



Pickerel River Fish Habitat Assessment



Executive Summary

The Eastern Georgian Bay Stewardship Council (EGBSC) received funding from Environment and Climate Change Canada to carry out a 32-month project to assess spawning, nursery, rearing, and foraging habitat in eight tributaries to eastern Georgian Bay, which included the Pickerel River. Fish habitat assessments were focused on Walleye, Lake Sturgeon, and Sucker species, between the river mouths and the first major spawning area or barrier to fish passage.

During the 2017 spawning season, EGBSC visited Trestle Gully (17 times), Horseshoe Falls (16 times), Bailey Bridge (18 times), and Squaw Rapids (16) between April 18 and June 20. Basic water chemistry measurements (water temperature, dissolved oxygen, pH, conductivity) were recorded on all site visits (with the exception of April 21 and 24 at Trestle Gully) and were generally within the expected range for Canadian Shield waters.

Several stations were set up at each spawning bed to measure water velocity and water level fluctuations. All water velocity measurements were under 1.5 m/s and would likely not limit Walleye, Lake Sturgeon, or Sucker movement throughout the spawning beds. At Horseshoe Falls, the main flow in the rapids could not be safely measured. Regardless, based on visual observations throughout the spring, it is reasonable to assume that Horseshoe Falls presents a barrier to fish passage.

Water levels fluctuated considerably at all sites throughout the spawning and egg incubation periods. Fluctuations appeared to be most dramatic at Squaw Rapids and Bailey Bridge, with egg mats found out of water or partially out of water on more than one occasion. Despite these fluctuations, no eggs were observed stranded at any of the spawning beds.

Fish observations were limited to Redhorse Sucker species' scales on shore, and a dead Walleye, both found at Squaw Rapids. No night surveys were conducted on the Pickerel River in 2017. Based on egg mat deposition, it appears that Sucker either do not use these spawning beds, or do so in very small numbers. This is to be expected given the limited presence of finer substrate (i.e., sand, gravel) at the spawning beds. In terms of Walleye egg deposition, egg counts were very low at Trestle Gully, slightly higher at Squaw Rapids, and much higher (but still considered low) at Bailey Bridge (no egg mats set at Horseshoe Falls). While these egg count totals may be indicative of very small spawning populations, it is also possible that a significant amount of spawning activity was missed due to fluctuating water levels and limited safe access to much of the spawning beds in order to install egg mats.

Plankton samples were taken during the time when fry would likely be hatching. These composite samples were visually compared to samples collected from the other tributaries being assessed in 2017 – Naiscoot River and Key River. The Pickerel River downstream of the spawning beds was considered to have good plankton production.

In the fall of 2017, seven transects were measured across the Bailey Bridge spawning bed with the intent of better understanding depth and substrate. All of the transects had at least some substrate considered ideal for Walleye, Lake Sturgeon, and/or Sucker spawning, and at the appropriate depth. EGBSC was unable to measure transects across the other three spawning beds. Instead, a qualitative approach was taken at Trestle Gully and Squaw Rapids in which the substrate that could be seen from the banks was described. At Trestle Gully, the most upstream area (main section of rapids) is predominantly made up

of bedrock and large boulders. Below the main section of rapids is an area with cobble and small boulders as the dominant substrate, followed by an area with small and large boulders as the predominant substrate. At Squaw Rapids, large boulders were the dominant substrate, with cobble and small boulders being the next dominant substrate types.

To assess nursery, rearing, and foraging habitat available downstream of the spawning beds, seventeen (17) underwater surveys were conducted. Bathymetry, side scan sonar data, and aerial photography were also collected. Based on these surveys, there appeared to be diverse substrate in the nearshore area including bedrock, boulders, cobble, gravel, sand, clay, and silt. Density of aquatic vegetation ranged from absent to abundant. Areas with no vegetation or sparse vegetation could potentially provide habitat for different life stages than areas with moderate to abundant vegetation. Fewer than half of the surveys had wood structure to provide habitat and cover for fish. Overall, the shorelines of the Pickerel River downstream of the spawning beds to Highway 69 are largely natural (86% natural, 14% altered). Some of the observed alterations included train and highway bridges, mown grass close to the shoreline, docks, compacted soil and disturbed vegetation at Crown land campsites, and boat launches.

Overall, EGBSC's assessment confirmed that there is suitable habitat for Walleye and Lake Sturgeon in the Pickerel River. Fish and egg observations likely did not capture the full extent of spawning activity at the spawning beds investigated. Whether Walleye and/or Lake Sturgeon spawn at Horseshoe Falls is still unclear as the site was very difficult to monitor due to water depth and velocity. Limited spawning substrate ideal for Sucker was observed at these sites, however, Sucker eggs were found at Bailey Bridge indicating some degree of Sucker spawning is taking place at that location.

As a result of this assessment, EGBSC recommends future investigations into Lake Sturgeon spawning on the Pickerel River. No Lake Sturgeon or Lake Sturgeon eggs were observed during the assessment. However, members of Henvey Inlet First Nation indicated that Lake Sturgeon do in fact spawn in the Pickerel River and can be seen moving upstream past Bailey Bridge. Furthermore, substrate and water depths at Trestle Gully, Bailey Bridge, and Squaw Rapids (Horseshoe Falls could not be assessed) appear to be favourable for Lake Sturgeon spawning. A more focused monitoring effort later in May and into June, as water temperatures rise, is recommended. EGBSC also recommends further, detailed analysis of the side scan sonar data to supplement the observations from underwater surveys. EGBSC does not recommend any habitat restoration at these sites.

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Project Overview and Methodologies

In 2015, the Eastern Georgian Bay Stewardship Council (EGBSC) received funding from Environment and Climate Change Canada to carry out a 32-month project to assess spawning, nursery, rearing, and foraging habitat in eight tributaries to eastern Georgian Bay, within the Parry Sound District. Lake Sturgeon, Walleye, and Sucker species have been experiencing varying levels of decline in parts of eastern Georgian Bay. Accordingly, fish habitat assessments were focused on these species with the goals of: (1) determining whether there is sufficient habitat available; and (2) identifying and prioritizing opportunities for restoration. Assessments were carried out between the river mouths and the first major spawning area or barrier to fish passage.

EGBSC formed a collaborative working group to aid in the development of a field protocol for data collection. This group consisted of:

- Arunas Liskauskas, Dave Gonder, Chris Davis, and Stephen James – Upper Great Lakes Management Unit, Ministry of Natural Resources and Forestry
- Scott Finucan – Ministry of Natural Resources and Forestry
- Greg Mayne – Environment and Climate Change Canada
- Karl Schiefer – Aquatic Biologist consultant and EGBSC member
- David Bywater – Environmental Scientist, Georgian Bay Biosphere Reserve
- David Sweetnam – Executive Director, Georgian Bay Forever

Two main protocols were considered for this project. The first was the Ontario Stream Assessment Protocol (OSAP), which is a standardized method of measuring and collecting field data in the province of Ontario. This protocol is applicable to wadeable streams. The rivers being considered in this project were non-wadeable. Nevertheless, components of the OSAP protocol were used when assessing spawning beds in late summer and fall.

The other protocol considered for tributary classification was the Rosgen Classification system. This protocol is often used in stream restoration projects. However, the Rosgen Classification system was designed based on U.S. rivers and may not be appropriate for central Ontario rivers. Consequently, the Rosgen Classification was not used.

EGBSC completed broad habitat surveys on each river – Shebeshekong, Seguin, Magnetawan, Shawanaga, Key, Pickerel, Naiscoot, Sucker Creek – to record the location and evaluate the amount and quality of habitat available. During assessments, EGBSC also considered whether there were habitat limitations from human or natural stressors and identified any potential restoration opportunities.

As part of the broad habitat assessments, the following information was collected on each river:

- Basic water quality parameters (pH, conductivity, dissolved oxygen)
- Water temperature
- Water velocity
- Water level fluctuations
- Aerial photographs
- Underwater photographs and videos

- Substrate type
- General size of habitat
- Accessibility of spawning areas during different flow regimes
- Potential limitations or indicators of stress
- Opportunity for restoration

For the assessments, EGBSC used a combination of methods to collect data and brought in standardized protocols where possible. The project advisory team helped guide the technical aspects of this project to ensure the data collected was not only valuable but useable for other work and reports.

To collect high quality imagery of the sites, EGBSC purchased and used a DJI Phantom 3 Advanced quadcopter.

Three software programs were used as part of this project. Pix4D was used to create orthomosaics from the drone photography. Reefmaster was used to map bathymetry and side scan sonar data that was collected using a Lowrance unit. Finally, QGIS 2.18 was used for mapping.

In addition to gathering field data, EGBSC also collected background information and local knowledge when possible. The information that can be shared is provided in the [Background Information](#) section.

Background Information

The Pickerel River is located north of the Key River and south of the French River (Figure 1). It extends from its headwaters in the Loring and Restoule area of the Almaguin Highlands in the northern part of Parry Sound District, to Georgian Bay. The Pickerel River falls within the Pickerel River quaternary watershed draining an area of 1,052 km² (Figure 2). The river and its watershed are situated in the ancestral and traditional territory of the Anishinabek people.



Figure 1. Location of the area of study on the Pickerel River in relation to Parry Sound, Pointe au Baril, and Britt

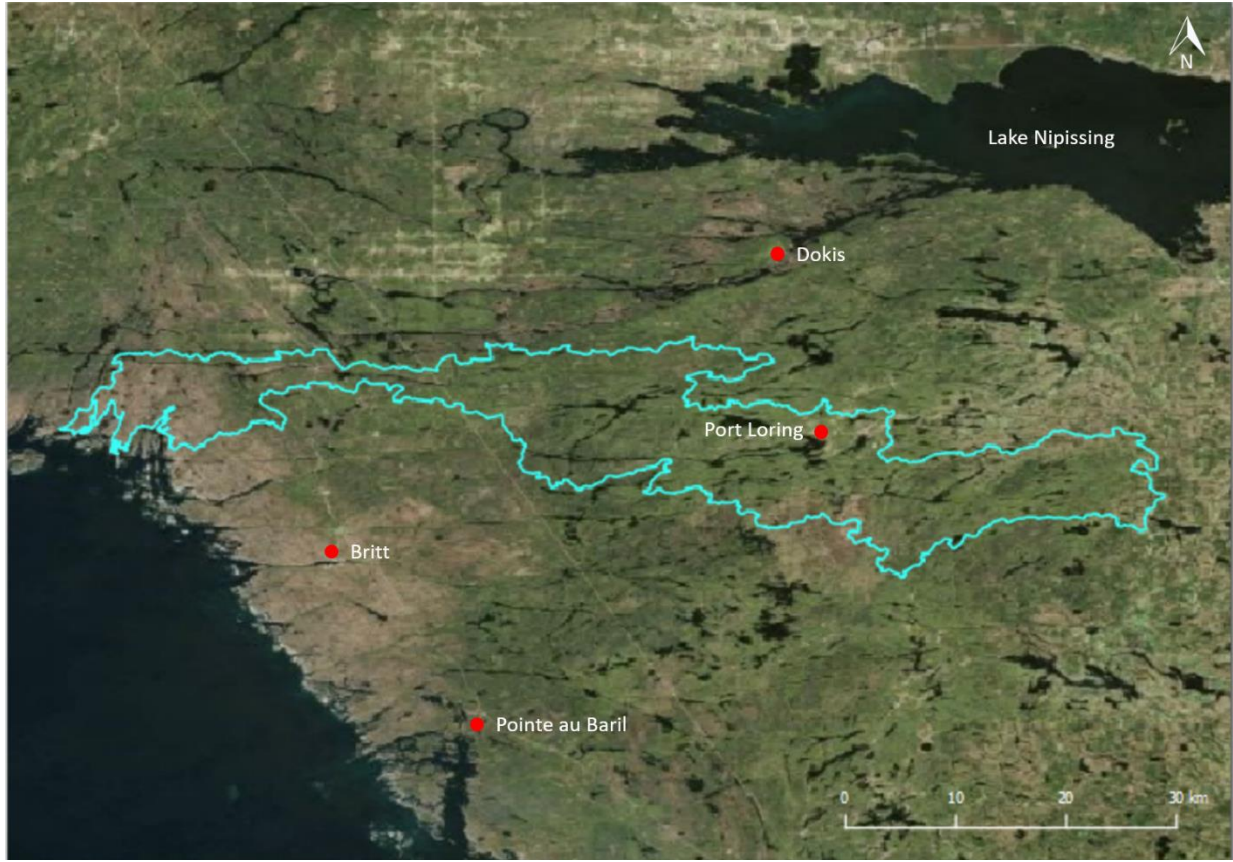


Figure 2. Pickerel River quaternary watershed

Several Ministry of Natural Resources and Forestry (MNR) reports were found pertaining to the lower Pickerel River, the focal area for this study. A 1979 report written by Kujala details spawning habitat improvements at Bailey Bridge, between Squaw rapids and Kidd's Landing. Prior to 1968, the north side of the island at Bailey Bridge was a spawning site for a large number of Walleye. In 1968, Ontario Hydro built a road across the river at this site. A bridge was constructed on the south side of the island and the north side was filled in with rock which acted as a "spill dam" during the spring freshet. Walleye continued to spawn here, but as the spring freshet receded, eggs were left exposed. In 1978, the Ministry upgraded the old hydro road to a forest access road. At this time, work was undertaken to enhance the site for Walleye spawning. A four-foot culvert was sunk in the fill on the north side to provide a continuous flow of water during the Walleye egg incubation period. Rock and large boulders were set downstream to provide appropriate spawning substrate. The site was inspected during the Walleye spawning period of 1979, however, no Walleye were seen. This was attributed to the extremely high water that spring. Mr. Kujala contended that the physical features of the rehabilitated site were conducive to successful Walleye spawning and incubation.

In 1988, 144 sites were netted from July 28 to August 29 on the lower Pickerel River. As a result of this effort, it was concluded that these waters contained low levels of sport fish. Walleye, Smallmouth Bass, Largemouth Bass, Northern Pike, and Muskellunge were not abundant (8.2% of biomass captured). Thurston (1988) stated that the percentage of sport fish caught was indicative of an unhealthy and unbalanced fish community. Age class distribution for Walleye and Smallmouth Bass indicated that recruitment had been poor in most years. Thurston (1988) suggested that effort would have to be directed at finding the factors adversely affecting spawning success for Walleye and Smallmouth Bass.

Moreover, he recommended planting Walleye fingerlings in the short term and commencing coarse fish removal to remove Northern Redhorse Sucker, Channel Catfish, Brown Bullhead, Gar, Bowfin, and possibly Black Crappie.

Trap netting took place on the lower Pickerel River again in 1990. Again, Thurston (1991) reported an unbalanced fish community (very low ratio of sport fish to other species). Black Crappie, Northern Redhorse Sucker, and Brown Bullhead were abundant. Smallmouth Bass were moderately abundant with strong 1987 and 1988 year classes. Largemouth Bass, Northern Pike, Muskellunge, and Walleye were present in low abundance. While Walleye were found in low abundance, it was believed that there was a low exploitation rate and good reproduction as indicated by an even distribution of young fish (<6 years), and fairly well represented older age classes.

Spring Spawning Assessments

In 2017, EGBSC studied four spawning bed sites upstream of Highway 69 on the Pickerel River – Trestle Gully, Horseshoe Falls, Bailey Bridge, and Squaw Rapids (Figure 3). EGBSC began spring field work on the Pickerel River on April 18 and ended on June 20. During this period, spawning beds were visited approximately every three to four days, whenever possible. Towards the end of the Walleye and Sucker spawning period (end of May, early June), site visits were less frequent. In total, Trestle Gully was visited seventeen (17) times, Horseshoe Falls was visited sixteen (16) times, Bailey Bridge was visited eighteen (18) times, and Squaw Rapids was visited sixteen (16) times.



Figure 3. Location of Trestle Gully, Horseshoe Falls, Bailey Bridge, and Squaw Rapids spawning beds

Water Chemistry

A YSI PROPLUS metre was used to measure basic water quality parameters on each site visit – water temperature, dissolved oxygen, conductivity, and pH. These parameters were selected because of the influence they can have on fish and fish activity, and to see if the levels recorded indicated any potential issues.

Water temperature is extremely important to fish. Aside from water velocity, water temperature is the main stimulus for spawning. For Walleye, spawning males begin to move towards spawning areas when water temperatures reach 2 to 5°C. Spawning takes place through a variety of temperatures, but peak

spawning typically occurs at 7 to 8°C (Kerr et al., 1997). Conversely, spawning activity typically ceases once water temperatures reach 10 to 11°C (Kerr et al., 1997). For Sucker species, spawning takes place between 10 and 16°C (Hasnain et al., 2010). For Lake Sturgeon, main spawning activity occurs between 13 and 18°C (Scott & Crossman, 1998). Water temperature also influences the speed and success of egg incubation. Optimal water temperature for egg incubation is 12.2°C for Walleye, 14.5°C for Lake Sturgeon, 15°C for White Sucker, and 12.5°C for Longnose Sucker (Hasnain et al., 2010).

Fish require dissolved oxygen to breathe. Fast flowing, cold water has higher dissolved oxygen concentrations than slow moving, warm water. Cold water can hold more oxygen as it rolls through rapids, which incorporates air from the atmosphere into the water. Dissolved oxygen is typically highest in early spring and declines as water temperatures increase and velocity slows.

The pH of water refers to how alkaline or acidic the water is, and is ranked on a scale of 0 to 14. pH will influence how soluble and available nutrients and heavy metals are in a system. pH can also influence fish health and reproductive success. In general, Walleye do best in waterbodies with a pH ranging between 6.0 and 9.0. Reproductive success can be jeopardized at pH levels below 6.0.

Conductivity measures the ability of water to pass an electrical current and is influenced by geology. For example, a clay substrate will have a high conductivity because of a greater amount of ions in the water. Rivers within the Parry Sound District typically have low conductivity, but conductivity can be significantly affected by stormwater runoff, and a sudden increase or decrease can indicate issues in a waterbody.

For complete water chemistry data, refer to [Appendix A](#).

Trestle Gully

As illustrated in Figure 4, water temperature at Trestle Gully increased fairly consistently from 4.1°C on April 18 to 17.3°C on June 20. Only one slight drop in temperature was observed from April 29 (6.7°C) to May 3 (6.4°C). Dissolved oxygen levels dropped steadily throughout the study period. The highest level was recorded on April 18 (13.9 mg/L) and reached a low of 10.79 mg/L on June 20. Between April 18 and June 20, all pH levels recorded at Trestle Gully were above 6.0. pH levels ranged from 6.71 to 7.32 with one spike up to 9.96 on May 20. Overall, the pH readings are mildly acidic and typical for Canadian Shield watersheds.

Figure 4 illustrates changes in temperature, dissolved oxygen, and pH over the spawning and egg incubation periods. pH remained relatively stable, while temperature and dissolved oxygen followed a typical pattern for spring.

Conductivity was also recorded between April 18 and June 20 (Figure 5). Conductivity was fairly consistent throughout the study period, fluctuating between a low of 56.3 uS/cm on May 20 and a high of 68.2 uS/cm on June 8.

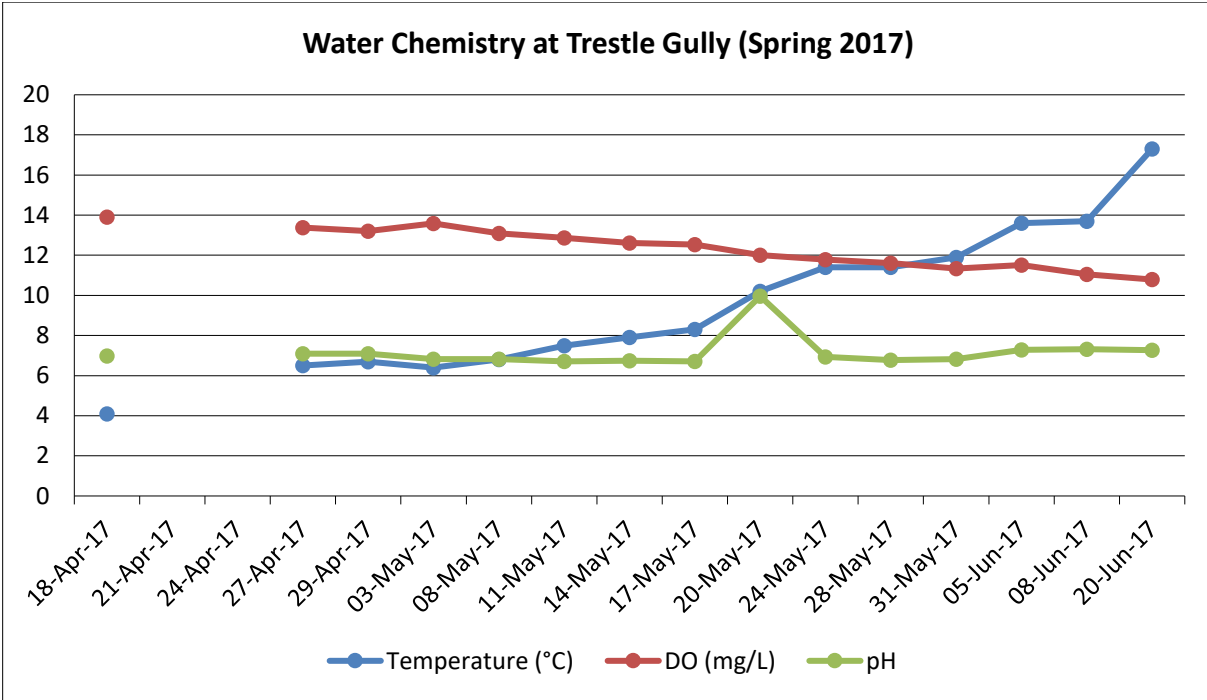


Figure 4. Water temperature (°C), dissolved oxygen (mg/L), and pH measurements taken at Trestle Gully in spring 2017

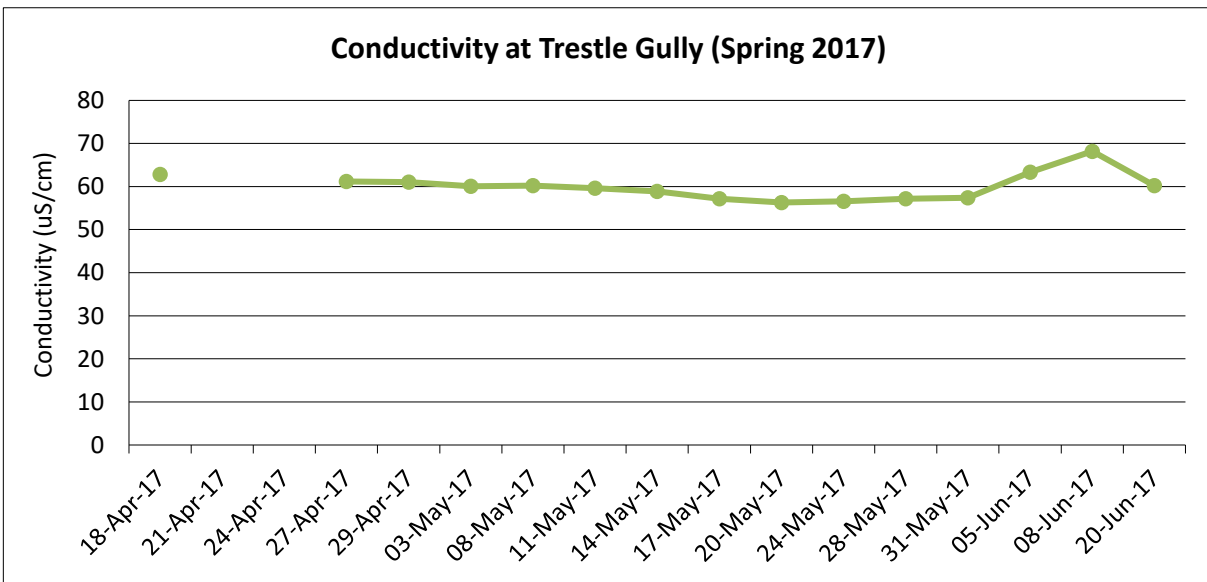


Figure 5. Conductivity measurements (uS/cm) taken at Trestle Gully in spring 2017

Horseshoe Falls

Water temperature at Horseshoe Falls increased steadily from 5.1°C on April 21 to 19.1°C on June 20 (Figure 6). Alike Trestle Gully, one small drop in temperature was observed from April 29 (7.9°C) to May 3 (7.3°C). Dissolved oxygen levels dropped fairly consistently throughout the study period. The highest level was recorded on April 24 (14.10 mg/L) and the lowest level of 9.38 mg/L was recorded on June 20. All pH levels recorded at Horseshoe Falls were above 6.0. The highest pH level was 7.57 on June 20 and

the lowest pH recorded was 6.76 on May 11. The pH readings are mildly acidic and typical for Canadian Shield watersheds.

Figure 6 illustrates changes in temperature, dissolved oxygen, and pH over the spawning and egg incubation periods. pH remained relatively stable, while temperature and dissolved oxygen followed a typical pattern for spring.

Conductivity was recorded between April 21 and June 20 at Horseshoe Falls (Figure 7). Conductivity was fairly consistent throughout the study period, fluctuating between a low of 56.1 uS/cm on May 20 and a high of 61.6 uS/cm on April 21.

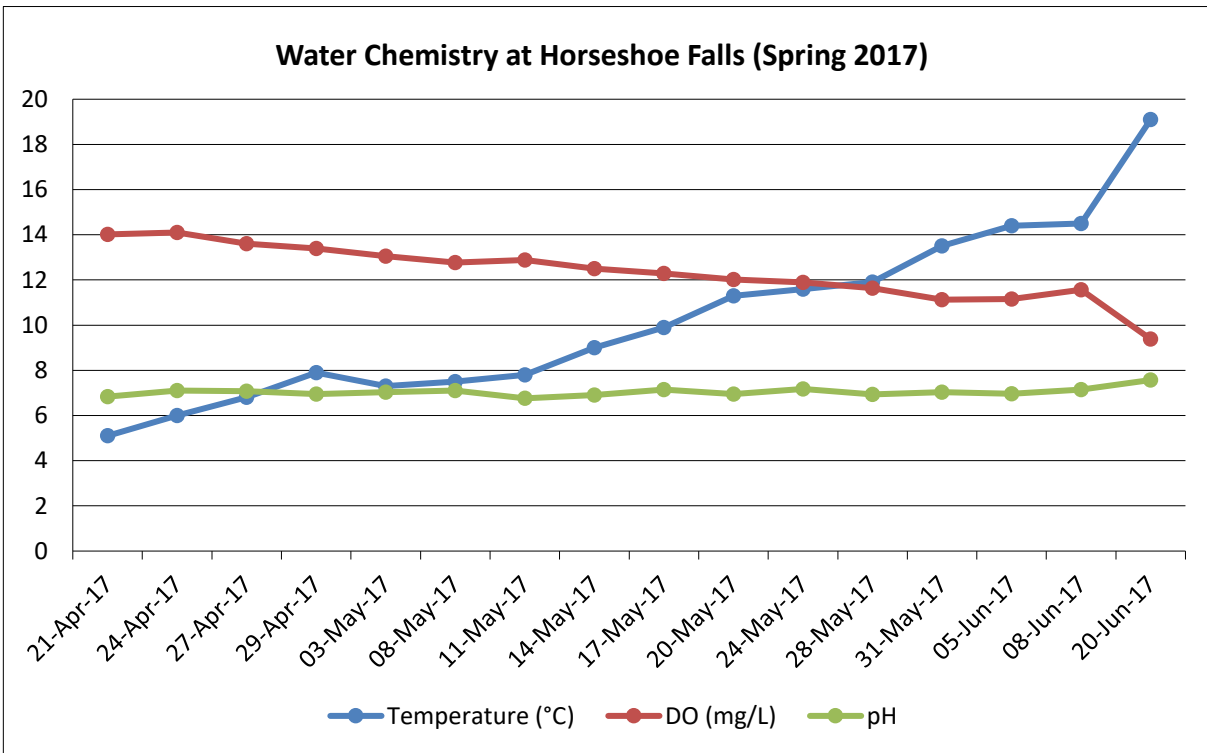


Figure 6. Water temperature (°C), dissolved oxygen (mg/L), and pH measurements taken at Horseshoe Falls in spring 2017

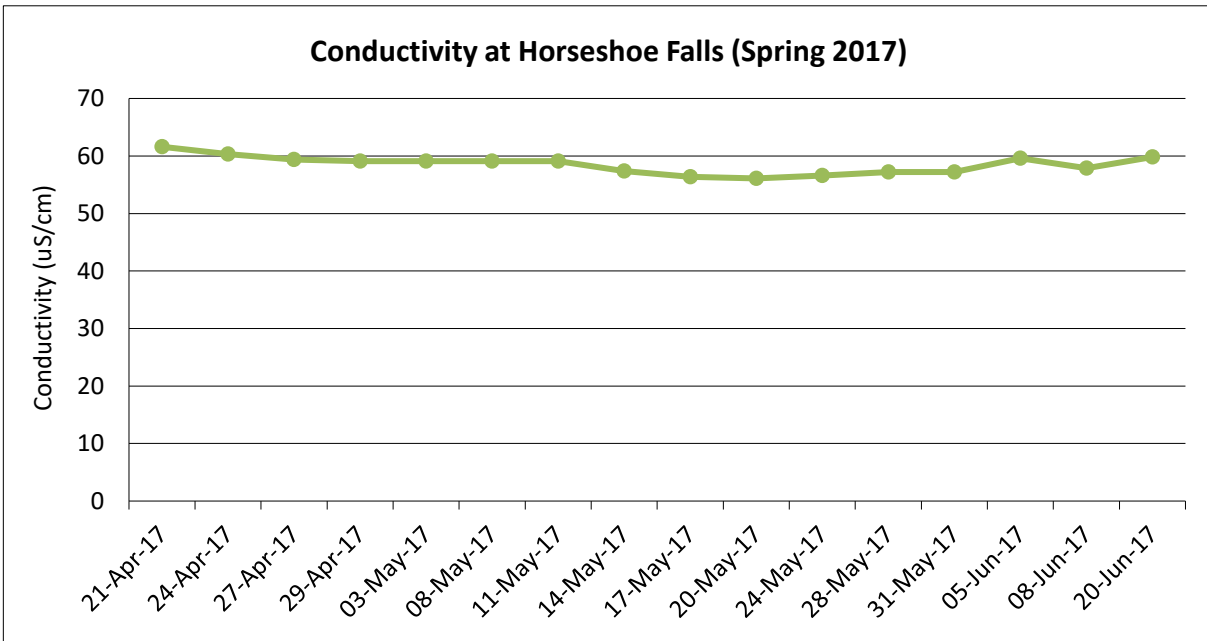


Figure 7. Conductivity measurements (uS/cm) taken at Horseshoe Falls in spring 2017

Bailey Bridge

Water temperature at Bailey Bridge increased from 6.7°C on April 18 to 21.0°C on June 20 (Figure 8). Small drops in temperature were observed several times throughout the spawning period with the largest drop recorded between April 29 (9.6°C) and May 3 (8.3°C). Dissolved oxygen levels dropped fairly consistently throughout the study period. The highest level was recorded on April 21 (13.43 mg/L) and the lowest level of 7.77 mg/L was recorded on June 20. All pH levels recorded at Bailey Bridge were above 6.0 ranging from 6.32 to 6.96. The pH readings are mildly acidic and typical for Canadian Shield watersheds.

