WRIG

Field Crew Supervisors Report 2017

Prepared for the Wheatley River Improvement Group

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Introduction

The Wheatley River Improvement Groups (WRIG), 2017 summer season started on June 19th. The field crew consisted of myself, Brittany MacLean as field crew supervisor, Clare FitzPatrick as Riparian Health Technician and Taylor Gallant as Field Crew Technician. This is my Fourth summer with WRIG and I am entering my final year at the University of New Brunswick, completing my BSc in Environment and Natural Resources with a specialization in wildlife conservation. Clare FitzPatrick joined WRIG this year for the first time, she is entering her third year at Dalhousie University double majoring in Biology and Chemistry. Taylor Gallant joined WRIG this year for the first time as well, he attends Bluefield High School and is going into grade 11 with a strong interest in the environment.

WRIG is a non-for-profit watershed group located out of Cymbria PEI, and manages four different watersheds within its boundary, Wheatley river, Hornes Creek, Chapel Creek and Lukes Creek. Some of the accomplishments this season include the planting of 826 native tree and shrub species in different riparian areas fallen tree removal brush mat construction and alder thinning for the improvement of fish habitat and passage. Water quality monitoring was performed weekly to get a sense of the quality of the fish habitat in the watershed along with much more to be discussed in detail throughout this report.

Figure 1: WRIG Tree Planting Locations for the 2017 Summer Season.

Tree Planting

WRIG completed the native tree planting portion of the summer season between June 26-July 7 this year. By finishing this early the saplings are provided with the best chance of survival and being able to establish a root system before the dry weather in August. WRIG received a total of 826 trees and shrubs between 19 different species from the island nursery, depicted in Table 1. We planted the trees and shrubs at 5 different sites throughout the watershed along with 100 that are given away on Canada day in Rustico each year.

Table 1:WRIG 2017 Tree and Shrub Amount Per Species Received from the Island Nursery.

Species	Amount
Eastern Hemlock	18
Mountain Holly	52
Red Osier Dogwood	42
Eastern Larch	47
American Elm	30
White Pine	76
White Spruce	64
Bayberry	66
Sweet Fern	27
Spiraea latifolia (Meadowsweet)	74
Green Ash	36
Common Elder	42
White Birch	36
Sugar Maple	66
Aronia melancarpa	36
Staghorn sumac	18
Staghorn sumac	36
Aronia prunifolia	24
Spiraea tomentosa	36
Total	826

The first site was a costal erosion prevention and mitigation site off the Church Rd on property #527986. This landowner noticed that the property was receding due to erosion from the Chapel Creek estuary in south Rustico, and contacted WRIG. 168 salt tolerant species like bayberry and *spiraea sp* were planted at this site. The second site was a wetland protection and forest extension site off the Buffalo Rd, property #1032325. This property had trees planted on in 3 years ago however very few survived, the landowner retired a portion of their property, to extend the forested area around the marshy headwaters off Chapel Creek. 102 moisture tolerant and intolerant species like maple and oak were planted in this section because of the slope of the site. The third site was a buffer zone extension and runoff prevention site off the Church Rd, property #1019066. Trees were planted at this site the last 2 years, where some of them have begun to establish themselves. This area is a retired hay field with a seasonal drainage basin trough the center, emptying into a tributary off the Wheatley River. There was an additional 102 trees planted amongst the established ones at this site. The Fourth site was a tributary protection site off the Millboro Rd, Property #240481. This property is a recently retired cattle pasture, where the landowner approached WRIG to try and enhance and protect the Wheatley River tributary that runs through it. 24 very water tolerant species were planted here. The fifth site was a buffer zone enhancement site off the Church Rd, property #795864. The buffer zone on this property was mostly comprised of grasses and sporadic shrubs, with no diversity or deep root structures for bank stabilization and runoff mitigation. 80 tree and shrub species were planted at this site to help enhance the effectiveness of the buffer zone. Refer to figure 1 for all planting locations.

Stream Restoration

This year WRIG has assessed and restored 6.01km of stream, to improve the overall health, native fish passage and spawning habitat throughout the system. Portions of 3 major systems were restored this year, seen in figure 2. Most of the effort was directed towards the Crooked creek main branch. Work started off the Crooked creek Rd, property #576587 and ending on the Parker Cross Rd, property #940361. The Crooked creek system was not

looked at by WRIG for multiple years. The first portion on property #576587 is still part of the estuary and is experiencing high erosion rates. The only bank stabilizing plant in that area are smooth cordgrass *Spartina alterniflora*, and other salt tolerant grasses. From property #241398 to property #992347 this portion had adequate buffer zones and late successional deep root trees surrounding and stabilizing the banks. Areas were over grown

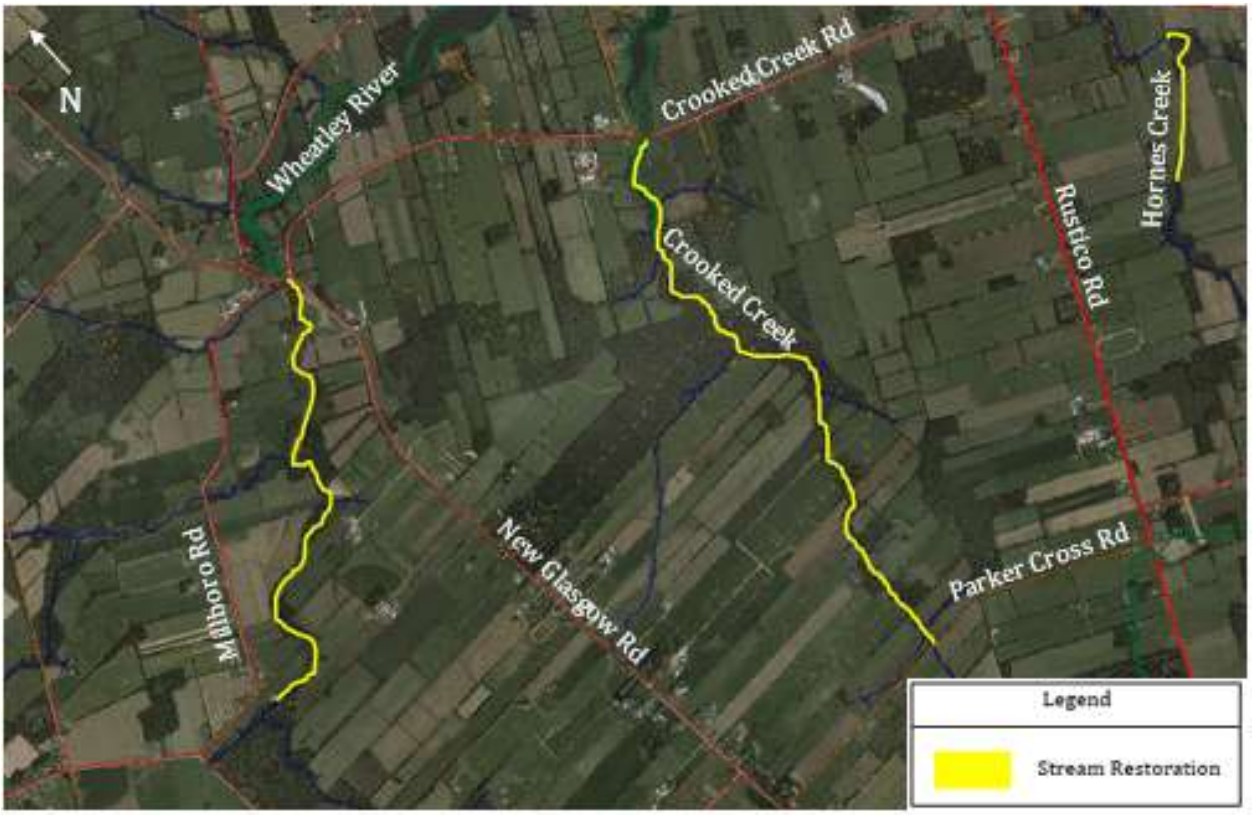

Figure 2: WRIG Stream Restoration Portions for the 2017 Summer Season.

by alders however. Property #992347 itself appeared to be an old beaver habitat with many blockages with excessive silt on the substrate. The banks of this beaver area were suffering form extensive erosion, to help mitigate the effects 6 brushmats were installed in this area, seen in figure 3, in an effort for fortify and build up the banks. From property #240846 to property #940361 the conditions remained consistent, the substrate had high amounts of silt with sporadic areas of cobble bottom, alders were heavily overgrown in areas providing very little bank stabilization and blockages, along with fallen trees. Property #240903 had several fallen trees over the stream system that require a chainsaw for removal. The second system that was restored was a portion of Hornes Creek, located on properties #241711 and #856153. The landowner contacted WRIG to assist in the removal of fallen trees in the stream on the property. There was a total of 3 trees that were removed. The rest of the portion of stream that was restored had very poor bank stabilization due to the lack of deep

rooting vegetation in the area, as a result the substrate was heavily silted. On Property #856153 this portion of the stream was overgrown by alders which were impeding stream flow and choking it out. The third system that was restored was the Wheatley River main branch, above and below Rackham's pond, starting off the New Glasgow Rd property #240614 and ending at property #240689 off the Millboro Rd. The portion above Rackham's pond, on property #240614 is restored annually in preparation for the celebrate our river even held on the last Saturday in August. There was very few blockages and the substrate was cobbled with little siltation in this section. The portion below Rackham's pond on property #1062900 to property #240689 has been restored by WRIG in the past, this time was to assess the health of the stream after the initial work. This portion of the Wheatley River had a rocky substrate and few recent blockages, the banks also had deep root vegetation for stability. There were two locations on this system however that no buffer zone is present between the agriculture field and the stream. Property #240671 have a livestock pasture fenced off at the edge of the river and large sections of the stream bank are eroding away where the fence was driven into the ground. Property #518225 have a spring fenced into the livestock field providing access for the animals to enter the spring, the path the livestock travels is starting to erode into the stream.

