

**Petite Rivière  
Fish Habitat  
Restoration Plan  
2014**

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Habitat Stewardship Program for Species at Risk

Canada 



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## Introduction

This is the first of annual reports as part of the development of the Petite Rivière Fish Habitat Restoration Plan. This document provides a background of the living biology, chemistry, and physical geology of the Petite Rivière watershed, as well as provides the beginnings of a habitat description and restoration opportunities for the watershed. The sub-watershed of Wildcat Brook (approximately 9 km watercourse) has been the first and only sub-watershed that has under-gone stream assessments and restoration during the 2014-15 field season. The Wildcat Brook system is situated in the upper right section of the Petite Rivière watershed. Future reports will investigate additional sub-watershed assessments and outline potential restoration opportunities.

The total area of the Petite Rivière Watershed is approximately 244 km<sup>2</sup>, of which approximately 19% is comprised of water-bodies. The largest bodies of water in the watershed are Fancy Lake, Milipsigate Lake, Minamkeak Lake, and Hebb Lake. The watershed also includes 22 smaller lakes, 8 tributaries, and many swamps and bogs. By taking a watershed-based approach to restoration planning, Coastal Action will gain a comprehensive view of overall restoration needs and determine specific actions that can be undertaken to improve habitat and environmental conditions within the watershed.

Coastal Action is especially interested in the Petite Rivière as it is home to the only known wild population of the endangered Atlantic whitefish, as well as the drinking water reservoir for the Town of Bridgewater. Bridgewater is a town of about 8300 and the drinking water for its residents is sourced above the Hebb Dam. There have been water quality issues, acidification in particular, within the upper part of the watershed that negatively affects fish habitat, not only of the Atlantic whitefish but for other fish species as well.

## Restoration Plan Objectives

The fish habitat restoration plan being developed for the Petite Rivière watershed is aimed at managing and improving fish habitat conditions and increasing fish populations in order to sustain and create biodiversity within the watershed. This plan focuses on how to improve salmonid habitat, as well as the habitat of other native fish species in the watershed, along with improving water quality.

From Coastal Action's monthly sampling of the Petite Rivière watershed, the sub-watershed of Wildcat Brook has been identified as having low concentrations of pH causing water acidity. This is believed to be caused by the nearby abandoned shale pits, where exposed pyritic slate reacts with air and water to form sulfuric acid. Through stream assessments this acidification will be further investigated and potential restoration projects will be developed to improve fish habitat within the Wildcat Brook system.

Objectives	<ol style="list-style-type: none"> <li>1. To assess the existing condition of fish habitat within the Petite Rivière watershed in order to determine the likely limiting habitat factors and the fish habitat restoration needs.</li> <li>2. To develop a strategy / plan that will include various recommendations for overall watershed improvements focusing on the restoration and improvement of fish habitat on a watershed basis.</li> </ol>
Specific Goals	<ol style="list-style-type: none"> <li>1. To assess the current state of habitat connectivity, water quality, altered physical habitat, riparian zone quality and function, and surrounding land use practices within the Petite Rivière watershed.</li> <li>2. To develop a prioritized list of potential projects to either restore or enhance fish habitat within the watershed.</li> </ol>

## Introductory Information – Petite Rivière Watershed

1	Location in province:	<b>Location:</b> Lunenburg County, Nova Scotia, Southern Upland Region.  <b>Nearest Communities:</b> Bridgewater, Camperdown, Crescent Beach, Conquerall Mill, Crousetown, Hebbville, Hebbs Cross, Italy Cross, Laconia, Lapland, New Cumberland, Newcombville, Petite Rivière, and Wileville.
2	Watershed area:	244 km <sup>2</sup>
3	Watershed drains into at coordinates of:	Petite Rivière drains into the Atlantic Ocean in Green Bay at 44°13'36.9" N, 64°26'03.2" W
4	Distance of watercourse mouth from ocean:	Petite Rivière discharges into a small estuary and is approximately 1 km from open ocean.

5	Distance of watercourse mouth from head of tide:	40 m
6	Natural watercourse width at mouth:	35 m
7	Length of watercourse:	40 km
8	Elevation at headwaters:	120 m
9	Elevation at mouth:	0 m
10	Lakes within watershed and their sizes:	<p>Little Lake: 9.7 ha  Hebb Lake: 4.2 km<sup>2</sup>  Garber Lake: 20.5 ha  Newcombe Lake: 15.2 ha  St. George Lake: 27.5 ha  Andrew Lake: 97.7 ha  Lewie Lake: 45.3 ha  Fredrick Lake: 48.9 ha  Matthew Lake: 25.1 ha  Milipsigate Lake: 3.0 km<sup>2</sup>  Minamikeak Lake: 7.7 km<sup>2</sup>  Moose Lake: 57.1 ha  Wallace Lake: 1.1 km<sup>2</sup>  Branch Lake: 71.9 ha  Fancy Lake: 4.1 km<sup>2</sup>  Hebb Mill Lake: 14.2 ha  Kaulback Long Lake: 10.8 ha  Little Beaver Lake: 34.6 ha  Demone Lake: 17.6 ha  Fitch Little Lake: 18.3 ha  Fitch Long Lake: 32.6 ha  Publicover Lake: 14.4 ha  Oikle Lake: 2.1 ha  Huey Lake: 9.8 ha  Marsh Lake: 8.3 ha</p>
11	Significant tributaries within watershed:	<p>Wamback Mill Brook: ~5.3 km  Brown Branch Brook: ~9.6 km  Kaulback Brook: ~3.8 km  Hebb Mill Brook: ~6.6 km  Wildcat Brook: ~10.0 km  Birch Brook: ~4.0 km  Still Brook: ~5.6 km  Newcombe Brook: ~4.3 km  Brandy Mill Brook: ~3.1 km  Fitch Brook: ~5.0 km  Frederick Brook: ~6.8 km  Wallace Brook: ~4.4 km</p>