Figure 8 illustrates changes in temperature, dissolved oxygen, and pH over the spawning and egg incubation periods. pH remained relatively stable, while temperature and dissolved oxygen followed a typical pattern for spring with some fluctuation.

Conductivity was recorded between April 18 and June 20. Conductivity held fairly steady throughout the study period with the exception of a significant spike up to 91.5 uS/cm on June 8 (Figure 9). All other conductivity measurements were below 34.0 uS/cm.

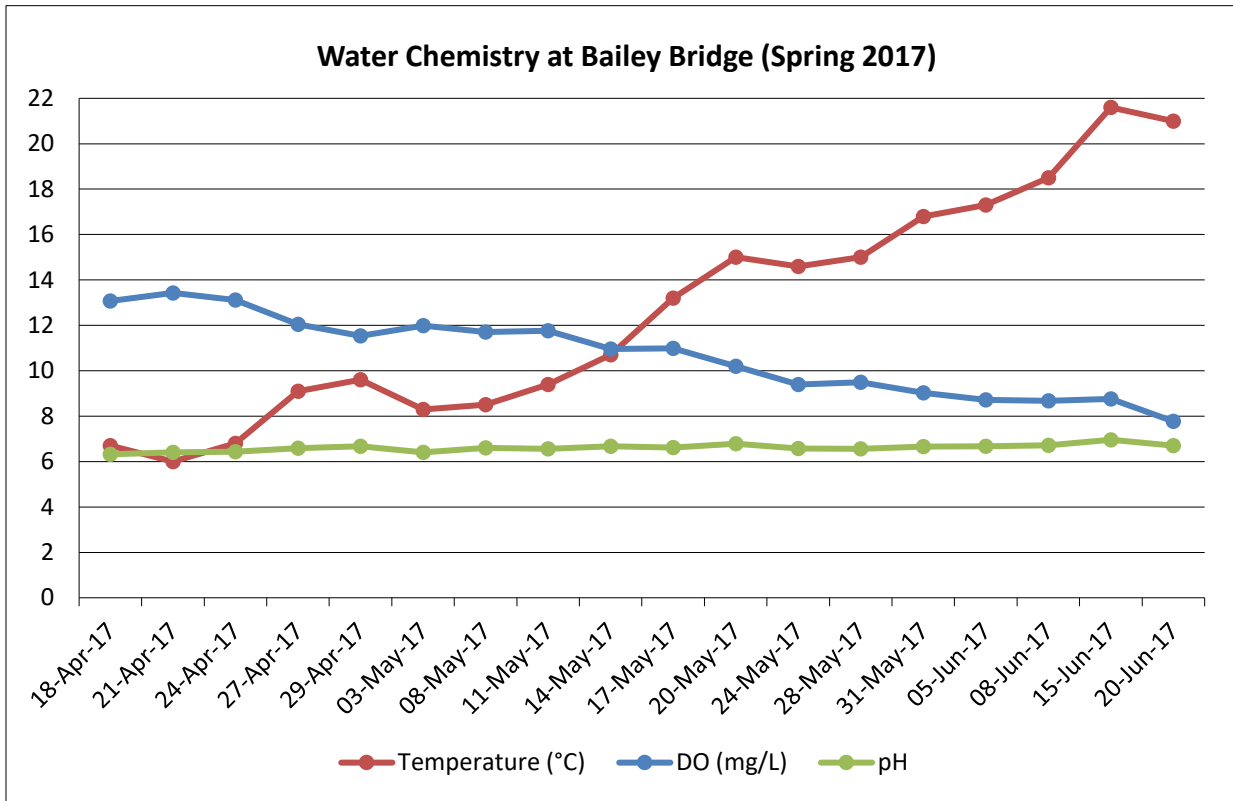


Figure 8. Water temperature (°C), dissolved oxygen (mg/L), and pH measurements taken at Bailey Bridge in spring 2017

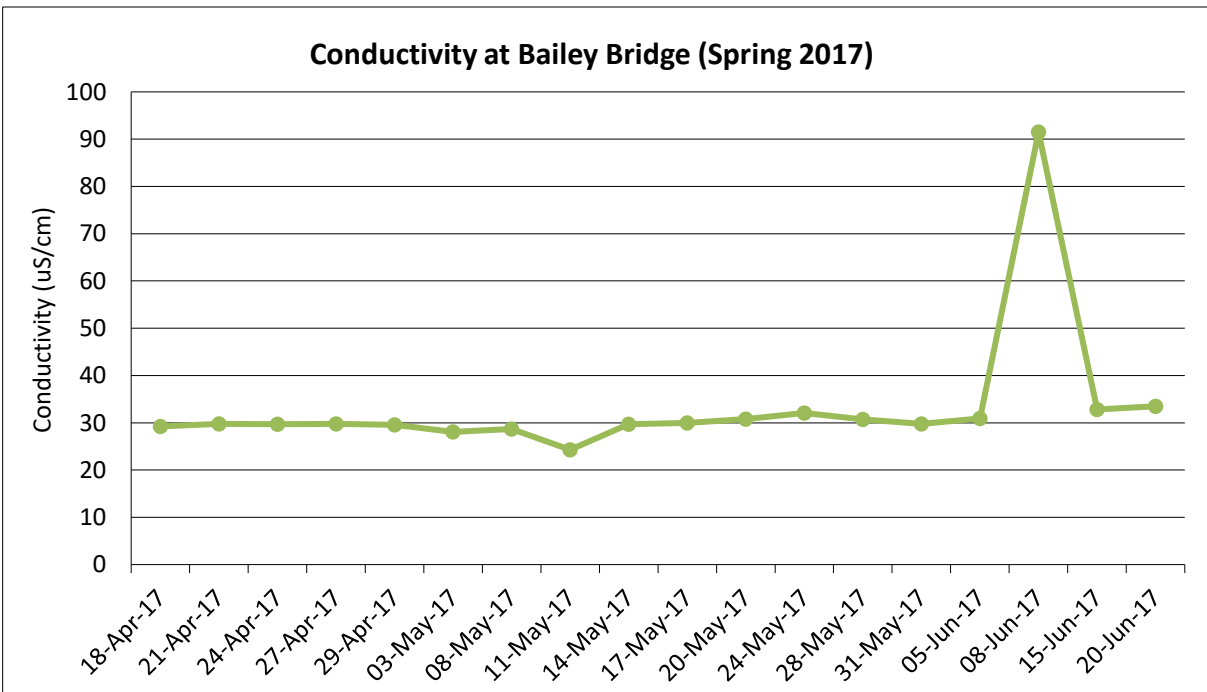


Figure 9. Conductivity measurements (uS/cm) taken at Bailey Bridge in spring 2017

Squaw Rapids

Water temperature at Squaw Rapids increased fairly consistently from 6.0°C on April 21 to 20.3°C on June 20 (Figure 10). Similar to Trestle Gully and Horseshoe Falls, only one small drop in temperature was observed from April 29 (9.5°C) to May 3 (8.3°C). Dissolved oxygen levels dropped consistently throughout the study period. The highest level was recorded on April 21 (13.58 mg/L) and the lowest level of 7.70 mg/L was recorded on June 20. All pH levels recorded at Squaw Rapids were above 6.0. The highest pH level was 6.76 on June 8 and the lowest pH recorded was 6.14 on May 14. The pH readings are mildly acidic and typical for Canadian Shield watersheds.

Figure 10 illustrates changes in temperature, dissolved oxygen, and pH over the spawning and egg incubation periods. pH remained relatively stable, while temperature and dissolved oxygen followed a typical pattern for spring.

Conductivity was recorded between April 21 and June 20. Conductivity was fairly consistent throughout the study period, fluctuating within a fairly narrow range of 28.0 uS/cm (May 3) to 33.5 uS/cm (June 20) (Figure 11).

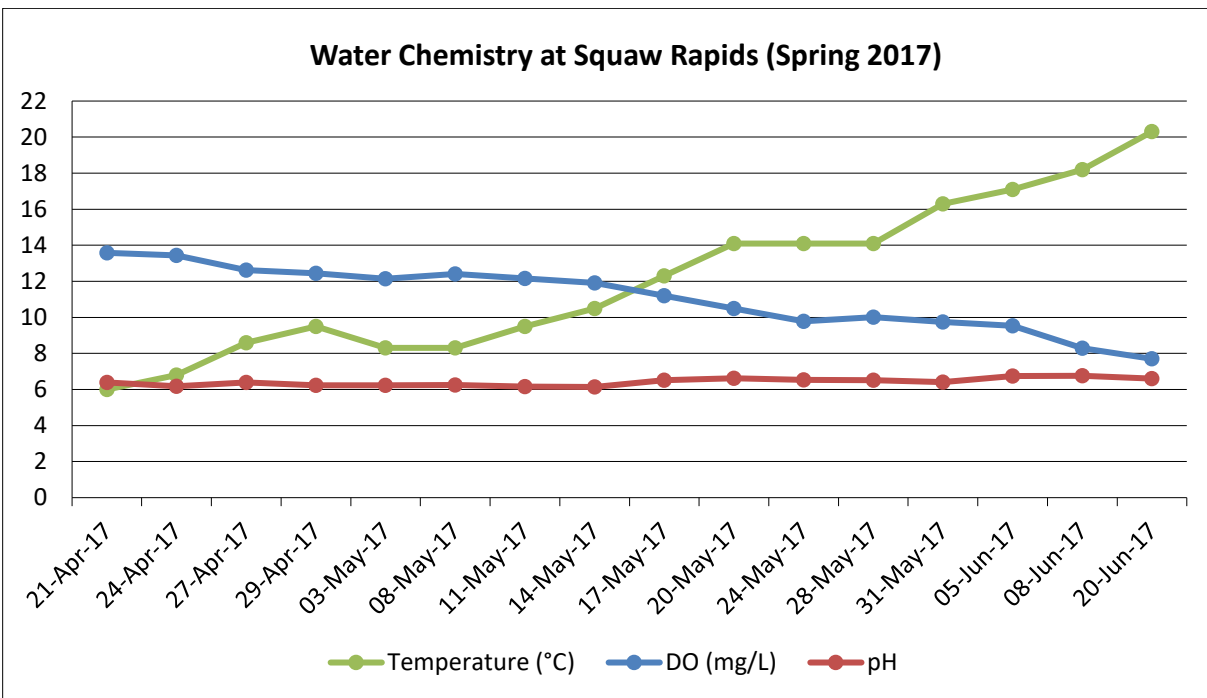


Figure 10. Water temperature (°C), dissolved oxygen (mg/L), and pH measurements taken at Squaw Rapids in spring 2017

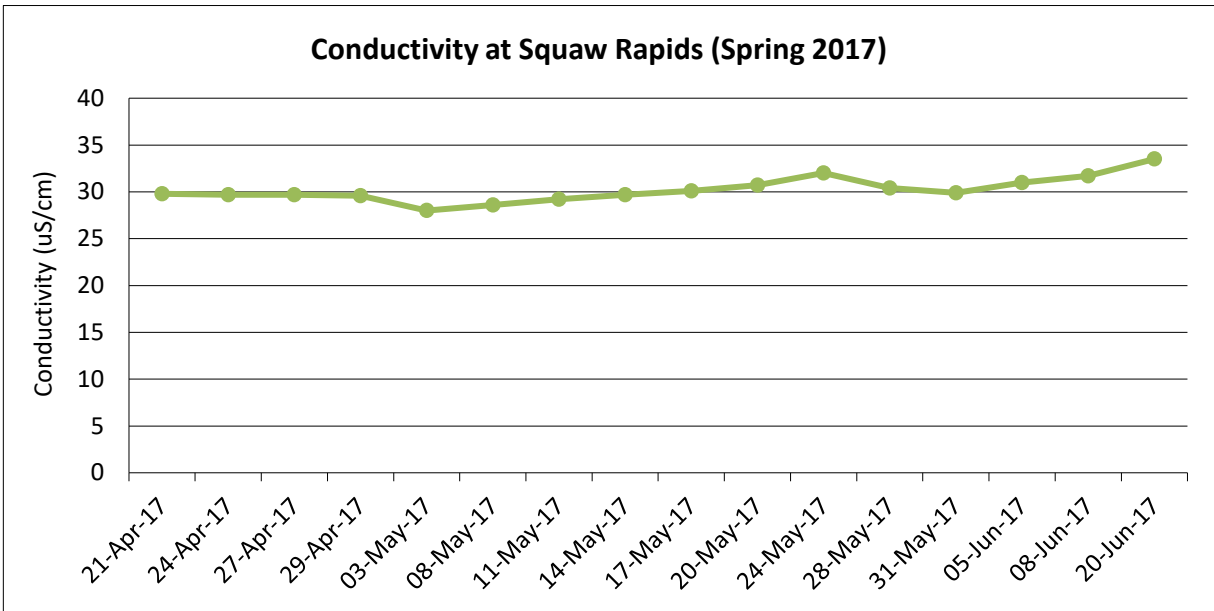


Figure 11. Conductivity measurements (uS/cm) taken at Squaw Rapids in spring 2017

Water Velocity

Water velocity has an influence on fish spawning. Species such as Walleye spawn in areas of fast-moving water, during the spring freshet. Walleye prefer velocities less than 2.0 m/s (Kerr et al., 1997). Lake Sturgeon generally spawn in conditions with a minimum velocity of 0.5 m/s to a maximum of 1.5 m/s (Golder Associates Ltd., 2011), and White Sucker typically spawn in velocities ranging from 0.14 m/s to 0.9 m/s (Twomey et al., 1984). Water velocity is typically high during the spawning period and declines over time.

Water velocity was measured with a Marsh McBirney Flo-mate 2000 flow meter to investigate whether there were areas where the flow would be too fast for fish to swim through. Mean velocity was measured at 60% of the water depth.

Trestle Gully

Three stations were established at Trestle Gully to collect information on water velocity and water level fluctuations from April 18 to June 20 (Figure 12).



Figure 12. Water velocity (2 and 3) and depth stations (1) at Trestle Gully

For safety reasons, water velocity could only be measured at Trestle Gully on two site visits – April 27 and April 29. Velocity at station 2 was 0.77 m/s on April 27 and 0.71 m/s on April 29. Velocity at station 3 was 0.71 m/s on April 29. None of the velocities recorded would prevent fish from accessing or spawning at the site.

Horseshoe Falls

Two stations were established at Horseshoe Falls to collect information on water velocity and water level fluctuations from April 21 to June 20 (Figure 13). Velocity measurements recorded at station 2 are displayed in Figure 14.



Figure 13. Water velocity (2) and depth stations (1) at Horseshoe Falls

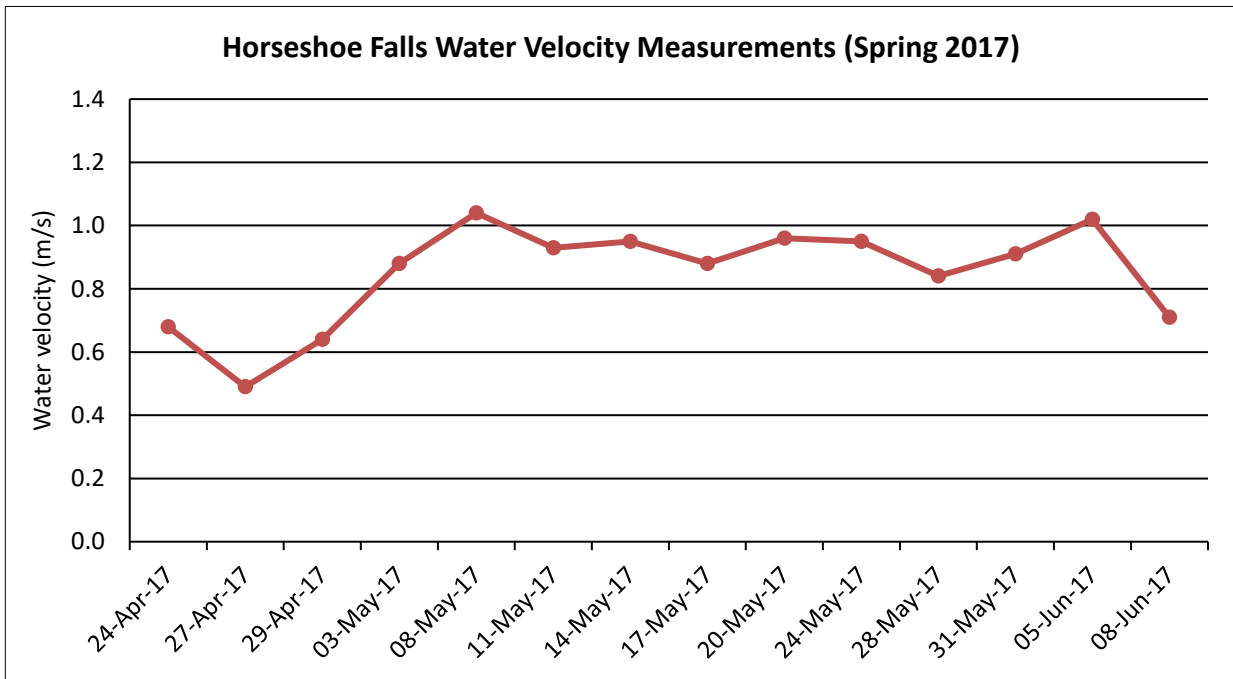


Figure 14. Water velocity measurements at Horseshoe Falls in spring 2017

The water velocity station at Horseshoe Falls was located above the rapids. The main flow in the rapids was not safely accessible with the flow meter. Accordingly, the water velocity measurements at Horseshoe Falls are only intended to show change over the spawning and egg incubation period and do not reflect the actual velocities that fish entering or moving through the rapids would face.

Bailey Bridge

Four stations were established at Bailey Bridge to collect information on water velocity and water level fluctuations from April 18 to June 20 (Figure 15). Velocity measurements recorded at both stations are displayed in Figure 16.



Figure 15. Water velocity (1 and 3) and depth stations (2 and 4) at Bailey Bridge

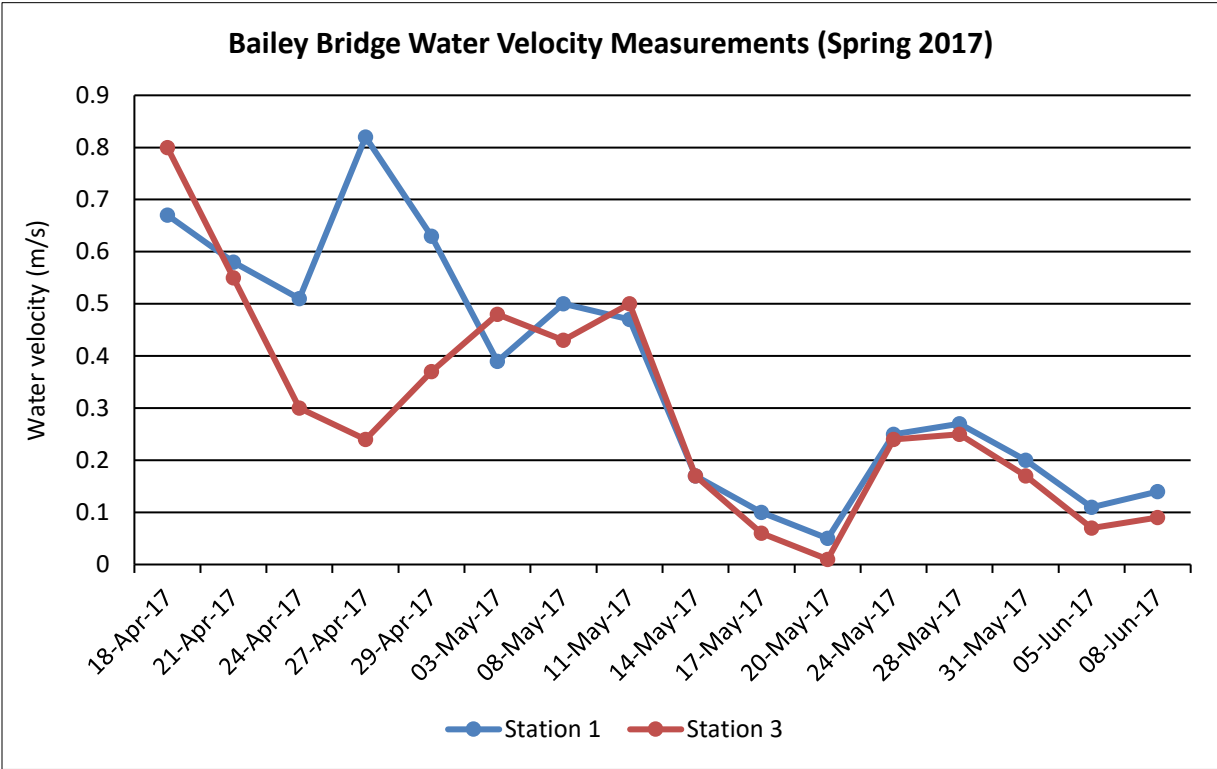


Figure 16. Water velocity measurements at Bailey Bridge in spring 2017

At station 1, the highest velocity recorded was 0.82 m/s on April 27 (highest overall velocity for both stations) and the lowest velocity recorded was 0.05 m/s on May 20. The highest velocity recorded at station 3 was 0.80 m/s on April 18, while the lowest velocity recorded was 0.01 m/s on May 20. Starting on May 11, stations 1 and 3 began following a similar trend in water velocity fluctuations. None of the velocities recorded at either station would prevent fish from accessing or spawning at the site.

Squaw Rapids

Three stations were established at Squaw Rapids to collect information on water velocity and water level fluctuations from April 21 to June 20 (Figure 17). Velocity measurements recorded at all stations are displayed in Figure 18.



Figure 17. Water velocity (1 and 3) and depth stations (2) at Squaw Rapids. Stations 1a and 1b were located further instream of station 1 as water levels diminished. Stations 3a-3c were located further instream of station 3 as water levels diminished.

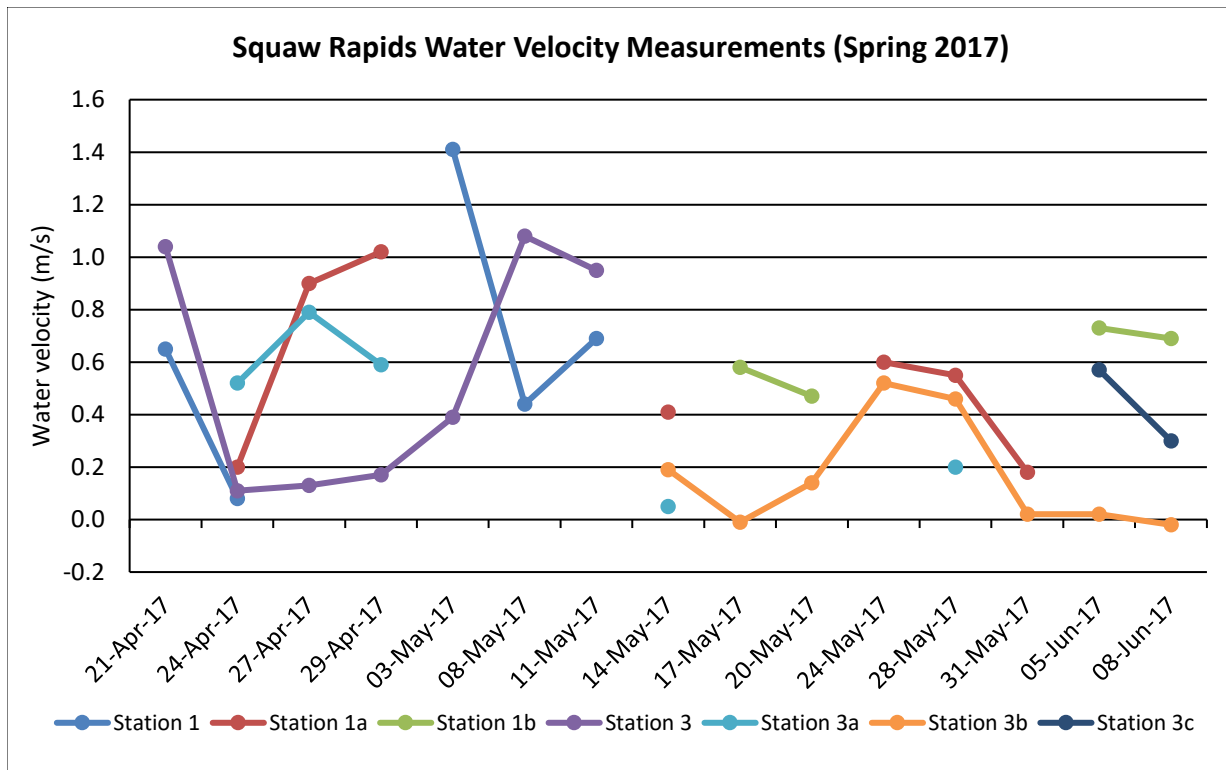


Figure 18. Water velocity measurements at Squaw Rapids in spring 2017

Due to fluctuating water levels, the original flow stations (1 and 3) had to be relocated several times over the study period as they went dry. As water levels decreased, the stations had to be moved further instream to areas with flow. Accordingly, it is difficult to identify trends in velocity over the study period. None of the velocities recorded at any of the stations would prevent fish from accessing or spawning at the site.

Water Level Fluctuations

Water levels were recorded at several stations (Figures 12, 13, 15, and 17) to understand how they change throughout spawning and egg incubation, and how they change along the spawning bed. Typically, when the spring freshet begins, water levels are high. Water levels subsequently decline over the following months. If water levels decline rapidly after the spawning period, deposited eggs may be left out of water and will not hatch.

Complete water level and velocity data can be found in [Appendix B](#).