Figure 3: Brushmat Installed on Property #992347 on Crooked Creek Main Branch in old Beaver meadow to Help Stabilize Stream Banks.

Rackham's Pond

Rackham's pond is a community pond, where WRIG takes responsibility for upkeep and overall productivity of the area. Weekly lawn maintenance was completed to provide better access for anglers and the public along with 2 additional projects, macroinvertebrate

bioindicator sampling to get better insight on water quality and a fish habitat restoration project.

Macroinvertebrate Sampling

Benthic macroinvertebrates serve an important role in overall health of aquatic ecosystems, providing food for many species living in that environment. They are widely used as biological indicators because they are found in nearly all freshwater environments. They are also easily collected, identified and the wide range of different taxa show varying degrees of sensitivity to pollutants. Different taxa of

Figure 4: Macroinvertebrate Sampling Areas Along Rackham's Pond on the Wheatley River, Each Location one Hester-Dendy Sampler was Placed.

macroinvertebrates colonize different habitats of substrates. Rackham's pond is composed of two different substrates, hard and soft. Hard substrates are comprised mostly of cobble and hardbottom substances, and soft substrates are comprised of silt and sand bottom. It is important that the scope of the sampling encompasses both substrates present in the area. At Rackham's pond 4 different sampling sites were used, shown in figure 4, using a multi-plate Hester-Dendy sampler. Hester-Dendy's provide an opportunity for the invertebrates to colonize the sampler, and later be examined. The Hester-Dendy's were anchored to the bottom of the stream bed with rocks but not in direct contact with the substrate, with the plates parallel to water flow. The sampling took place from July 7-July 24, 2017. Referring to table 2 and 3, location 1 had more variety of species compared to 4 and 3, however most all species were tolerant and somewhat tolerant to pollutant in the water.

Table 2: Rackham's Pond Macroinvertebrate Sampling Results Using Hester-Dendy Samplers.

Trap Name	Location	Species Found
D	4	Micro/northern Caddisfly, Midge
B	3	Leech, Snails, Midge, Eggs
A	1	Mayfly, Midge, Alderfly, Black fly &pupa, Dance fly, Small minnow mayfly, Aquatic worm, Round worm, Riffle beetle, Free living caddisfly.
C	2	Sample stolen.

Table 3: Tolerance of Species Observed During Sampling at Rackham's Pond.

Species	Tolerance
Micro caddisfly	Moderate tolerance, abundant in streams with nutrient pollution, because to the increased algae growth on the surface of rocks. Occurring in dense patches in these environments.
Northern case maker caddisfly	Largest group of caddisflies, with a very divers level of tolerance.
Non-biting midges	Very diverse group with varying stress levels. An indication of poor water quality and some type of pollution. Bright red midges (which were present) thrive in nutrient polluted water with reduced dissolved oxygen levels.
Leech	The presence of leeches does not indicate poor water quality or pollution. Living in lentic habitats or slow-moving water habitats
Pleurocerid snail	Lotic-erosional habitat somewhat sensitive.
Common burrower mayflies	Somewhat tolerant, populations increase with the moderate increase of nutrient levels. Sensitive to dissolved oxygen levels, about 1 ppm, and to chemicals that can be bound to sediment.
Physid snail	Soft silty habitat, somewhat tolerant of pollution.
Small minnow mayflies	Very tolerant to pollution, are found in waters with high nutrient concentrations, sedimentation and reduced dissolved oxygen.
Alderflies	Very tolerant, thrive in low dissolved oxygen, excess nutrients and organic waste.

Black flies	Somewhat tolerant, populations increase with moderate increase of nutrients and organic matter concentrations. Good indication of moderate pollution.
Dance flies	Somewhat tolerant, predatory insect.
Aquatic worm	Very tolerant
Riffle beetles	Somewhat sensitive
Free living caddisfly	Very sensitive, the lack of a case increases its sensitivity to pollutants in the water.

Fish Habitat Restoration (Log Crib Deflector)

Rackham's pond was originally a large pond basin dating back to 1935, which can be seen in figure 5. Now in 2017 the pond is gradually returning to its original meander along the back portion, figure 6. This portion has very little cover for fish regarding vegetation overhead and pool areas, with excessive silt. Pool distance measurements were taken and using the data collected two log crib defectors were built in this area, to provide the fish with better

Figure 6: Arial Photo of Rackham's Pond on the Wheatley River, 2017. The Red Marker Indicates Location of Log Crib Deflector, Yellow Marker Indicates Location of Pinching Deflector.

Figure 5: Arial Photo of Rackham's Pond on the Wheatley River, 1935.

habitat for rearing and migration along with the displacement of some sediment buildup. Using access from property #1062900 the first deflector, indicated by the red marker in figure 6, was built using 4-16 ft 6x6 juniper beams and 4-12ft 6x6 beams, connecting at a 90° angle, 7ft from the banks and keyed into the bank 4ft. Juniper beams were used because the wood is more resilient from rotting when submerged. The beams were secured together with galvanized nails and anchored to the stream bed using untreated rebar. To protect the opposite bank at this location a log jam was placed and anchored to prevent scouring from the discharge off the deflector. The purpose of the log crib deflector is to create a large pool using the force of high spring melt water, for fish to utilize in the warmer summer months when water levels drop and temperatures rise. The second location indicated by the yellow mark in figure 6 was a pinching deflector was placed, where two deflectors adjacent to one another creating a pool towards the center of a waterway. One deflector was built using the crib design, using 3-8ft 6x6 juniper beams and 3-8ft 6x6 beams connecting at a 90° angle, being keyed into the bank 3ft and anchored with rebar. The second deflector at this location was built using the wing deflector design, one single 7ft unprocessed log was anchored with rebar at a 30° angle from the bank. All crib deflectors were lined with filter fabric and spruce limbs to help protect the inside from erosion and then filled with 15 tons of grade 6 rocks between the 4 deflectors for stabilization. In addition, brush mats were placed along the banks up and downs stream of the deflectors for added bank support and sediment control. This fish habitat restoration project was completed with the help of 3 neighbouring groups, Hunter-Clyde watershed group, Central Queens Wildlife Federation and the Bedeque Bay Environmental Management Association, shown in figure 7.

Figure 7: Central Queens Wildlife Federation, Bedeque Bay Environmental Management Association and Wheatley River Improvement Group with Finished Log Crib Deflector.

Water Quality Monitoring

Water quality monitoring was performed every week on all the major tributaries in the Wheatley River watershed. WRIG shared a YSI water quality monitoring meter with the Hunter Clyde watershed group, that just recently had a nitrate probe installed. A total of 22 sites were monitored this year, as seen in figure 8 for temperature, dissolved oxygen, specific conductance, conductivity, total dissolved solids, salinity, pH and nitrates. Overall With the results collected form this sampling WRIG will have a better understanding of the quality of

