438997) (Fig. 9). A total of 11 km was surveyed in 2018 and 19 obstructions were identified as impeding or potentially impeding upstream salmon migration. Only three (3) were deemed complete obstructions.

In 2019, during the later weeks of July when the removal of obstructions on St. Georges Dribble was conducted, water levels were low, and the air temperature was approximately 26 degrees Celsius. The 19 obstructions identified in 2018 were revaluated and seven (7) (obstructions 7, 8, 9, 10, 14, 16 and 17) of these were determined to potentially have a negative impact on salmon migration. These obstructions were removed (Figs 10-34).

Obstruction 18 (in survey report 2018) is a water supply dam which has a fishway in it that is frequently blocked by debris, primarily caused by beaver clippings. The dam and fishway is maintained by the town of St. Georges. Our team discussed the issue of removing debris from the water supply dam with St. Georges town workers and they agreed to conduct biweekly cleaning of the water supply dam and fishway.

3.1.4 Coal Brook

The mouth of Coal Brook is located 1.3 km down a commercial logging road, off the Trans-Canada Highway (N 48.380136, W -58.456795) (Fig 35). Fifteen (15) obstructions to salmon passage were recorded on Coal Brook during the habitat surveys in 2018, most of which consisted of large woody debris (LWD). Eleven (11) of these were recommended for removal.

Obstruction removal was conducted in late July 2019. Water levels were very low and air temperatures were approximately 25 degrees Celsius. The obstructions that were removed include obstruction 2, 5, 6, 9 and 10 (Figs. 36-49).

Two locations (N 48.376840, W -58.456213, and N 48.371601, W -58.449935) were reported in 2018 to have high amounts of erosion with little to no vegetation or stabilization. When conducting removal in 2019, these locations were still greatly affected by erosion partly due to lack of bank support, fallen trees and possibility of heavy precipitation.

3.2 Little Barachois Brook

One (1) obstruction was recorded on Little Barachois Brook in 2018; a beaver dam, located upstream from Barachois Pond Provincial Park (N 48.44761, W -58.17824) (Fig 50). Although the main stem splits in to two sections, the dam is a 100% blockage affecting salmon migration of only one side. This dam was labeled as active from the 2018 report and after being observed in the year 2019 it was concluded that it is still active and was not removed.

Little Barachois Brook has great bank stability due to the presence of abundant vegetation.

3.3 Middle Barachois Brook

In 2018, 20 km of Middle Barachois Brook was surveyed. No obstructions were recorded on the portion of the main stem that was surveyed. On one tributary, Big Dribble Brook, 21 obstructions were recorded; of which five (5) were identified as partial barriers to upstream salmon migration. High amounts of erosion and a number of serious partial obstructions were recorded.

3.3.1 Big Dribble Brook

In 2019, five (5) obstructions were removed on Big Dribble Brook (Fig. 51). These were listed as Obstructions 1, 3, 6, 9 and 11 in the 2018 survey report. Obstruction 6 was not listed to be removed; but since the survey in 2018, trees had fallen across the stream bed making the blockage almost 100%. Although there were five (5) dams on Big Dribble Brook, only three (3)

were listed to be removed. When the 2019 removal was conducted only one of those dams was inactive; therefore, the four (4) active dams were not removed.

The beaver dam removed, obstruction 1 (N 48.18960, W -58.710353), had been catching lots of excess woody debris thus making it a greater obstruction to salmon migration (Fig. 52). The other two (2) dams were documented and reported to provincial authorities. They are listed as obstruction 2 (N 48.18968, W -58.711144), obstruction 4 (N 48.18979, W -58.71709), obstruction 12 (N 48.18758, W -58.70349), and obstruction 20 (N 48.18533, W -58.698039). Obstruction 12 continues to increase in size and has the entire stream blocked creating a great risk to salmon migration. There is access to this beaver dam off Camp 180 road.

A description of the obstructions removed are in Table 2 and photos of the obstructions removed are in figures 52 to 69.

4.0 CONCLUSION

Obstructions to upstream salmon migration were removed on tributaries of two (2) scheduled salmon rivers in Bay St. George, NL, during the months of July, August, and September of 2019. The rivers were Flat Bay Brook (tributaries Sheep Brook, St. Georges Dribble, and Coal Brook) and Middle Barachois River (tributary Big Dribble Book). A beaver dam on Little Barachois Brook was re-evaluated; but not removed since it was still an active site. The assessment from 2018 identified mainly natural barriers such as large woody debris and beaver dams. The findings reported 46 obstructions on the 3 tributaries of Flat Bay Brook, one on Little Barachois Brook, and 21 on Big Dribble , tributary of Middle Barachois Brook.

The total in-stream habitat improved for Flat Bay Brook was approximately 9362.71 m (88, 009.47 m^2), Sheep Brook tributary 116.05 m (1090.87 m^2), St. Georges Dribble tributary 6452.25 m (60,651.15 m^2), and Coal Brook tributary 2794.45 m (60,651.15 m^2).

Total in-stream habitat improved for Big Dribble, Middle Barachois River was approximately 3008.77 m (15,043.85 m^2). With respect to the total amount of area improved on this tributary, it would be beneficial to do further analysis and planning for the beaver dams that were active and unable to be removed. There were four in total that were still very much active and are a complete obstruction to salmon passage. Although bank stability is fair in this area, it is also to be noted that there are numerous aged trees along the buffer zone that in time has the potential to become future obstructions. More surveying over the years would be beneficial.

Although there was no actual in-stream habitat improvement for Little Barachois Brook due to the activeness of the beaver dam there should still be more analysis and surveying done on the active dam to see if there are salmon being affected from migrating up and down stream.

The removal conducted during this year will be aiding to increasing salmon passage through three main rivers and their tributaries. The success of this project enables adult Atlantic salmon to migrate successfully to the headwaters of the rivers and reach their spawning grounds. Therefore, the barrier removal helps aid the continued migrations and successful spawning of wild Atlantic salmon populations in rivers of Bay St. George.

5.0 RECOMMENDATIONS

To ensure improved salmon habitat is achieved, it is recommended that habitat assessments be conducted more frequently. Frequent monitoring of these rivers will grant residents of the area a better understanding of their environment and allow the routine maintenance of salmon rivers, which in turn promotes more ease to salmon migration. Conducting habitat assessments allows for better management of obstructions as well as making it easier to plan for future monitoring. The constantly changing river conditions is unpredictable and natural barriers is a constant occurrence; therefore, making it crucial to conduct habitat assessments on these rivers along with their tributaries.

Although there were obstructions from the 2018 report that were not recommended to be removed or altered, it should be noted that over the course of a year they may pose a greater threat. For instance, while conducting the removal in 2019 it was reported that there were new obstructions on Coal Brook and St. Georges Dribble, tributaries of Flat Bay Brook that should be reassessed and possibly removed. Some obstructions act as cover for both adult and salmon par and in some cases provide food source. Over time a partial obstruction has the possibility to become a complete obstruction.

Flat Bay Brook

5.1 Sheep Brook

Although Sheep Brook only had one obstruction that required removal, it would be worth surveying further up stream. While the 2019 removal was being conducted it was noted that a lot of the stream had not been surveyed in the previous year. This tributary had great bank stability and lots of vegetation along the riverbanks. Although there were few obstructions, a further analysis upstream would be beneficial to ensure no obstructions impeding salmon migration.