Trestle Gully

At Trestle Gully, water level fluctuated a considerable amount throughout the study period. The largest increase occurred between April 27 and May 3, and the largest decrease occurred between June 8 and June 20, also the longest time period between site visits. Figure 19 illustrates the changes in water level from April 18 to June 20.

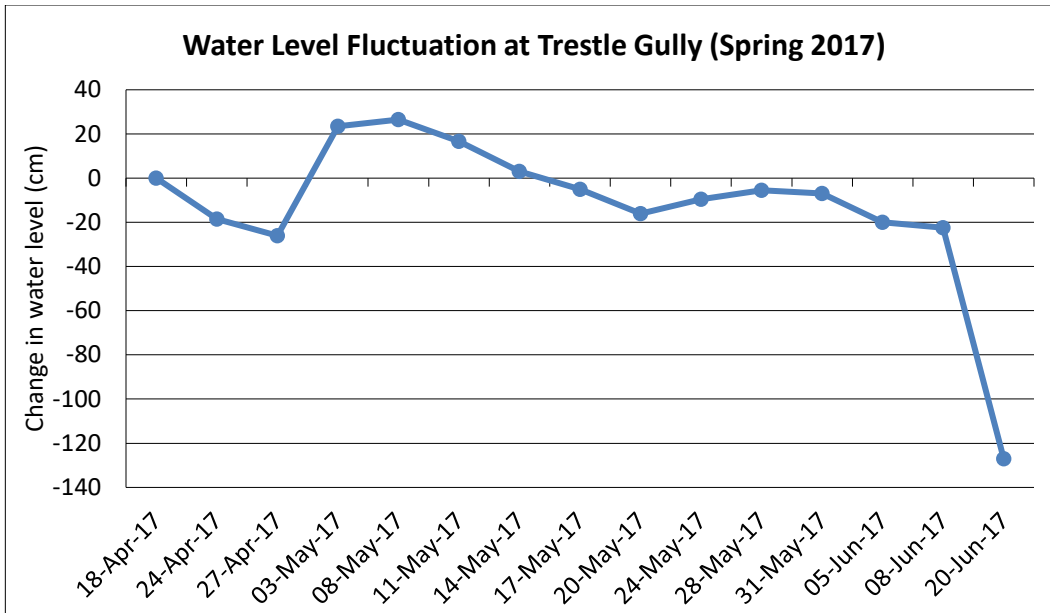


Figure 19. Water level fluctuations at Trestle Gully. Measurements on the first site visit served as the benchmark against which future measurements were compared (i.e., water level up or down compared to the first site visit).

Horseshoe Falls

At Horseshoe Falls, water level decreased after the first site visit, rose from April 29 to May 3, and then decreased again for the most part until June 20. Figure 20 illustrates the changes in water level from April 21 to June 20.

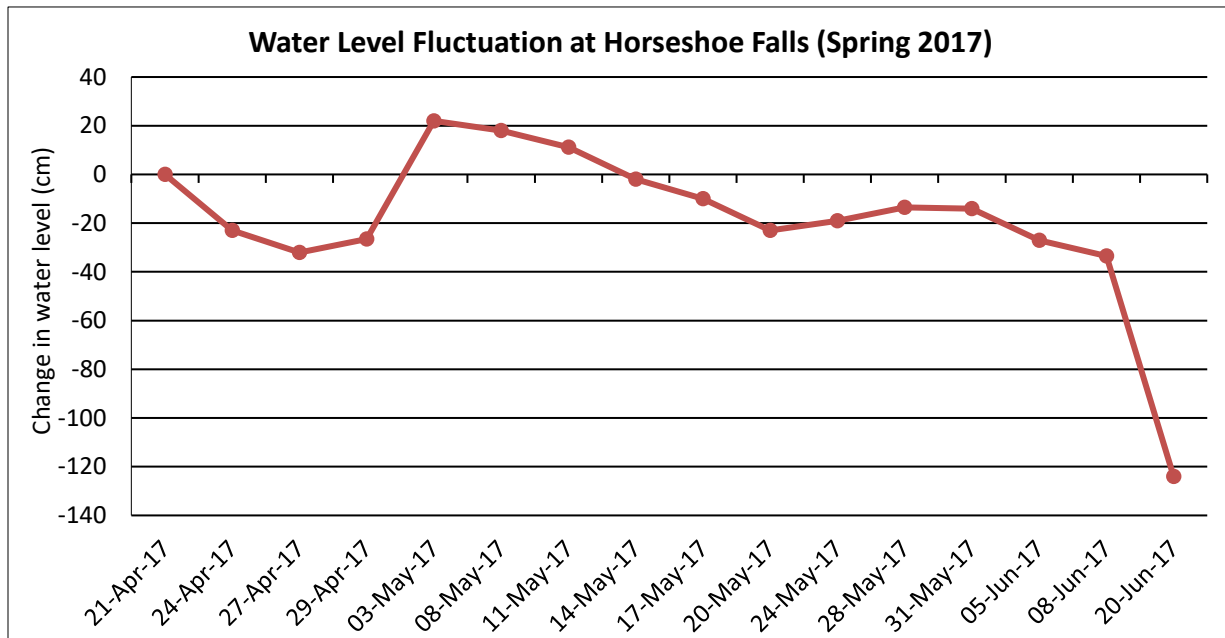


Figure 20. Water level fluctuations at Horseshoe Falls. Measurements on the first site visit served as the benchmark against which future measurements were compared (i.e., water level up or down compared to the first site visit).

Bailey Bridge

Stations 2 and 4 at Bailey Bridge followed a similar pattern of water level fluctuation. Additionally, this pattern was very similar to that of Horseshoe Falls. Figure 21 illustrates the changes in water level from April 18 to June 20 (measurements began at station 4 on April 24).

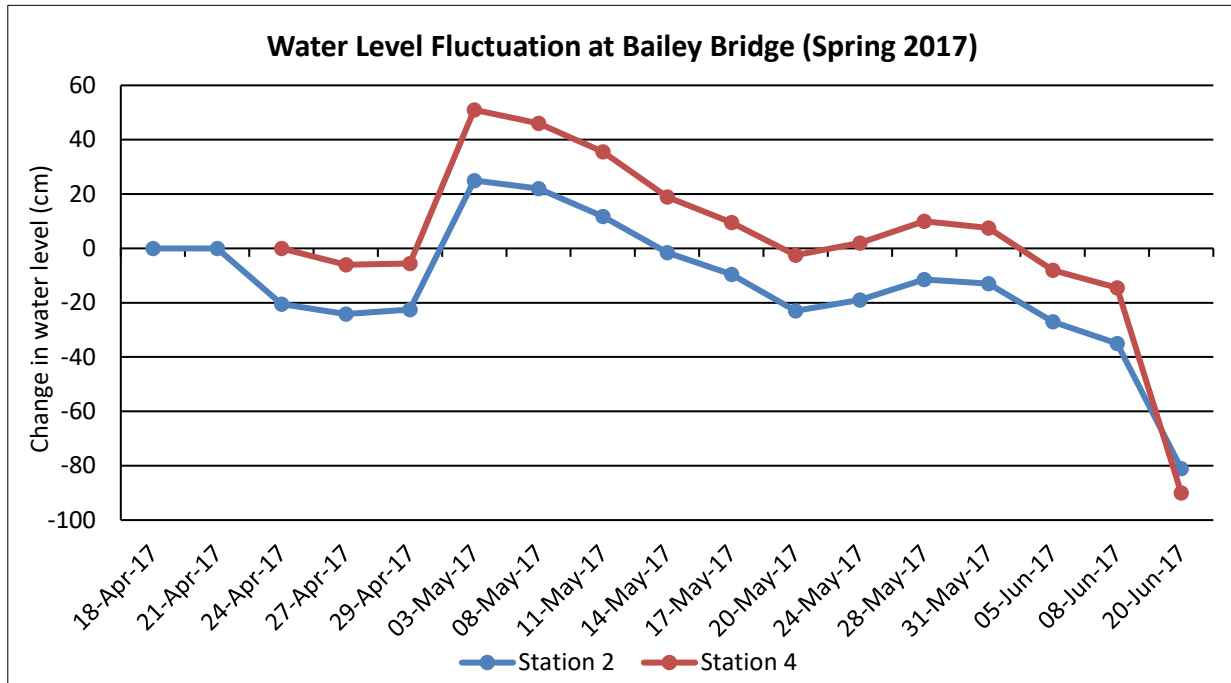


Figure 21. Water level fluctuations at Bailey Bridge measured at stations 2 and 4. Measurements on the first site visit served as the benchmark against which future measurements were compared (i.e., water level up or down compared to the first site visit).

Squaw Rapids

Water level at Squaw Rapids fluctuated greatly over the spawning and egg incubation periods. This was apparent based on the need to relocate water velocity stations on several occasions. Figure 22 illustrates the changes in water level from April 21 to June 20.

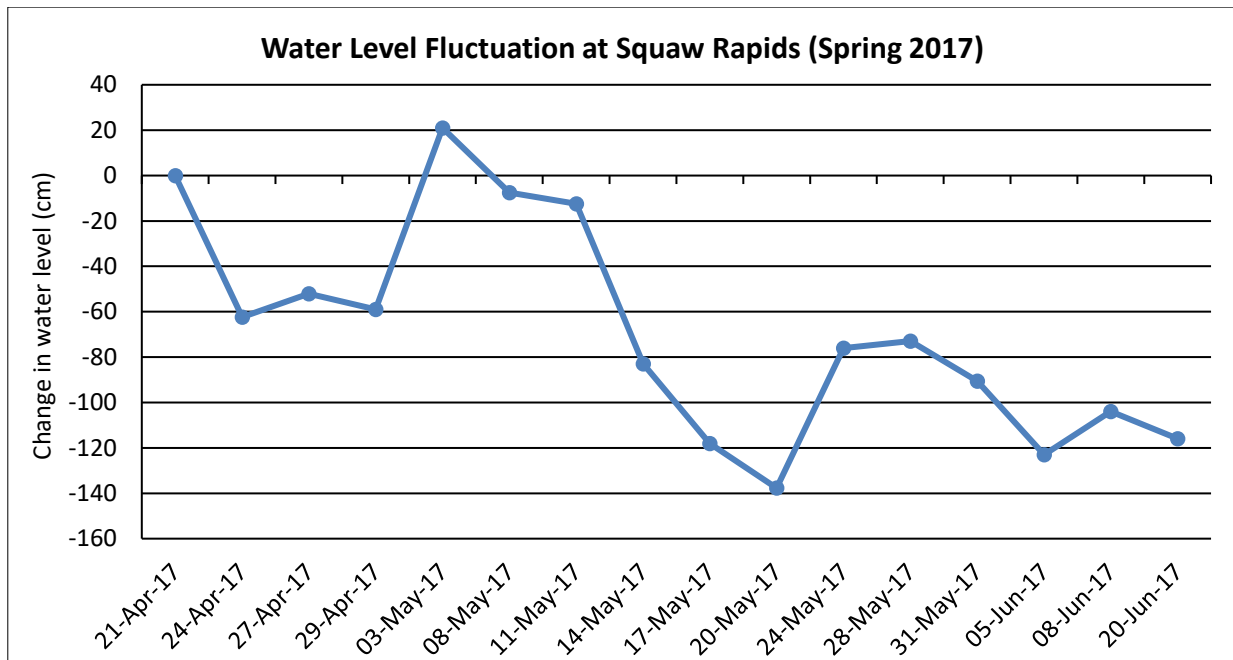


Figure 22. Water level fluctuations at Squaw Rapids. Measurements on the first site visit served as the benchmark against which future measurements were compared (i.e., water level up or down compared to the first site visit).

Aerial Photographs

An important component of the spawning bed assessments was taking a series of drone photographs during the spawning and egg incubation period to help evaluate how the spawning area changed throughout the spring freshet. During each visit, weather permitting, EGBSC staff flew a drone to capture photos of the spawning bed. Multiple photos were taken during each flight and then stitched together using Pix4D software to create an orthomosaic showing the entire spawning bed for each visit. The following orthomosaics illustrate changes in water levels at each of the spawning beds over the spawning and egg incubation periods. The images show that the spawning beds remained underwater, which is crucial for successful egg incubation. There were no observations of eggs being stranded out of water.