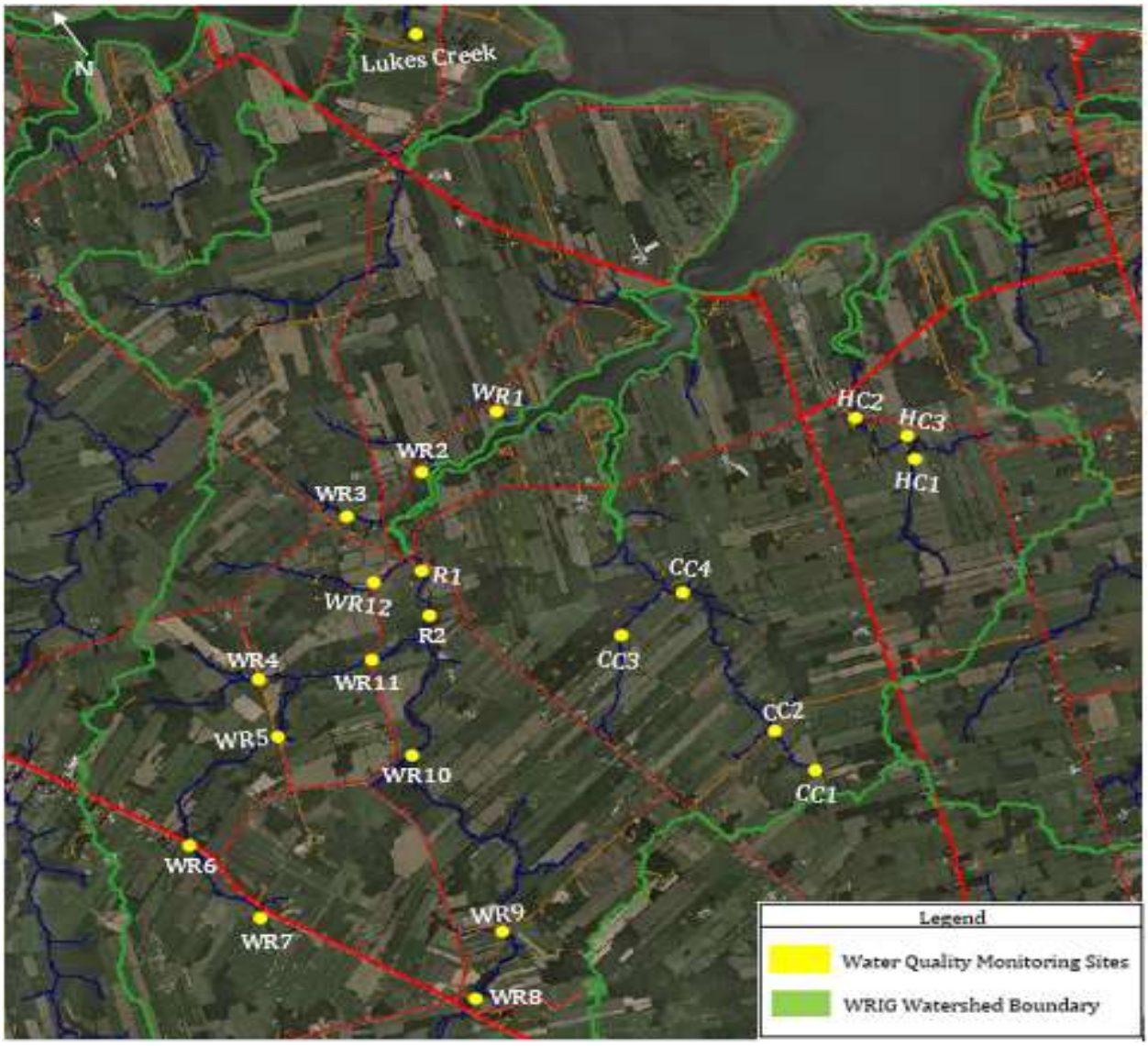

Figure 8: Locations of all Water Quality Monitoring Site Across the Wheatley River Watershed.

water and habitat in the watershed, and be equipped to make informed management decisions. All results form this monitoring can be seen in appendix A.

In addition to tributary water quality monitoring, estuary monitoring was also preformed monthly to determine the severity of anoxic events happening in the Wheatley River estuary, through observational canoe surveys. A qualitative survey was conducted due to the new nitrate probe could not be used in water bodies with high salinity levels. Overall anoxia levels were predominant in the estuary again this year occurring later in July and early August compared to last years levels, when the full anoxia even occurred in early July. In addition to monthly qualitative surveys there is also an estuary watch program available to the community surrounding the estuary, where they receive a booklet from WRIG and observe and record the state of the estuary each day, either online or on paper. This program has been going on for the last couple years.

Riparian Health Assessments/Crossing Assessments

Riparian zones are transitional areas directly adjacent to a stream or water body and between the upland area. These zones preform many different functions like filter and buffer water form the upland, recharge the aquifer and trap sediment. Because riparian areas are

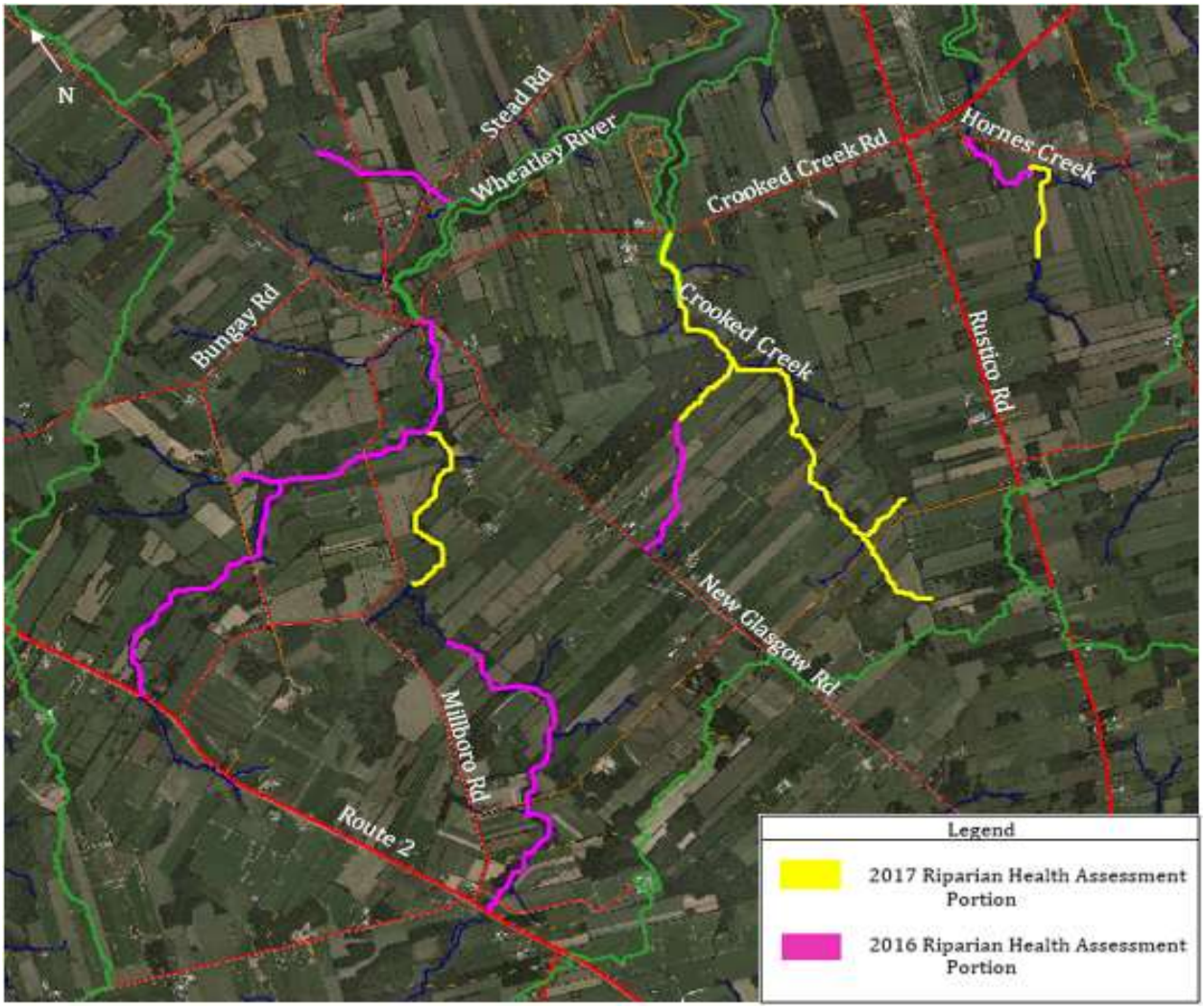

Figure 9:Stream Restoration Work Completed in Both 2016 and 2017 Summer Seasons.

part of a continuous landscape it is difficult to determine changes in the overall health, so WRIG conducts assessments using a generalized riparian health assessment survey protocol. The survey contains 13 questions that assess individual reaches of the riparian zone that are relatively homogenous, a reach ends when there is a change in vegetation, topography or usage of the riparian area. That is the area that is to be assessed. Referring to figure 9 over the last 2 years WRIG has completed 20.49km of riparian health assessments, 13.01km in the 2016 summer season and 7.48km in the 2017 season. The assessments were completed

in Wheatley River main, Little Bungay branch, the majority of the Crooked Creek, Hornes Creek and Ross Creek. Results from the 2017 season can be seen in Appendix B.

Culvert assessments are also preformed in the same manner during riparian health assessment using a generalized protocol. It is important to preform culvert assessments to determine the effect on fish passage and disturbance to the ecosystem, allowing groups to pinpoint problem areas for management. There were 9 culvert assessments complete in the 2017 summer season and the results can be found in Appendix C.

Community Involvement

Environmental Fun Day

A major goal of WRIG is to increase public awareness of the environment and issues surrounding it, especially in today's youth. On June 19, 2017 WRIG partnered with the Hunter-Clyde watershed group and invited 92 grade 6 students from Gulf Shore School, Central Queens Elementary and home-schooled students to take part in the environmental fun day. This event was healed at the Garden of Hope in New Glasgow. Upon arrival, the students were split into 6 groups and would travel around to different stations throughout the garden. Each station had a different topic that the students would learn about, the stations included a falconry demonstration, butterfly ecology, coastline and piping plover protection, tree ecology and forestry practices, fly fishing demonstrations and water quality monitoring. Each station was taught by specialists in each area.