12	Most common substrate type and size:	The substrate varies throughout the watershed: fines, medium, cobble, boulder, and bedrock.
13	Soil types and geological characteristics:	<b>Soil types:</b> Farmville sandy loam (drumlin phase), Bridgewater sandy loam, LaHave gravelly sandy loam, Halifax sandy loam, swamp (peaty material), rock land, Wolfville loam (drumlin phase), and Middlewood sandy loam.  <b>Geological characteristics:</b> Meguma Group – Halifax Formation (slate, siltstone) and Goldenville Formation (greywacke, slate).
14	Average water temperature in summer (June-September):	20°C  <b>Note:</b> Average water temperature based on data collection from 18 sites throughout the Petite Rivière from 2011-2014.
15	Peak water temperature:	The peak water temperatures occur in the summer months of August and September. The highest recorded water temperature by Coastal Action was 26.7°C on August 10, 2012 in Wallace Brook.
16	pH range:	5.20 - 6.67  <b>Note:</b> This range is calculated from an average pH at each of the 18 sites Coastal Action samples from 2011-2014.
17	Native fish species present:	American eel, Atlantic salmon, Gaspereau, Brook trout, Lake trout, Brown bullhead, Creek chub, Lake chub, Blacknose shiner, Common shiner, Golden shiner, White sucker, Yellow perch, White perch, and Banded killifish.
18	Non-native fish species present:	Chain pickerel, Smallmouth bass
19	Endangered / threatened / at risk species present (aquatic or non-aquatic):	The following species have been marked as either endangered / threatened / at risk within the Municipality of the District of Lunenburg: Ipswich Sparrow (NS - vulnerable), Blanding's turtle (SARA - endangered), Eastern ribbonsnake (SARA - threatened), Atlantic whitefish (SARA - endangered), Southern Uplands Atlantic salmon (COSEWIC - endangered), Boreal felt lichen (SARA - endangered), Monarch butterfly (SARA - special concern), Rockrose (NS - endangered), Golden crest (SARA - threatened), Long's bulrush (SARA – special concern), and Mainland moose (NS - endangered).
20	Annual fish stocking:	<b>Spring Stocking:</b> June 6, 2014 speckled trout were stocked in Wallace Lake.  <b>Fall Stocking:</b> None
21	Angling regulations for the watershed:	Apr 1 to Jun 14, bag limit two (2) trout, single hook lure or artificial fly, natural bait is prohibited. Jun 15 to end of all fishing seasons, artificial fly only. Sep 1 to Sep 30, all speckled trout must be released. From the Highway 331 Bridge upstream

		<p>to Hebb Lake, not including tributaries.</p> <p>Wallace Brook, from Petite Rivière at Crousetown to a point 180 m upstream, including tributaries, closed Apr 1 to Sep 30.</p>
22	Forestry activities and impacts:	<p>Small scale harvesting of the forests is occurring at various locations throughout the watershed. A minimum riparian zone of 30 m should ideally be kept along the perimeter of the watercourse, and for the most part this perimeter is honored along the Petite Rivière.</p> <p>Logging practices can have a major impact on water quality and wildlife habitat in the area; and without a healthy riparian area fish habitat may be lost. These riparian zones provide shade, food, and protection for wildlife, as well as assisting in bank stabilization.</p>
23	Urban/residential development impacts:	<p>Petite Rivière watershed area is mostly comprised of rural residential properties. The densest commercial and residential development occurs closest to the Town of Bridgewater and at the mouth of the river in the community of Petite Rivière.</p> <p>There are residential homes built along the watercourse that have not maintained an accurate shoreline riparian buffer, clearing land to the water's edge. These practices can lead to high erosion rates, sedimentation, and the introduction of fertilizers from runoff and infiltration. There is also the concern of improperly installed or leaking sewage systems.</p>
24	Agricultural impacts:	<p>There are some farmland areas along the Petite Rivière watercourse that presently have a minimal impact on the water quality of the river. The main concerns are farms without proper fencing allowing farm animals to freely access waterways contaminating and trampling riparian zones. There is also concern over runoff from fertilizer and pesticide use into the river.</p>
25	Other industry impacts:	<p>The upper part of the watershed has been used for mining operations both past and present.</p> <p>There are also impacts from acid rain caused by industrial emissions produced in Central Canada and the US Midwest. Nova Scotia soils have poor pH buffering ability and the decrease of pH causes the destruction of certain species that cannot thrive at low pH. Low pH can also cause metals to precipitate out of soils and into water where they then accumulate in the gills of salmonids causing physical stress of the fish.</p>
26	Historical conditions, impacts, and	<p>Historical mining operations for shale gravel have left behind</p>