5.2 St. Georges Dribble

Further surveying of this tributary is recommended seeing as many obstructions were reported in the 2018 habitat report, seems apparent that lots of large wood debris (LWD) continues to find its way in the main stream due to high amounts of land erosion and despite higher water levels there is always the possibility of larger obstructions to salmon migration when left alone. Obstructions 5, 6, 11, 12, 15, 19, and 20 were not removed, although outlined for removal in the 2018 report; factors like changing river conditions altered the obstructions to an extent that they no longer needed removal. These remaining obstructions should be monitored and reassessed over the years to ensure they are still not obstructing salmon migration.

5.3 Coal Brook

Obstruction 4 (N 48.37698, W -58.45581), obstruction 11 (N 48.36616, W -58.44033), and obstruction 12 (N 48.3646, W -58.43815) should be reassessed due to poor bank stability. Obstruction 1, 3, 7, 8, 13, 14, and 15 were not removed. After reassessing these obstructions in 2019 it was noted that higher water elevation had altered these obstructions, no longer making them complete obstructions that required removal. It was also reported that there were higher numbers of new obstructions on Coal Brook when the 2019 habitat removal was conducted. It is recommended that these new obstructions as well as the obstructions that were not removed be monitored and recorded in the future years to ensure they are not hindering salmon migration. Two area of higher bank erosion, (N 48.376840, W -58.456213, and N 48.371601, W -58.449935), were also reported and it is recommended that some seedlings or vegetation be planted along the eroding banks to create some type of support.

5.4 Little Barachois Brook

There was one obstruction reported on this river, a large beaver dam, blocking half of the mainstream. This beaver dam was recorded as active and was believed to not pose a threat to salmon migration but there should still be further observation done to ensure there are not salmon getting trapped on the opposite side. Active dams are protected but with help from government officials there may be an alternative route of action to help increase salmon passage while keeping beaver habitat protected.

5.5 Middle Barachois Brook

5.5.1 Main Stem

There were no obstructions recorded on the main stem of Middle Barachois Brook, however, bank erosion and several waterfalls were noted (from the 2018 report) upstream from where the surveys began, which are considered serious partial obstructions.

An engineering report was development from a site assessment conducted by Anderson Engineering Consultants Ltd. This report includes cost estimates and recommended remedial work to be carried out to improve salmon migration above falls (Appendix A). Figures 1 to 3 are photos taken of the site and additional recommendations are stated.

5.5.2 Big Dribble Brook

Big Dribble Brook has numerous areas of higher erosion as well as larger areas of matured and inactive trees. These conditions make it essential to conduct further surveying. With rises in water elevation combined with the factors above there is always increased possibility of greater obstructions. Obstructions 5, 7, 8, 10, 18, 19, 21, and 22 were not removed despite being recommended for removal in the 2018 report because after being revaluated they were no longer obstructing salmon passage, but it is recommended that they be monitored and

revaluated. Obstructions 13, 14, 15, 16, and 17 had been shifted from higher water elevation to the extent that they were no longer present. Although there were five beaver dams recorded on Big Dribble Brook only one was inactive, leaving four remaining. The four beaver dams (obstructions 2, 4, 12, 20) have the main stem completely blocked and it is recommended that they be further assessed to get a better understanding of how great their impacting salmon migration. There were also several tributaries and parts of the main stem that were not surveyed in the 2018 report. These tributaries and parts of the main stem should be surveyed and recorded to ensure that the most restoration/improvement was achieved.

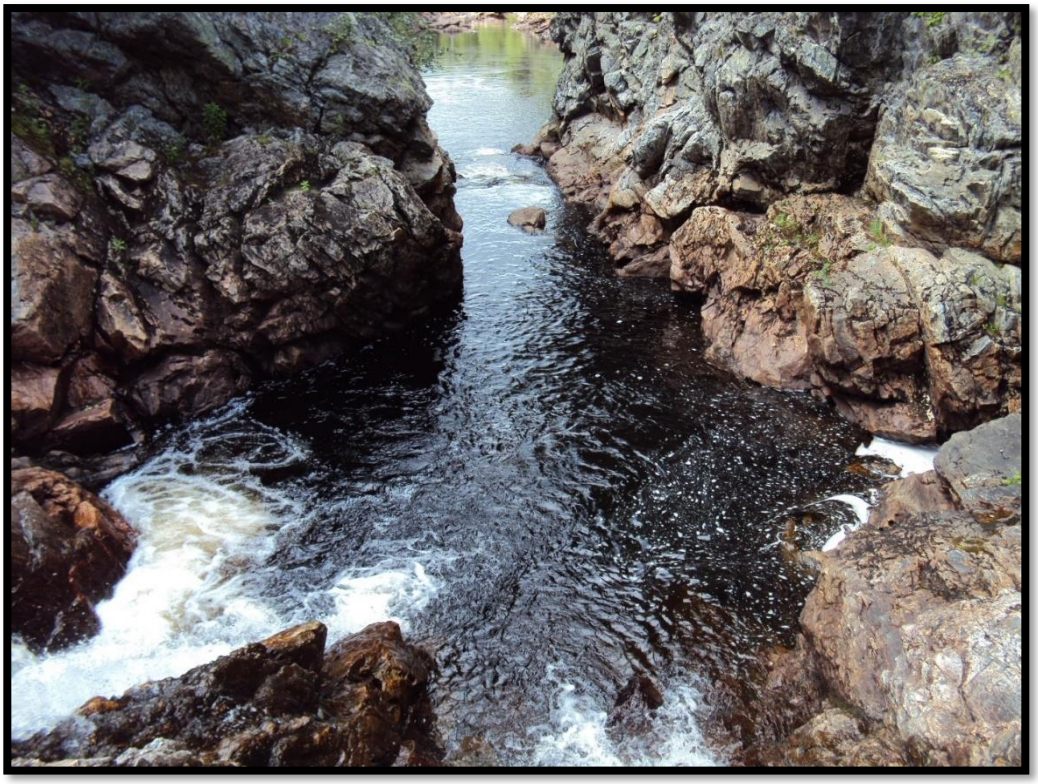

Figure 1: Pool at base of falls on Middle Barachois Brook. Rocks to be placed in the constriction to raise water levels in pool.

Figure 2: Photo of right side of falls (looking downstream) Middle Barachois Brook. Rocks to be removed from base of falls (right side).

Figure 3: Top of falls, Middle Barachois Brook. Water to be diverted to right side (looking downstream).

Appendix A

Upper Falls on Middle Barachois Brook Site Assessment, Final Report

BAY ST. GEORGE SOUTH AREA DEVELOPMENT ASSOCIATION
UPPER FALLS ON MIDDLE BARACHOIS BROOK SITE ASSESSMENT

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INTRODUCTION

As per the request of the Bay St. George South Area Development Association (ADA), Anderson Engineering Consultants Ltd. (AECL) staff visited the area of Upper Falls on Middle Barachois Brook on September 19, 2019. Steve Osmond, P.Eng., and Josh Randell, C.E.T., reviewed and surveyed the site with ADA employees, Troy and Kyle, to assess the feasibility and costs associated with site improvements to increase access for salmon passage.