Osprey Pole Installation

Ecole Saint. Agustin school located in Cymbria has been experiencing problems with ospreys making nests on the electrical and light poles in front of the school. Partnering with WRIG and Maritime Electric they wish to us this situation and create a learning opportunity for the students and install an osprey nesting pole on school grounds. This project hopes to be the catalyst to encourage the students in leaning more about the environment in their own communitys. Initial visits and estimates have been made by Maritime Electric for the installation of the pole, installation should get underway in the fall of 2017.

Coastal Clean up Living Shoreline Project

WRIG was contacted and informed of an old farm dumping site located on the coastline of the oyster bed estuary, that has been exposed due to erosion and was spilling into the water. On July 19, 2017 WRIG with the help of the landowners removed most of the garbage which consisted of glass, metal and plastic. To help mitigate the effects of the erosion

a living shoreline is also going to be installed at this site. By using plants and organic material to help stabilize the coastline they do not impede natural riparian processes from happening, they also provide habitat for aquatic and terrestrial species. This living shoreline project will get underway in the fall of 2017.

Youth Tree Planting

To assist in the learning and the appreciation for trees, on May 19, 2017 WRIG donated a total of 187 native trees and shrubs to Ecole Saint Agustin, for a youth tree planting project along with David Carmichael from the green spaces program. The trees were planted by students form multiple grade in 2 different locations, one on the school grounds around a playset area and the second on property #576785 to create a wind blocking hedge in front of their crop.

4H Picnic

On July 15, 2017 WRIG hosted an event at Rackham's community pond for the local 4H group. The 4H group recently learned about bats on PEI and donated a bat house to WRIG. The event was a bat themed picnic located at the Wheatley River hall where food and refreshments were served. Attendees also had the opportunity to walk the pond where there was an information booth set up about what WRIG does as a watershed, scavenger hunt that could be completed and other activities.

Celebrate Our River Day

The celebrate our river day is held on the last Saturday of August and is an annual event hosted by WRIG at Rackham's community pond. It is put in place so the community has a chance to come, learn and appreciate the watershed they live in. At the pond, there are information booths set up for the public to learn and ask questions about some of the work WRIG does throughout the summer along with activities for children to participate in. At 12:00pm there is a barbeque and shortly after a rubber duck race, where people can buy tickets to enter a duck in the race. The race begins at the mouth of the pond and finishes at the Wheatley River bridge with cash prizes for the winners.

Collaborations

Canada Day Tree Giveaway

On July 1, 2017 WRIG partners with the Hunter-Clyde watershed group and holds a native tree give away in a booth at the Canada Day celebrations in North Rustico. This year WRIG provided 82 trees to give away, 24 white pine, 18 common elder and 40 sugar maple. Hunter-Clyde provided 128 native trees for a total of 200 trees. At the booth, there

are memberships for each watershed for the public who is interested and visual aids of the work we accomplish.

Beach Clean up

WRIG along with Hunter-Clyde have extensive shoreline bordering the watersheds, on July 17, 2017partnering with each other complete a shoreline and beach cleanup. 3 different locations were completed, starting at the Barachois beach in Cymbria, north Rustico shoreline in Rustico bay and Campbells pond area. In total around 600 lb of garbage was removed form the environment.

Cavendish Beach Hut

A educational hut was paced at Cavendish beach where every Friday members from the Hunter-Clyde watershed, WRIG and Parks Canada set up and provide information about the environment to beach goers. WRIG would bring various wildlife habitat boxes to the booth as a visual aid for the public.

Electrofishing

On August 14, 2017 backpack electrofishing was conducted by freshwater fisheries biologist Rosie Macfarlane for the third year, on property #240689. Electrofishing is preformed to accumulate data for population and breeding estimates as well as species variety. A portion of the river is closed off using sen netting and all sampling is preformed inside the barrier. Compared to samplings done in passed years this was the first-year Rainbow trout were collected in the sampling process. Rainbow trout are a non-native invasive species on PEI and were introduced via stocking and hatchery escapees. Rainbow trout are now present in over 20 rivers in Prince Edward Island including neighbouring Hunter River, and now in the Wheatley River system also. Rainbow trout and Brook trout have conflicting hatching cycles, and Brook trout populations decline when Rainbows trout are present. Brook trout lay their eggs in the fall, to incubate over winter and hatch in the spring, Rainbow trout lay their eggs in the spring in the same habitat as Brook trout. Because

Figure 10:Comparison Between Rainbow Trout and Brook Trout Pulled from the Electrofishing Sampling Preformed on August 14, 2017.

of this Rainbow trout have the potential to destroy native Brook trout nests and prey upon the fry that hatch.

APPENDIX A

Water Quality Monitoring Results

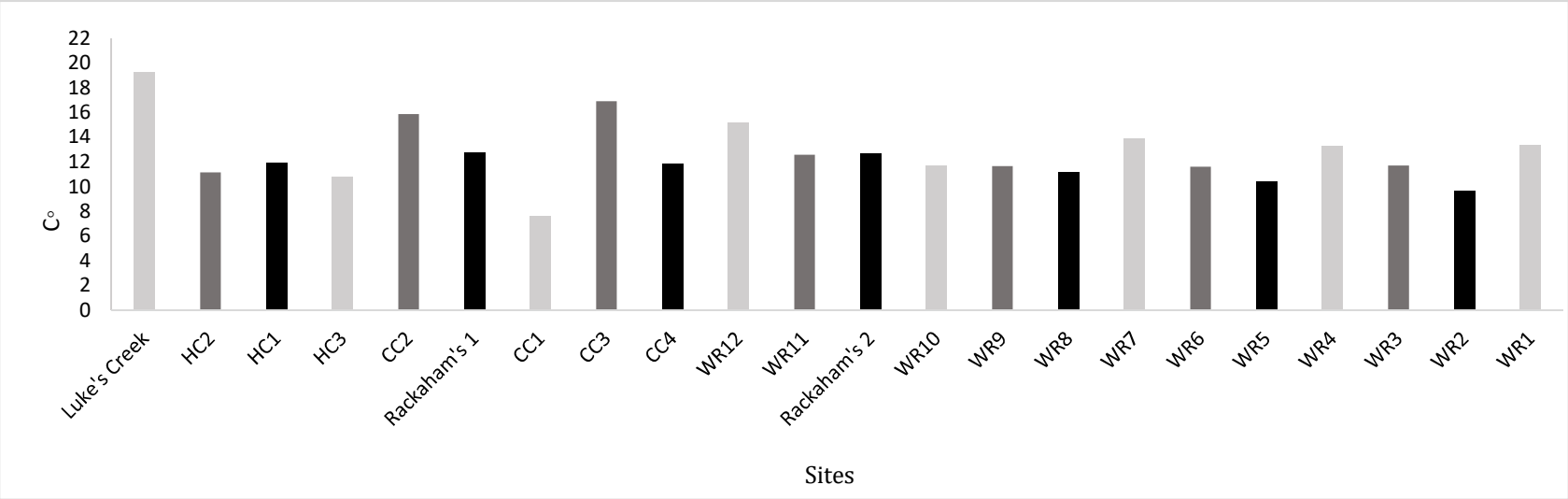

Figure A- 1: Average Temperature Across All Water Quality Monitoring Sites in the Wheatley River Watershed. Date Accumulated Using YSI Sampling Meter.

Figure A- 2: Average Dissolved Oxygen (DO) Across all Water Quality Monitoring Sites in the Wheatley River Watershed. Data Accumulated Using YSI Sampling Meter.Figure A- 3: Average Temperature Across All Water Quality Monitoring Sites in the Wheatley River Watershed. Date Accumulated Using YSI Sampling Meter.

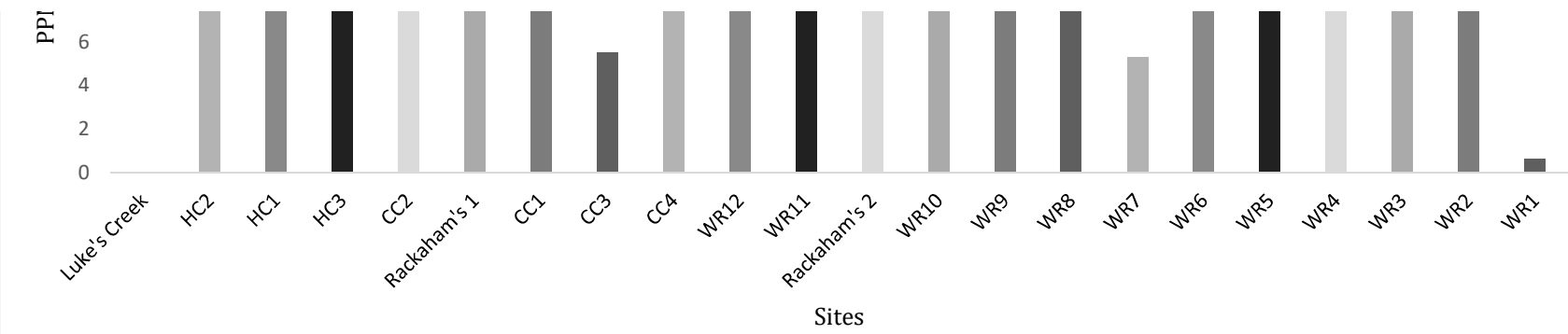

Figure A- 4: Average Dissolved Oxygen (DO) Across all Water Quality Monitoring Sites in the Wheatley River Watershed. Data Accumulated Using YSI Sampling Meter.