Trestle Gully

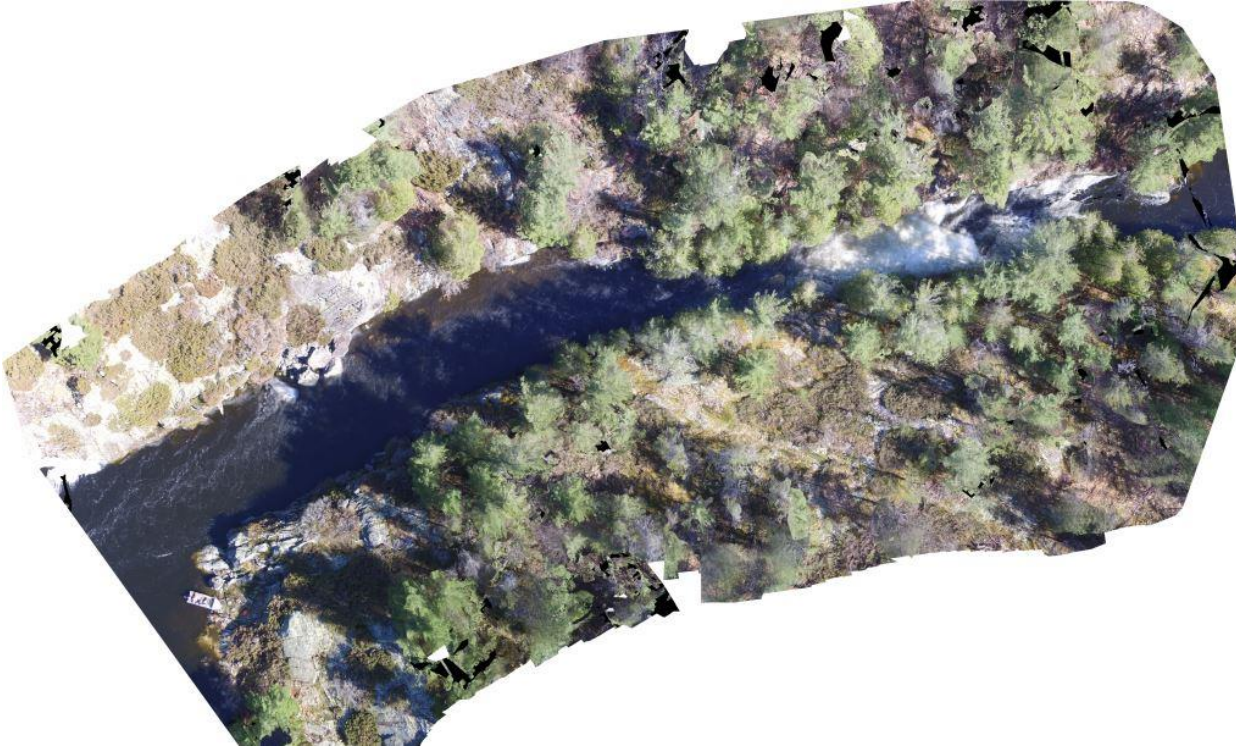
April 24, 2017



April 29, 2017 – unable to fly drone



May 3, 2017



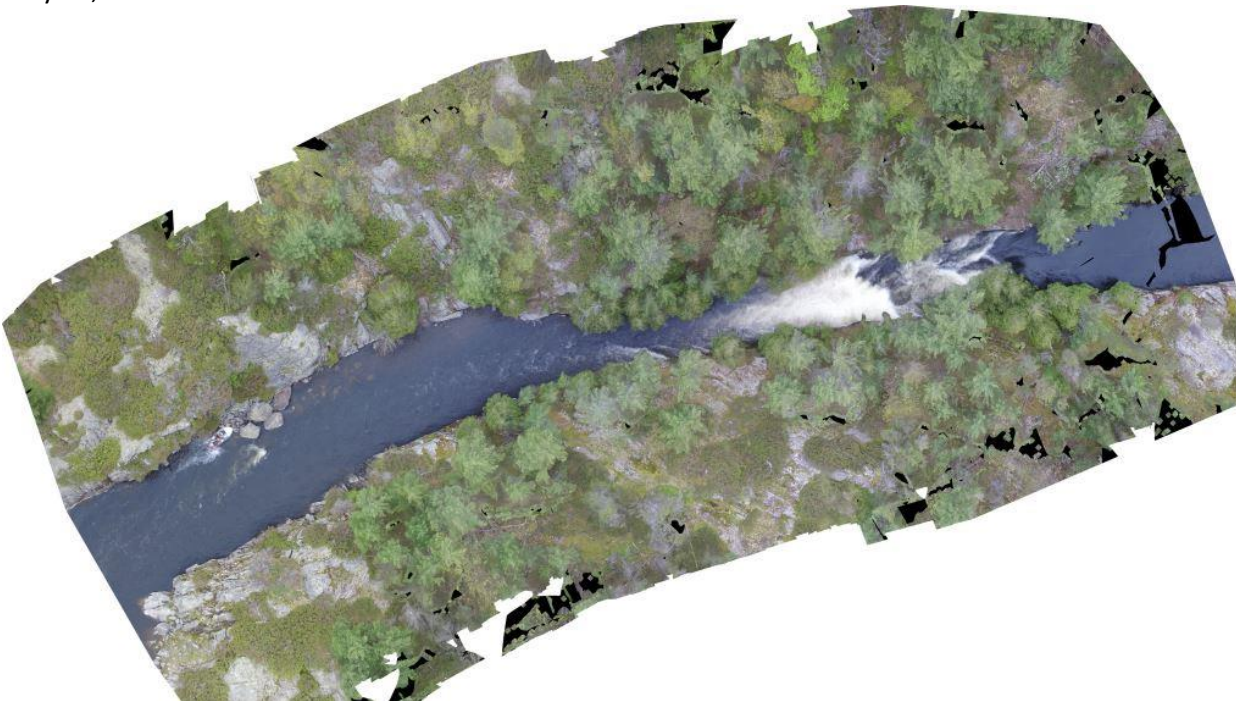
May 8, 2017



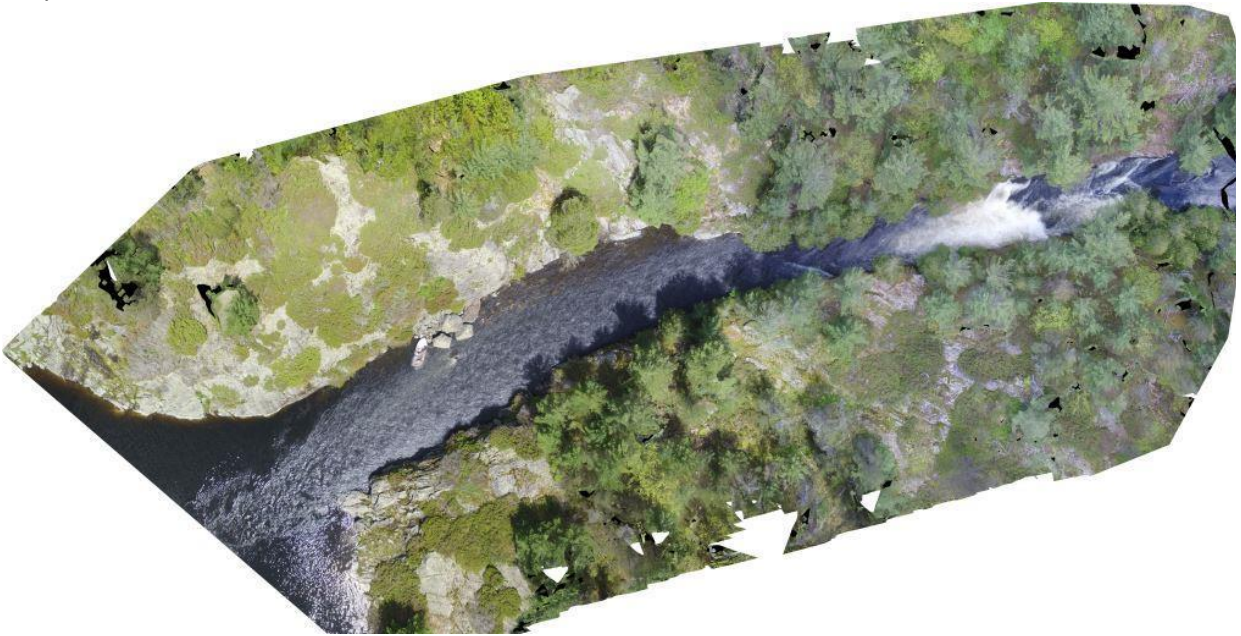
May 17, 2017 – unable to fly drone



May 24, 2017



May 28, 2017



May 31, 2017 – unable to fly drone



June 8, 2017 – unable to fly drone

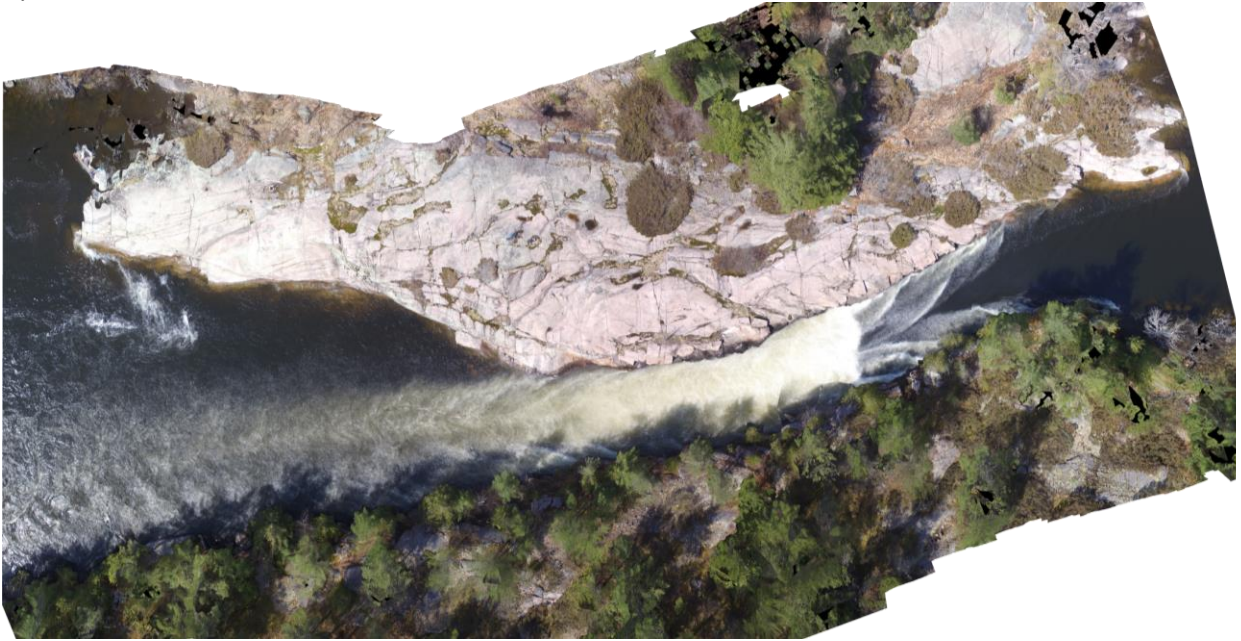


June 20, 2017



Horseshoe Falls

April 24, 2017



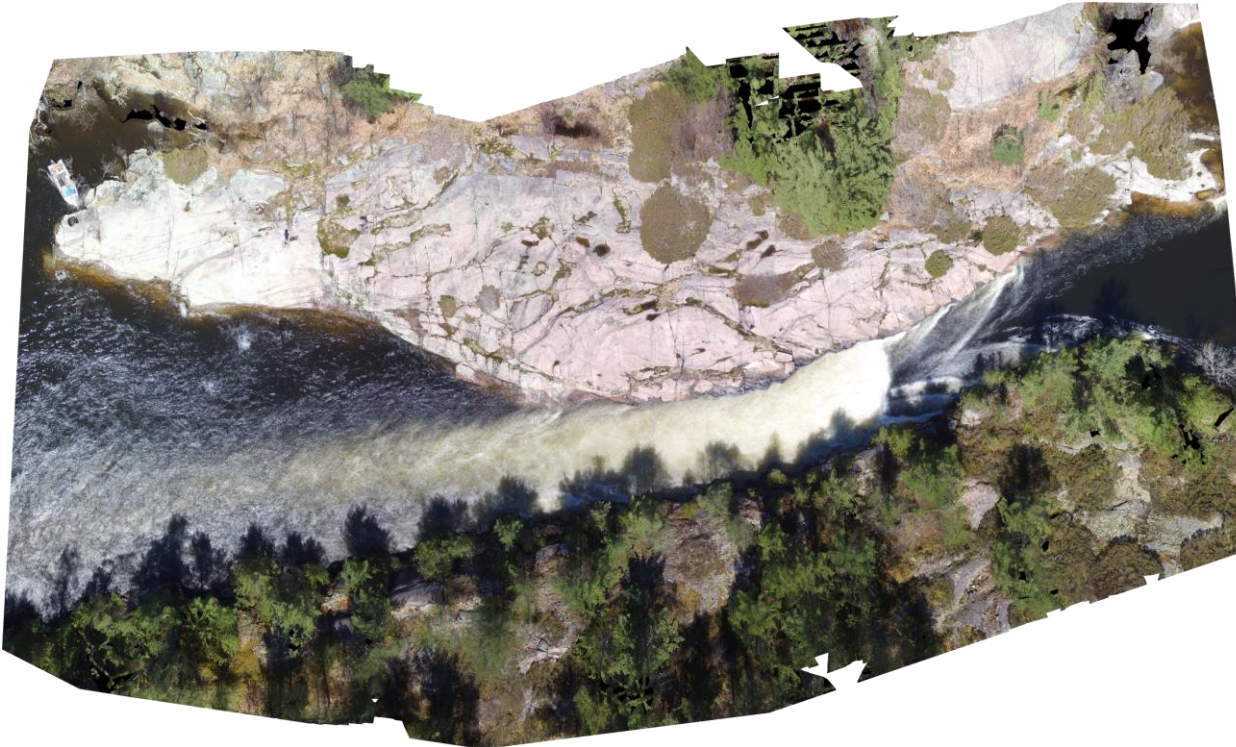
April 27, 2017 – unable to fly drone



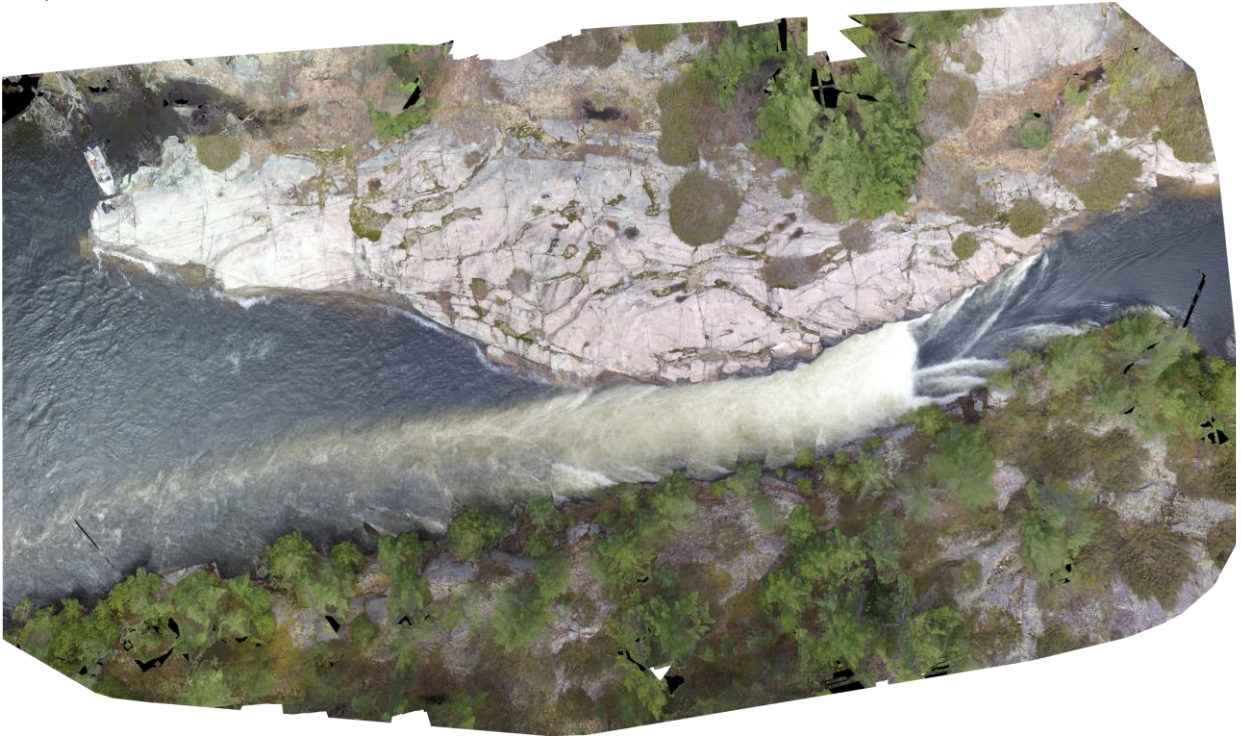
April 29, 2017 – unable to fly drone



May 3, 2017



May 8, 2017



May 11, 2017 – unable to fly drone



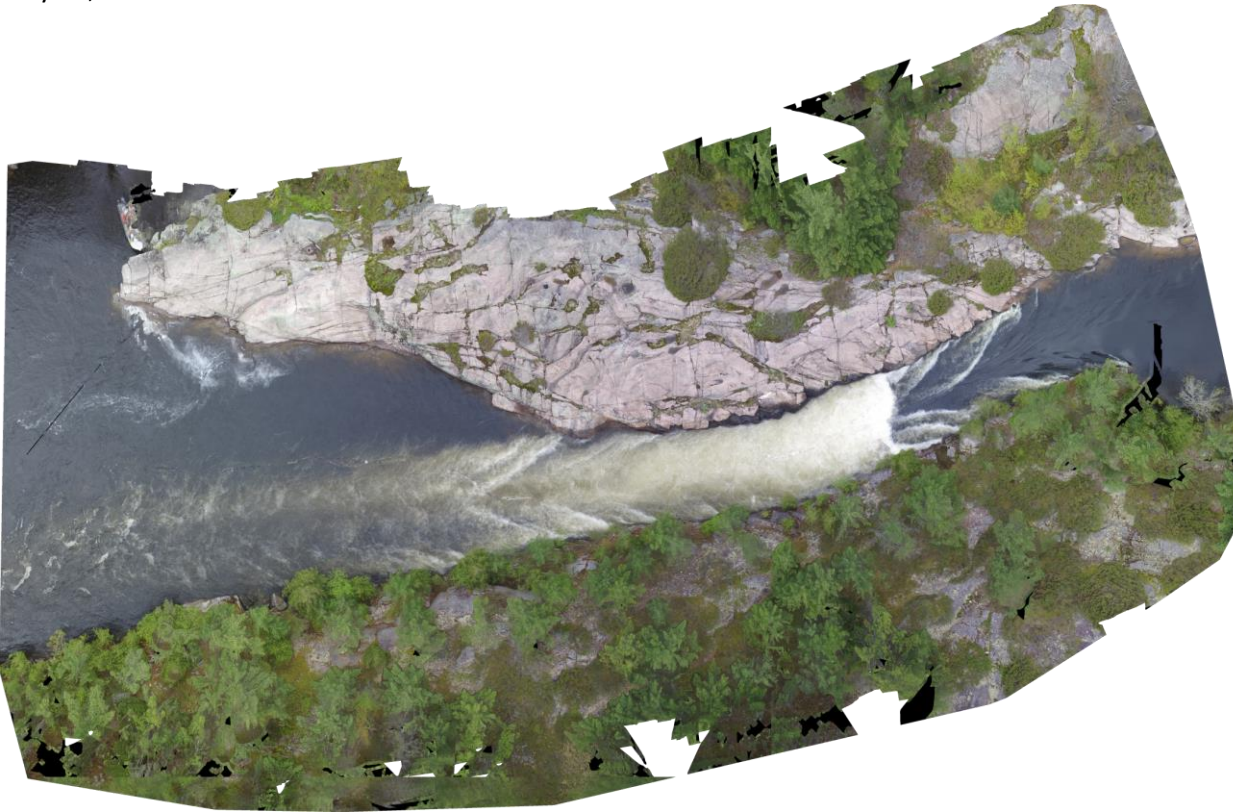
May 14, 2017 – unable to fly drone



May 17, 2017 – unable to fly drone



May 24, 2017



May 28, 2017



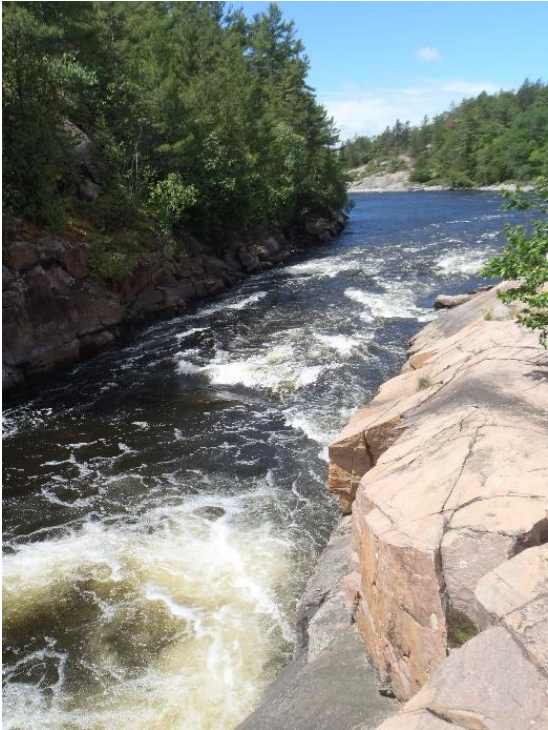
May 31, 2017 – unable to fly drone



June 8, 2017 – unable to fly drone



June 20, 2017 – unable to fly drone

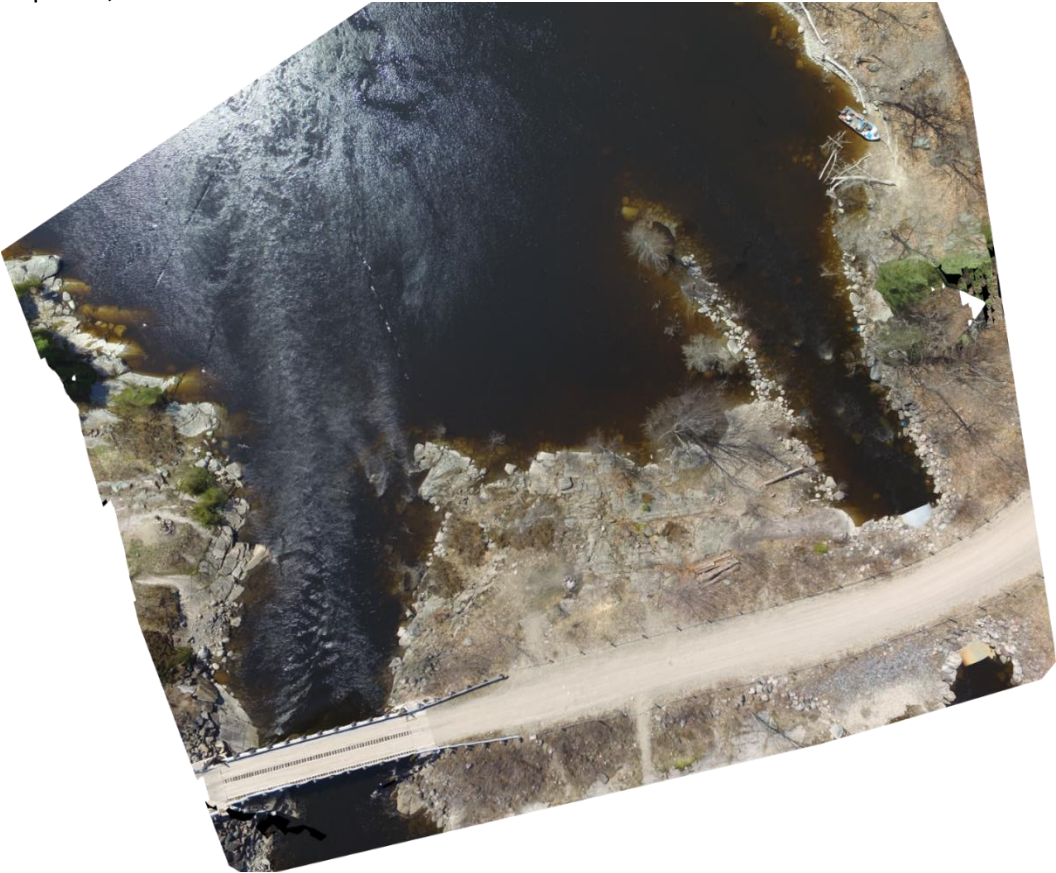


Bailey Bridge

April 18, 2017



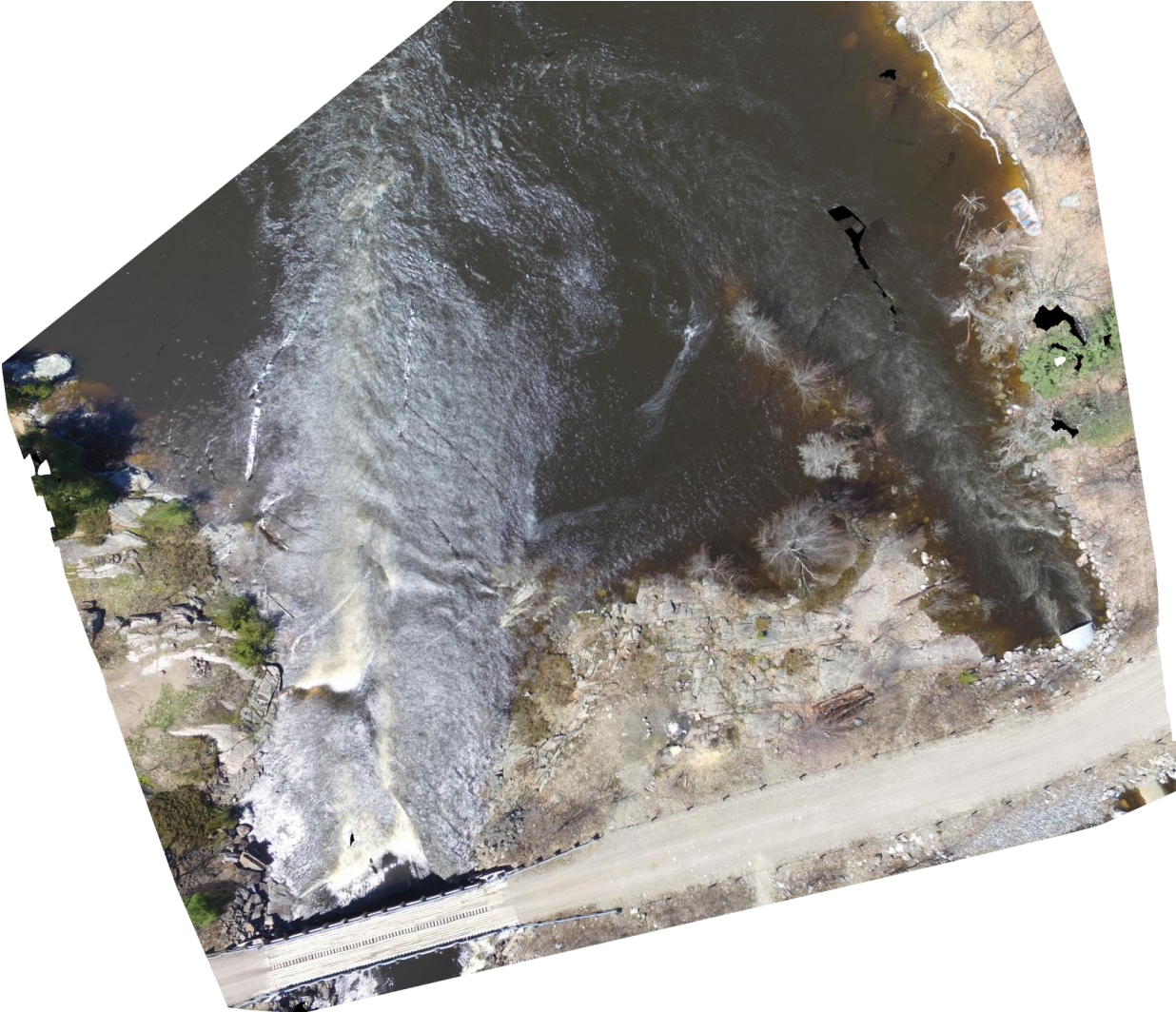
April 24, 2017



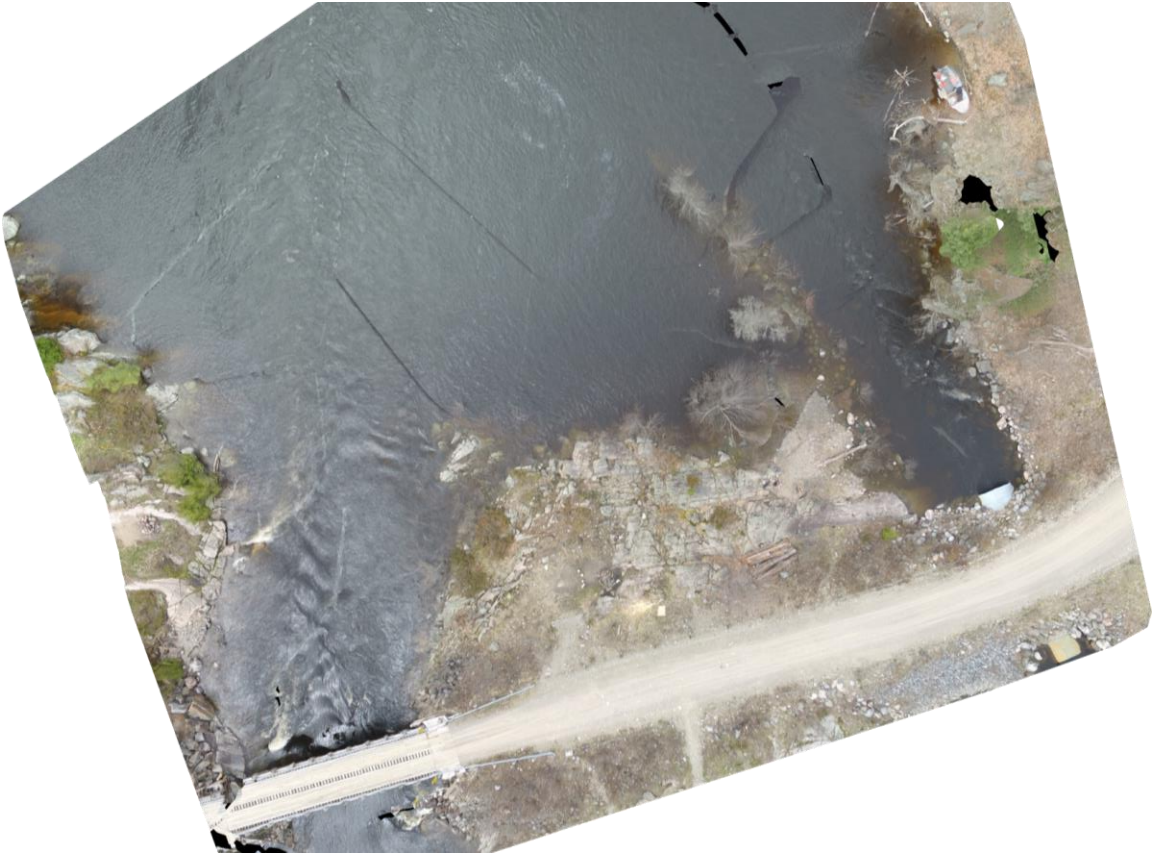
April 29, 2017 – unable to fly drone



May 3, 2017



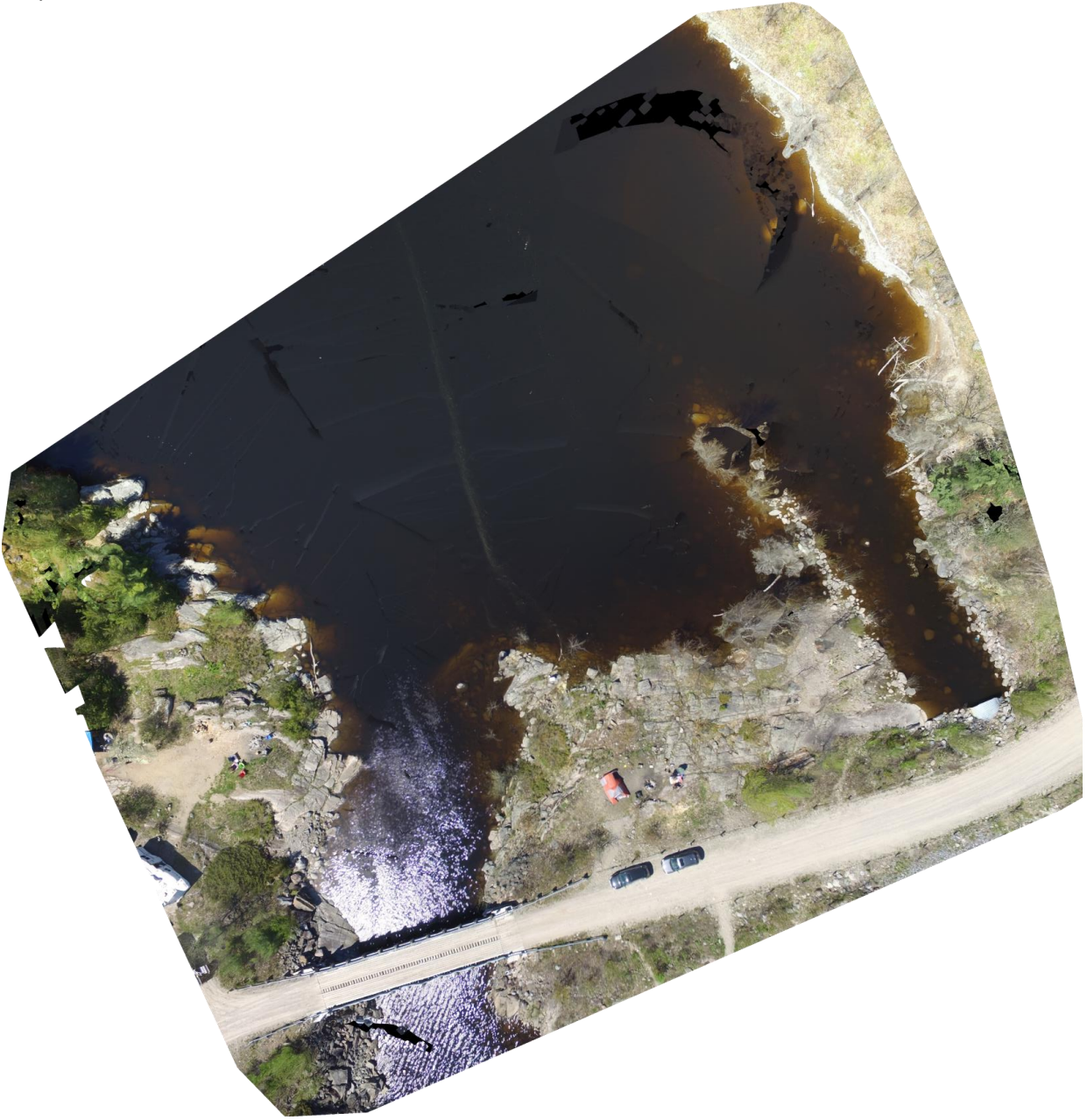
May 8, 2017



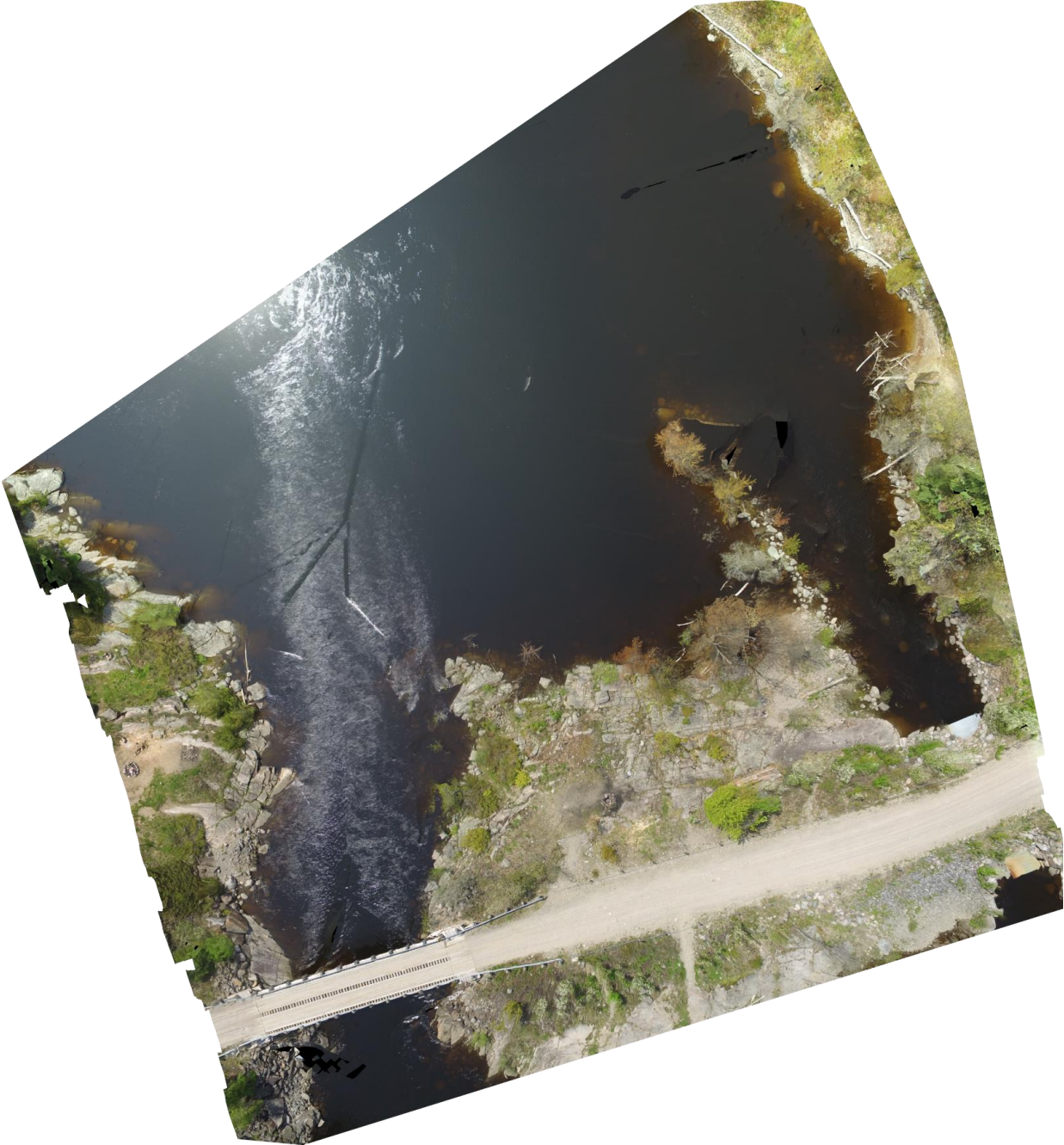
May 11, 2017 – unable to fly drone



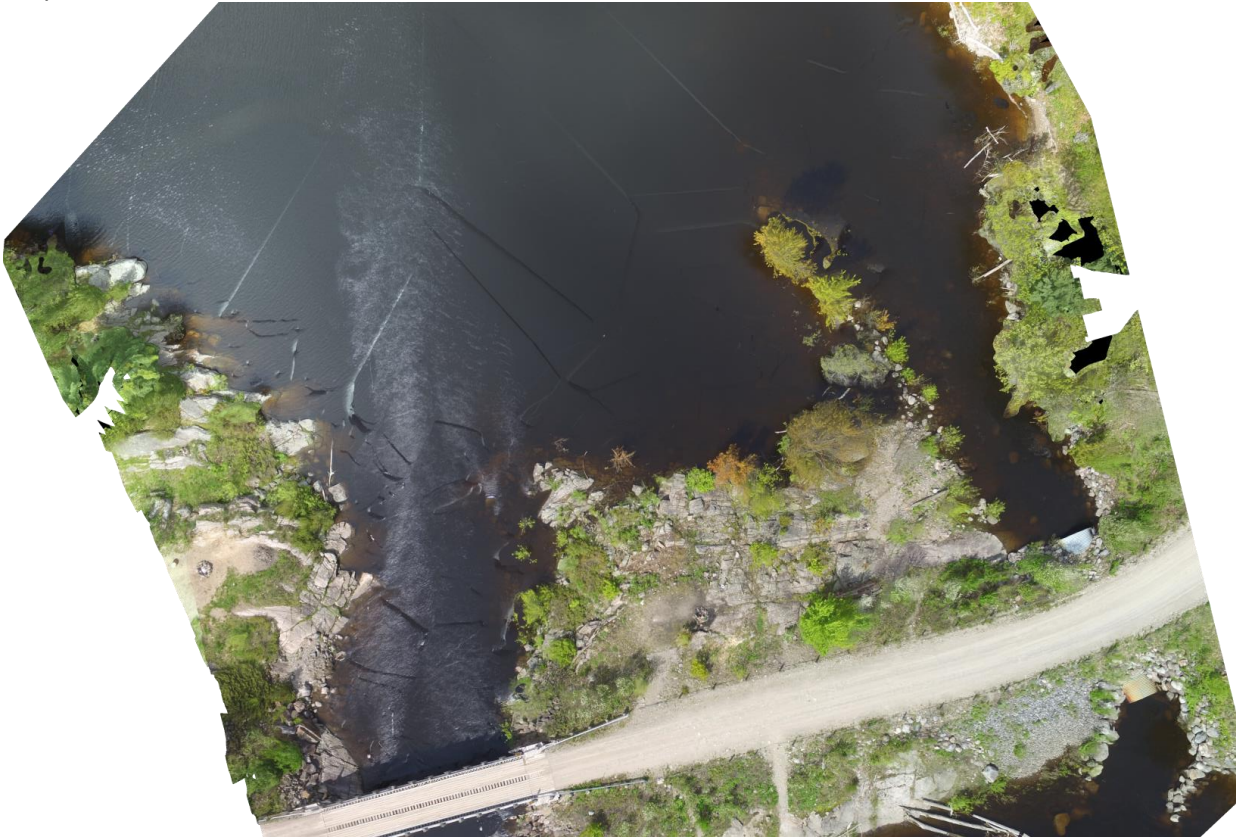
May 20, 2017



May 24, 2017



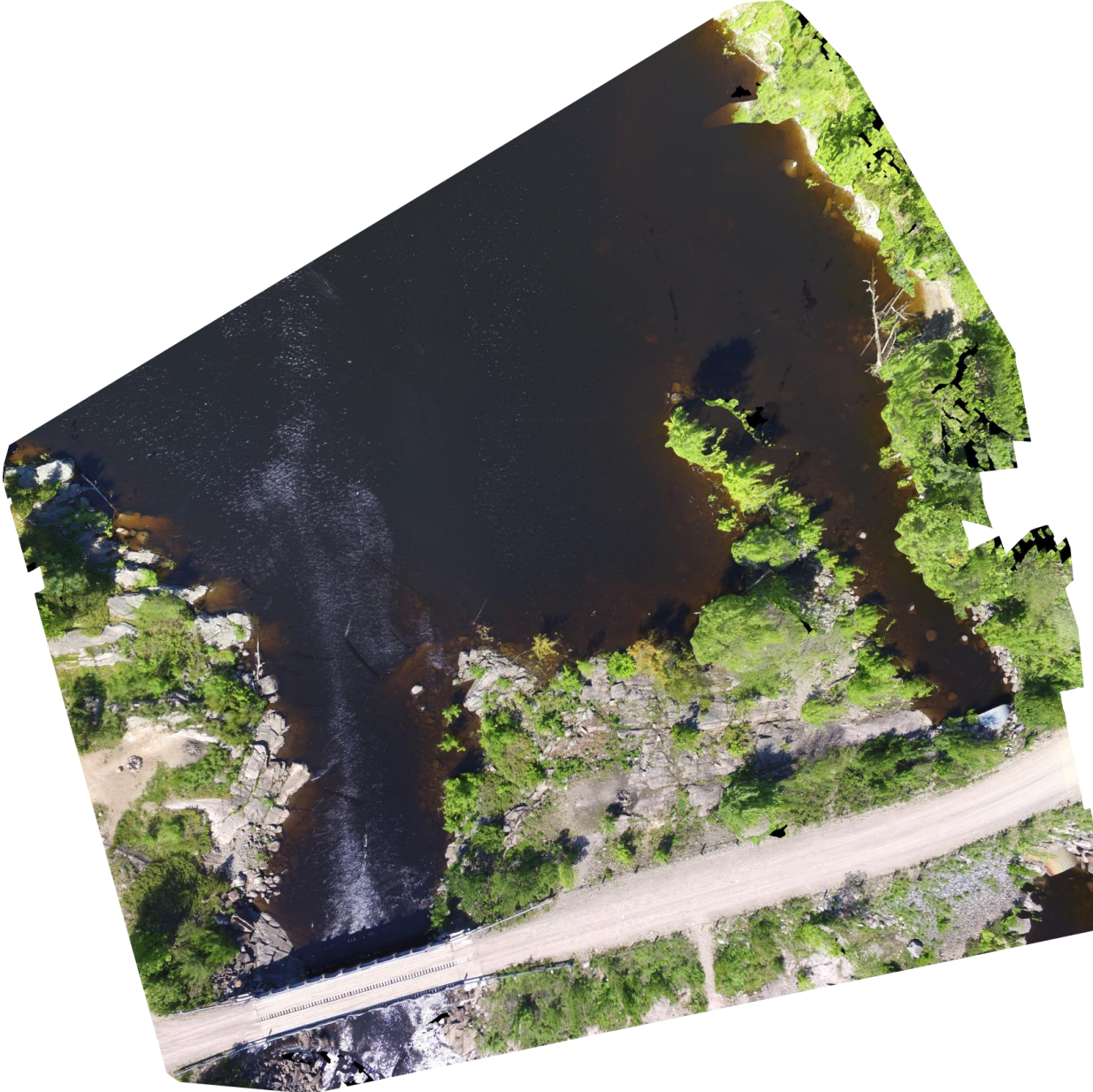
May 28, 2017



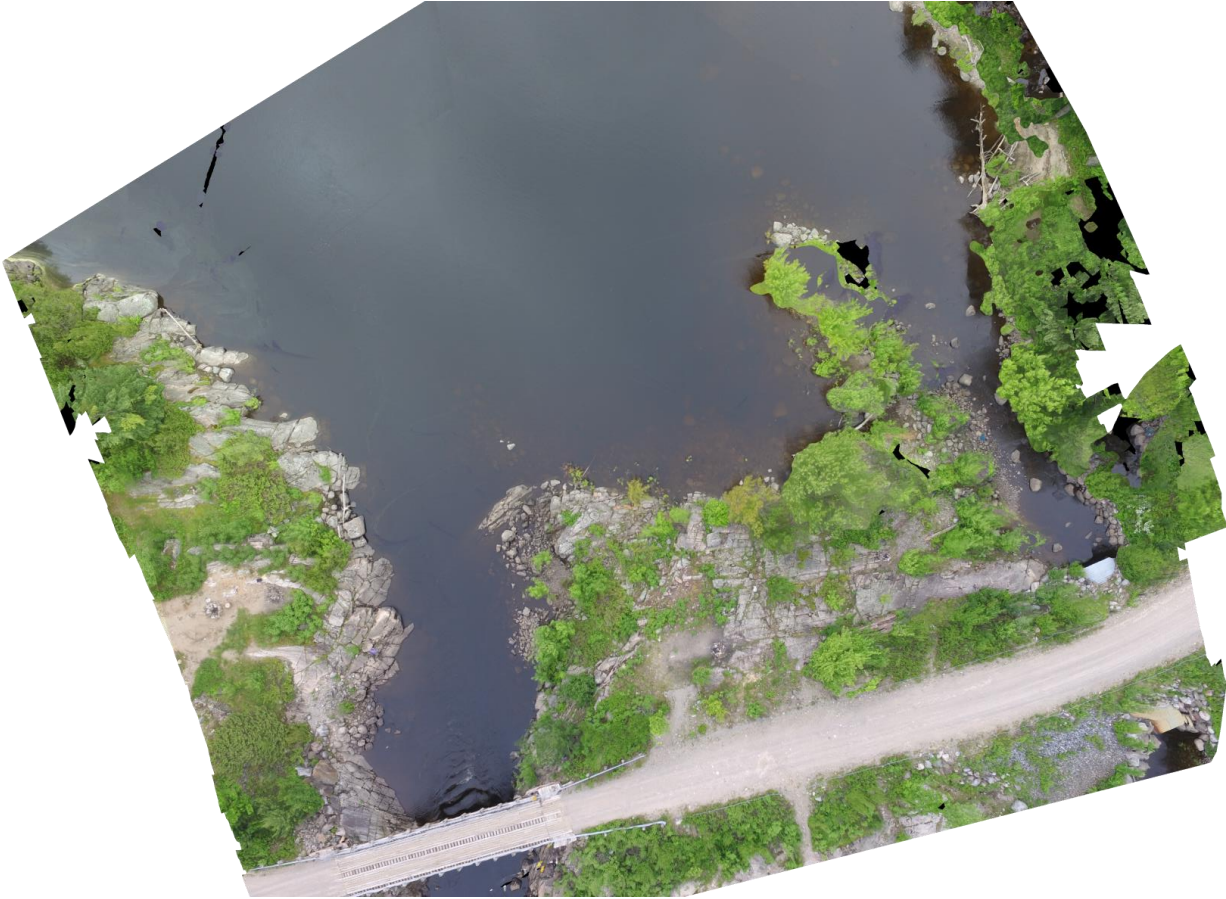
May 31, 2017 – unable to fly drone



June 8, 2017



June 15, 2017

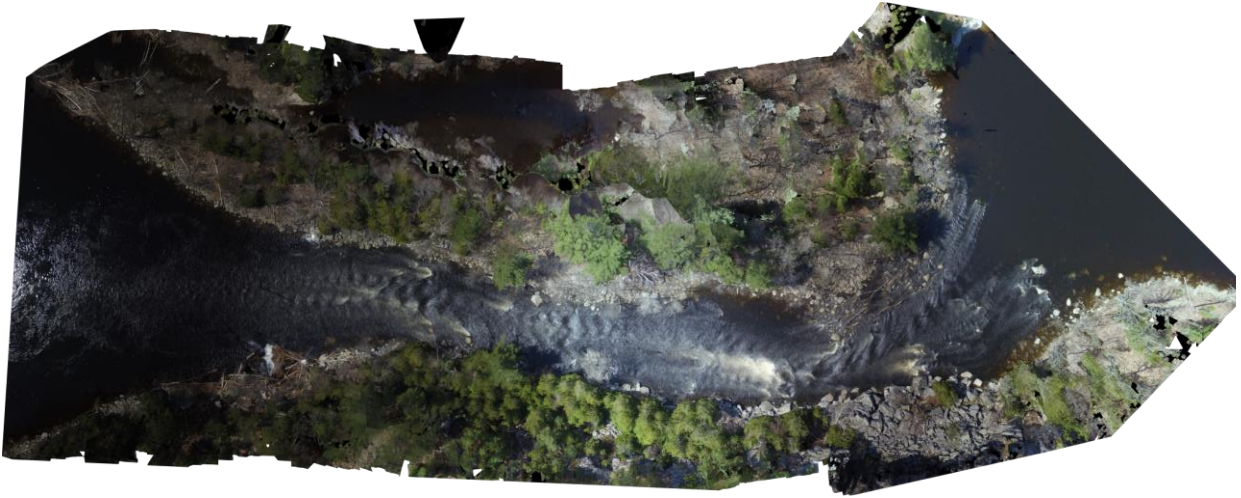


June 20, 2017 – unable to fly drone

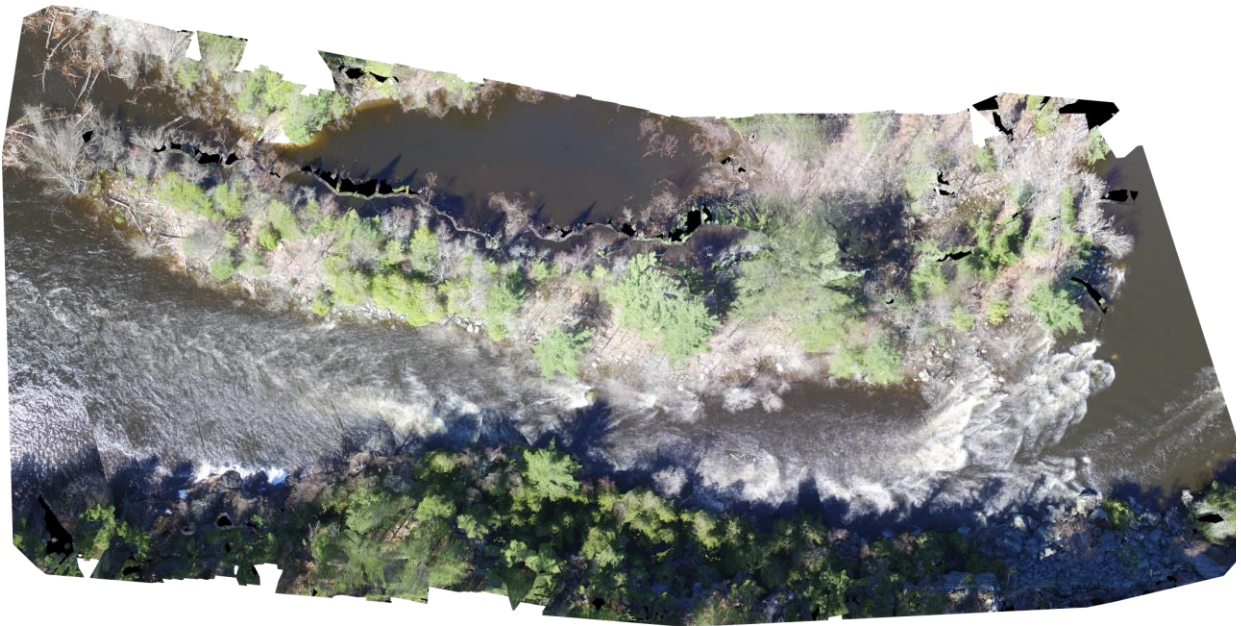


Squaw Rapids

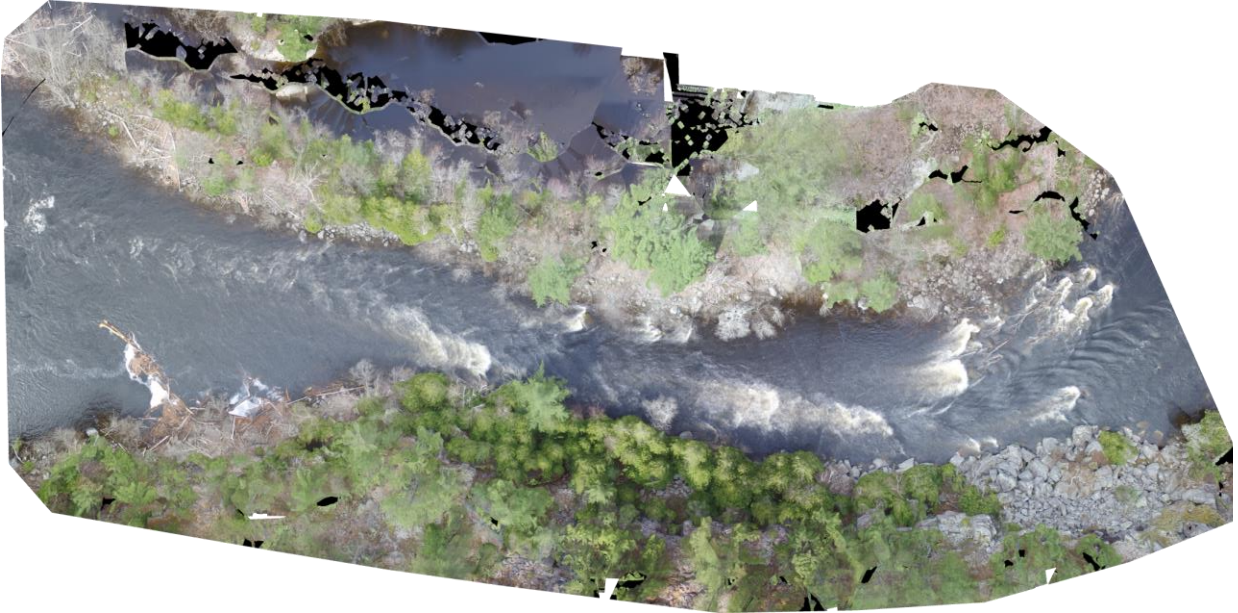
April 24, 2017



May 3, 2017



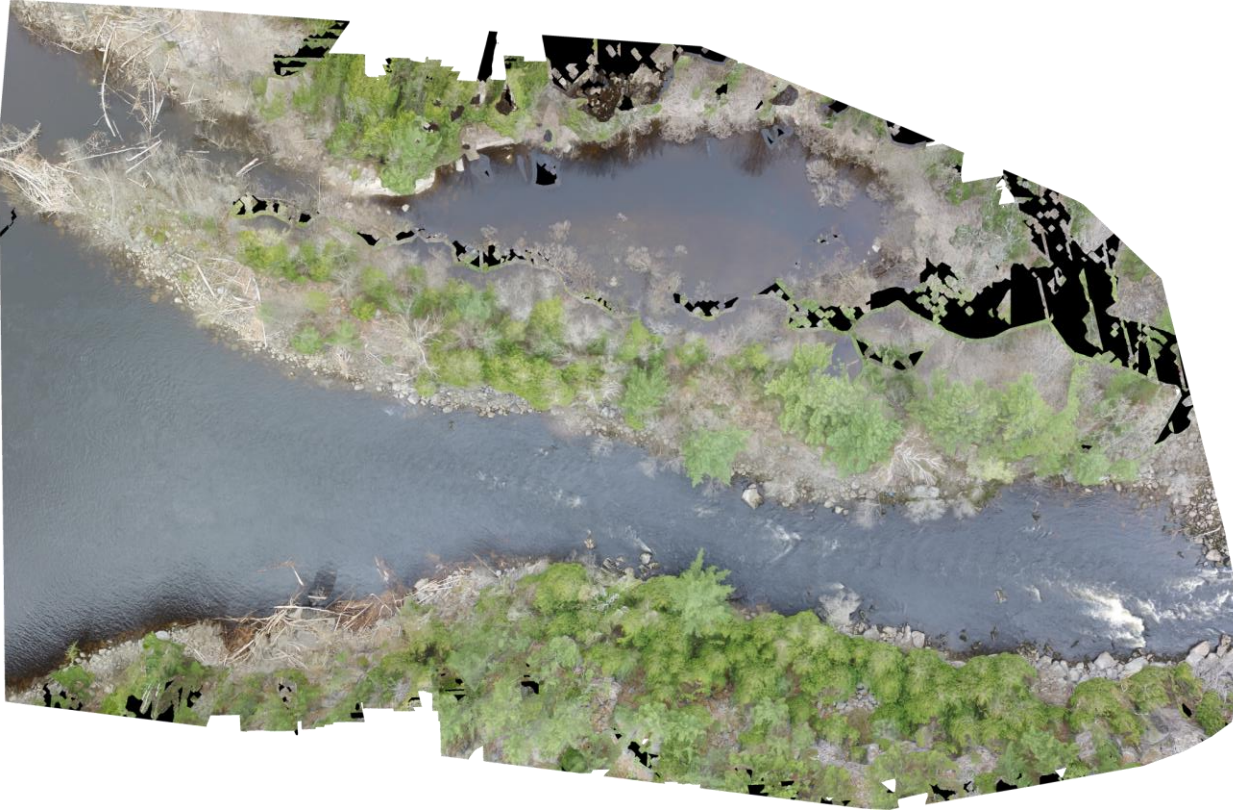
May 8, 2017



May 11, 2017 – unable to fly drone



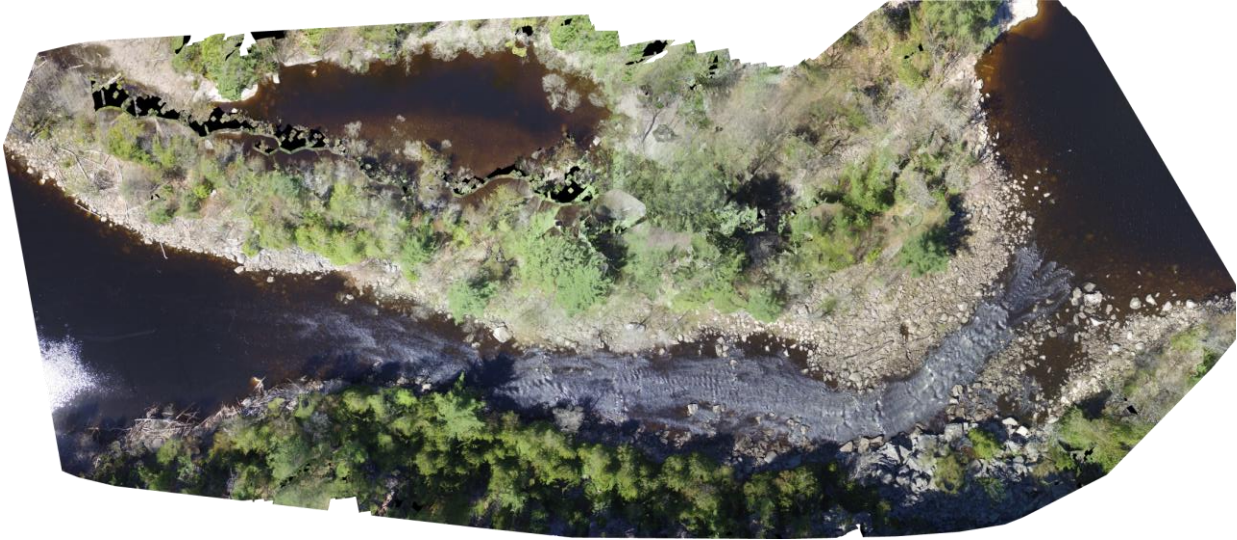
May 14, 2017



May 17, 2017



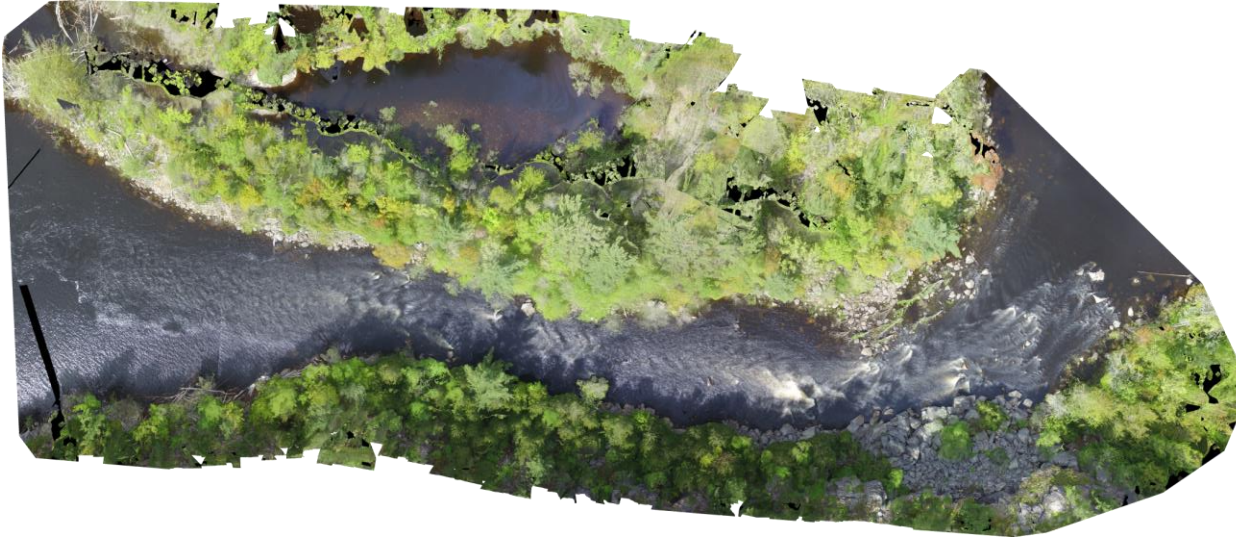
May 20, 2017



May 24, 2017



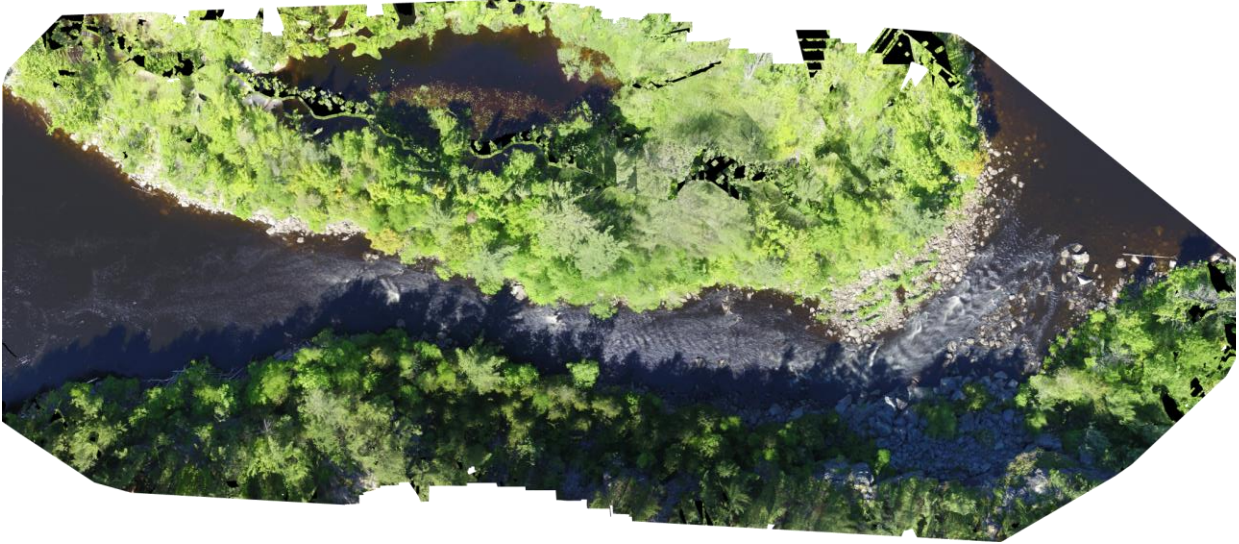
May 28, 2017



May 31, 2017 – unable to fly drone



June 8, 2017



June 20, 2017 – unable to fly drone



Fish Observations

No fish were observed during regular daytime site visits at Trestle Gully, Horseshoe Falls, or Bailey Bridge. At Squaw Rapids, Redhorse Sucker scales were seen on the left bank amongst the boulders on May 24 (Figure 23). Also at Squaw Rapids, a dead Walleye was found at the upstream end of the rapids on the left bank. No night surveys were conducted on the Pickerel River in 2017.



Figure 23. Redhorse Sucker scales found at Squaw Rapids on May 24, 2017

Egg Deposition

Trestle Gully

EGBSC set two egg mats at Trestle Gully to help assess the amount, type, and location of egg deposition (Figure 24). Egg mats were placed on a small, accessible portion of the spawning bed, and therefore, only represent a very small portion of the entire spawning area. No eggs were counted on any of the egg mats at any time throughout the study period. Based on size, eggs could be differentiated between Walleye and Sucker species, but it was not possible to identify the Sucker eggs to species level. Had Lake Sturgeon eggs been deposited, they would have also been distinguishable by size and colour.