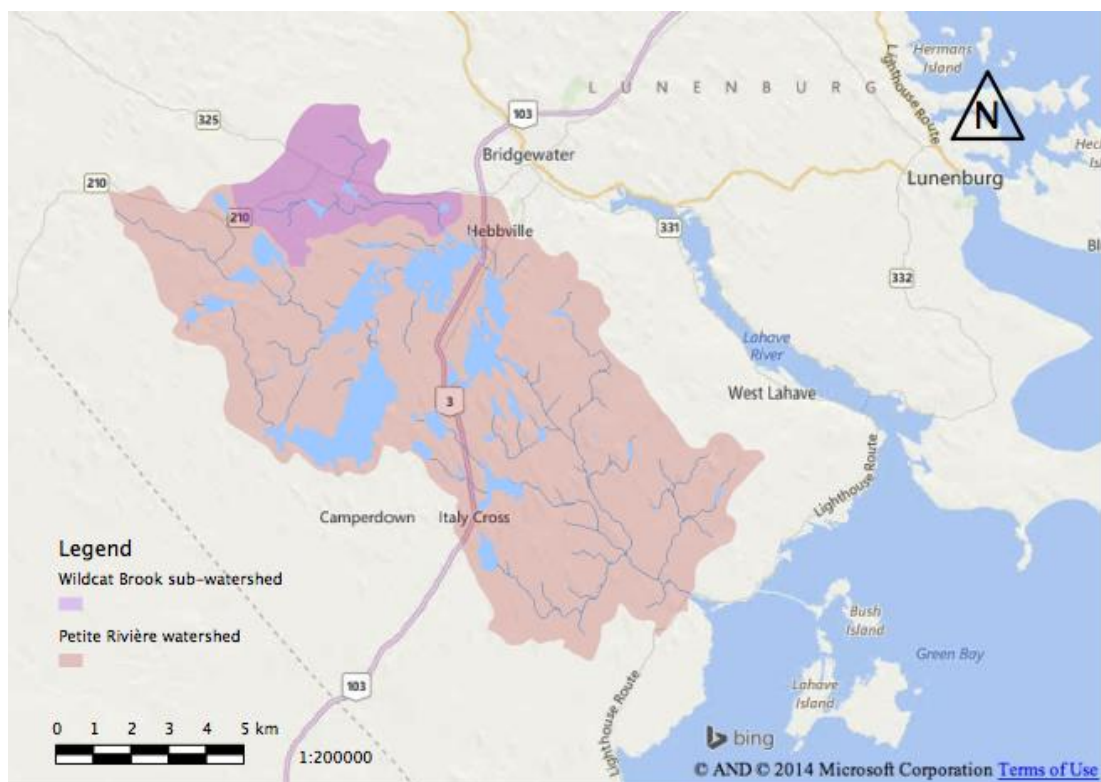
	considerations:	open shale pits that pool highly acidic waters. During heavy rainfall events these acidic waters can overflow into the nearby Wildcat Brook causing acidic shock to the system.
27	Barriers present on the main river stem:	Historically there have been six dams on the main river that have acted as barriers to fish passage and even more still on the smaller tributaries of the Petite Rivière. There are still five existing dams on the main river channel, one of which has a fish ladder. Those dams being Crousetown Dam (runaround channel), Hebb Lake Dam (fish ladder), Milipsigate Lake Dam, Minamkeak Lake Dam, and Weagle's Dam.
28	Other Information:	Petite Rivière holds the drinking water reservoir for the Town of Bridgewater, and also includes the only known wild population of the endangered Atlantic whitefish, making the health of the river highly important.

## Labeled Maps

### Watershed Boundary Maps:



**Figure 1:** Petite Rivière watershed boundary (red) located in Nova Scotia.



**Figure 2:** Wildcat Brook sub-watershed (pink) within the Petite Rivière watershed (red).

## Sub-watershed of Wildcat Brook

### Sites Assessed



**Figure 3:** Locations of site assessments on Wildcat Brook. Red markers show sites WCDS1, downstream from Lapland Rd. and sites upstream from Lapland Rd. WC001 to WC007 (scale 1:2000).





**Figure 4:** Location of site assessments on Wildcat Brook. Red markers show sites WC008 to WC013 (scale 1:2000).



**Figure 5:** Location of site assessments on Wildcat Brook. Red markers show sites WC014 to WC018 (scale 1:2000).





**Figure 6:** Location of site assessments on Wildcat Brook. Red markers show sites WC019 to WC022 (scale 1:2000).

## Restoration Work Sites



**Figure 7:** Purple markers show the location of the installed (WCDL2 to WCDL6) digger logs and deflectors. WCDL1 has yet to be installed in proposed location.