Figure A- 5: Average Conductivity (C) Across all Water Quality Monitoring Sites in the Wheatley River Watershed. Data Accumulated using YSI Sampling Meter.Figure A- 6: Average Dissolved Oxygen (DO) Across all Water Quality Monitoring Sites in the Wheatley River Watershed. Data Accumulated Using YSI Sampling Meter.

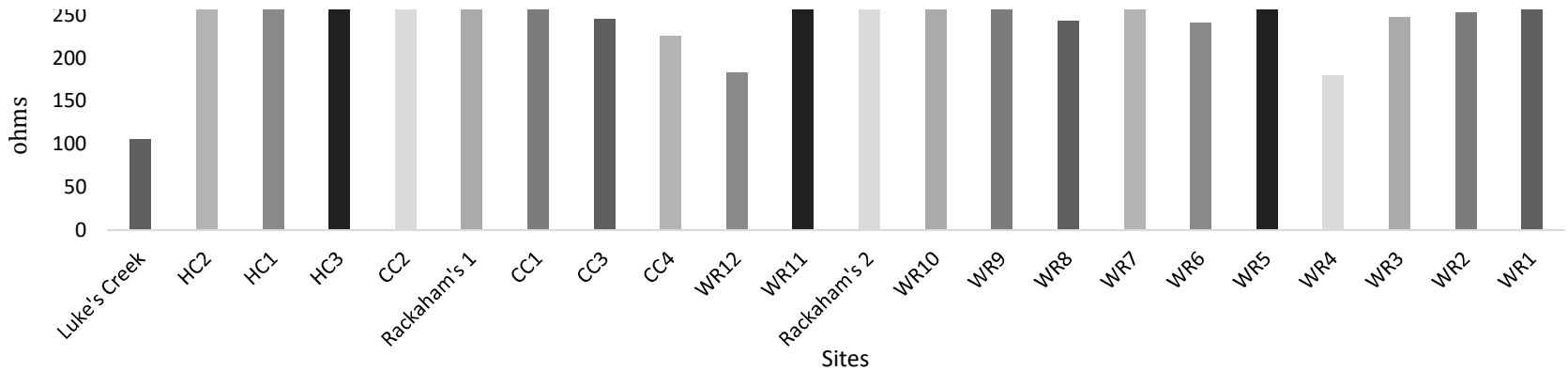

Figure A- 10: Average Specific Conductance (SPC) Across all Water Quality Monitoring Sites in the Wheatley River Watershed. Data Accumulated Using YSI Sampling Meter.

Figure A- 11: Average Total Dissolved Solids (TDS) Across all Water Quality Monitoring Sites in the Wheatley River Watershed. Data Accumulated using YSI Sampling Meter.Figure A- 12: Average Specific Conductance (SPC) Across all Water Quality Monitoring Sites in the Wheatley River Watershed. Data Accumulated Using YSI Sampling Meter.

Figure A- 7: Average Conductivity (C) Across all Water Quality Monitoring Sites in the Wheatley River Watershed. Data Accumulated using YSI Sampling Meter.

Figure A- 8: Average Specific Conductance (SPC) Across all Water Quality Monitoring Sites in the Wheatley River Watershed. Data Accumulated Using YSI Sampling Meter.Figure A- 9: Average Conductivity (C) Across all Water Quality Monitoring Sites in the Wheatley River Watershed. Data Accumulated using YSI Sampling Meter.

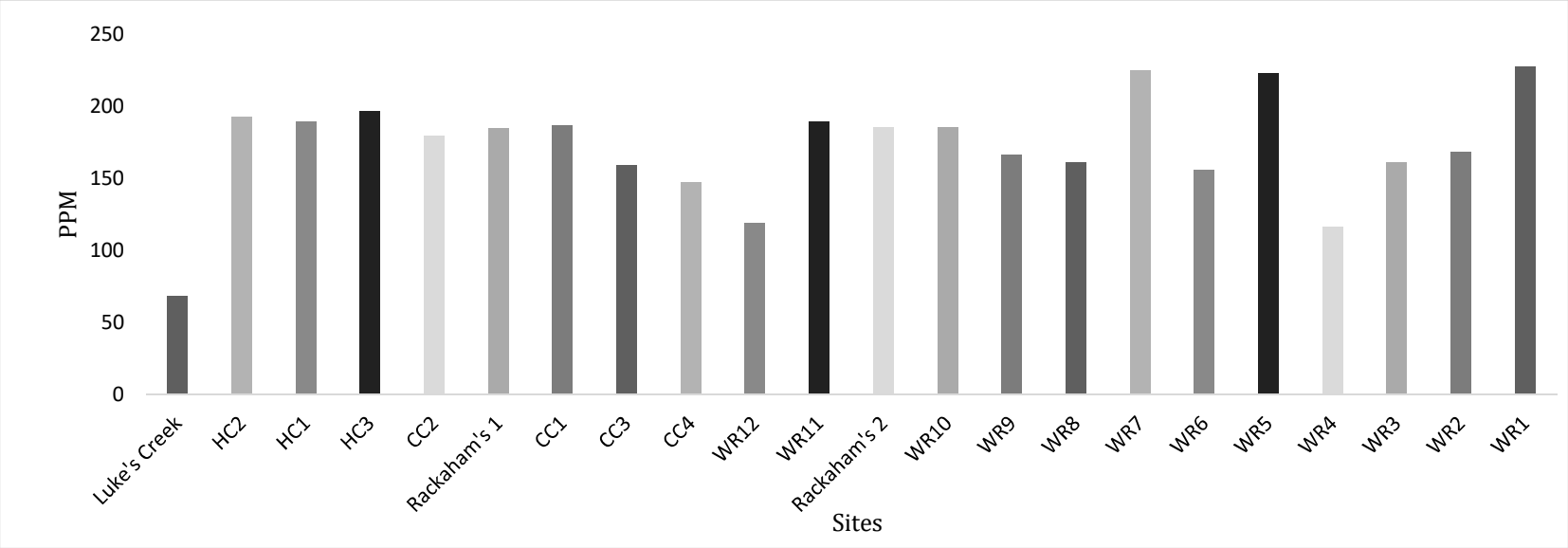

Figure A- 13: Average Total Dissolved Solids (TDS) Across all Water Quality Monitoring Sites in the Wheatley River Watershed. Data Accumulated using YSI Sampling Meter.

Figure A- 14: Average Salinity Across all Water Quality Monitoring Sites in the Wheatley River Watershed. Data Accumulated using YSI Sampling Meter.Figure A- 15: Average Total Dissolved Solids (TDS) Across all Water Quality Monitoring Sites in the Wheatley River Watershed. Data Accumulated using YSI Sampling Meter.

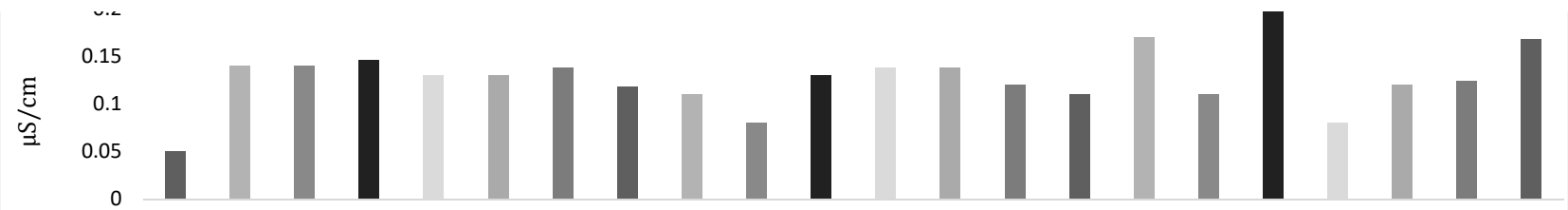

Figure A- 16: Average Salinity Across all Water Quality Monitoring Sites in the Wheatley River Watershed. Data Accumulated using YSI Sampling Meter.

Figure A- 17: Average pH Across all Water Quality Monitoring Sites in the Wheatley River Watershed. Data Accumulated using YSI Sampling Meter.Figure A- 18: Average Salinity Across all Water Quality Monitoring Sites in the Wheatley River Watershed. Data Accumulated using YSI Sampling Meter.