The egg mats were installed on April 27 and reset on April 29. After being reset on April 29, the egg mats were not safely accessible again until June 20 (see [Appendix C](#) for more detail). Egg deposition on the mats was very low. A total of eighty-six (86) Walleye eggs were counted (sixty-six (66) on egg mat 1, twenty (20) on egg mat 2) and no Sucker eggs were observed.



Figure 24. Location of egg mats installed at Trestle Gully in 2017

Horseshoe Falls

No egg mats could be set at Horseshoe Falls due to the depth and velocity of the water. The banks of the channel below the falls are steeply sloped and not conducive to egg mat placement. Entering the water to attempt to find an area to install egg mats would not have been safe during the spring.

Bailey Bridge

Seven egg mats were set at Bailey Bridge at different times throughout the study period to help assess the amount, type, and location of egg deposition (Figure 25). Egg mats were only placed on a small, accessible portion of the spawning bed, and therefore, only represent a small portion of the entire spawning area. Based on size, eggs could be differentiated between Walleye and Sucker species, but it was not possible to identify the Sucker eggs to species level. Had Lake Sturgeon eggs been deposited, they would have also been distinguishable by size and colour.



Figure 25. Location of egg mats installed at Bailey Bridge in 2017

The egg mats were installed at various times throughout the study period (see [Appendix C](#) for complete egg mat details). Overall, egg deposition on the mats was low. From April 18 to June 15, a total of 9,374 Walleye eggs and only sixty-seven (67) Sucker eggs were counted. By far, egg mat 2 had the greatest total number of Walleye eggs (8,001). Egg mat 6 had the greatest total number of Sucker eggs (forty-two (42)).

After egg mats were reset on April 29, water levels rose and rendered most of the mats inaccessible until May 14. Accordingly, there was a period of over two weeks when egg mats could not be checked and counted.

Squaw Rapids

Nine egg mats were set at Squaw Rapids at different times throughout the study period to help assess the amount, type, and location of egg deposition (Figure 26). Egg mats were only placed on a small, accessible portion of the spawning bed, and therefore, only represent a small portion of the entire spawning area. Based on size, eggs could be differentiated between Walleye and Sucker species, but it was not possible to identify the Sucker eggs to species level. Had Lake Sturgeon eggs been deposited, they would have also been distinguishable by size and colour.

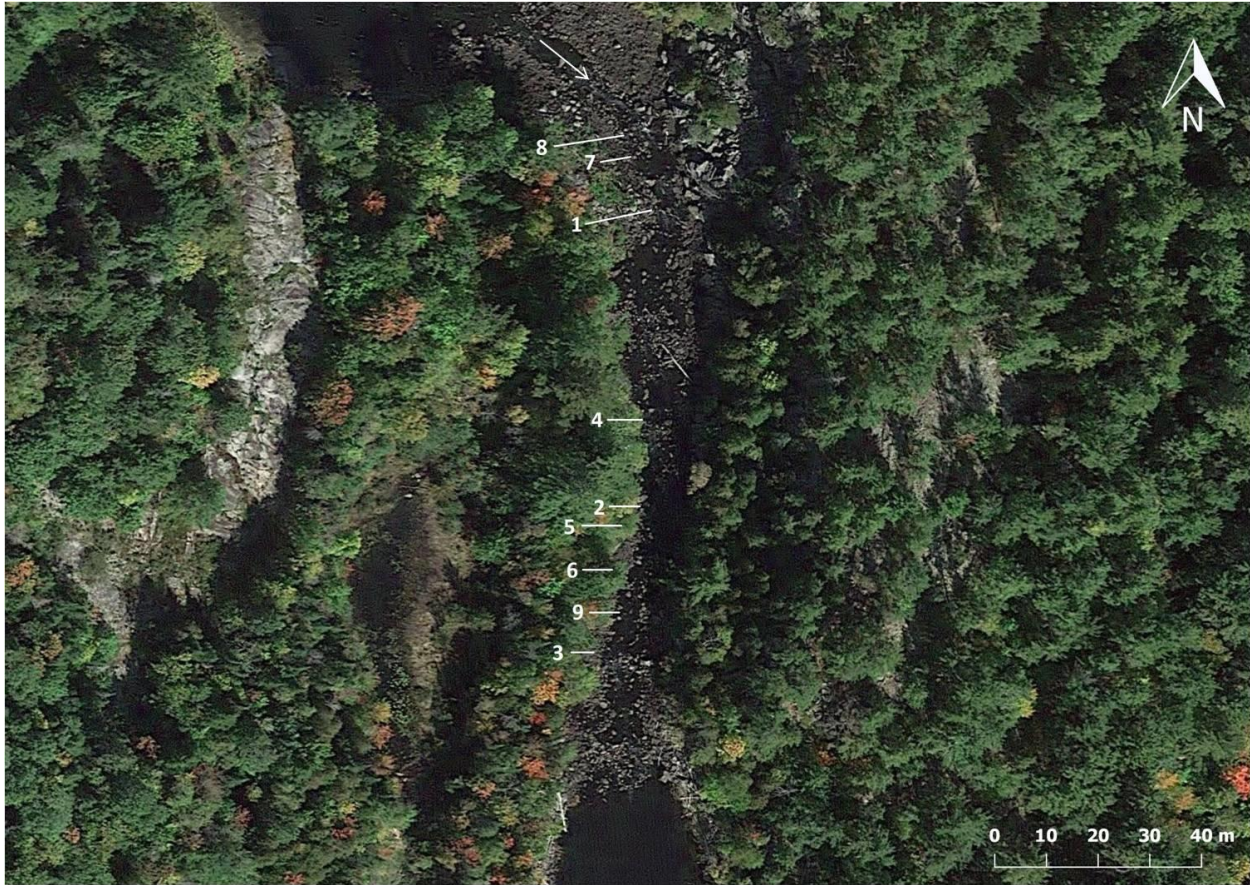


Figure 26. Location of egg mats installed at Squaw Rapids in 2017

The egg mats were installed at various times throughout the study period. Egg deposition on the mats was higher than at Trestle Gully, but much lower than at Bailey Bridge. From April 21 to June 20, a total of 667 Walleye eggs were counted. No Sucker eggs were seen on any of the egg mats. Egg mat 1 had the greatest total number of Walleye eggs (379). In addition to eggs counted on the egg mats, a small number of Walleye eggs were observed in the substrate on the left bank on May 20.