Access to the site is via gravel roads approximately 30 km from the TCH at Camp 180 road. Vehicular access for most vehicles should be adequate but areas of the road and at least one bridge could restrict access for larger construction equipment or trucks. As such, needed work to increase possible salmon passage will have to be done using small equipment and close to site. For the improvements to be made at Upper Falls, access to the falls will also have to be improved.

RECOMMENDATIONS

A detailed description of the site can be found in Appendix A as provided by Mr. Rex Porter (retired DFO biologist). In Appendix B, a conceptual site plan can be found for the current planned work. Please note, the prescribed final design, tender and construction will have to be done in consultation with a marine biologist familiar with the requirements to increase salmon access. As such, this plan is conceptual only and may change.

AECL in consultation with Mr. Porter made the following recommendations to improve access for salmon passage at Upper Falls on Middle Barachois Brook:

Year 1:

a) Rock be placed in the constriction to raise the water level in the pool below the falls by about 0.75 to 1.0 m. To keep construction costs to a minimum, needed rock material should be blasted near the site for placement in the constriction. The rock may need to be blasted a distance from the top of the gorge constriction or may have to be busted dependent on direction from the marine biologist. Placing the rock in the constriction could be challenging since the rock has to be strategically placed and cannot cause a barrier to upstream migrating salmon. Method of placement will be determined by the low bidder in consultation with the marine biologist and may include a loader, boom truck or cable placement systems. Also, the rock has to be large enough so that it would not be washed out.

b) At the base of the falls, on the right looking downstream, there are some small rock outcroppings that may cause problems for salmon jumping the falls. These should be removed. There is only a small amount of rock that needs to be removed, possibly with jack hammer or with expansion grout. These could be disposed of into the pool.

c) Sandbags or a wooden diversion dam be placed at the top of the falls to divert water to the right side of the falls (looking downstream) at low water levels as per the direction by on-site marine biologist.

d) The Development Association should carry out an evaluation of the effectiveness of the remedial work. One suggestion would be to place a salmon counting fence upstream from the falls.

Year 2:

Based on the evaluation of the work done in Year 1 and gaining knowledge on how and when salmon jump the falls, further modifications to the falls, baffle at the base of falls, and/or a more permanent diversion dam at the top of the falls may be considered.

Costs – Year 1 – Class C Estimate

Item Description	**Costs**
Mobilization/Demobilization	$8,000.00
Construction of Site Access Road including approx. 540 m² clearing/grubbing, 90 m long gravel access road including Class B topping	$40,000.00
Drill/Blast rock and place for constriction	$29,750.00
Removal of rock at Falls	$8,000.00
Build Diversion at top of falls	$16,500.00
Marine Biologist	$10,000.00
Contingency (10%)	$11,225.00
Subtotal	$123,475.00
Engineering Estimate	$18,500.00
Subtotal	$141,975.00
HST	$21,296.25
Total	$163,271.25

Please note, during the design process, it may become evident that the current gravel road or 1 or more of the bridges will have to be upgraded in order to adequately to do the work. As such, it is possible additional funds may be needed as the construction and engineering costs for this has not been allowed.

Year 2 costs will have to be made after Year 1 work is complete.

Appendix A

Site Description by Mr. Rex Porter

Upper falls on Middle Barachois Brook, Bay St. George.

The falls is located at 48° 8' 45.21" N, 58° 29' 3.66" W, about 2.7 km upstream from the estuary (straight line). It is located about 20 m downstream from a bridge on Camp 180 resource road. The falls is a serious partial barrier to upstream migrating salmon. Some salmon do surmount the falls; but snorkel surveys of the river upstream suggests that salmon gain passage in the fall, when higher flows are more conducive to leaping the falls.

The following photos were taken on August 11, 2019 at a time of very low water levels.

Photo 1: Falls is about 3 meters high at a slope of about 70° (30° off vertical) At the low level when photo taken the falls has 2 channels. The left channel (looking upstream is about 0.5 m wide at the top; whereas the channel to the right is about 2 m wide and contains most of the river flow at this water level. Note, the rocky slope and base of both falls would prevent salmon from surmounting the falls at this water level.

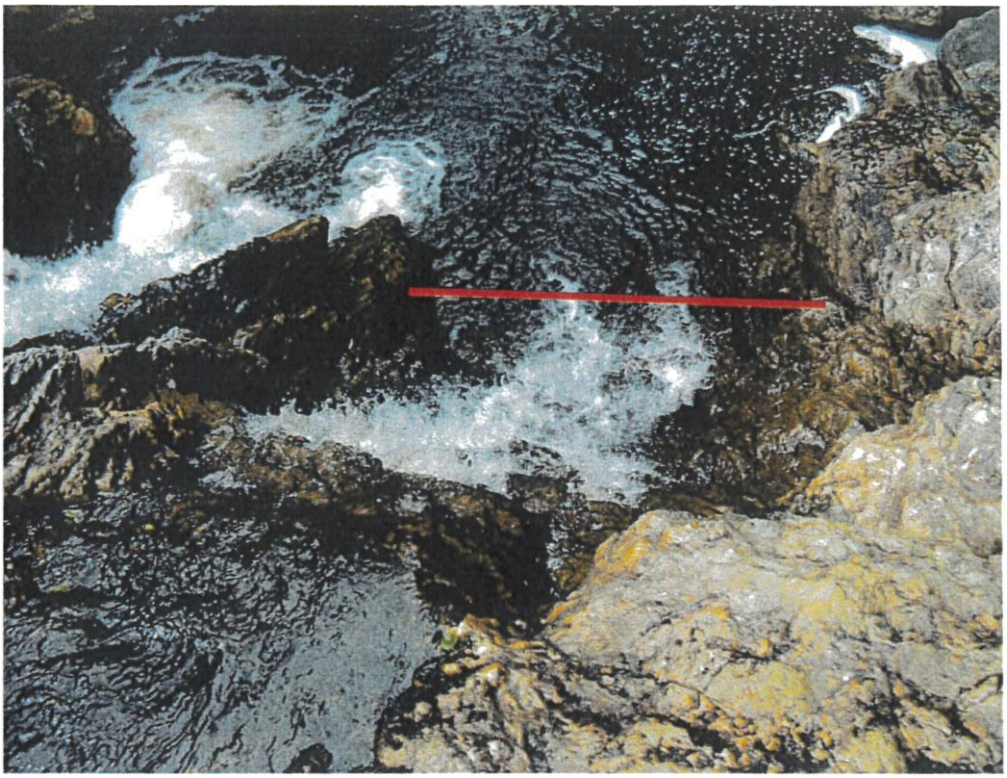


Photo 2. This photo shows the top of the left (looking upstream) channel of the falls. The width of the wetted area is approx. 0.5 m. Note the rocks at the base of the falls. These would impede salmon from jumping the falls. Also note the rocks at the base of the falls in the right (looking upstream) channel.