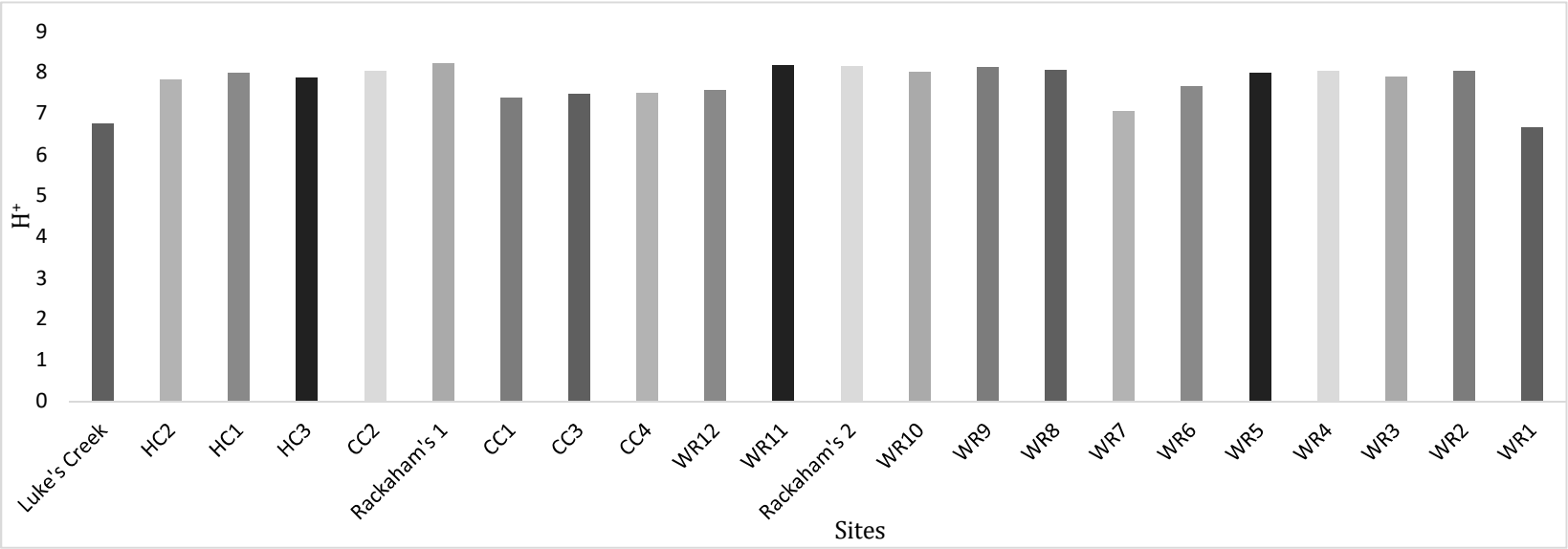

Figure A- 19: Average pH Across all Water Quality Monitoring Sites in the Wheatley River Watershed. Data Accumulated using YSI Sampling Meter.

Figure A- 20: Average Nitrate Levels (NO_3-N) Across all Water Quality Monitoring Sites in the Wheatley River Watershed. Data Accumulated using YSI Sampling Meter.Figure A- 21: Average pH Across all Water Quality Monitoring Sites in the Wheatley River Watershed. Data Accumulated using YSI Sampling Meter.

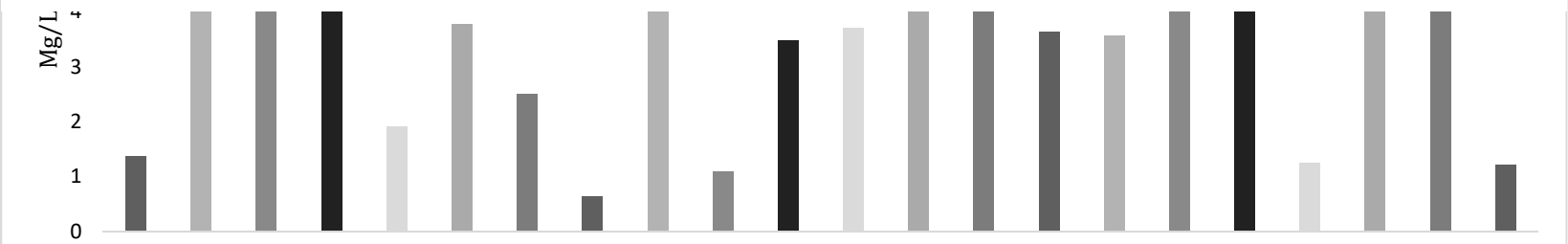

Figure A- 22: Average Nitrate Levels (NO_3-N) Across all Water Quality Monitoring Sites in the Wheatley River Watershed. Data Accumulated using YSI Sampling Meter.

Table B- 1: All Riparian Health Assessment Results for the 2017 Summer Season.Figure A- 23: Average Nitrate Levels (NO_3-N) Across all Water Quality Monitoring Sites in the Wheatley River Watershed. Data Accumulated using YSI Sampling Meter.

APPENDIX B

Riparian Health Assessment Results

Table B- 2: All Riparian Health Assessment Results for the 2017 Summer Season.

From_WP	To_WP	ID	Assessed_With	Location	Group	Date	Time	Last_Rainfall	Avg_Stream_Width_m	Avg_Water_Depth_m	Avg_Sediment_Depth_m	Q1	Q1_percent
RH1	RH2	RH1	Clare, Taylor, Kayla	Crooked Creek bridge area	WRIG	10/07/2017	10:15	09/07/2017	4 m	1 m	15cm	6	100
RH2	RH3	RH2	Clare, Taylor, Kayla	Grassy area of CC	WRIG	10/07/2017	10:40	09/07/2017	4 m	0.75m	30 cm	6	95
RH3	RH4	RH3	Clare, Taylor, Kayla	Transitioning to wooded CC area	WRIG	10/07/2017	12:15	09/07/2017	5m , fluctuates/ blockages	0.25 m	35 cm	4	95%
RH4	RH5	RH4	Clare, Taylor, Kayla	Wooded CC area	WRIG	10/07/2017	1:00	09/07/2017	4 m	0.5m	<10 cm	6	95%
RH5	RH6	RH5	Clare, Taylor, Kayla	Small stream off of main channel	WRIG	10/07/2017	2:30	09/07/2017	2m	0.15 m	< 5cm	6	>95%
RH6	RH7	RH6	Clare, Taylor, Kayla		WRIG	11/07/2017	11:45	09/07/2017	1m	0.1 m	< 5cm	6	97%
RH7	RH8	RH7	Clare, Taylor, Kayla		WRIG	11/07/2017	12;15	09/07/2017	1M	5-10cm	<5cm	6	95%
RH8	RH9	RH8	Clare, Taylor, Kayla	End of creek, vegetative area	WRIG	11/07/2017	12:30	09/07/2017	0.5 m	~5 cm	<5cm	2	75%, W forest E road
RH01	RH02	RH01	Clare, Taylor, Brittany	Crooked Creek main channel	WRIG	21/07/2017	10:16		2m	0.15m	0.10m	6	95%
RH02	RH03	RH02	Clare, Taylor, Brittany	Begins at crossing	WRIG	21/07/2017	11:20		2m	0.5m	0.3m	6	95%
RH03	RH04	RH03	Clare, Taylor, Brittany		WRIG	24/07/2017	12:40	21/07/2017	3m	0.5m	0.3m; fluctuates, very deep at start	6	95%
RH04	RH05	RH04	Clare, Taylor, Brittany		WRIG	24/07/2017	2:20	21/07/2017	3m	0.3m	0.05m	6	95%
RH05	RH06	RH05	Clare, Taylor, Brittany		WRIG	26/07/2017	1:00	21/07/2017	3m	0.15m	0.05m	6	95%
RH06	RH07	RH06	Clare, Taylor, Brittany		WRIG	26/07/2017	3:11		3m	0.25m	0.10m	4	85%; some bare banks
RHH1	RHH2	RHH	Clare, Taylor, Brittany	Harvé's	WRIG	25/07/2017	9:15	21/07/2017	0.75m	0.25m	<0.05m	4	85%
CA01	RHA	CA01	Clare, Brittany		WRIG	31/07/2017	2:38	28/07/2017	0.75m; some areas very narrow	0.20m	< 5cm	6	95%
RHA	RHB	RHA	Clare, Brittany		WRIG	04/08/2017	8:55		1m	0.25m	<5cm	6	95%
RHB	RHC	RHB	Clare, Brittany		WRIG	04/08/2017	9:20		1.5m	0.4m	<5cm	6	97%
RHC	RHD	RHC	Clare, Brittany		WRIG	04/08/2017	9:39		0.5m	0.15m	>5cm	6	95%
RHD	RHE	RHD	Clare, Brittany		WRIG	04/08/2017	9:56		1m	0.15m	0.3m	6	97%
RHE	RHF	RHE	Clare, Brittany		WRIG	04/08/2017	10:40		0.5m	0.20m	0.10m	6	95%
RHF	RHG	RHF	Clare, Brittany		WRIG	04/08/2017	10:57		1m	0.3m	0.4m	6	95%
CCT1	CCT2	CCT1	Clare, Brittany	Crooked Creek	WRIG	07/08/2017		06/08/2017	0.40m	0.1m	<5cm	6	95%
CCT2	CCT3	CCT2	Clare, Brittany	Crooked Creek	WRIG	07/08/2017	11:26	06/08/2017	0.75m	0.1m	<5cm	6	95%
CCT3	CCT4	CCT3	Clare, Brittany		WRIG	07/08/2017		06/08/2017	0.5m	0.10m	< 5cm	6	95%
CAH1	CAH2	CAH	Clare, Brittany	Harvé's	WRIG	07/08/2017	3:00	06/08/2017	2m	0.2m	0.1m	6	95%
CCTRIB1	CCTRIB2	CCTR	Clare, Brittany	Crooked creek tributary	WRIG	07/08/2017	11:44	06/08/2017	0.3m	0.10m	<5cm	6	95%
FORKS	RHOA	FORK	Clare, Taylor, Brittany	Forks of pond (left stream)	WRIG	22/08/2017		20/08/2017	2.5m	0.3m	<5cm	6	95%
RHOA	RHOB	RHOA	Clare, Taylor, Brittany		WRIG	22/08/2017		20/08/2017	2m; one area very wide	0.25m	< 5cm	6	95%
RHOB	RHOC	RHOB	Clare, Taylor, Brittany		WRIG	22/08/2017	1:15	20/08/2017	2m	0.4m	5cm; some areas have no sedimentation	6	95%
RHOC	RHOD	RHO	Clare, Taylor, Brittany	RHOC to end of first cow pasture	WRIG	22/08/2017	2:00	20/08/2017	3m	0.3m	< 5cm	6	97%
RHOD	RHOE	RHO	Clare, Taylor, Brittany	RHOD to start of forest area	WRIG	22/08/2017	2:23	20/08/2017	1.75m	0.36m	< 5cm	6	97%
RHOE	RHOF	RHO	Clare, Taylor, Brittany	End of next cow field, start of forest area	WRIG	22/08/2017	2:41	20/08/2017	2m	0.35m	<5cm	6	95%
RHOF	Bridge	RHO	Clare, Taylor, Brittany	Forest to bridge	WRIG	22/08/2017	3:21	20/08/2017	2m	0.45m	< 5cm	6	97%