As with Bailey Bridge, after egg mats were reset on April 29, water levels rose and rendered most of the mats inaccessible for an extended period of time (see [Appendix C](#) for complete egg mat details). Some of the mats were not able to be found again until much later, or in some cases, at all. Accordingly, there was a period of time when several egg mats could not be checked and counted.

In 2017, egg mats were set at a total of seven spawning areas on three rivers – Naiscoot River (two spawning beds), Pickerel River (three spawning beds), and Key River (two spawning beds). Table 1 compares the total Walleye and Sucker egg counts for these sites.

Table 1. Comparison of egg mat totals at all spawning beds assessed in 2017

| Eggs | Naiscoot River | | Key River | | Pickerel River | | |
|---------|----------------|---------------|-----------|---------------------|----------------|---------------|--------------|
| | Naiscoot Dam | Harris Branch | Ludgate | Portage Lake Outlet | Trestle Gully | Bailey Bridge | Squaw Rapids |
| Walleye | 0 | 11 | 1,840 | 7,017 | 86 | 9,374 | 667 |
| Sucker | 0 | 184 | 0 | 1 | 0 | 67 | 0 |

Plankton Sampling

Once eggs incubate and hatch, fish enter their larval stage. Larval Walleye have limited mobility and typically move by drifting with water flow and wave action. Shortly after hatching, Walleye need to feed on zooplankton to ensure survival, growth, and development. The availability of zooplankton is a major factor in surviving this life stage. To help evaluate the amount of zooplankton downstream of the Pickerel River spawning beds, EGBSC conducted several plankton tows using a 12" diameter, 153 micron plankton net.

EGBSC did not identify and count the zooplankton in the samples. Only a visual observation of the samples could be made and compared with the two other rivers sampled in 2017.

Trestle Gully

Three samples were taken downstream of Trestle Gully on May 24 and June 8. Each time, the three samples were combined to create one composite sample (Figures 27 and 28). Based on the composite samples, the waters downstream of Trestle Gully can be described as having good plankton production. In fact, downstream of Trestle Gully appeared to have the best plankton production of the four areas sampled on the Pickerel River.



Figure 27. Trestle Gully composite plankton sample (May 24, 2017)



Figure 28. Trestle Gully composite plankton sample (June 8, 2017)

Horseshoe Falls

As with Trestle Gully, three samples were taken downstream of Horseshoe Falls on May 24 and June 8. Each time, the three samples were combined to create one composite sample (Figures 29 and 30). The waters downstream of Horseshoe Falls can be described as having good plankton production.



Figure 29. Horseshoe Falls composite plankton sample (May 24, 2017)



Figure 30. Horseshoe Falls composite plankton sample (June 8, 2017)

Bailey Bridge

Downstream of Bailey Bridge, three plankton samples were taken on May 24 and June 8. Each time, the three samples were combined to create one composite sample (Figures 31 and 32). Based on the composite samples, the waters downstream of Bailey Bridge can be described as having good plankton production.



Figure 31. Bailey Bridge composite plankton sample (May 24, 2017)



Figure 32. Bailey Bridge composite plankton sample (June 8, 2017)

Squaw Rapids

As with the other three sites, three plankton samples were taken downstream of Squaw Rapids on May 24 and June 8. A composite sample was created both times by combining the three samples into one (Figures 33 and 34). Based on the composite samples, the waters downstream of Squaw Rapids can be considered to have good plankton production.

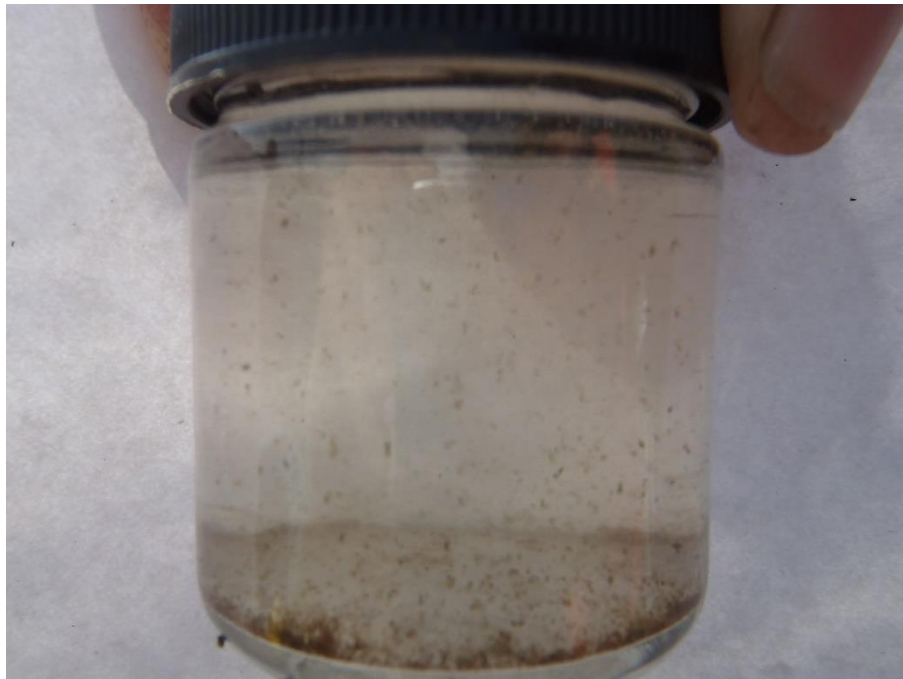


Figure 33. Squaw Rapids composite plankton sample (May 24, 2017)



Figure 34. Squaw Rapids composite plankton sample (June 8, 2017)

Spawning Bed Measurements

Reproductive success for Walleye, Lake Sturgeon, and White Sucker is optimized when water depth, velocity, and appropriately sized substrate are present at the same location within a spawning area. The optimal substrate size for Walleye egg incubation ranges from gravel (0.2 to 6.4 cm) to cobble (6.4 to 25 cm) (Kerr et al., 1997). The optimal substrate size for Lake Sturgeon ranges from 10 to 60 cm in diameter (Golder Associates Ltd., 2011). White Sucker spawn on a clean bottom of coarse sand to gravel ranging from 2 to 16 mm in size (Twomey et al., 1984). Optimal depth for spawning Walleye ranges from 30 to 100 cm (Kerr et al., 1997) and 10 to 200 cm for Lake Sturgeon spawning (Golder Associates Ltd., 2011).

In the fall of 2017, transects were measured across the Bailey Bridge spawning bed with the intent of identifying areas “ideal” for spawning for Walleye, Lake Sturgeon, and Sucker species. EGBSC used some of the methods from the Ontario Stream Assessment Protocol (developed by MNRF) to complete the transects. Along each transect, six points were measured for depth and substrate type, based on the width (taken at bankfull) of each transect. In addition to depth and substrate, any aquatic vegetation was noted at each point, and shoreline vegetation was recorded at each transect. Depth was recorded with a metre stick and substrate was estimated with the aid of a grid marked at 10 cm increments. Transects were completed later in the season, when it was safe to wade across the spawning bed; because of this, only depth and substrate information was collected. Any velocity data collected would not have been the same as during the spawning season. Therefore, the analysis of ideal spawning habitat is based on depth and substrate only.

Wading across the spawning beds at Trestle Gully, Horseshoe Falls, and Squaw Rapids was not possible due to water depth, velocity, or both. Therefore, transects could not be safely measured across these spawning beds. Instead, a qualitative approach was taken in which the substrate that could be seen from the banks was described. Depth measurements at bankfull were not possible without being able to stretch a tape measure across the entire channel. Furthermore, any velocity data collected would not have been the same as during the spawning season.

Trestle Gully

As water levels diminished over the summer and into the fall, more substrate at Trestle Gully became visible. Figure 35 outlines the substrate observed in three sections of Trestle Gully. The most upstream area, the main section of rapids, is predominantly made up of bedrock and large boulders (dashed white line). Below the main section of rapids, the yellow dashed line delineates an area with cobble and small boulders as the dominant substrate. Finally, the area outlined by the red dashed line has small and large boulders as the predominant substrate. Figure 36 exemplifies this transition from mainly cobble and small boulders to small and large boulders as the dominant substrate. Limited substrate suitable for Sucker was observed at Trestle Gully.



Figure 35. Spawning bed at Trestle Gully. Dashed white line indicates area of primarily bedrock and large boulder substrate. Dashed yellow line shows an area of primarily cobble and small boulders. Red dashed line highlights an area of primarily small and large boulders.



Figure 36. View of Trestle Gully showing the transition along the left bank from primarily cobble and small boulders to primarily small and large boulders

Horseshoe Falls

Due to the morphology of this site, water depth and velocity in the fall were still such that the substrate could not be seen from the banks. Furthermore, water velocity prohibited snorkelling the site. As such, EGBSC was unable to collect any additional information on substrate at Horseshoe Falls.

Bailey Bridge

EGBSC completed seven transects across the spawning bed, spaced roughly 6 m apart (Figures 37 and 38). In total, across the seven transects, forty-two (42) points were measured for depth and substrate. For Walleye, 90% of the points met the optimal depth and 93% of the points had at least some of the optimal substrate type. Overall, 88% of the points measured (37 of the 42) had both the ideal depth and the ideal substrate size. For Lake Sturgeon, 100% of the points measured fell into the optimal depth range, and 95% of the points had at least some substrate in the optimal substrate range. Overall, 95% of the points measured met both depth and optimal substrate for Lake Sturgeon. For White Sucker, EGBSC was unable to find the ideal depth for spawning in any of the literature searched. As a result, habitat for White Sucker was only based on ideal substrate type and size. Very few of the points measured at Bailey Bridge were ideal for White Sucker. Only 19% of the points measured had the ideal substrate (8 of the 42 points). White Sucker substrate was found at three points on transects 1 and 2, and one point on transects 3 and 4.

This evaluation was based on identifying ideal spawning habitat only. It does not indicate the actual amount of spawning, as fish will spawn in areas without ideal substrate. In addition, the ideal habitat has only been measured at certain points along the transect lines, and therefore does not represent the entire spawning bed. The measurements are a sample of the spawning bed and serve as an indicator of potential site limitations. Complete transect data is provided in [Appendix D](#).



Figure 37. Spawning bed measurement transects at Bailey Bridge. Green dots indicate points with ideal depth and at least some ideal substrate for Walleye, Lake Sturgeon, and/or Sucker spawning.



Figure 38. Measuring bankfull width and depths along transect 3

Squaw Rapids

As water levels diminished over the summer and into the fall, more substrate at Squaw Rapids became visible. Substrate visible from the left bank was recorded. Overall, large boulders were the dominant substrate at Squaw Rapids with cobble and small boulders being the next dominant substrate types. Large and small boulders make up the overwhelming majority of the substrate at the upper end of the rapids (Figures 39 and 40). More cobble and a small amount of gravel appears further down the rapids; however, small and large boulders are still present in these areas as well. Limited substrate suitable for Sucker was observed at Squaw Rapids.



Figure 39. Example of large and small boulders dominating the substrate at the upper end of Squaw Rapids



Figure 40. Example of large and small boulders dominating the substrate at the upper end of Squaw Rapids

Nursery, Rearing, and Foraging Habitat

Until they become mobile, newly hatched fry of most riverine spawning species are dispersed largely according to water currents. In lake environments, wind-driven current can be a major factor in dispersing fry. Accordingly, the availability of nursery habitat in the downstream (or down-wind) vicinity of spawning sites is an important factor in reproductive success.

EGBSC completed surveys downstream of Bailey Bridge, Horseshoe Falls, and Trestle Gully to determine if there is habitat – nursery, rearing, and foraging – for Walleye, Lake Sturgeon, and Sucker fry. To assess nursery, rearing, and foraging habitat, EGBSC combined bathymetry and side scan sonar data, as well as, underwater survey data. The purpose of the underwater surveys was to help ground truth what was being displayed from the sonar data. In addition, EGBSC compared the length of natural shoreline (unaltered) downstream of the spawning beds to the length of altered shoreline. Natural shorelines are critical for maintaining water quality and fish habitat. Natural shorelines help to slow runoff from roads, houses, and other areas of development, improving water filtration and filtering nutrients before they reach the watercourse. Natural vegetation along watercourses helps to create shade and moderate temperature. Natural debris (branches, leaves, etc.) that fall into the water are a source of food for aquatic insects, which in turn, are a source of food for certain fish, such as White Sucker.

There were a number of challenges associated with gathering and interpreting the data collected. First, there is very little information on nursery, rearing, and foraging habitat for Sucker species. More information is available for Walleye and Lake Sturgeon, but it is quite vague. For example, adult Walleye are described as being found between 2 to 10 m depth, this wide range makes it challenging to focus in on specific habitat. EGBSC focused survey efforts in the nearshore area at depths of approximately 1.5 m. Second, once eggs hatch, the larvae drift downstream, according to currents and wind. It is not possible to say how far the larvae drift, and this distance would vary river by river. Third, side scan sonar data was collected to help identify the type of substrate present in the river and identify areas with vegetation and boulders (.sl2 files are available upon request). However, in some areas, interpretation of the side scan data was very difficult making it challenging to discern between different types of substrate. In the areas where the substrate was not clear, that information was not used in determining fish habitat due to a lack of confidence in interpretation. Finally, the fourth challenge was integrating all of the data collected.

Underwater Surveys

Underwater videos were taken by snorkelling for 100 m approximately every 1 km, using a GoPro camera. In total, EGBSC carried out seventeen (17) underwater surveys between Bailey Bridge and Highway 69. Each survey location has been identified in Figure 41. Bathymetry maps are presented in [Appendix E](#).



Figure 41. Underwater survey locations downstream of Bailey Bridge, Horseshoe Falls, and Trestle Gully

For each underwater survey, types of substrate and aquatic vegetation, as well as, abundance of aquatic vegetation and woody debris (sticks, branches, logs) were recorded. Aquatic vegetation and woody debris offer cover for fish at various life stages and provide cover for predatory fish to ambush their prey. Classifications and definitions of abundance are detailed in Table 2. Each of the underwater surveys is summarized in Table 3.

Table 2. Definitions of aquatic vegetation and wood structure abundances

| Abundance | Sparse | Moderate | Abundant |
|--------------------|---|---|---|
| Aquatic vegetation | Observed in small, inconsistent patches | Observed consistently along the substrate, camera moves easily through the area | Consistent and thick, difficult to move camera through the area |
| Wood structure | 1-2 branches or sticks | 2 logs and/or several branches or sticks (<10) | >3 logs and/or >10 branches |

Table 3. Summary of findings from underwater surveys (MS = main stem, TG = Trestle Gully, HF = Horseshoe Falls, BB = Bailey Bridge)

| Survey | Substrate | Wood Structure | Aquatic Vegetation | Notes |
|--------|-----------|-----------------------|--------------------|---|
| MS - 1 | Bedrock | Absent (none visible) | Sparse | Appears to be a lot of algae on surface of water – did not swim, observations from boat |

| Survey | Substrate | Wood Structure | Aquatic Vegetation | Notes |
|---------|--|-----------------------|-----------------------|--|
| MS - 2 | Bedrock | Absent (none visible) | Sparse | Foul smell, appears to be blue-green algae – did not swim, observations from boat |
| MS - 3 | Mainly cobble, some small and large gravel, sand | Sparse | Sparse | |
| MS - 4 | Bedrock to start then sand and clay (where vegetation starts) | Absent | Moderate | |
| MS - 5 | 80% bedrock, 20% cobble and sand with some silt and clay | Absent | Sparse | |
| MS - 6 | Bedrock with some boulders to start, last 1/2 sand with some clay and silt, ended with bedrock | Moderate | Sparse | A few logs right at shore |
| MS - 7 | All bedrock except for some patches of sand and a bit of clay and silt at end | Sparse | Sparse | |
| MS - 8 | Started rocky (large & small boulders), transitioned to sand/silt/clay mix | Sparse | Sparse | |
| MS - 9 | Rocky, sand/silt/clay, then back to rocky | Absent | Sparse | Dark (poor visibility) due to the angle of the sun at this time of day |
| MS - 10 | Muck, clay, and sand and silt mix | Absent | Abundant | Poor visibility due to dense vegetation |
| MS - 11 | Muck, clay bar where there is no vegetation | Absent | Abundant | Dense vegetation throughout entire survey |
| MS - 12 | Muck | Absent | Abundant | Very dense vegetation |
| TG - 1 | First section - silty clay with some sand Second section - bedrock, boulder, then cobble and boulder | Abundant | Moderate | Lots of logs, good structure. Yellow Perch, Smallmouth Bass, Black Stripe Shiners, Pumpkinseed or Blue Gill. |
| TG - 2 | Part bedrock, part muck with heavy vegetation, a couple patches of cobble and boulder | Moderate | Moderate | |
| HF - 1 | Mainly bedrock with boulder and cobble | Absent | Sparse | At transition from bedrock to vegetated shoreline, lots of cobble. |
| BB - 1 | Sand, gravel, cobble, large boulders | Sparse | Sparse | |
| BB - 2 | Boulders | Absent (none visible) | Absent (none visible) | Deep and dark, poor visibility |

The following list of aquatic vegetation (submergent, emergent, and floating) was recorded from the surveys: Common Cattail, Water Smartweed, White Water Lily, Bulrush spp., Canada Waterweed, Potamogeton spp., Floating Heart, Coontail, Tapegrass, Pickerelweed, Bladderwort, Soft Stem Bulrush,

Yellow Pond Lily, and Bur Reed. White Water Lily, Bulrush spp., and Water Smartweed were the most dominant species observed.

Shoreline Characteristics

Along each of the underwater surveys, shoreline characteristics were also recorded and photographed. The Pickerel River, downstream of Squaw Rapids to Highway 69, has a predominantly natural shoreline (86% natural, 14% altered) (Figures 42-44). Observed alterations included train and highway bridges, mown grass close to the shoreline, docks, compacted soil and disturbed vegetation at Crown land campsites, and boat launches. The natural shoreline along the surveys consisted mainly of bedrock with forest set back, low lying forest, pockets of wetland, and flooded alders. Photos of the shoreline from each survey can be found in [Appendix F](#). It is important to note that surveys did not cover the entire length of the shoreline, therefore, they do not represent all possible alterations or types of natural shoreline.

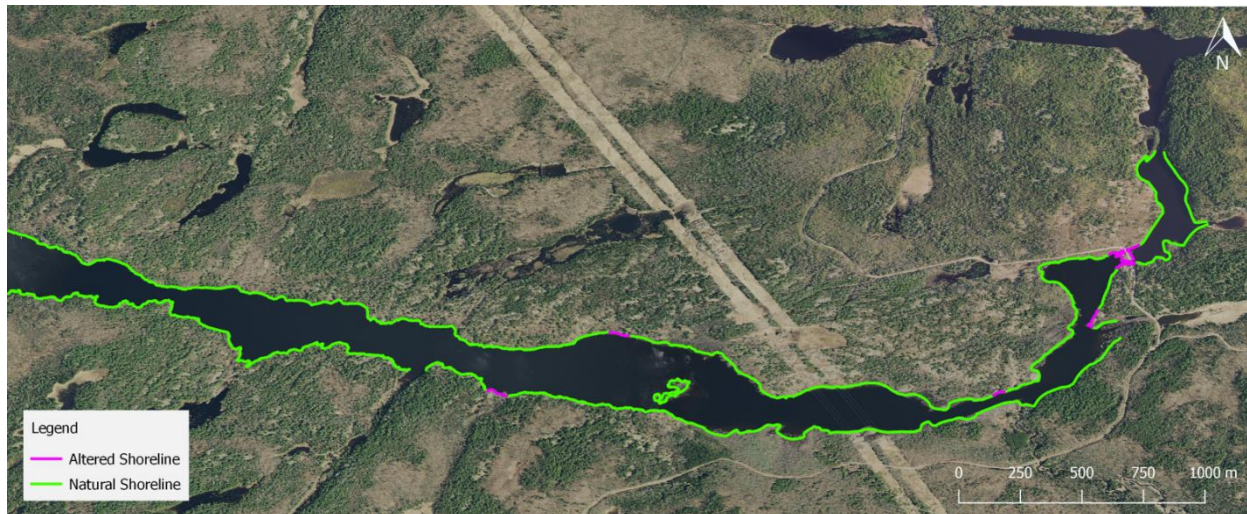


Figure 42. Natural and altered shoreline downstream of Squaw Rapids and Bailey Bridge

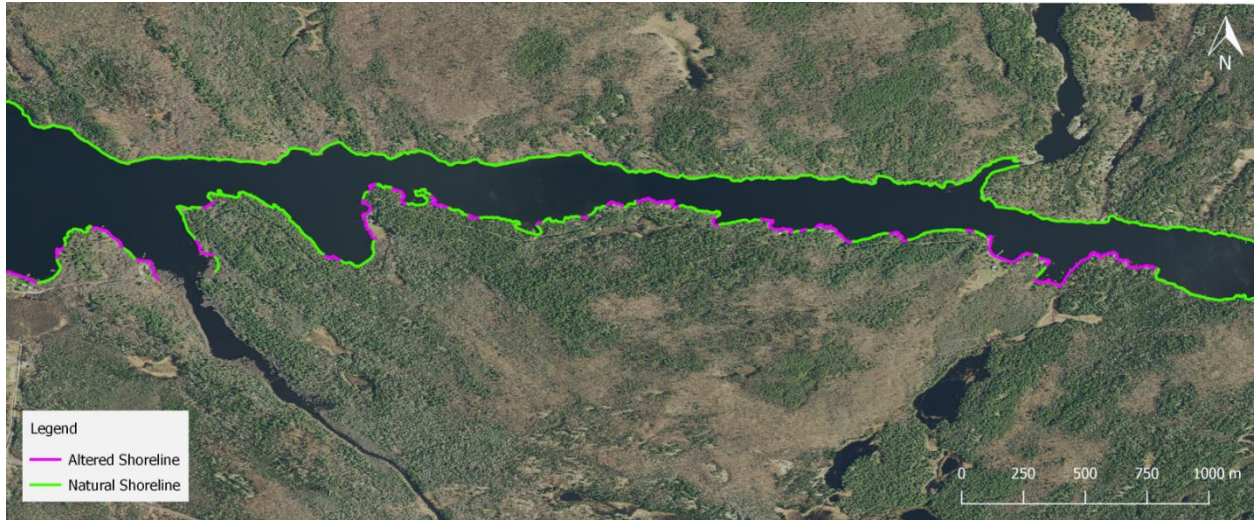


Figure 43. Natural and altered shoreline downstream of Horseshoe Falls

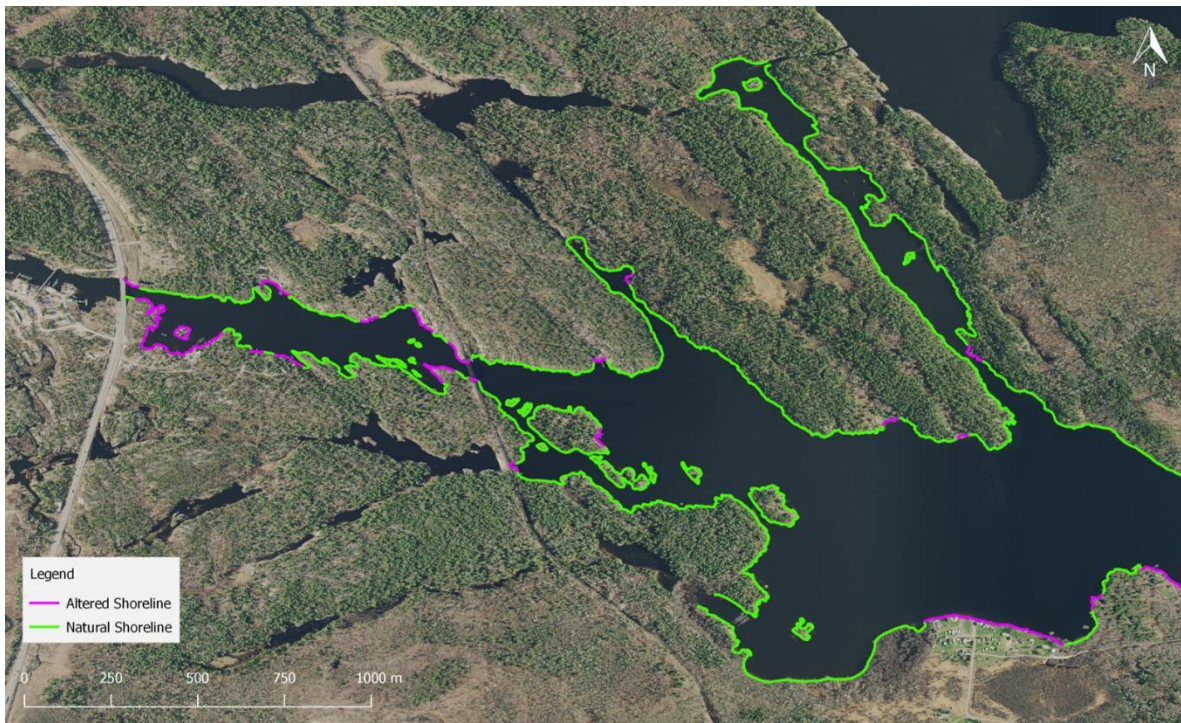


Figure 44. Natural and altered shoreline downstream of Trestle Gully

Shoreline substrate was also recorded and photographed for each of the seventeen (17) surveys. Only the shoreline substrate that was visible was recorded. Table 4 lists the shoreline characteristics for each survey.

Table 4. Shoreline characteristics along the underwater surveys (MS = main stem, TG = Trestle Gully, HF = Horseshoe Falls, BB = Bailey Bridge)

| Survey | Shoreline Characteristics |
|--------|--|
| MS - 1 | Gently sloping bedrock |
| MS - 2 | Bedrock shoreline with some sloping areas and some areas with cliffs |

| | |
|---------|---|
| MS - 3 | Sloping bedrock |
| MS - 4 | Sloping bedrock gives way to vegetated shoreline |
| MS - 5 | Sloping bedrock |
| MS - 6 | Bedrock, short break in bedrock, vegetated shoreline then back to bedrock |
| MS - 7 | Sloping bedrock and docks |
| MS - 8 | Boulders along shoreline (some cobble), switches to bedrock cliff then vegetated shoreline |
| MS - 9 | Bedrock steeply sloped toward water's edge, moves to mixed shore of part vegetation and part boulders/bedrock |
| MS - 10 | Flooded meadow with forested fringe, first time in 13 years it has been flooded |
| MS - 11 | Wetland backed by forest |
| MS - 12 | Low-lying flooded forest |
| TG - 1 | Sloping bedrock giving way to vegetated shoreline and then back to bedrock |
| TG - 2 | Sloping bedrock |
| HF - 1 | Sloped bedrock shoreline to start, alternates between bedrock and vegetated shoreline approaching falls |
| BB - 1 | Boulders and cobble along first section, boulders give way to more cobble and then sandy beach |
| BB - 2 | Starts as bedrock cliffs, closer to spawning bed it changes to gradually sloped bedrock |

In addition to substrate, shoreline vegetation that could be identified was recorded for each survey (Table 5). No terrestrial or aquatic invasive species were observed in the survey locations.