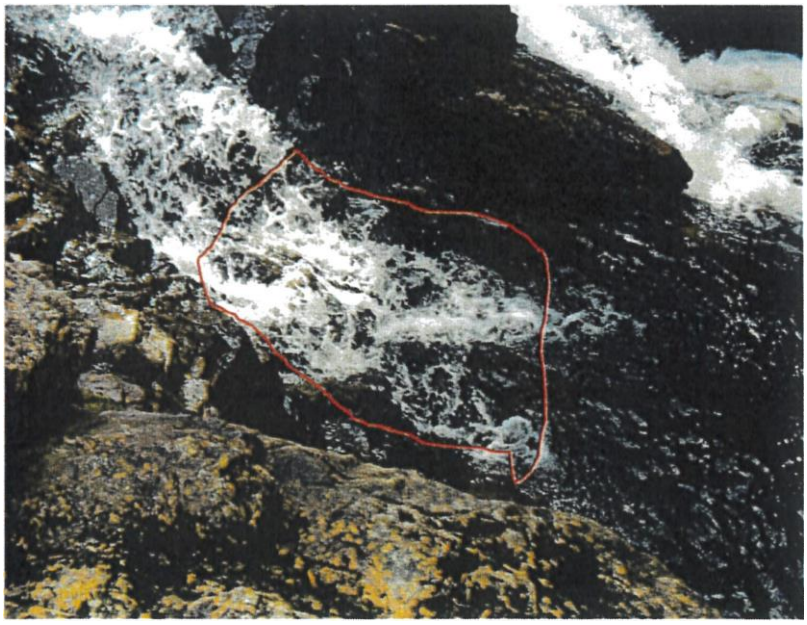


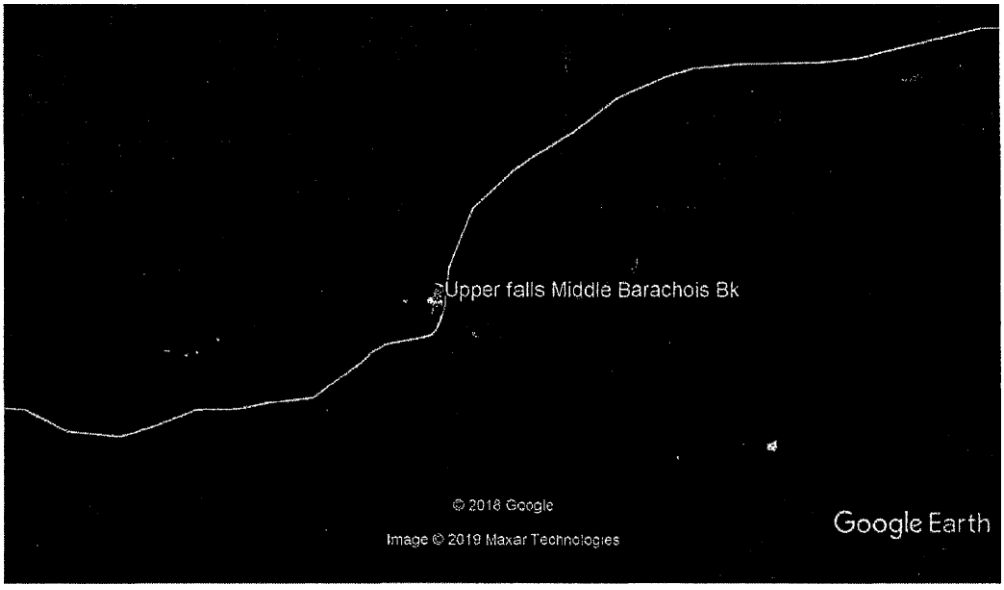
Photo 3. Photo of rocks at base of falls

Photo 4. Pool at base of falls. Pool is approx. 10 m x 10 m. Constriction at the lower end of pool is about 2 m. Note rocks or out cropping in constriction. This constriction and rocks results in higher water level in pool during high flows as indicated by the staining of 1 m of rock walls of pool.

Photo 5. Constriction at downstream end of pool below falls. Note staining on rock wall, indicating increased height of pool during higher discharge.

Photo 6. Pool at top of falls, approx. 5 m wide and 0.3 m deep. Rocks in pool may interfere with salmon after they jump the falls at higher discharge.

Photo 7. Crest of falls. The stick across left (looking upstream) channel is about 0.5 m. Flow in channel would be greater at higher river discharge



Location of Upper falls, Middle Barachois Bk, 20 m below bridge on camp 180 resource road