Table B- 5: All Riparian Health Assessment Results for the 2017 Summer Season.

Q2A	Q2A_percent	Q2B	Q2B_class	Q3	Q4	Q4_percent	Q5	Q5_percent	Q6	Q7
3	<5	3	0	2	2	<5%	3 N/A	0%	3	6
3	unsure	2	unsure, 2	3	6	50%	3	0%	3	6 grasses
3	<5	3	0	2	6	50%	3	0%	2	4 high sediment
3	<5	3	0	3 ferns	6	95%	3 N/A	0%	2	6
2	<1	2	2	3	6	0	3	0%	3	6
1	1-15%	0	8	2	6	>15%	3 N/A	0%	2, fallen trees	6
2	<1	2	2, few sporadic	3 ferns	6	>15%	3	0%	2	6
2	1%	2	1	0, E has some	6	>15%, W side	2	1-10%	3	2, W yes, E no
3	0%	3	0	3	6	15%	3	0%	2, lots of fallen trees	6
3	0%	3	0	3	6	15	3	0%	2, Lots of blockages	4, 75%; bank on one side much worse
3	0%	3	0	3	6	>15%	3	0%	5; fallen trees	6
3	0%	3	0	2; ferns	6; small maples growing	>15%	3	0%	3; lots of logs in water	6; lots of tall trees on bank
3	0%	3	0	3; ferns	6	>15%	3	0%	3	6; mostly held by trees, some grass
3	0%	3	0	3	6	15.00%	3	0%	3; lots of fallen trees	4; some bare banks, some very sloped
2	1%	2	1	3; ferns	6; lots of young growth	>15%	3	0%	3	4, 85% a lot of trees, but ferns as well
3	1%	3	0	3, jewelweed	6	>15%	2	15%, field cleared	3, a lot of logs	4; A lot of exposed bank
3	0%	3	0	3; hedgeweed	6	>15%	3	0%	3	4; some trees, mostly grass
3	0%	3	0	3; ferns	6	>15%	3	0%	3	4; some exposed sediment
3	0%	3	0	2; hedgeweed	6	>15%	3	0%	3	4; grass, some trees
3	0%	3	0	3	6	>15%	3	0%	3	6
3	0%	3	0	3, hedgeweed	6	>15%	3	0%	3	4
3	0%	3	0	2	6	>15%	3	0%	3	6
3	0%	3	0	1; Golden rod, thistle	4	15%; a lot of grasses	3	0%	3	4
3	0%	3	0	2; ferns	6	15%, Alders	3	0%	3	4
3	0%	3	0	2; Goldenrod	6; lots of trees	>15%	3 N/A	0%	3	4
3	0%	3	0	2; Jewelweed, Doc	6	>15%	3 N/A	0%	3; some dead trees in reach	6; lots of trees
3	0%	3	0	3; ferns	6	>15%	3 N/A	0%	2; some dead trees	4
3	1%	3	1	2; golden rod	6	>15%	3	0%	3	4; mostly grasses
2	1%	2	1; Nightshade	2; Goldenrod	6	>15%	3	0%	3	6; some larger trees along bank
1	1-15%	1	7	3; Goldenrod, fern	6	>15%	3	0%	3	6; lots of larger trees, some grass
2	1%	2	1	2; ferns and Jewelweed	6	>15	3	0%	3	4; alders and grasses
3	0%	3	0; one Nightshade spotted	2	6	>15%	3	0%	3	4
3	0%	3	0	3	6	>15	3	0%	3	4; trees but some exposed bank
2	1%	2	1	3; ferns	6	95%	3	0%	3	6

Table B- 8: All Riparian Health Assessment Results for the 2017 Summer Season.

Q8	Q9	Q10	Q11	Q11_stage	Q12	Q20
6	6	3	9	1a	5-10 m	2 non-row crops
6	6	3	9	1b	>10 m	2 non-row crops
6	6	3	9	1b	10+m	6 trees
6	6	3	9	1a	10+m	6, trees
6	6	3	9	1b	10+m	6, trees
6	6	3, plowing close	9	1b, 3 at very end	10+m	4, trees W,field E
6	6	3	6	2	10+m, getting smaller as head S	4, trees W,NR crops E
2, road close	4	2, soil compaction	0	4b	5-10 m	4, trees W,NR crops E
6	6	3	9	1a	>10 m	5, trees, row crops past
6	6	3	9	1b	5-10m	6, trees
6	6	3	9	1a	>10 m	6
6	6	3	9	1b; sometimes 2	5-10m	6
6	6	3	9	1b	>10 m	6; trees, then crops past
6	4; giant old culvert	3	9	1b, one side slopes a lot	>10 m	6
6	6	3	9	1b, mostly	5-10m	5, trees, row crops past
6	6	3	6	2	10m	2 non-row crops
6	6	2,farm field close	6	2	10m	4; field
6	6	2	0	4a	10m	4
6	6	2	9	1a	>10 m	4
6	6	3	9	1a	>10 m	6, trees/forest
6	6	2, behind tree line plowing	9	1b	>10m	4
6	6	3	9	1b	>10m	6
6	6	2; field close	9	1a	5-10m	4
6	6	3; field	9	1a	>10m	4; pasture
6	6	3	9	1a	>10m	4
6	6	3	9	1a	>10m	6; trees
6	6	3; field close	9	1a	5-10 m	4
5; path made by fishermen	6	3	9	1a	5-10m	6
6	6	3	9	1a	>10m	6
6	3	3	9	1b	>10m	6
6	6	3	9	1a	5m; one side is very close to a field, almost no buffer zone	4; trees and a field
6	6	3	9	1b	5-10m	6
4	4; cow drinking area	2	9	1a	5-10m, one area there is no buffer zone	6
6	6	3	9	1a	>10m	4

Table B- 11: All Riparian Health Assessment Results for the 2017 Summer Season.

Q21A	Q21B	Q21C	Q21D	Q21D	Q21E	Crossing_waypoint	Q22	Q23	Q24
4 pinches estuary	3	3	14.7m	0.22	0.8	CR1	6	0	2 road
6	N/A	N/A	N/A	N/A	N/A	N/A	6	0	3
6	N/A	N/A	N/A	N/A	N/A	N/A	6	2	3
6	N/A	N/A	N/A	N/A	N/A	N/A	6	3	3
6	N/A	N/A	N/A	N/A	N/A	N/A	6	4, 75%	3
6	N/A	N/A	N/A	N/A	N/A	N/A	6	5, 80%	2, trash
6	N/A	N/A	N/A	N/A	N/A	N/A	6	4, 75%	2, dump
4, CRO1	2	3				CR01	6	0, all vegetation	2, road, dump
2	1	0				WC1	6	2	3
6							6	2, some not a lot	3
6	N/A	N/A	N/A	N/A	N/A	N/A	6	0; some visible near end	3
6	N/A	N/A	N/A	N/A	N/A	N/A	6	4; some areas of very deep sediment	3
6							6	6; not a lot of sedimentation	3
6							6	2; areas of very high sedimentation	3
6, crossing made by owner							6	4; visible when present, some areas a lot of sedimentation	3
5; okay crossing	Wood	2	5.5m			CA01	6	5, a lot of rock	2; at the end
6							6	2; almost none, mostly sediment	2
6							6	4; large rocks	3
6							6	5, 80%	3
6							6	2	3
2	2	1	8.5m	8.5m/27sec	0.5m/sec	CA02	6	0	3
6							6	2	3
6							6	2	3
6						CCTCROSS1	6	2	3
2	1	3	7.70m			CCTCROSS2	6	2	3
2	2	3	9.8m			CAH1, CAH2	6	2	3
6							6	2	3
6							6	4	3
6							6	6	3
6							6	2	3
6							6	2	2;cows close
6							6	2	3
							6	2	2
2; bad crossing but not really effecting stream	4	2	11.5m	11.5m/30sec	1m/5sec	BRIDGE	6	2	3

Table B- 14: All Riparian Health Assessment Results for the 2017 Summer Season.