Table 5. Shoreline vegetation observed along the underwater surveys (MS = main stem, HB = Harris branch, NB = Naiscoot branch)

| Survey | Shoreline Vegetation |
|---------|--|
| MS - 1 | Ash spp., Cedar, Maple spp., Juniper, Jack Pine, Goldenrod spp., Aster spp., Buttonbush, Spruce, Sumac, Grass spp. |
| MS - 2 | Juniper, White Pine, Cedar, Grass spp., Red Pine, Red Oak, Meadowsweet, Lowbush Blueberry, Goldenrod spp., Ash spp., Trembling Aspen |
| MS - 3 | Juniper, Cedar, Sumac, Ash spp., Grass spp., Red Pine, White Pine, Moss, Meadowsweet, Goldenrod spp., Sumac, White Birch, Maple spp. saplings, Trembling Aspen |
| MS - 4 | White Pine, White Birch, Red Oak, Juniper, Meadowsweet, Aster spp., Goldenrod spp., Grass spp., Red Pine, Lichen, Maple spp., Sweet Gale, Royal Fern, Ash spp. |
| MS - 5 | Meadowsweet, Cedar, Juniper, Jack Pine, Red Pine, Ash spp., Goldenrod spp., Aster spp., Cherry spp., Winterberry |
| MS - 6 | Moss, Lichen, Juniper, Grass spp., Red Pine, White Pine, Red Oak, Maple spp., Meadowsweet, Ash spp., Aster spp., Birch spp., Cedar |
| MS - 7 | Sumac, Juniper, Goldenrod spp., White Pine, White Birch, Jack Pine, Meadowsweet, Wild Red Raspberry, Cedar |
| MS - 8 | White Pine, Red Oak, White Birch, Ash spp., Maple spp., Sweet Gale, Cedar, Juniper, Silver Maple, Fern spp., Aster spp., Buttonbush |
| MS - 9 | White Pine, White Cedar, Goldenrod spp., Maple spp. saplings, Meadowsweet, Cardinal Flower, Buttonbush, Sweet Gale |
| MS - 10 | Silver Maple, White Cedar, White Pine, Buttonbush |
| MS - 11 | Maple spp., Red Oak, Buttonbush, Ash spp. |
| MS - 12 | Silver Maple, mature and sapling trees |
| TG - 1 | Ash spp., Cedar, Red Pine, Black Spruce, Virginia Creeper, Sedge spp., Meadowsweet, Winterberry, Royal Fern, Aster spp., Joe-Pye Weed, Cardinal Flower, Maple spp., Sumac, Juniper |
| TG - 2 | Meadowsweet, Juniper, Sumac, Jack Pine, Trembling Aspen, Red Oak, White Pine, Grass spp., Ash spp., Maple spp. |
| HF - 1 | Juniper, White Pine, Maple spp., Grass spp. |

| | |
|--------|--|
| BB - 1 | Red Oak, White Pine, Sweet Fern, Maple spp., Sumac |
| BB - 2 | Cedar, White Pine, Maple spp., Juniper |

Discussion and Recommendations

Water chemistry measurements that were monitored (water temperature, dissolved oxygen, pH, and conductivity) were generally normal and typical of what one would expect from a Canadian Shield watershed. One spike in pH was recorded at Trestle Gully on May 20, up to 9.96. At Bailey Bridge, a considerable spike in conductivity was recorded on June 8 (91.5 uS/cm). Aside from these two abnormal measurements, there were no other indications of water quality having any adverse effects on fish spawning or egg incubation.

All of the spawning beds experienced considerable water level fluctuations throughout the spawning and egg incubation periods. Fluctuations appeared to be most dramatic at Squaw Rapids and Bailey Bridge with egg mats found out of water or partially out of water on more than one occasion. Bailey Bridge and Squaw rapids are fed by the Pickerel River with a dam upstream of Squaw Rapids at the outlet of Dollars Lake. Trestle Gully and Horseshoe Falls are fed by the French River. Water fluctuations did not appear to impact the spawning beds at Trestle Gully or Horseshoe Falls. Despite more pronounced fluctuations at Bailey Bridge and Squaw Rapids, no eggs were observed stranded.

Water velocities did not exceed 1.5 m/s for any of the readings at any of the spawning beds. At Horseshoe Falls, the main flow in the rapids was not safely accessible with a flow meter due to the slope of the banks. Accordingly, EGBSC was unable to get an accurate picture of the water velocity at Horseshoe Falls. Nevertheless, based on visual observations throughout the spring, it is reasonable to say that Horseshoe Falls presents a barrier to fish passage. There is no reason to believe that water velocity at the other sites would impede movement of fish throughout each of the spawning beds.

No night surveys were conducted on the Pickerel River. Species observed during regular monitoring were recorded. Walleye eggs were seen in the substrate (not on an egg mat), Redhorse Sucker species' scales were found on shore, and a dead Walleye was found at the upstream end of Squaw Rapids. No other visual observations were made aside from egg mat counts.

Egg counts were very low at Trestle Gully, slightly higher at Squaw Rapids, and much higher (but still considered low) at Bailey Bridge. Sucker eggs were only found in extremely low numbers at Bailey Bridge. While these egg count totals may be indicative of very small spawning populations, it is also possible that a significant amount of spawning activity was missed for two reasons. First, water levels dropped at all sites up until April 29, at this point, egg mats were set or moved further instream to remain in the main area of flow. After April 29, water levels increased considerably following several large rain events. Most of the egg mats set prior to these rain events became inaccessible for roughly two or more weeks. Some were not found again until the end of the spring field work. Therefore, there may have been more eggs deposited on the mats than were able to be counted. Second, the depth and water velocity at these spawning beds greatly limited the areas in which egg mats could be installed. Because EGBSC staff waded into the channel and manually weigh the egg mats down with rocks, there is a limit to the areas that can be safely monitored using this technique.

Downstream of the spawning beds to the Highway 69 bridge, the majority of the shoreline is natural, although there are some lodges/cottage resorts and a trailer park with boat launches. Underwater surveys revealed a variety of substrate, sparse wood structure, and a sparse to moderate abundance of vegetation overall. Furthermore, plankton samples indicated good plankton production downstream of

the spawning beds, particularly Trestle Gully. No obvious stressors or limiting factors were identified with regard to nursery, rearing, or foraging habitat.

In summary, the Pickerel River appears to have adequate habitat for the various life stages of the species of concern in this study. An exception to this may be appropriately sized spawning habitat for Sucker species. Substrate at Trestle Gully, Bailey Bridge, and Squaw Rapids (Horseshoe Falls could not be assessed) is quite coarse with limited smaller sized substrate (i.e., gravel, sand). The number of eggs counted on egg mats seemed low given the presence of ideally sized substrate and water depths, however, it is acknowledged that egg mats were placed in only a small fraction of the total spawning bed areas.

As a result of this assessment, EGBSC recommends future investigations into Lake Sturgeon spawning in the Pickerel River. No Lake Sturgeon or Lake Sturgeon eggs were observed during the assessment. However, members of Henvey Inlet First Nation indicated that Lake Sturgeon do in fact spawn in the Pickerel River and can be seen moving upstream, past Bailey Bridge. Furthermore, substrate and water depths at Trestle Gully, Bailey Bridge, and Squaw Rapids (Horseshoe Falls could not be assessed) appear to be favourable for Lake Sturgeon spawning. A more focused monitoring effort later in May and into June, as water temperatures rise, is recommended. EGBSC also recommends further, detailed analysis of the side scan sonar data to supplement the observations from underwater surveys and provide more in-depth insights into nursery, rearing, and foraging habitat (.sl2 files available upon request). EGBSC is not recommending any habitat restoration work at any of these sites.

Acknowledgements

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- Karl Schiefer – Aquatic Biologist consultant and EGBSC member
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- David Sweetnam – Executive Director, Georgian Bay Forever

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Environment and
Climate Change Canada

References

- Golder Associates Ltd. (2011). *Recovery strategy for Lake Sturgeon (Acipenser fulvescens) – Northwestern Ontario, Great Lakes-Upper St. Lawrence River and Southern Hudson Bay-James Bay populations in Ontario*. Ontario Recovery Strategy Series. Peterborough, ON: Ontario Ministry of Natural Resources.
- Hasnain, S.S., Minns, K.C., & Shuter, B.J. (2010). *Key ecological temperature metrics for Canadian freshwater fishes*. Retrieved from http://www.climateontario.ca/MNR_Publications/stdprod_088017.pdf
- Kerr, S.J., Corbett, B.W., Hutchinson, N.J., Kinsman, D., Leach, J.H., Puddister, D., et al. (1997). *Walleye habitat: a synthesis of current knowledge with guidelines for conservation*. Peterborough, ON: Percid Community Synthesis Walleye Habitat Working Group, OMNR.
- Kujala, K.H. (1979). *Bailey bridge pickerel spawning bed improvement Pickerel River, Blair Township, The Parry Sound District*. Internal Report. Ontario Ministry of Natural Resources.
- Scott, W.B., & Crossman, E.J. (1998). *Freshwater fishes of Canada*. Oakville, ON: Galt House Publications Ltd.
- Thurston, L. (1988). *Results of the 1986 Trap Net Survey on the Pickerel River watershed*. Internal Report. Ontario Ministry of Natural Resources.
- Thurston, L.D.W. (1991). *Summary of the 1990 trap net survey on the lower Pickerel River (Blair, Mowat and Henvey Townships)*. Internal Report. Ontario Ministry of Natural Resources.
- Twomey, K.A., Williamson, K.L., & Nelson, P.C. (1984). *Habitat suitability index models and instream flow suitability curves: White Sucker*. Washington, DC: U.S. Fish and Wildlife Service.

Appendix A – Water Chemistry

Water Chemistry – Trestle Gully, 2017

| Date | Time | Temperature (°C) | DO (mg/L) | DO (%) | pH | Conductivity |
|-----------|-------|------------------|-----------|--------|------|--------------|
| 18-Apr-17 | 2:30 | 4.1 | 13.9 | 106.3 | 6.98 | 62.8 |
| 27-Apr-17 | 4:20 | 6.5 | 13.38 | 108.9 | 7.09 | 61.2 |
| 29-Apr-17 | 2:10 | 6.7 | 13.21 | 108.1 | 7.09 | 61.0 |
| 03-May-17 | 10:05 | 6.4 | 13.59 | 110.0 | 6.82 | 60.1 |
| 08-May-17 | 10:20 | 6.8 | 13.09 | 107.4 | 6.82 | 60.2 |
| 11-May-17 | 12:00 | 7.5 | 12.87 | 107.1 | 6.71 | 59.6 |
| 14-May-17 | 12:52 | 7.9 | 12.62 | 106.3 | 6.75 | 58.9 |
| 17-May-17 | 2:28 | 8.3 | 12.54 | 106.9 | 6.71 | 57.2 |
| 20-May-17 | 1:40 | 10.2 | 12.01 | 106.9 | 9.96 | 56.3 |
| 24-May-17 | 4:00 | 11.4 | 11.79 | 108.5 | 6.94 | 56.6 |
| 28-May-17 | 12:40 | 11.4 | 11.61 | 105.9 | 6.78 | 57.2 |
| 31-May-17 | 12:30 | 11.9 | 11.33 | 105.7 | 6.82 | 57.4 |
| 05-Jun-17 | 3:00 | 13.6 | 11.52 | 11.01 | 7.29 | 63.3 |
| 08-Jun-17 | 12:25 | 13.7 | 11.05 | 106.1 | 7.32 | 68.2 |
| 20-Jun-17 | 11:45 | 17.3 | 10.79 | 111.7 | 7.27 | 60.2 |

Water Chemistry – Horseshoe Falls, 2017

| Date | Time | Temperature (°C) | DO (mg/L) | DO (%) | pH | Conductivity |
|-----------|-------|------------------|-----------|--------|------|--------------|
| 21-Apr-17 | 3:26 | 5.10 | 14.02 | 110.00 | 6.84 | 61.6 |
| 24-Apr-17 | 3:07 | 6.00 | 14.10 | 113.20 | 7.11 | 60.3 |
| 27-Apr-17 | 3:29 | 6.80 | 13.61 | 111.50 | 7.08 | 59.4 |
| 29-Apr-17 | 1:14 | 7.90 | 13.39 | 112.70 | 6.95 | 59.1 |
| 03-May-17 | 1:25 | 7.30 | 13.06 | 108.50 | 7.04 | 59.1 |
| 08-May-17 | 1:40 | 7.50 | 12.77 | 106.60 | 7.11 | 59.1 |
| 11-May-17 | 2:25 | 7.80 | 12.89 | 108.40 | 6.76 | 59.1 |
| 14-May-17 | 12:26 | 9.00 | 12.50 | 108.60 | 6.91 | 57.4 |
| 17-May-17 | 2:03 | 9.90 | 12.29 | 108.70 | 7.14 | 56.4 |
| 20-May-17 | 1:10 | 11.30 | 12.02 | 109.80 | 6.95 | 56.1 |
| 24-May-17 | 3:30 | 11.60 | 11.89 | 109.00 | 7.17 | 56.6 |
| 28-May-17 | 12:11 | 11.90 | 11.63 | 107.20 | 6.94 | 57.2 |
| 31-May-17 | 12:05 | 13.50 | 11.12 | 106.70 | 7.03 | 57.2 |
| 05-Jun-17 | 2:40 | 14.40 | 11.16 | 109.10 | 6.96 | 59.6 |
| 08-Jun-17 | 11:55 | 14.50 | 11.56 | 113.30 | 7.14 | 57.9 |
| 20-Jun-17 | 12:40 | 19.10 | 9.38 | 100.70 | 7.57 | 59.8 |

Water Chemistry – Bailey Bridge, 2017

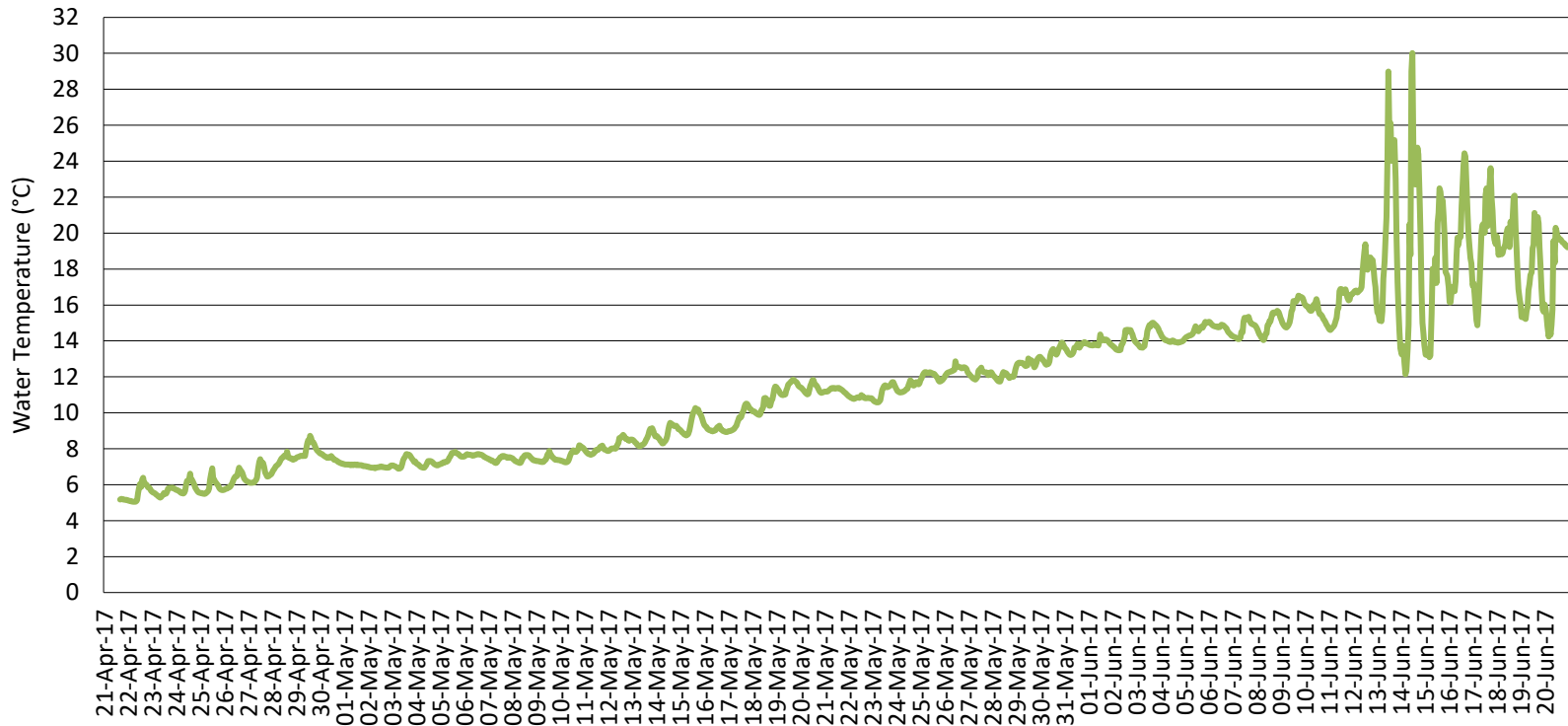
| Date | Time | Temperature (°C) | DO (mg/L) | DO (%) | pH | Conductivity |
|-----------|-------|------------------|-----------|--------|------|--------------|
| 18-Apr-17 | 4:30 | 6.7 | 13.07 | 110.4 | 6.32 | 29.20 |
| 21-Apr-17 | 1:58 | 6.0 | 13.43 | 107.9 | 6.40 | 29.80 |
| 24-Apr-17 | 2:42 | 6.8 | 13.11 | 107.4 | 6.43 | 29.70 |
| 27-Apr-17 | 2:44 | 9.1 | 12.05 | 104.4 | 6.59 | 29.80 |
| 29-Apr-17 | 12:32 | 9.6 | 11.54 | 101.2 | 6.68 | 29.60 |
| 03-May-17 | 12:40 | 8.3 | 11.99 | 101.9 | 6.40 | 28.10 |
| 08-May-17 | 12:30 | 8.5 | 11.71 | 100.1 | 6.60 | 28.70 |

| | | | | | | |
|-----------|-------|------|-------|-------|------|-------|
| 11-May-17 | 1:50 | 9.4 | 11.76 | 103.2 | 6.56 | 24.30 |
| 14-May-17 | 11:52 | 10.7 | 10.96 | 97.9 | 6.68 | 29.70 |
| 17-May-17 | 1:25 | 13.2 | 10.99 | 105.5 | 6.62 | 30.00 |
| 20-May-17 | 12:35 | 15.0 | 10.20 | 101.7 | 6.78 | 30.80 |
| 24-May-17 | 2:45 | 14.6 | 9.39 | 91.7 | 6.58 | 32.10 |
| 28-May-17 | 11:40 | 15.0 | 9.49 | 94.0 | 6.56 | 30.70 |
| 31-May-17 | 11:30 | 16.8 | 9.03 | 93.5 | 6.66 | 29.80 |
| 05-Jun-17 | 2:10 | 17.3 | 8.72 | 91.4 | 6.68 | 30.90 |
| 08-Jun-17 | 11:15 | 18.5 | 8.67 | 92.5 | 6.72 | 31.50 |
| 15-Jun-17 | 2:09 | 21.6 | 8.76 | 99.4 | 6.96 | 32.80 |
| 20-Jun-17 | 1:20 | 21.0 | 7.77 | 87.7 | 6.70 | 33.50 |

Water Chemistry – Squaw Rapids, 2017

| Date | Time | Temperature (°C) | DO (mg/L) | DO (%) | pH | Conductivity |
|-----------|-------|------------------|-----------|--------|------|--------------|
| 21-Apr-17 | 1:11 | 6.0 | 13.58 | 109.2 | 6.39 | 29.8 |
| 24-Apr-17 | 12:39 | 6.8 | 13.43 | 110.3 | 6.17 | 29.7 |
| 27-Apr-17 | 1:25 | 8.6 | 12.63 | 103.7 | 6.40 | 29.7 |
| 29-Apr-17 | 10:45 | 9.5 | 12.44 | 108.0 | 6.24 | 29.6 |
| 03-May-17 | 11:35 | 8.3 | 12.14 | 103.2 | 6.23 | 28.0 |
| 08-May-17 | 11:47 | 8.3 | 12.41 | 105.6 | 6.25 | 28.6 |
| 11-May-17 | 1:00 | 9.5 | 12.16 | 106.4 | 6.16 | 29.2 |
| 14-May-17 | 10:55 | 10.5 | 11.92 | 106.8 | 6.14 | 29.7 |
| 17-May-17 | 12:44 | 12.3 | 11.20 | 105.1 | 6.51 | 30.1 |
| 20-May-17 | 11:30 | 14.1 | 10.49 | 102.9 | 6.62 | 30.7 |
| 24-May-17 | 1:38 | 14.1 | 9.78 | 94.9 | 6.53 | 32.0 |
| 28-May-17 | 10:45 | 14.1 | 10.01 | 97.5 | 6.52 | 30.4 |
| 31-May-17 | 10:50 | 16.3 | 9.74 | 90.3 | 6.41 | 29.9 |
| 05-Jun-17 | 1:30 | 17.1 | 9.54 | 97.3 | 6.74 | 31.0 |
| 08-Jun-17 | 10:30 | 18.2 | 8.29 | 88.0 | 6.76 | 31.7 |
| 20-Jun-17 | 1:00 | 20.3 | 7.70 | 85.4 | 6.60 | 33.5 |

Pickrel River Hourly Temperature (°C) Taken at Horseshoe Falls From April 21, 2017 - June 20, 2017



Note: Temperature logger found out of water on June 20. The drastic temperature fluctuations that begin around June 13 may be the result of the temperature logger being out of water and recording air temperature rather than water temperature.

Appendix B – Water Level and Velocity

Water Level Data – Trestle Gully, 2017

| Benchmark | Date | Depth (cm) |
|-----------|-----------|------------|
| 1 | 18-Apr-17 | 106 |
| 1 | 24-Apr-17 | 124.5 |
| 1 | 27-Apr-17 | 132 |
| 1 | 03-May-17 | 82.5 |
| 1 | 08-May-17 | 79.5 |
| 1 | 11-May-17 | 89.3 |
| 1 | 14-May-17 | 103 |
| 1 | 17-May-17 | 111 |
| 1 | 20-May-17 | 122 |
| 1 | 24-May-17 | 115.5 |
| 1 | 28-May-17 | 111.5 |
| 1 | 31-May-17 | 113 |
| 1 | 05-Jun-17 | 126 |
| 1 | 08-Jun-17 | 128.5 |
| 1 | 20-Jun-17 | 233 |

Water Level Data – Horseshoe Falls, 2017

| Benchmark | Date | Depth (cm) |
|-----------|-----------|------------|
| 1 | 21-Apr-17 | 45 |
| 1 | 24-Apr-17 | 68 |
| 1 | 27-Apr-17 | 77 |
| 1 | 29-Apr-17 | 71.5 |
| 1 | 03-May-17 | 23 |
| 1 | 08-May-17 | 27 |
| 1 | 11-May-17 | 33.8 |
| 1 | 14-May-17 | 47 |
| 1 | 17-May-17 | 55 |
| 1 | 20-May-17 | 68 |
| 1 | 24-May-17 | 64 |
| 1 | 28-May-17 | 58.5 |
| 1 | 31-May-17 | 59 |
| 1 | 05-Jun-17 | 72 |
| 1 | 08-Jun-17 | 78.5 |
| 1 | 20-Jun-17 | 169 |

Water Level Data – Bailey Bridge, 2017

| Benchmark | Date | Depth (cm) |
|-----------|-----------|------------|
| 2 | 18-Apr-17 | 39 |
| 2 | 21-Apr-17 | 39 |
| 2 | 24-Apr-17 | 59.5 |
| 2 | 27-Apr-17 | 63.2 |
| 2 | 29-Apr-17 | 61.5 |
| 2 | 03-May-17 | 14 |

| | | |
|---|-----------|-------|
| 2 | 08-May-17 | 17 |
| 2 | 11-May-17 | 27.2 |
| 2 | 14-May-17 | 40.5 |
| 2 | 17-May-17 | 48.5 |
| 2 | 20-May-17 | 62 |
| 2 | 24-May-17 | 58 |
| 2 | 28-May-17 | 50.5 |
| 2 | 31-May-17 | 52 |
| 2 | 05-Jun-17 | 66 |
| 2 | 08-Jun-17 | 74 |
| 2 | 20-Jun-17 | 120 |
| 4 | 24-Apr-17 | 25 |
| 4 | 27-Apr-17 | 31 |
| 4 | 29-Apr-17 | 30.5 |
| 4 | 03-May-17 | -26 |
| 4 | 08-May-17 | -21 |
| 4 | 11-May-17 | -10.5 |
| 4 | 14-May-17 | 6 |
| 4 | 17-May-17 | 15.5 |
| 4 | 20-May-17 | 27.5 |
| 4 | 24-May-17 | 23 |
| 4 | 28-May-17 | 15 |
| 4 | 31-May-17 | 17.5 |
| 4 | 05-Jun-17 | 33 |
| 4 | 08-Jun-17 | 39.5 |
| 4 | 20-Jun-17 | 115 |

Water Level Data – Squaw Rapids, 2017

| Benchmark | Date | Depth (cm) |
|-----------|-----------|------------|
| 2 | 21-Apr-17 | 37 |
| 2 | 24-Apr-17 | 99.4 |
| 2 | 27-Apr-17 | 89 |
| 2 | 29-Apr-17 | 96 |
| 2 | 03-May-17 | 16 |
| 2 | 08-May-17 | 44.5 |
| 2 | 11-May-17 | 49.5 |
| 2 | 14-May-17 | 120 |
| 2 | 17-May-17 | 155 |
| 2 | 20-May-17 | 174.7 |
| 2 | 24-May-17 | 113 |
| 2 | 28-May-17 | 110 |
| 2 | 31-May-17 | 127.5 |
| 2 | 05-Jun-17 | 160 |
| 2 | 08-Jun-17 | 141 |
| 2 | 20-Jun-17 | 153 |

Velocity Data (m/s) – Trestle Gully, 2017

| Date | Station 2 | Station 4 |
|-----------|-----------|-----------|
| 27-Apr-17 | 0.77 | |
| 29-Apr-17 | 0.71 | 0.71 |

Velocity Data (m/s) – Horseshoe Falls, 2017

| Date | Station 2 |
|-----------|-----------|
| 24-Apr-17 | 0.68 |
| 27-Apr-17 | 0.49 |
| 29-Apr-17 | 0.64 |
| 03-May-17 | 0.88 |
| 08-May-17 | 1.04 |
| 11-May-17 | 0.93 |
| 14-May-17 | 0.95 |
| 17-May-17 | 0.88 |
| 20-May-17 | 0.96 |
| 24-May-17 | 0.95 |
| 28-May-17 | 0.84 |
| 31-May-17 | 0.91 |
| 05-Jun-17 | 1.02 |
| 08-Jun-17 | 0.71 |

Velocity Data (m/s) – Bailey Bridge, 2017

| Date | Station 1 | Station 3 |
|-----------|-----------|-----------|
| 18-Apr-17 | 0.67 | 0.8 |
| 21-Apr-17 | 0.58 | 0.55 |
| 24-Apr-17 | 0.51 | 0.3 |
| 27-Apr-17 | 0.82 | 0.24 |
| 29-Apr-17 | 0.63 | 0.37 |
| 03-May-17 | 0.39 | 0.48 |
| 08-May-17 | 0.5 | 0.43 |
| 11-May-17 | 0.47 | 0.5 |
| 14-May-17 | 0.17 | 0.17 |
| 17-May-17 | 0.1 | 0.06 |
| 20-May-17 | 0.05 | 0.01 |
| 24-May-17 | 0.25 | 0.24 |
| 28-May-17 | 0.27 | 0.25 |
| 31-May-17 | 0.2 | 0.17 |
| 05-Jun-17 | 0.11 | 0.07 |
| 08-Jun-17 | 0.14 | 0.09 |