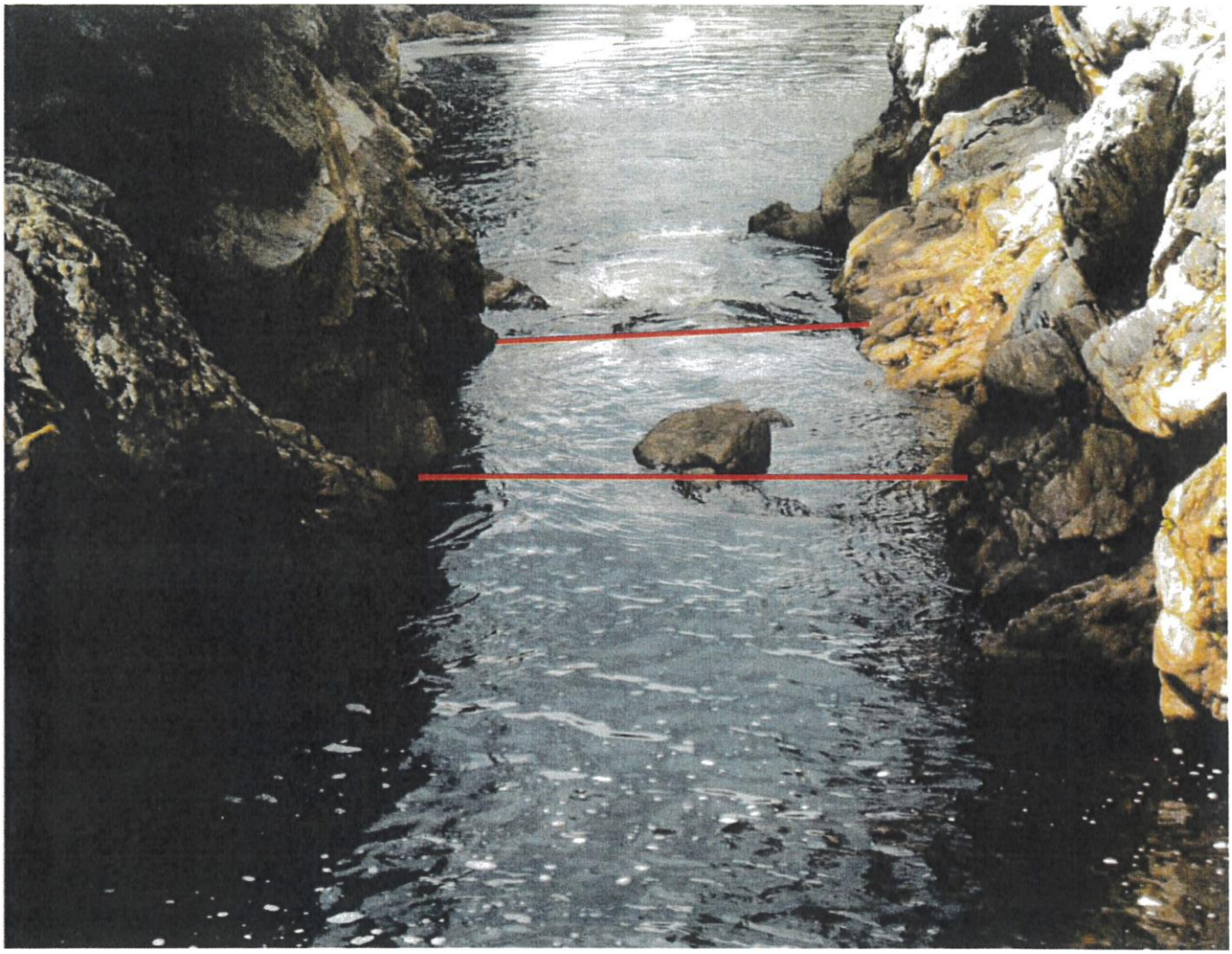
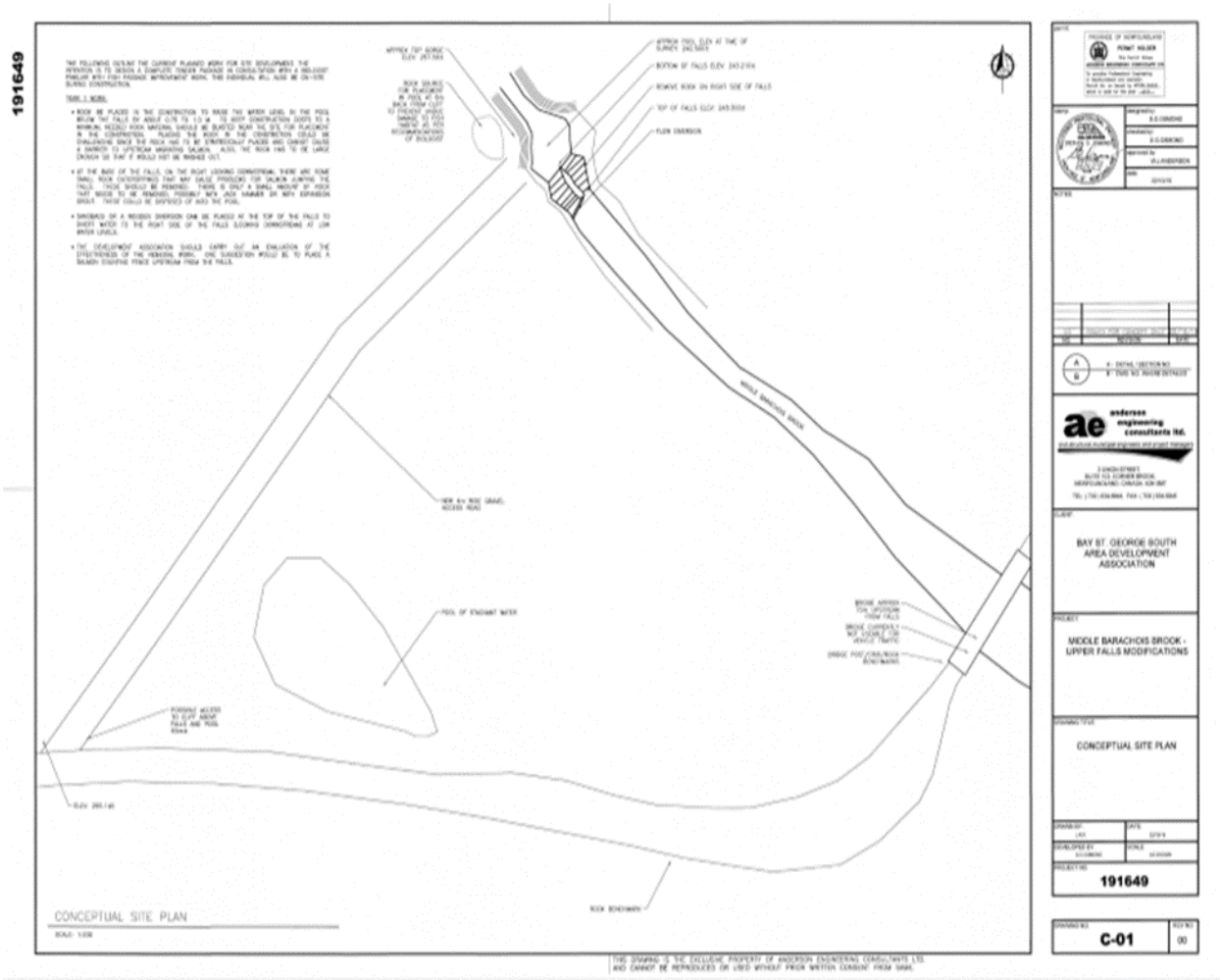


Photo 8. Gap below falls showing location for rock placement to raise water level in pool below falls.

Appendix B Site

Drawing


191649
THE FOLLOWING OUTLINE THE CURRENT PLANNED WORK FOR SITE DEVELOPMENT. THE INTENTION IS TO DESIGN A COMPLETE TENDER PACKAGE IN CONSULTATION WITH A WELL-COST FISHERY WITH FISH PASSAGE IMPROVEMENT WORK. THIS INDIVIDUAL WILL ALSO BE ON-SITE DURING CONSTRUCTION.
TASK 1 WORK:
• ROCK BE PLACED IN THE CONSTRUCTION TO RAISE THE WATER LEVEL IN THE POOL BELOW THE FALLS BY ABOUT 0.75 TO 1.0 M. TO ASSIST CONSTRUCTION CREWS TO A MINIMUM, NEEDED ROCK MATERIAL SHOULD BE QUARTZ ROAD THE SITE FOR PLACEMENT IN THE CONSTRUCTION. PLACING THE ROCK IN THE CONSTRUCTION COULD BE CHALLENGING SINCE THE ROCK HAS TO BE STRATEGICALLY PLACED AND CANNOT CAUSE A BARRIER TO UPSTREAM MIGRATING SALMON. ALSO, THE ROCK HAS TO BE LARGE ENOUGH SO THAT IT WOULD NOT BE WASHED OUT.
• AT THE BASE OF THE FALLS, ON THE RIGHT LOOKING DOWNSTREAM, THERE ARE SOME SMALL ROCK OUTCROPPINGS THAT MAY CAUSE PROBLEMS FOR SALMON JUMPING THE FALLS. THESE SHOULD BE REMOVED. THERE IS ONLY A SMALL AMOUNT OF ROCK THAT NEEDS TO BE REMOVED, POSSIBLY WITH JACK HAMMER OR WITH EXPANSION GROUT. THESE COULD BE DISPOSED OF INTO THE POOL.
• SANDBAGS OF A WOODEN DIVERSION DAM BE PLACED AT THE TOP OF THE FALLS TO DIVERT WATER TO THE RIGHT SIDE OF THE FALLS (LOOKING DOWNSTREAM) AT LOW WATER LEVELS.
• THE DEVELOPMENT ASSOCIATION SHOULD CARRY OUT AN EVALUATION OF THE EFFECTIVENESS OF THE REMOVAL WORK. ONE SUGGESTION WOULD BE TO PLACE A SALMON COUNTING FENCE UPSTREAM FROM THE FALLS.
APPROX TOP BORDE ELEV. 257.593
ROCK SOURCE FOR PLACEMENT IN POOL AT TOP OF FALLS (MAKE TO FOLLOW GUIDELINES AS PER RECOMMENDATIONS OF BIOLOGIST
APPROX POOL ELEV AT TIME OF SURVEY 243.593
BOTTOM OF FALLS ELEV. 243.210
REMOVE ROCK ON RIGHT SIDE OF FALLS
TOP OF FALLS ELEV. 245.500
FLOW DIVERSION
MIDDLE BARACHOIS BROOK
NEW 4m WIDE GRAVEL ACCESS ROAD
POOL OF STAGNANT WATER
BRIDGE ABUTMENTS FOR UPSTREAM FISH FALLS
BRIDGE CURRENTLY NOT USABLE FOR VEHICLE TRAFFIC
ORANGE POST (CRACK/ROCK BENCHMARK)
POSSIBLE ACCESS TO CLIFF ABOVE FALLS AND POOL AREA
ELEV. 260.140
ROCK BENCHMARK
CONCEPTUAL SITE PLAN
SCALE: 1:200
PROVINCE OF NEWFOUNDLAND
PERMIT HOLDER
anderson engineering consultants ltd.
BAY ST. GEORGE SOUTH AREA DEVELOPMENT ASSOCIATION
MIDDLE BARACHOIS BROOK - UPPER FALLS MODIFICATIONS
CONCEPTUAL SITE PLAN
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Appendix B