Fish	Comments
Small fish	Salt marsh habitat, multiple channels
Young brook trout, 6 inch brook trout, heavily sedimented	Heavily sedimented, lacks a good pool ripple struture
Brook trout varying size	Good vegitative cover, high sediment load at beignning of reach, less sediment in heavily treed area
Various sizes of brook trout	Series of blockages, heavy alder growth, brush matting as required, gravel imbedded in sediment
Small and medium brook trout, isoalted pool with stranded fish	Small west branch of CC, good bank cover, majority of subsrtate is gravel, large trees present, one blockage
Fish of various sizes,mostly little	a lot of blocks/disruptions in channel. A lot of fallen trees currently blocking stream or have potential to. Lot of gravel, low sediment. Would benifit from
Few very small fish	Increasing trash, suspected dump at end. Bank erosion, blockages, requires cleaning and blockage removal. Several trees fallen over stream.
Fish passage unlikely	Divides into multiple channels, (vegation filled) before pooling at culvert
Fish spotted, mostly small.	Lots of fallen trees throughout reach.
Few fish spotted	Horrible crossing at beiginning, large downed trees throughout. Lots of dead wood causing blockages.
Few small trout spotted	Lots of dead wood near banks interrupting flow. Blockage near end of reach, close to RH04.
Tiny fish spotted.	Lots of large trees, lots of logs in water. Deeps pools where wood has caused blockages. Areas of very deep and very shallow sedimentation. Fairly shaded.
Small fish spotted	Heavy alder-age. Larger rocks in bottom of stream. Lots of downed trees disrupts flow.
One medium fish spotted.	At beiginning, a very large downed tree causing a blockage. Giant, rusting old culvert in middle of reach. Lots of alders growing over stream. Water flows
Brook trout, 3.5 inches.	Lots of fallen trees and dead wood. A lot of young trees and new growth. Lots of long grasses and islands throuhout stream, disrupting flow. Bottom of the
A lot of 3 inch fish spotted.	Some poorly placed brushmats in beginning. Some trash near start, full back seat of a car. Spring near the end marked Spring1. A lot of overgrowth and trees
Some small fish spotted.	Large blockage in middle, downed tree with grass growing over it. Lots of roots in stream. One open area at beiginning with point source pollution. Toad
Tiny fish spotted.	Rusting, old culvert in stream. Water going through it. Extremely entrenched in some areas. Lots of woody vegetation and branches growing over stream.
Young of the year spotted	Some garbage in middle of reach. Narrow, lots of moss on banks.A few small blockages. Good/fast flow where no blockages.
No fish spotted, hard to see inbetween branches	Wood frog spotted. Very forestry, lots of trees overgrowing/ branching into stream. Lots of peat moss. Some very large trees.
Very small fish seen	Old culvert in middle above water, not a crossing, marked "culvert". Very grassy, few alders. Farm road crossed it. Very narrow at some points.
Very, very few small fish seen	Very overgrown. Lots of blockages. Woody. One area looks like an abandoned field in rip zone. One channel off main route is completely dry.
No fish seen, water levels very low.	Lots of disturbance cuased vegetation. Some alder overgrowth. One fallen tree near end.
No fish seen.	Some deeper pools, mostly shallow. Lots of cover and trees. Large blockage at crossing.
Small fish seen	Lots of overgrowth. Wood frog spotted. Fairly narrow. Lots of trees. Shallow. Some rock.
Some small fish	Lots of alder overgrowth, needs stream clearing. Lots of fallen trees and logs in the stream. Blockage by second crossing (CAH2)
No fish, very shallow and narrow	Small chain off main stream. Very grassy and narrow. Some tree overgrowth, branches growing across stream. Lots of shade. Some new growth, mostly
Lots of small fish.	Alders present, mostly growing on only one bank, the other side just grass. Lots of disturbance caused vegetation.
Some small trout spotted	More forested area with larger trees. Lots of birds. Some nightshade. Good, strong flow with lots of rocks.
Small fish spotted	Lots of blockages and fallen trees. Old brush mat near end (RHOC) that has been destroyed.
Small trout	Very close to a cow pasture. Tall trees, overgrown. Lots of blockages. Ducks spotted in stream. Lots of fish cover.
Small brook trout	Lots of fallen trees and blockages. Mostly grass at the bank, and trees farther back. Some deeper areas.
Small brook trout	Are with no buffer zone, exposed cliff to allow cows to drink from stream- picture on camera.
Medium sized trout spotted	Muskrat spotted.

APPENDIX C

Crossing Assessment Results

Table C- 5: All Crossing Assessments Results for the 2017 Summer Season.

GPS Waypoint Number	Assessor	Location	Date	Time	Last Rainfall	Tide	Type of Crossing	Q2	Q3	Q4
CR1	Clare, Taylor, Kayla	Crooked Creek Bridge	10/07/2017	9:35	09/07/2017	In	Bridge	14.7m	1.25m	N/A
WC1	Clare, Taylor, Brittany	Crooked creek, by broken road	21/07/2017	10:30			OTH; made of large rocks	7.7m	No real opening, old crossing	N/A
CA01	Clare, Brittany	Parker Cross Road	31/07/2017	1:47	28/07/2017		Box	5.5m	1m	0, raised above water level
CA02	Clare, Brittany		04/08/2017				CPP	8.5m	0.5m	0
CAH1	Clare, Brittany	Harvé's	07/08/2017	1:45	06/08/2017		CMP	6.3m	2 culverts, 1m and 0.5m	0
CAH2	Clare, Brittany	HC	07/08/2017	2:33	06/08/2017		CPP/CMP	9.8m	0.76m; 2 culverts all same size	0
CCTCROSS1	Clare, Brittany	Crooked creek	07/08/2017		06/08/2017		CMP	13.40m	1m	0
CCTCROSS2	Clare, Brittany		07/08/2017		06/08/2017		CMP	7.7m	0.8m	0
Stuart's bridge	Clare, Taylor, Brittany	Crooked creek	22/08/2017	3:25	20/08/2017		Bridge; wooden	11.5m	3.5m	0

Table C- 2: All Crossing Assessments Results for the 2017 Summer Season.

Q5	Q6	Q7	Q8	Q9	Water Velocity	Water Velocity Above	Damage Q1	Q2	Q3	Q4	Q5	Q6
60%	75% waterline	2 m	Yes, Gabion up and down	No beaver Leveler	0.22 m/sec	0.83 m/sec	Top is at an angles	N/A	N/A	N/A	N/A	N/A
N/A	N/A	0.1m	N	N	Could not get, kept getting stuck on rock		Y	Y; very narrow opening for water to flow through	N	N	N	N/A
5%	10%	1m	N	N	Unable to get		N	N/A	N	N	Y	0.20m
10%	20%	0.1m	N	N	8.5m/27sec	0.5m/6sec	N	N/A	N	N	N	N/A
20% for the larger culvert, 10% for the smaller	50%	5cm	N	N	6.3m/20sec	1m/8sec	Y, 10% of the larger one	N	Y	N	Y	0.5m
2 empty, one 20%	40%	0.43m	N	N	9.8m/26sec		N	N	N	N	N	N/A
10%	40%	2m	N	N	Leaves and branches kept getting stuck	Flow seems good	N	N	N	N	N	N/A
10%	15%	5cm	N	N			N	Y, moss growing on sides and throughout culvert	N	N	N	N/A
10%	20%	0.2m	N	N	11.5m/20sec	1m/5sec						

Table C- 8: All Crossing Assessments Results for the 2017 Summer Season.

Road Type	Road Condition	Road Width	Road Issues	Bridge Length	Span Width	Height	Surface	Bank 1	Bank 2	Comments
PV	WM	6.5 m	None	N/A	4.9 m	N/A	GD	N/A	N/A	
SF	AB, VP	6.7m	DC							Very poor and old crossing, basically just water flowing over rocks now
SF	PM	5m	Just not well maintained							Overgrown with alders and ash
SF	PM	4m	RT							
SF	PM	3.2m								
SF	PM	3.2m	Unpaved, overgrown							
SF	PM	5.5m	Grassy							Unable to get velocity, but flow seems good.
SF	PM	3.8m	Just grassy and bumpy							
SF	PM	5m		11.5m	5m	3.5m	PR; lots of holes			