## Habitat Description and Restoration Opportunities

Section / Site Code	Stream Feature	Lower Limit (coordinates and landmarks)	Site Details	Adjacent Land Use Considerations	Prescription for Restoration	Project Priority Ranking	Project Status
Section	Sub-watershed of Wildcat Brook (WC): Upstream from Lapland Rd. Bridge in Wileville, NS						
WC001	Upstream from Lapland Rd. Bridge	N 44° 22' 00.8" W 064° 35' 03.5"	<b>Left Bank:</b> ~2 m high bank slope, young vegetation, alders, moss, leaf and wood debris, mostly hardwood. <b>Right Bank:</b> ~1 m high bank slope, moss, grass, alders, mostly hardwood. <b>Water Description:</b> Tannin/brown, some algae on rocks, moderate moving riffle-run area, 50% shade, 20% embedded, with one caddis fly found. <b>Wetted Width:</b> 4.8 m <b>Bankfull:</b> 5.4 m <b>Floodplain:</b> ~20 m (on right bank, and restricted on left bank) <b>Average Depth:</b> 15 cm <b>Thalweg:</b> 22 cm <b>Substrate:</b> 50% bedrock, 5% boulder, 30% cobble, 5% coarse, 7% medium, 3% fine.	Paved road with metal/creosote wood bridge, and forested area	n/a	n/a	n/a
WC002	Channel widens	N 44° 22' 01.2" W 064° 35' 05.3"	<b>Left Bank:</b> ~3 m high-rise, sedges on flat area closest to stream for ~1 m, young alders and mixed wood farther back from bank (mostly hardwood). <b>Right Bank:</b> ~3 m high-rise with 2 m of a flat section with moss and sedges, young firs and mixed wood farther back. <b>Water Description:</b> Brown algae on rock and very slow moving, almost still, with 30% shade, and ~5% embedded. <b>Wetted Width:</b> 7.9 m <b>Bankfull:</b> 9 m <b>Floodplain:</b> ~15 m <b>Average Depth:</b> 21 cm <b>Thalweg:</b> 26 cm <b>Substrate:</b> 30% bedrock, 10% cobble, 30% coarse, 20% fines.	Forested area	n/a	n/a	n/a
WC003	Marshy section with muddy substrate	N 44° 22' 00.6" W 064° 35' 08.0"	<b>Left Bank:</b> ~30 cm high, flat with sedges, low bushes, maple trees and a few large pine trees. <b>Right Bank:</b> ~35 cm high, with a downed tree in water, ferns, moss, alders, and hardwood. <b>Water</b>	Forested area	n/a	n/a	n/a



Section / Site Code	Stream Feature	Lower Limit (coordinates and landmarks)	Site Details	Adjacent Land Use Considerations	Prescription for Restoration	Project Priority Ranking	Project Status
			<b>Description:</b> Dark colour, muddy, wood debris, a few sedges in water, very slow moving, 15% shade, 10% embedded, and caddis fly found. <b>Wetted Width:</b> 8 m <b>Bankfull:</b> 9.5 m <b>Floodplain:</b> +30 m <b>Average Depth:</b> ~27 cm <b>Thalweg:</b> 30 cm <b>Substrate:</b> 10% shale bedrock, 10% boulders, 30% cobble, 10% coarse, 20% medium, 30% fine.				
WC004	Stream narrows with vegetation in stream.	N 44° 22' 01.4" W 064° 35' 09.3"	<b>Left Bank:</b> ~50 cm high, flat to water for ~1.5 m till increased bank height, sedges, mixed wood, and alders. <b>Right Bank:</b> ~30 cm high, sedges in water and bank, alders, mostly hardwood. <b>Water Description:</b> Tannin/brown colour, fresh water sponge (Spongillidae) and other vegetation growth, faster water speed. <b>Wetted Width:</b> 8 m <b>Bankfull:</b> 9.8 m <b>Floodplain:</b> +30 m <b>Average Depth:</b> 20 cm <b>Thalweg:</b> 25 cm <b>Substrate:</b> 20% boulders, 30% cobble, 10% coarse, 30% medium, 10% fine	Forested area	n/a	n/a	n/a
WC005	Change in substrate and vegetation, and presents of cloudy water	N 44° 22' 01.3" W 064° 35' 10.5"	<b>Left Bank:</b> ~ 40 cm up from water and gentle slope for another ~5 m back from bank with mixed wood, forest debris and moss. <b>Right Bank:</b> ~30 cm high, flat, grass, sedges, alders, and some wood debris. <b>Water Description:</b> Tannin/red, and cloudy with suspended particles, looks "dusty", slow moving and shade is ~50% <b>Wetted Width:</b> 5.8 m <b>Bankfull:</b> 6.5 m <b>Floodplain:</b> +30 m <b>Average Depth:</b> 27 cm <b>Thalweg:</b> 32 cm <b>Substrate:</b> 10% boulders, 5% cobble, 15% coarse, 60% medium, 10% fine.	Forested area	n/a	n/a	n/a