Table of Obstructions Removed on Flat Bay Brook and Tributaries

Table 1 : List of obstructions removed on Flat Bay Brook and its tributaries

Tributary	Obstruction #	Latitude	Longitude	Obstruction width (m)	Obstruction height (m)	Obstruction length (m)	Obstruction plunge depth (m)	Channel width (m)	Bank erosion	Water levels	Obstruction type	Comments
Sheep Brook	2	48.38337	-58.42922	6.8	0.5	11.8	N/A	12.0	N	L	LWD	Larger sections of the obstruction removed with chainsaw.
St. Georges Dribble	7	48.40346	-58.47945	13	7	1.4	N/A	6.9	Y	L	LWD	Larger sections of the tree were removed by chainsaw. Total area improved is approximately 89.7 m^2.
St. Georges Dribble	8	48.402730	-58.4806	11	4.3	1.5	1.1	8.3	Y	M	LWD	Tree that was rooted in bank was now in mainstream. Used chain saw to remove larger sections of it. Total area improved was approximately 91.3 m^2.
St. Georges Dribble	9	48.40313	-58.48190	14	5.3	2.7	N/A	9.3	Y	M	LWD	Removed parts of trees that were in mainstream with chainsaw. Total area improved was approximately 130.2 m^2.
St. Georges Dribble	10	48.40260	-58.48161	6.6	2.7	1.0	N/A	7.5	Y	M	LWD	Tree fell completely across mainstream. Chainsaw was used to remove larger section of tree. Total area improved was approximately 49.5 m^2.
St. Georges Dribble	14	48.39220	-58.52782	0.5	0.75	9.5	0.6	3.7	N	M	LWD	Fallen tree and limbs pose greater risk overtime to salmon passage. Parts of tree removed with chainsaw. Are improved is approximately 35.15 m^2.
St. Georges Dribble	16	48.39031	-58.53618	10.5	4.5	1.3	N/A	4	N	M	LWD	Tree was completely across mainstream. Chainsaw was used to remove it. Total area improved was approximately 42 m^2.
St. Georges Dribble	17	48.407436	-58.45115	1.2	0.8	3.2	N/A	4	N	M	LWD	Removed sections of tree with chainsaw. Total area improved was approximately 12.8 m^2.
Coal Brook	2	48.37991	-58.45703	5.3	0.5	10.8	N/A	5.0	Y	L	LWD	Removed larger sections of the fallen trees with chainsaw. Total area improved is approximately 55.08 m^2.
Coal Brook	5	48.3755	-5845364	9.1	1.1	2.7	N/A	2.7	Y	L	LWD	Removed tree and limbs from stream bed. Chainsaw was used. Total area improved was approximately
Coal Brook	6	48.37452	-58.45331	1.4/ 3.1/ 3.5	1.7	13.2	N/A	3.2	N	L	BEAVER	Removed larger sections of the debris dam with chainsaw and axe. Total area that was improved was approximately 42.24 m^2.
Coal Brook	9	48.37039	-58.45331	5.9	1.9	7.6	N/A	8.6	N	L	CWD	Tree fell in mainstream causing greater blockage than recorded. Used chainsaw to cut out larger sections of tree. Total area improved approximately 65.36 m^2.
Coal Brook	10	48.36783	-5844194	9.2	4.2	8.4	N/A	4.4	N	L	LWD	Removed larger sections of trees and limbs with chainsaw and axe. Total area improved was approximately 36.96 m^2.

Appendix C

Obstruction Removal on Sheep Brook,

A Tributary of Flat Bay Brook

Figure 4: Map of obstructions removed on Sheep Brook, a tributary of Flat Bay Brook

Figure 5: View of obstruction 2, Sheep Brook

Figure 6: Removal efforts on obstruction 2, Sheep Brook

Figure 7: Debris removed from obstruction 2, Sheep Brook

Figure 8: Improved fish passage from obstruction 2 removal, Sheep Brook

Appendix D

Obstruction Removal on St. Georges Dribble,

A Tributary of Flat Bay Brook

Figure 9: Map of obstructions removed on St. Georges Dribble, tributary of Flat Bay Brook

Figure 10: Downstream view of obstruction 7, St. Georges Dribble.

Figure 11: Obstruction 7 removal, St. Georges Dribble.

Figure 12: Upstream view of improved area after obstruction 7 was removed, St. Georges Dribble.

Figure 13: Removal of obstruction 8, St. Georges Dribble.

Figure 14: Debris removed away from flood zone, St. Georges Dribble.

Figure 15: Upstream view of improved area after obstruction 8 removal, St. Georges Dribble.

Figure 16: Downstream view of improved fish passage, St. Georges Dribble.

Figure 17: Upstream view of obstruction 9, St. Georges Dribble.

Figure 18: Removal efforts on obstruction 9, St. Georges Dribble.

Figure 14: Debris removed from obstruction 9, St. Georges Dribble.

Figure 20: Upstream view of improved area after removal of obstruction 9, St. Georges Dribble.

Figure 21: Side view of improved fish passage at Obstruction 9, St. Georges Dribble.

Figure 22: Upstream view of obstruction 10, St. Georges Dribble.

Figure 23: Debris removed from obstruction 10, St. Georges Dribble.

Figure 24: Upstream view of improved fish passage after obstruction 10 removal, St. Georges Dribble.

Figure 25: Upstream view of obstruction 14, St. Georges Dribble.

Figure 26: Upstream view of improved fish passage from obstruction 14 removal, St. Georges Dribble.

Figure 27: Debris removal from obstruction 14, St. Georges Dribble.

Figure 28: Downstream view of improved area after obstruction 14 was removed, St. Georges Dribble.

Figure 29: Downstream view of obstruction 16, St. Georges Dribble.