Section / Site Code	Stream Feature	Lower Limit (coordinates and landmarks)	Site Details	Adjacent Land Use Considerations	Prescription for Restoration	Project Priority Ranking	Project Status
WC006	Pool on left side, wider channel, and beaver activity	N 44° 22' 00.6" W 064° 35' 11.9"	<b>Left Bank:</b> ~ 20 cm high, pool is about 2x5 m in size, alders and mostly large hardwood trees. <b>Right Bank:</b> ~40 cm high with a smaller pool under a fallen tree, erosion, and mixed wood forest. <b>Water Description:</b> Very slow moving, cloudy, reddish colour, 45% shade and 30% embedded. <b>Wetted Width:</b> 9.5 m <b>Bankfull:</b> 9.7 cm <b>Floodplain:</b> +30 m <b>Average Depth:</b> 28 cm <b>Thalweg:</b> 30 cm <b>Substrate:</b> 10% boulders, 5% cobble, 10% medium, 5% coarse, 70% fines	Forested area	n/a	n/a	n/a
WC007	Channel narrows, more shade and less boulders	N 44° 21' 59.7" W 064° 35' 12.5"	<b>Left Bank:</b> ~20 cm high, grass, sedges, alders, and hardwood trees. <b>Right Bank:</b> ~50 cm high, with moss, alders, small shrubs, and mostly hardwood trees. <b>Water Description:</b> Slow moving, shallow, tannin, very little vegetation, 50% shade, 5% embedded, and woody debris in water. <b>Wetted Width:</b> 5.6 m <b>Bankfull:</b> 6.7 m <b>Floodplain:</b> +30 m <b>Average Depth:</b> 20 cm <b>Thalweg:</b> 28 cm <b>Substrate:</b> 5% boulders, 35% cobble, 20% coarse, 30% medium, 10% fine.	Forested area	n/a	n/a	n/a
WC008	Above alder swale (~30 m long), narrow channel, mostly medium substrate, brown/orange algae on banks.	N 44° 21' 59.8" W 064° 35' 15.7"	<b>Left Bank:</b> ~30 cm high, lots of leaf miner eating remaining alders, sedges, grasses, and hardwood forest. <b>Right Bank:</b> ~5 cm high, sandy and muddy banks with sedges, mostly hardwood forest, and sandy beach area appears to be a dinking hole for deer. <b>Water Description:</b> Moderate to slow moving, debris, brown colour, orange algae flakes and sponge finger growths. 55% shade and 5% embedded. <b>Wetted Width:</b> 2.5 m <b>Bankfull:</b> 7.5 m	Forested area	n/a	n/a	n/a

Section / Site Code	Stream Feature	Lower Limit (coordinates and landmarks)	Site Details	Adjacent Land Use Considerations	Prescription for Restoration	Project Priority Ranking	Project Status
			<b>Floodplain:</b> 17 cm <b>Average Depth:</b> 25 cm <b>Thalweg:</b> 24 cm <b>Substrate:</b> 5% cobble, 10% coarse, 75% medium, 10% fine.				
WC009	Higher banks, and erosion	N 44° 22' 01.4" W 064° 35' 18.3"	<b>Left Bank:</b> ~50 cm high, erosion, exposed roots, sandy, flood area same level as water, alders, sedges, well spaced out alder swale for ~20 m downstream. <b>Right Bank:</b> ~55 cm high, can see the large shale pit about 30 m back from bank, mostly hardwood, moss, grass, flooding evidence, small pool 3x1 m, erosion. <b>Water Description:</b> Tannin, slow moving, left side has brown/red algae, wood debris, and 80% shade. <b>Wetted Width:</b> 4.8 m <b>Bankfull:</b> 5.4 m <b>Floodplain:</b> +30 m <b>Average Depth:</b> 20 cm <b>Thalweg:</b> 21 cm <b>Substrate:</b> 50% coarse, 40% medium, 10% fine.	Forested area	n/a	n/a	n/a
WC010	Break in alders, lots of debris in water, and small riffles.	N 44° 22' 04.4" W 064° 35' 21.7"	<b>Left Bank:</b> ~40 cm high, alders, mixed wood, sedges, very small pool, and erosion. <b>Right Bank:</b> ~35 cm high, grass, mixed wood, old trail, with lots of debris, erosion and muddy. <b>Water Description:</b> Water is clearer (not as "dusty"), tannin, slow moving, and 70% shade. <b>Wetted Width:</b> 5 m <b>Bankfull:</b> 6.5 m <b>Floodplain:</b> +30 m <b>Average Depth:</b> 22 cm <b>Thalweg:</b> 26 cm <b>Substrate:</b> 40% coarse, 40% medium, 20% fine.	Forested area	n/a	n/a	n/a
WC011	End of marshy area and into mixed wood forest area. Stream is wide and straight	N 44° 22' 05.9" W 064° 35' 23.7"	<b>Left Bank:</b> ~30 cm high, with 3 m slope upwards, moss, mixed wood, and leaf debris. <b>Right Bank:</b> ~20 cm high, flat, grass, mixed wood and young firs. <b>Water Description:</b> Tannin, some grass vegetation, fresh sponge algae, slow moving riffle-run-riffle, small meanders at both ends of	Forested area	Install two to three digger logs and deflectors in straight section area	Medium	Two digger logs and deflectors completed (September 2014), third one to be installed

Section / Site Code	Stream Feature	Lower Limit (coordinates and landmarks)	Site Details	Adjacent Land Use Considerations	Prescription for Restoration	Project Priority Ranking	Project Status
	for ~40 to 50 m, and there is a change in substrate.		straight section, 10% embedded and 85% shade. <b>Wetted Width:</b> 6.8 m <b>Bankfull:</b> 7.3 m <b>Floodplain:</b> +30 m on right bank <b>Average Depth:</b> 15 cm <b>Thalweg:</b> 18 cm <b>Substrate:</b> 5% boulders, 20% cobble, 35% coarse, 30% medium, 10% fine				late summer or fall of 2015.
WC012	Top of ~100° meander, deep pool on left bank	N 44° 22' 07.5" W 064° 35' 25.0"	<b>Left Bank:</b> ~35 cm high, moss, mixed wood, erosion, some old exposed roots, hardwood trees close to bank edge. <b>Right Bank:</b> ~30 cm high, moss, mostly hardwood, grass, flood stream making braid when water levels would be high enough. <b>Water Description:</b> Dark, slow moving, lots of organic debris, 90% shade, and 5% embedded. <b>Wetted Width:</b> 6.1 m <b>Bankfull:</b> 6.3 m <b>Floodplain:</b> +30 m <b>Average Depth:</b> 45 cm <b>Thalweg:</b> 65 cm <b>Substrate:</b> 5% boulders, 5% cobble, 50% coarse, 20% medium, 20% fine	Forested area	n/a	n/a	n/a
WC013	Middle of ~50 to 60 m straight section, close to large shale pit.	N 44° 22' 06.6" W 064° 35' 28.5"	<b>Left Bank:</b> ~25 cm high with flat top, grass, sedges, mixed wood, ATV trail. <b>Right Bank:</b> ~30 cm high with a ~2 m unnatural (made from mining) hill that sits between the stream and pit, thin line of trees on top of tree. <b>Water Description:</b> Slow moving, lots of vegetation on rocks, organic debris, erosion occurring on both banks. <b>Wetted Width:</b> 6.4 m <b>Bankfull:</b> 7 m <b>Floodplain:</b> +30 m <b>Average Depth:</b> 15 cm <b>Thalweg:</b> 20 cm <b>Substrate:</b> 15% boulder, 25% cobble, 30% coarse, 20% medium, 10% fine.	Forested area	Install two digger logs and two deflectors	Medium	Completed (September 2014)

Section / Site Code	Stream Feature	Lower Limit (coordinates and landmarks)	Site Details	Adjacent Land Use Considerations	Prescription for Restoration	Project Priority Ranking	Project Status
WC014	Start of alder swale on right bank, beaver stumps	N 44° 22' 05.6" W 064° 35' 33.6"	<b>Left Bank:</b> ~50 cm high, mixed wood forest, moss, forest litter, trees to water edge, erosion. <b>Right Bank:</b> ~20 cm high, mostly hardwood, lots of alders, ferns, grass, muddy banks, with beaver sticks. <b>Water Description:</b> Very slow moving, cloudy dirty water, tannin, wood and organic in water, and 80% shade. <b>Wetted Width:</b> 7.1 m <b>Bankfull:</b> 7.3 m <b>Floodplain:</b> +30 m <b>Average Depth:</b> 50 cm <b>Thalweg:</b> 55 cm <b>Substrate:</b> 3% boulder, 5% cobble, 7% coarse, 60% medium, 20% fine	Forested area	n/a	n/a	n/a
WC015	Beaver blockage (not fully across), pool on left side after dam.	N 44° 22' 03.8" W 064° 35' 35.4"	<b>Left Bank:</b> ~35 cm high with flat tops, lots of spruce trees, few maples, grass, older growth and erosion. <b>Right Bank:</b> ~25 cm high with flat tops, moss mixed wood, younger growth, water can freely move through and around dam on this side. There is also a cage on bank possibly to trap beaver. <b>Water Description:</b> Fresh water sponge, slow moving, pooling on left side where dam has stopped flow, 95% shade, lots of organic and leaf debris in water. <b>Wetted Width:</b> 6.5 m <b>Bankfull:</b> 8.2 m <b>Floodplain:</b> +30 m <b>Average Depth:</b> 23 cm <b>Thalweg:</b> 25 cm <b>Substrate:</b> 5% cobble, 15% coarse, 60% medium, 20% fine	Forested area	n/a	n/a	n/a
WC016	Downstream from braid in stream riffle area	N 44° 22' 01.5" W 064° 35' 40.1"	<b>Left Bank:</b> ~40 cm high, erosion, mixed wood, dirt exposed on banks from being walked on possibly. <b>Right Bank:</b> ~20 cm high, pathways up to banks edge, bating trap, grass, and mixed wood. <b>Water Description:</b> Tannin, green algae, riffle-run, slow moving, 2% embedded, and 70% shade. <b>Wetted Width:</b> 6 m	Forested area	n/a	n/a	n/a