Figure 30: Upstream view of improved area after removal of obstruction 16, St. Georges Dribble.

Figure 31: Debris removed from obstruction 16, St. Georges Dribble.

Figure 32: Upstream view of obstruction 17, St. Georges Dribble.

Figure 33: View of debris removed from obstruction 17, St. Georges Dribble.

Figure 34: Downstream view of improved salmon habitat after removal of obstruction 17, St. Georges Dribble.

Appendix E

Obstruction Removal on Coal Brook,

A Tributary of Flat Bay Brook

Figure 35: Map of obstructions removed in 2019 on Coal Brook, a tributary of Flat Bay Brook.

Figure 36: Downstream view of obstruction 2, Coal Brook.

Figure 37: Removal of obstruction 2, Coal Brook.

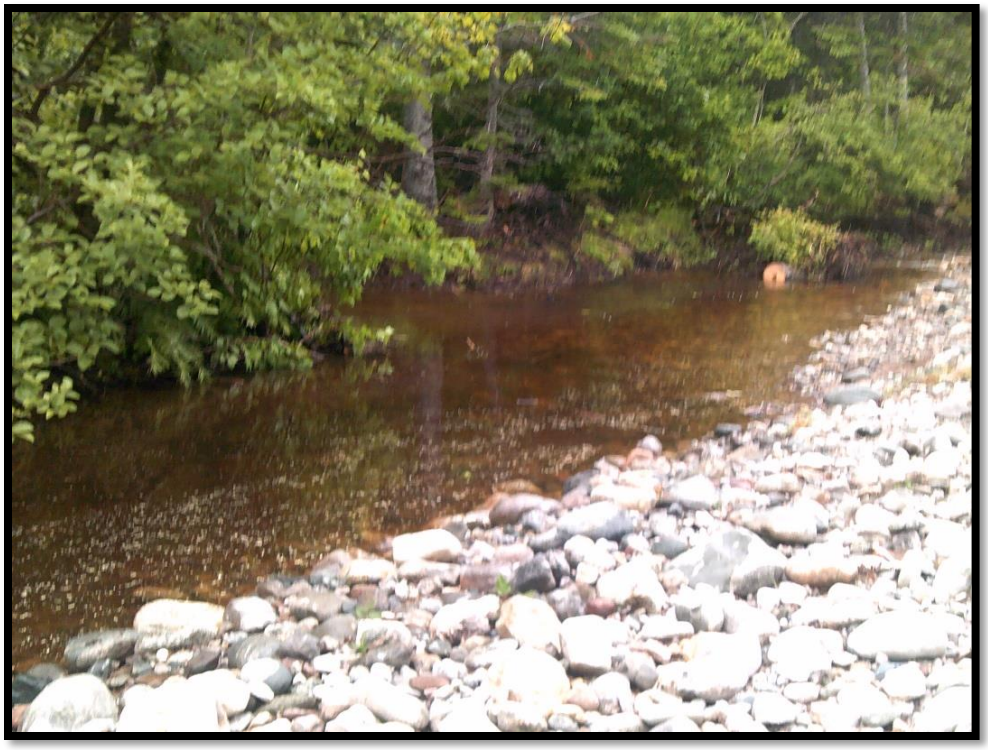

Figure 38: Upstream view of improved fish passage after obstruction 2 removal, Coal Brook.

Figure 39: Side view of improved fish passage at Obstruction 2, Coal Brook.

Figure 40: Side view of obstruction 5, Coal Brook.

Figure 41: Downstream view of improved salmon habitat after obstruction 5 removal, Coal Brook.

Figure 42: Side view of improved fish habitat at obstruction 5, Coal Brook.

Figure 43: Downstream view of obstruction 6, Coal Brook.

Figure 44: Removal underway of obstruction 6, Coal Brook.

Figure 45: Improved fish passage from partial removal of obstruction 6, Coal Brook.

Figure 46: Side view of obstruction 9, Coal Brook.

Figure 47: Upstream view of improved fish passage after removal of obstruction 9, Coal Brook.

Figure 48: Side view of obstruction 10. Large woody debris caused by bank destabilization, Coal Brook.

Figure 49: View of improved habitat after obstruction 10 removal, Coal Brook.

Appendix F

Map of Little Barachois and

Remaining Obstruction

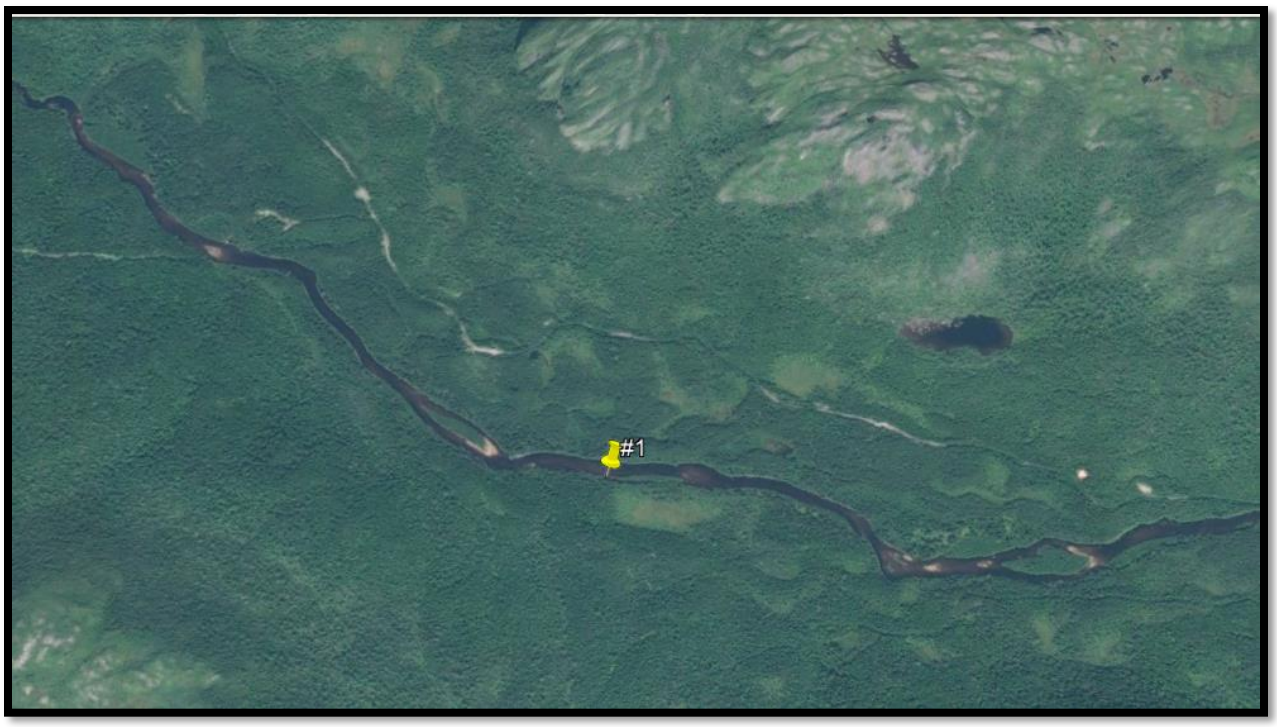

Figure 50: Map of obstructions on Little Barachois Brook.