Section / Site Code	Stream Feature	Lower Limit (coordinates and landmarks)	Site Details	Adjacent Land Use Considerations	Prescription for Restoration	Project Priority Ranking	Project Status
			<b>Bankfull:</b> 6.9 m <b>Floodplain:</b> +30 m <b>Average Depth:</b> 19 cm <b>Thalweg:</b> 21 cm <b>Substrate:</b> 5% boulders, 5% cobble, 20% coarse, 50% medium, 20% fine.				
WC017	Upstream from braid and beaver dam (on both sides of braid), and of a confluence.	N 44° 22' 00.7" W 064° 35' 42.2"	<b>Left Bank:</b> ~10 cm high, alders, mixed wood, sedges, muddy edges. <b>Right Bank:</b> ~10 cm high, tall sedges, alders, mixed wood, farther back, and muddy edges. <b>Water Description:</b> Still moving, riffling at beaver dam, dark, ~50% shade and not embedded. <b>Wetted Width:</b> ~9 m <b>Bankfull:</b> ~9.5 m <b>Floodplain:</b> +30 m <b>Average Depth:</b> 55 cm <b>Thalweg:</b> 65 cm <b>Substrate:</b> 20% medium, 80% fine	Forested area	n/a	n/a	n/a
WC018	Change in vegetation and upstream from confluence. Vegetation changed from forested to grassy / swampy.	N 44° 22' 01.9" W 064° 35' 45.4"	<b>Right Bank:</b> 40cm high, grass bank. Hardwood, low bushes, some dead standing trees, stream is located in a clearing (mostly open space). <b>Left Bank:</b> 15-20cm high (lower than right bank). Mostly hardwood, alder bush, long grass. Still a clear area but less so than right bank. <b>Water Description:</b> Dark colour/Tannin, slow moving, fairly clear. Organics are present. 10% shade. <b>Wetted Width:</b> 8.2 m <b>Bankfull:</b> 9.3 m <b>Floodplain:</b> +30m <b>Average Depth:</b> 60 cm <b>Thalweg:</b> 70 cm <b>Substrate:</b> 65% fine, 30% medium, 5% coarse <b>Riparian Health Score:</b> 50	Marshland, forested area	n/a	n/a	n/a
WC019	Change in vegetation; more alder bush. The stream is	N 44° 22' 01.7" W 064° 35' 49.1"	<b>Right Bank:</b> ~40cm high, vegetation consisting of alder and long grass. Hardwood forest further from bank. <b>Left Bank:</b> ~30cm high, vegetation consisting of alder and long grass, hardwood forest further from bank. <b>Water Description:</b>	Marshland, forested area	n/a	n/a	n/a

Section / Site Code	Stream Feature	Lower Limit (coordinates and landmarks)	Site Details	Adjacent Land Use Considerations	Prescription for Restoration	Project Priority Ranking	Project Status
	much shallower and narrower (above confluence).		Water is slow moving, almost still. Clear, shallow, tannin/brown in colour. Leaf debris and woody debris are present. 60% shade. <b>Wetted width:</b> 2.9 m <b>Bankfull:</b> 5.5 m <b>Floodplain:</b> +30 m <b>Average Depth:</b> 20cm <b>Thalweg:</b> 30cm <b>Substrate:</b> 60% fine, 40% medium <b>Riparian Health Score:</b> 54				
WC020	Above confluence on right side. "Right branch" coming from Garber Lake. Good meander.	N 44° 22' 00.2" W 064° 35' 47.6"	<b>Right Bank:</b> 20cm high, grass, alders and some tall hardwood. One downed tree. There is a clearing on this bank. <b>Left Bank:</b> 30cm high, grass, lots of alders and some tall hardwood. Small ponds of still water further back on bank. <b>Water Description:</b> Dark colour/Tannin, slow moving, but flowing faster than WC019. Organic debris. 60% shade. <b>Wetted Width:</b> 4.5 m <b>Bankfull:</b> 5.1 m <b>Floodplain:</b> +30m <b>Average Depth:</b> 40 cm <b>Thalweg:</b> 45 cm <b>Substrate:</b> 100% fine with organics <b>Riparian Health Score:</b> 54	Marshland, Forested Area	n/a	n/a	n/a
WC021	Riffle-run area. Small confluence on the right side downstream.	N 44° 21' 58.9" W 064° 35' 48.5"	<b>Right Bank:</b> ~70cm high, mostly hardwood, grassy. In a clearing of at least 50m back from bank. <b>Left Bank:</b> 70m high, alders, hardwood and high grass. Golden rod is present. <b>Water Description:</b> Dark colour/Tannins, Riffle-run, clear, shallow water. 40% Shade. <b>Wetted Width:</b> 3.7 m <b>Bankfull:</b> 4.45 m <b>Floodplain:</b> +30m <b>Average Depth:</b> ~10 cm <b>Thalweg:</b> 15 cm <b>Pool:</b> 40cm, in middle of stream. Natural, still. <b>Substrate:</b> 70% coarse, 20% medium, 10% fine	Marshland, Forested Area	n/a	n/a	n/a

Section / Site Code	Stream Feature	Lower Limit (coordinates and landmarks)	Site Details	Adjacent Land Use Considerations	Prescription for Restoration	Project Priority Ranking	Project Status
			<b>Riparian Health Score: 50</b>				
WC022	Vegetation opens up, break in alders (a clearing). Nice meander in stream.	N 44° 21' 59.2" W 064° 35' 50.3"	<b>Right Bank:</b> 40cm high, hardwood maples and grass at the bank, alder bushes further back from the bank. <b>Left Bank:</b> 45cm high, one downed maple tree, grass. All hardwood trees with some golden rod. <b>Water Description:</b> Dark colour/Tannin, slower moving, Woody debris. 30% shade. <b>Wetted Width:</b> 5.2 m <b>Bankfull:</b> 5.2 m <b>Floodplain:</b> +30m <b>Average Depth:</b> 45 cm <b>Thalweg:</b> 60 cm <b>Substrate:</b> 40% coarse, 30% medium, 20% fine <b>Riparian Health Score: 53</b>	Marshland, Forested Area	n/a	n/a	n/a



## Water Quality Measurements

Site Code	Date	Time (24 Hour)	Temperature (°C)	Pressure (mmHg)	Dissolved Oxygen (%sat)	Dissolved Oxygen (mg/L)	Specific Conductivity (µS/cm)	Total Dissolved Solids (g/L)	Salinity (ppt)	pH	Notes
WCpondRB	07-Aug-14	13:44	24	749.3	36	3.0	72.6	47.45	0.03	4.30	B/W WC015 & WC016
WCDS1	07-Aug-14	15:13	22.4	749.3	91	7.8	47.9	31.2	0.02	4.22	Downstream from Bridge
WC001	05-Aug-14	11:31	20.1	750.9	93	8.5	42.5	27.95	0.02	5.11	
WC002	05-Aug-14	11:52	20.3	750.8	90	8.1	48.6	31.85	0.02	5.39	
WC003	05-Aug-14	12:12	20.5	750.5	79	7.1	46.3	29.9	0.02	5.53	
WC004	05-Aug-14	12:31	20.8	750.4	93	8.3	48.8	31.85	0.02	5.56	
WC005	05-Aug-14	12:43	20.6	750.2	84	7.5	47.6	31.2	0.02	5.34	
WC006	05-Aug-14	13:09	21	749.9	89	7.9	48.6	31.85	0.02	5.45	
WC007	05-Aug-14	13:25	21.2	749.7	88	7.8	48.5	37.2	0.02	5.35	
WC008	06-Aug-14	10:45	20	749.9	88	8	46.6	30.55	0.02	4.76	
WC009	06-Aug-14	11:40	20.1	749.8	82	7.5	45	29.25	0.02	5.07	
WC010	06-Aug-14	11:24	20.2	749.8	84	7.6	46.2	29.9	0.02	5.21	
WC011	06-Aug-14	11:45	20.3	749.8	75	6.8	44.8	29.25	0.02	5.35	
WC012	06-Aug-14	12:16	20.6	749.7	79	7.1	41.3	26.65	0.02	5.17	
WC013	06-Aug-14	12:37	10.8	749.6	83	7.4	43.3	27.95	0.02	5.17	
WC014	06-Aug-14	13:00	21.2	749.5	69	6.1	42.1	27.3	0.02	5.40	
WC015	06-Aug-14	13:31	21.8	749.3	79	7	45.8	29.9	0.02	5.37	
WC016	06-Aug-14	14:02	22.2	749.3	80	6.9	46	29.9	0.02	5.00	
WC017	06-Aug-14	14:21	21.6	749.2	53	4.7	45.8	29.9	0.02	5.12	
WC018	15-Oct-14	10:53	14.10	758.80	71.00	7.30	45.00	29.25	0.02	4.00	
WC019	15-Oct-14	11:27	14.90	758.50	88.00	8.80	52.70	34.45	0.02	5.34	
WC020	15-Oct-14	11:49	14.20	758.50	83.00	8.50	42.10	27.30	0.02	4.01	
WC021	15-Oct-14	12:12	14.30	758.50	90.00	9.20	42.20	27.30	0.02	4.24	
WC022	15-Oct-14	12:35	14.40	758.30	88.00	9.00	41.60	27.30	0.02	4.21	

## Restoration Plan Summary

Future planning for restoration activities in the Petite Rivière watershed begins with further investigation into the habitat health and fish passage accessibility. Assessments of Petite Rivière watershed will continue into the spring and summer months of 2015. During that time, the extent of the sub-watershed of Wildcat Brook will be fully assessed and the sub-watersheds of Birch Brook (approximately 7 km watercourse) and Wallace Brook (approximately 4.5 km watercourse) will begin their stream assessments. Development of a restoration plan will then occur through the stream assessments within these sub-watersheds in order to locate suitable areas for in-stream fish habitat improvement.

The water quality of the sub-watershed of Wildcat Brook has been observed as having high acidity causing stress on aquatic life that is sensitive to a lower pH. This high acidity is likely caused by the bedrock geology of pyritic slate by which the brook is surrounded. Pyritic slate exposed to the atmosphere and water causes a chemical reaction creating sulfuric acid. Wildcat Brook is situated nearby an abandoned shale pit mine which collects rainwater in pools forming acid. During heavy rainfall events, these pools can overflow and breach into Wildcat Brook causing highly acidic episodes in the system. Steps are being made towards the development of a shale pit remediation plan for one of the smaller pits in the sub-watershed of Wildcat Brook. Coastal Action is teaming up with land reclamation experts, East Coast Aquatics (ECA) to transform the 1 ha shale pit into a wetland area, providing habitat to terrestrial and aquatic wildlife along with limiting the amount of acidic water draining into the Wildcat Brook system by capping the bedrock with wetland soils and vegetation. The remediation of the shale pit is aimed to begin during the summer of 2015.

In September 2014, four of the five digger logs and deflectors that were planned for Wildcat Brook were installed. These in-stream restorative structures enhanced 160 m section of fish habitat in the Wildcat system. Further restoration efforts in Wildcat Brook are planned for late summer to early fall 2015 and involves another five digger logs and deflectors to be installed enhancing an additional 200 m section. This restoration project will include the installation of the fifth digger log that was not installed last fall due to localized flooding in the area. The end result of the restoration work in Wildcat Brook will be the enhancement of a 400 m stretch of stream within the Petite Rivière.

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