Appendix G

Obstruction Removal on Big Dribble,

A Tributary of Middle Barachois Brook

Obstruction #	Latitude	Longitude	Obstruction width (m)	Obstruction width (m)	Obstruction height (m)	Obstruction plunge depth (m)	Channel width (m)	Bank erosion	Water Levels	Obstruction type	Comments
1	48.18960	-58.710353	5	2.5	3	N/A	N/A	N	L	BEAVER	Use chainsaw to cut out the dam. Removal of full dam was needed.
3	48.18991	-58.7134	N/A	N/A	N/A	N/A	N/A	Y	L	CWD	Obstruction was unmeasurable due to the range of where the trees were downstream. Chainsaw was used to cut out larger sections of the fallen trees.
6	48.19049	-58.71805	N/A	N/A	N/A	N/A	N/A	Y	L	CWD	Trees that were hanging over the mainstream dropped further over the course of a year causing greater potential to obstruct salmon migration. Chainsaw was used to remove larger sections of the trees.
9	48.19698	-58.72394	1.5	1.5	4.8	0.8	4.8	N	L	LWD	Obstruction continued to drop over the course of a year. Causing greater blockage to streamflow. Chainsaw was used to remove larger sections of the trees. Total area improved to stream flow is approximately 23.04 m^2.
11	48.18728	-58.70623	0.5	0.5	8.0	0.178	7	N	L	LWD	Debris was catching on fallen trees making obstruction greater than recorded. Chainsaw was used to remove larger sections of the trees. Total area improved was approximately 56 m^2.

Table 2: List of obstructions removed on Middle Barachois and tributaries.

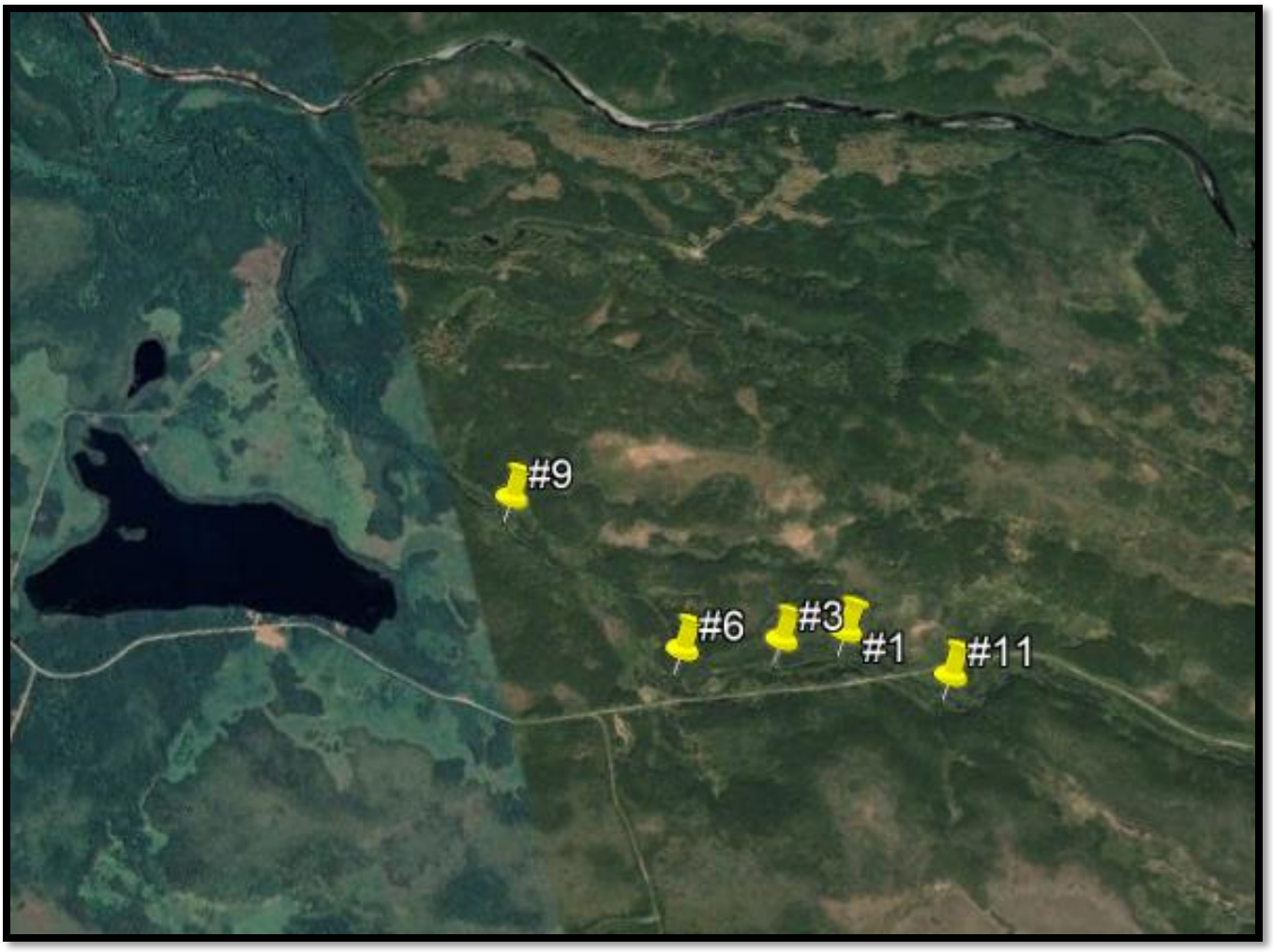

Figure 51: Map of obstructions removed on Big Dribble, a tributary of Middle Barachois Brook.

Figure 52: Obstruction 1; inactive dam, Big Dribble Brook.

Figure 53: Debris removed from obstruction 1, out of flood zone, Big Dribble Brook.

Figure 54: Upstream view of improved fish passage from obstruction 1 removal, Big Dribble Brook.

Figure 55: Side view of improved fish passage after obstruction 1 removal, Big Dribble Brook.

Figure 56: Downstream view of obstruction 3, Big Dribble Brook.

Figure 57: Additional downstream view of obstruction 3, Big Dribble Brook.

Figure 58: Upstream view of improved salmon habitat after obstruction 3 removal, Big Dribble Brook.

Figure 59: Upstream view of obstruction 6, Big Dribble Brook.

Figure 60: Downstream view of improved habitat from obstruction 6 removal, Big Dribble Brook.

Figure 61: Side view of increased fish passage after obstruction 6 removal, Big Dribble Brook.

Figure 62: Upstream view of obstruction 9, Big Dribble Brook.

Figure 63: Obstruction 9 debris removed out of flood zone, Big Dribble Brook.

Figure 64: Improved fish passage after removal of obstruction 9, Big Dribble Brook.

Figure 65: Closer upstream view of improved fish passage, obstruction 9, Big Dribble Brook.

Figure 66: Upstream view of obstruction 11, Big Dribble Brook.

Figure 67: Woody debris removed from obstruction 11, Big Dribble Brook.

Figure 68: Upstream view of improved fish passage, Obstruction 11, Big Dribble Brook.

Figure 69: Downstream view of improved habitat after obstruction 11 removal, Big Dribble Brook.