Velocity Data (m/s) – Squaw Rapids, 2017

| Date | Station 1 | Station 1a | Station 1b | Station 3 | Station 3a | Station 3b | Station 3c |
|-----------|-----------|------------|------------|-----------|------------|------------|------------|
| 21-Apr-17 | 0.65 | | | 1.04 | | | |
| 24-Apr-17 | 0.08 | 0.2 | | 0.11 | 0.52 | | |
| 27-Apr-17 | | 0.9 | | 0.13 | 0.79 | | |
| 29-Apr-17 | | 1.02 | | 0.17 | 0.59 | | |
| 03-May-17 | 1.41 | | | 0.39 | | | |
| 08-May-17 | 0.44 | | | 1.08 | | | |
| 11-May-17 | 0.69 | | | 0.95 | | | |
| 14-May-17 | | 0.41 | | | 0.05 | 0.19 | |
| 17-May-17 | | | 0.58 | | | -0.01 | |
| 20-May-17 | | | 0.47 | | | 0.14 | |
| 24-May-17 | | 0.6 | | | | 0.52 | |
| 28-May-17 | | 0.55 | | | 0.2 | 0.46 | |

| | | | | | | | |
|-----------|--|------|------|--|--|-------|------|
| 31-May-17 | | 0.18 | | | | 0.02 | |
| 05-Jun-17 | | | 0.73 | | | 0.02 | 0.57 |
| 08-Jun-17 | | | 0.69 | | | -0.02 | 0.3 |

Appendix C – Visual Observations

Visual Observations – Squaw Rapids, 2017

| Date | Observation Method | Fish Species |
|-----------|--------------------|--|
| 20-May-17 | Visual (day) | 8 Walleye eggs instream |
| 24-May-17 | Visual (day) | Redhorse Sucker species' scales |
| 28-May-17 | Visual (day) | Dead Walleye at upstream end of rapids |

Egg Mat Counts – Trestle Gully, 2017

| Egg Mat | Date Set | Date Counted | Sucker Eggs | Walleye Eggs | Notes |
|--------------|-----------|--------------|-------------|--------------|----------------------------------|
| 1 | 27-Apr-17 | 29-Apr-17 | 0 | 66 | 174 on back of mat, some smelt |
| 2 | 27-Apr-17 | 29-Apr-17 | 0 | 20 | 5 on back of mat, smelt eggs too |
| 1 or 2 | 29-Apr-17 | 20-Jun-17 | 0 | 0 | pulled |
| TOTAL | | | 0 | 86 | |

Egg Mat Counts – Bailey Bridge, 2017

| Egg Mat | Date Set | Date Counted | Sucker Eggs | Walleye Eggs | Notes |
|---------|-----------|--------------|-------------|--------------|---|
| 1 | 18-Apr-17 | 21-Apr-17 | n/a | n/a | forgot to count |
| 1 | 18-Apr-17 | 24-Apr-17 | 0 | 1200 | 4" grid used, moved US slightly |
| 1 | 24-Apr-17 | 27-Apr-17 | 0 | 0 | |
| 2 | 18-Apr-17 | 21-Apr-17 | 0 | 5,828 | 4" grid used, eggs on back but not as dense |
| 2 | 21-Apr-17 | 24-Apr-17 | 0 | 2,055 | 4" grid used |
| 2 | 24-Apr-17 | 27-Apr-17 | 0 | 87 | eggs on bottom not counted |
| 2 | 27-Apr-17 | 29-Apr-17 | 0 | 31 | full mat count, some smelt eggs |
| 2 | 29-Apr-17 | 03-May-17 | n/a | n/a | water levels too high |
| 2 | 29-Apr-17 | 08-May-17 | n/a | n/a | water levels too high |
| 2 | 29-Apr-17 | 11-May-17 | n/a | n/a | still can't see - missing? |
| 3 | 18-Apr-17 | 21-Apr-17 | 0 | 0 | looked but did not see any eggs |
| 3 | 21-Apr-17 | 24-Apr-17 | 0 | 0 | half out of water when checked, not reset |
| 4 | 24-Apr-17 | 27-Apr-17 | 0 | 14 | walleye eggs |
| 4 | 27-Apr-17 | 29-Apr-17 | 0 | 24 | full mat count |
| 4 | 29-Apr-17 | 03-May-17 | n/a | n/a | water levels too high |
| 4 | 29-Apr-17 | 08-May-17 | n/a | n/a | water levels too high |
| 4 | 29-Apr-17 | 11-May-17 | n/a | n/a | still can't see - missing? |
| 4 | 29-Apr-17 | 17-May-17 | 2 | 0 | sucker eggs |
| 5 | 24-Apr-17 | 27-Apr-17 | 0 | 7 | flipped over when reset - walleye |
| 5 | 27-Apr-17 | 29-Apr-17 | 0 | 46 | full mat count - walleye |
| 5 | 29-Apr-17 | 03-May-17 | n/a | n/a | water levels too high |
| 5 | 29-Apr-17 | 08-May-17 | n/a | n/a | water levels too high |
| 5 | 29-Apr-17 | 11-May-17 | n/a | n/a | still can't see - missing? |
| 5 | 29-Apr-17 | 14-May-17 | 9 | 0 | sucker eggs |
| 5 | 14-May-17 | 17-May-17 | 0 | 0 | |
| 5 | 17-May-17 | 20-May-17 | 0 | 0 | |
| 5 | 20-May-17 | 24-May-17 | 0 | 0 | |
| 5 | 24-May-17 | 28-May-17 | 0 | 3 | same eggs described above |
| 5 | 28-May-17 | 31-May-17 | 0 | 0 | |
| 5 | 31-May-17 | 05-Jun-17 | 0 | 0 | |

| | | | | | |
|--------------|-----------|-----------|-----------|--------------|--|
| 6 | 24-Apr-17 | 27-Apr-17 | 0 | 25 | did not count bottom side eggs, moved instream |
| 6 | 27-Apr-17 | 29-Apr-17 | 0 | 42 | full mat count |
| 6 | 29-Apr-17 | 03-May-17 | n/a | n/a | water levels too high |
| 6 | 29-Apr-17 | 08-May-17 | n/a | n/a | water levels too high |
| 6 | 29-Apr-17 | 11-May-17 | n/a | n/a | still can't see - missing? |
| 6 | 29-Apr-17 | 14-May-17 | 0 | 7 | walleye eggs |
| 6 | 14-May-17 | 17-May-17 | 0 | 3 | reset ~2m US |
| 6 | 17-May-17 | 20-May-17 | 16 | 16 | reset ~3m DS |
| 6 | 20-May-17 | 24-May-17 | 0 | 0 | |
| 6 | 24-May-17 | 28-May-17 | 0 | 26 | several small, delicate unknown eggs break easily when touched |
| 6 | 28-May-17 | 31-May-17 | 0 | 0 | some small unidentified eggs, possibly cyprinid |
| 6 | 31-May-17 | 05-Jun-17 | 0 | 0 | |
| 6 | 05-Jun-17 | 08-Jun-17 | 0 | 0 | |
| 6 | 08-Jun-17 | 15-Jun-17 | 0 | 0 | totally out of water, huge drop in water level |
| 7 | 03-May-17 | 08-May-17 | 0 | 0 | reset but poor location, unable to get a good spot right now |
| 7 | 08-May-17 | 11-May-17 | 2 | 5 | reset DS ~5m |
| 7 | 11-May-17 | 14-May-17 | 0 | 0 | |
| 7 | 14-May-17 | 17-May-17 | 0 | 0 | |
| 7 | 17-May-17 | 20-May-17 | 0 | 0 | |
| 7 | 20-May-17 | 24-May-17 | 0 | 0 | |
| 7 | 24-May-17 | 28-May-17 | 0 | 9 | same eggs described above |
| 7 | 28-May-17 | 31-May-17 | 0 | 0 | same as above, fewer though |
| 7 | 31-May-17 | 05-Jun-17 | 0 | 0 | |
| 7 | 05-Jun-17 | 08-Jun-17 | 0 | 0 | |
| 7 | 08-Jun-17 | 15-Jun-17 | 0 | 0 | totally out of water, huge drop in water level |
| TOTAL | | | 27 | 9,414 | |

Egg Mat Counts – Squaw Rapids, 2017

| Egg Mat | Date Set | Date Counted | Sucker Eggs | Walleye Eggs | Notes |
|---------|-----------|--------------|-------------|--------------|---|
| 1 | 24-Apr-17 | 27-Apr-17 | 0 | 359 | 114 on back of mat - walleye |
| 1 | 27-Apr-17 | 29-Apr-17 | 0 | 20 | walleye eggs, 131 on back |
| 1 | 29-Apr-17 | 03-May-17 | n/a | n/a | water levels too high |
| 1 | 29-Apr-17 | 08-May-17 | n/a | n/a | water levels too high |
| 2 | 24-Apr-17 | 27-Apr-17 | 0 | 202 | roughly equivalent on bottom side - walleye |
| 2 | 27-Apr-17 | 29-Apr-17 | n/a | n/a | couldn't find |
| 2 | 27-Apr-17 | 03-May-17 | n/a | n/a | water levels too high |
| 2 | 27-Apr-17 | 08-May-17 | n/a | n/a | water levels too high |
| 2 | 17-May-17 | 20-May-17 | 0 | 2 | reset at same location - 545777,5093217 - walleye |
| 2 | 20-May-17 | 24-May-17 | n/a | n/a | cannot get at due to flows, still there |
| 2 | 20-May-17 | 28-May-17 | n/a | n/a | too deep |
| 2 | 20-May-17 | 31-May-17 | n/a | n/a | can see but cannot get to |
| 2 | 20-May-17 | 05-Jun-17 | 0 | 0 | |

| | | | | | |
|--------------|-----------|-----------|----------|------------|--|
| 2 | 05-Jun-17 | 08-Jun-17 | 0 | 0 | |
| 2 | 08-Jun-17 | 20-Jun-17 | 0 | 0 | |
| 3 | 24-Apr-17 | 27-Apr-17 | 0 | 0 | reset further US, ~5m DS of campfire, adjacent to lg rock in water |
| 3 | 27-Apr-17 | 29-Apr-17 | 0 | 33 | walleye eggs |
| 3 | 29-Apr-17 | 03-May-17 | n/a | n/a | water levels too high |
| 3 | 29-Apr-17 | 08-May-17 | n/a | n/a | water levels too high |
| 4 | 03-May-17 | 08-May-17 | 0 | 1 | just US of location set on May 3, walleye |
| 4 | 08-May-17 | 11-May-17 | 0 | 2 | walleye eggs |
| 4 | 11-May-17 | 14-May-17 | 0 | 4 | found dry, all walleye eggs, reset ~3-4m further instream |
| 4 | 14-May-17 | 17-May-17 | 0 | 0 | reset ~4.5 m US |
| 4 | 17-May-17 | 20-May-17 | 0 | 34 | walleye eggs, reset at same spot ~1m instream |
| 5 | 03-May-17 | 08-May-17 | 0 | 0 | |
| 5 | 24-May-17 | 28-May-17 | 0 | 0 | |
| 5 | 28-May-17 | 31-May-17 | 0 | 0 | |
| 5 | 31-May-17 | 05-Jun-17 | 0 | 0 | out of water |
| 6 | 08-May-17 | 11-May-17 | 0 | 9 | walleye eggs |
| 6 | 11-May-17 | 14-May-17 | 0 | 0 | found dry, reset further instream |
| 6 | 14-May-17 | 17-May-17 | 0 | 0 | found out of water |
| 7 | 14-May-17 | 17-May-17 | 0 | 1 | walleye egg, mat out of water |
| 8 | 17-May-17 | 20-May-17 | 0 | 0 | reset at same location |
| 8 | 20-May-17 | 24-May-17 | n/a | n/a | assumed missing, flow up, reset |
| 8 | 24-May-17 | 28-May-17 | n/a | n/a | mat missing, reset |
| 8 | 28-May-17 | 31-May-17 | 0 | 0 | out of water, reset slightly US and instream |
| 8 | 31-May-17 | 05-Jun-17 | 0 | 0 | found out of water, reset further instream ~1m |
| 8 | 05-Jun-17 | 08-Jun-17 | 0 | 0 | |
| 8 | 08-Jun-17 | 20-Jun-17 | 0 | 0 | |
| 9 | 24-May-17 | 28-May-17 | 0 | 0 | |
| 9 | 28-May-17 | 31-May-17 | 0 | 0 | |
| 9 | 31-May-17 | 05-Jun-17 | 0 | 0 | found 1/2 out of water, reset ~1m instream |
| 9 | 05-Jun-17 | 08-Jun-17 | 0 | 0 | |
| TOTAL | | | 0 | 667 | |

Appendix D – Transect Data

Transect 1

| Point | Depth (m) | | Particle sizes | Aquatic vegetation present |
|-----------|-----------|---------|-----------------------------|----------------------------|
| | Bankfull | Present | | |
| (1) 0.92 | 0.55 | 0 | 80% lg b, 20% cobble/gravel | none |
| (2) 2.75 | 0.57 | 0 | 100% lg b | none |
| (3) 4.58 | 0.90 | 0 | 100% sm b/cobble | none |
| (4) 6.41 | 0.70 | 0 | 100% sm b/cobble | none |
| (5) 8.24 | 0.40 | 0 | 100% cobble/gravel | none |
| (6) 10.07 | 0.20 | 0 | 20% lg b, 80% gravel/sand | none |

| Walleye | | Point 1 | Point 2 | Point 3 | Point 4 | Point 5 | Point 6 |
|------------------------|-----------|---------|---------|---------|---------|---------|---------|
| Optimal depth (m) | 0.3 - 1.0 | | | | | | |
| Optimal substrate (cm) | 0.2 - 25 | * | | * | * | * | * |
| Lake Sturgeon | | | | | | | |
| Optimal depth (m) | 0.1 - 2.0 | | | | | | |
| Optimal substrate (cm) | 10 - 60 | * | | * | * | * | |
| Sucker species | | | | | | | |
| Optimal depth (m) | | | | | | | |
| Optimal substrate (cm) | 0.2 - 1.6 | * | | | | * | * |

*mixed substrate, some optimal



Transect 2

| Point | Depth (m) | | Particle sizes | Aquatic vegetation present |
|--------|-----------|---------|--|----------------------------|
| | Bankfull | Present | | |
| (1) 1 | 0.65 | 0 | 30% lg b, 30% sm b, 20% cobble, 20% gravel | none |
| (2) 3 | 1.10 | 0 | 100% sm b/cobble | none |
| (3) 5 | 0.85 | 0 | 100% sm b/cobble | none |
| (4) 7 | 0.84 | 0 | 100% cobble | none |
| (5) 9 | 0.88 | 0 | 80% cobble/gravel, 20% lg b | none |
| (6) 11 | 0.50 | 0 | 40% soil, 30% lg b, 20% sm b, 10% cobble | terrestrial veg |

| Walleye | | Point 1 | Point 2 | Point 3 | Point 4 | Point 5 | Point 6 |
|------------------------|-----------|---------|---------|---------|---------|---------|---------|
| Optimal depth (m) | 0.3 - 1.0 | | | | | | |
| Optimal substrate (cm) | 0.2 - 25 | * | * | * | | * | * |
| Lake Sturgeon | | | | | | | |
| Optimal depth (m) | 0.1 - 2.0 | | | | | | |
| Optimal substrate (cm) | 10 - 60 | * | | | | * | * |
| Sucker species | | | | | | | |
| Optimal depth (m) | | | | | | | |
| Optimal substrate (cm) | 0.2 - 1.6 | * | | | | * | * |

*mixed substrate, some optimal



Transect 3

| Point | Depth (m) | | Particle sizes | Aquatic vegetation present |
|----------|-----------|---------|--|----------------------------|
| | Bankfull | Present | | |
| (1) 1.1 | 0.60 | 0 | 70% cobble, 10% lg b, 10% sm b, 10% gravel | none |
| (2) 3.4 | 0.77 | 0 | 70% cobble, 10% lg b, 20% sm b | none |
| (3) 5.7 | 0.70 | 0 | 90% cobble, 10% sm b | none |
| (4) 8 | 0.60 | 0 | 80% cobble, 10% lg b, 10% sm b | none |
| (5) 10.3 | 0.42 | 0 | 60% cobble, 30% sm b, 10% lg b | terrestrial veg |
| (6) 12.6 | 0.25 | 0 | 70% cobble, 10 % lg b, 10% sm b, 10% soil | terrestrial veg |

| Walleye | | Point 1 | Point 2 | Point 3 | Point 4 | Point 5 | Point 6 |
|------------------------|-----------|---------|---------|---------|---------|---------|---------|
| Optimal depth (m) | 0.3 - 1.0 | | | | | | |
| Optimal substrate (cm) | 0.2 - 25 | * | * | * | * | * | * |
| Lake Sturgeon | | | | | | | |
| Optimal depth (m) | 0.1 - 2.0 | | | | | | |
| Optimal substrate (cm) | 10 - 60 | * | * | | * | * | * |
| Sucker species | | | | | | | |
| Optimal depth (m) | | | | | | | |
| Optimal substrate (cm) | 0.2 - 1.6 | * | | | | | |

*mixed substrate, some optimal



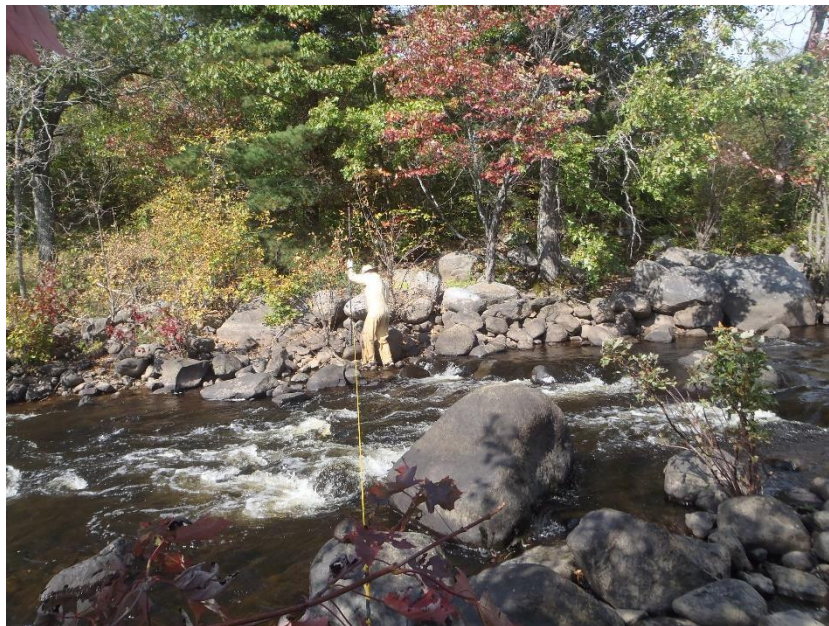
Transect 4

| Point | Depth (m) | | Particle sizes | Aquatic vegetation present |
|---------|-----------|---------|--------------------------------|----------------------------|
| | Bankfull | Present | | |
| (1) 1.1 | 0.35 | 0 | 40% lg b, 40% cobble, 20% sm b | none |
| (2) 3.2 | 0.88 | 0 | 40% lg b, 40% sm b, 20% cobble | none |
| (3) 5.3 | 0.80 | 0 | 80% lg b, 20% sm b | none |

| | | | | |
|----------|------|---|---|------|
| (4) 7.4 | 0.85 | 0 | 80% lg b, 20% sm b | none |
| (5) 9.5 | 0.92 | 0 | 40% cobble, 30% lg b, 20% sm b, 10% gravel | none |
| (6) 11.6 | 0.28 | 0 | 50% lg b, 50% cobble | none |

| | | | | | | | |
|------------------------|-----------|----------------|----------------|----------------|----------------|----------------|----------------|
| Walleye | | Point 1 | Point 2 | Point 3 | Point 4 | Point 5 | Point 6 |
| Optimal depth (m) | 0.3 - 1.0 | | | | | | |
| Optimal substrate (cm) | 0.2 - 25 | * | * | | | * | * |
| Lake Sturgeon | | | | | | | |
| Optimal depth (m) | 0.1 - 2.0 | | | | | | |
| Optimal substrate (cm) | 10 - 60 | * | * | * | * | * | * |
| Sucker species | | | | | | | |
| Optimal depth (m) | | | | | | | |
| Optimal substrate (cm) | 0.2 - 1.6 | | | | | * | |

*mixed substrate, some optimal



Transect 5

| Point | Depth (m) | | Particle sizes | Aquatic vegetation present |
|----------|-----------|---------|--------------------------------|----------------------------|
| | Bankfull | Present | | |
| (1) 1.1 | 0.48 | 0 | 100% cobble | none |
| (2) 3.2 | 0.65 | 0 | 50% cobble, 30% lg b, 20% sm b | none |
| (3) 5.3 | 0.95 | 0 | 80% cobble, 10% lg b, 10% sm b | none |
| (4) 7.4 | 0.55 | 0 | 60% cobble, 30% lg b, 10% sm b | none |
| (5) 9.5 | 0.54 | 0 | 80% cobble, 10% lg b, 10% sm b | none |
| (6) 11.6 | 0.45 | 0 | 80% cobble, 20% lg b | none |

| | | | | | | | |
|------------------------|-----------|----------------|----------------|----------------|----------------|----------------|----------------|
| Walleye | | Point 1 | Point 2 | Point 3 | Point 4 | Point 5 | Point 6 |
| Optimal depth (m) | 0.3 - 1.0 | | | | | | |
| Optimal substrate (cm) | 0.2 - 25 | | * | * | * | * | * |
| Lake Sturgeon | | | | | | | |

| | | | | | | | |
|------------------------|-----------|---|---|---|---|---|---|
| Optimal depth (m) | 0.1 - 2.0 | | | | | | |
| Optimal substrate (cm) | 10 - 60 | * | * | * | * | * | * |
| Sucker species | | | | | | | |
| Optimal depth (m) | | | | | | | |
| Optimal substrate (cm) | 0.2 - 1.6 | | | | | | |

*mixed substrate, some optimal



Transect 6

| Point | Depth (m) | | Particle sizes | Aquatic vegetation present |
|----------|-----------|---------|--------------------------------|----------------------------|
| | Bankfull | Present | | |
| (1) 1.4 | 0.23 | 0 | 60% cobble/gravel, 40% lg b | none |
| (2) 4.2 | 0.68 | 0 | 90% cobble, 10% sm b | none |
| (3) 7 | 0.80 | 0 | 40% lg b, 40% cobble, 40% sm b | none |
| (4) 9.8 | 0.95 | 0 | 100% cobble | none |
| (5) 12.6 | 0.65 | 0 | 100% cobble | none |
| (6) 15.4 | 0.40 | 0 | 80% cobble/gravel, 20% sm b | none |

| Walleye | | Point 1 | Point 2 | Point 3 | Point 4 | Point 5 | Point 6 |
|------------------------|-----------|---------|---------|---------|---------|---------|---------|
| Optimal depth (m) | 0.3 - 1.0 | | | | | | |
| Optimal substrate (cm) | 0.2 - 25 | * | * | * | | | * |
| Lake Sturgeon | | | | | | | |
| Optimal depth (m) | 0.1 - 2.0 | | | | | | |
| Optimal substrate (cm) | 10 - 60 | * | | * | | | * |
| Sucker species | | | | | | | |
| Optimal depth (m) | | | | | | | |
| Optimal substrate (cm) | 0.2 - 1.6 | | | | | | |

*mixed substrate, some optimal

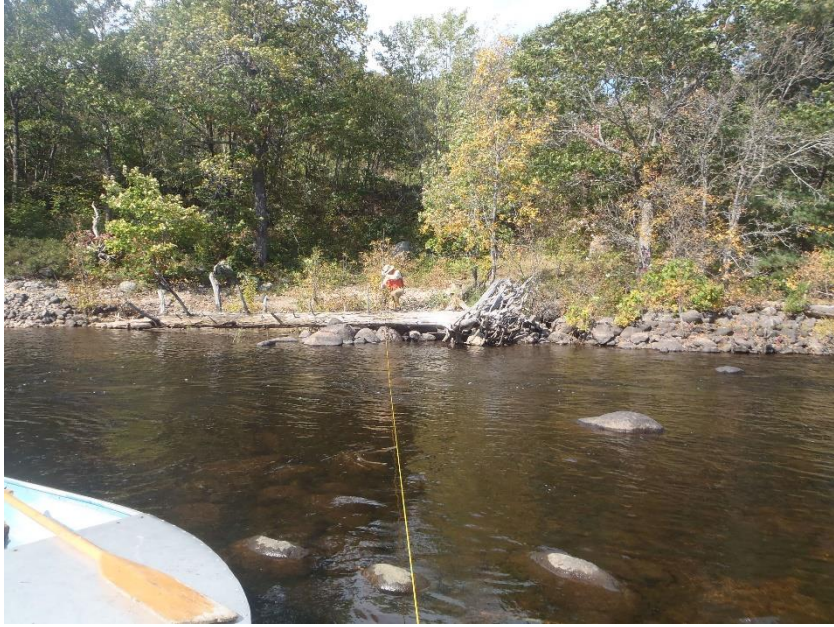


Transect 7

| Point | Depth (m) | | Particle sizes | Aquatic vegetation present |
|----------|-----------|---------|--------------------------------|----------------------------|
| | Bankfull | Present | | |
| (1) 1.7 | 0.32 | 0 | 40% lg b, 40% sm b, 20% cobble | none |
| (2) 5.0 | 0.70 | 0 | 80% cobble, 10% lg b, 10% sm b | none |
| (3) 8.3 | 0.60 | 0 | 100% cobble | none |
| (4) 11.6 | 0.65 | 0 | 90% cobble, 10% sm b | none |
| (5) 14.9 | 0.58 | 0 | 50% cobble, 30% lg b, 20% sm b | none |
| (6) 18.2 | 0.30 | 0 | 60% lg b, 20% sm b, 20% cobble | none |

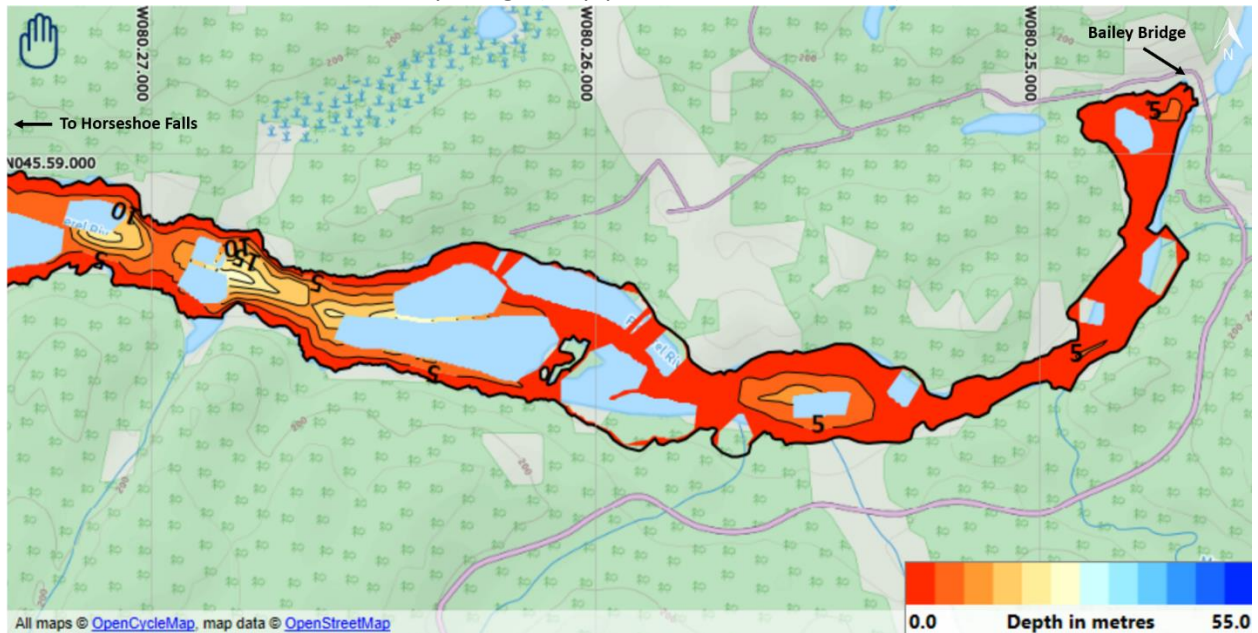
| | | Point 1 | Point 2 | Point 3 | Point 4 | Point 5 | Point 6 |
|------------------------|-----------|---------|---------|---------|---------|---------|---------|
| Walleye | | | | | | | |
| Optimal depth (m) | 0.3 - 1.0 | | | | | | |
| Optimal substrate (cm) | 0.2 - 25 | * | * | | * | * | * |
| Lake Sturgeon | | | | | | | |
| Optimal depth (m) | 0.1 - 2.0 | | | | | | |
| Optimal substrate (cm) | 10 - 60 | * | * | | | * | * |
| Sucker species | | | | | | | |
| Optimal depth (m) | | | | | | | |
| Optimal substrate (cm) | 0.2 - 1.6 | | | | | | |

*mixed substrate, some optimal

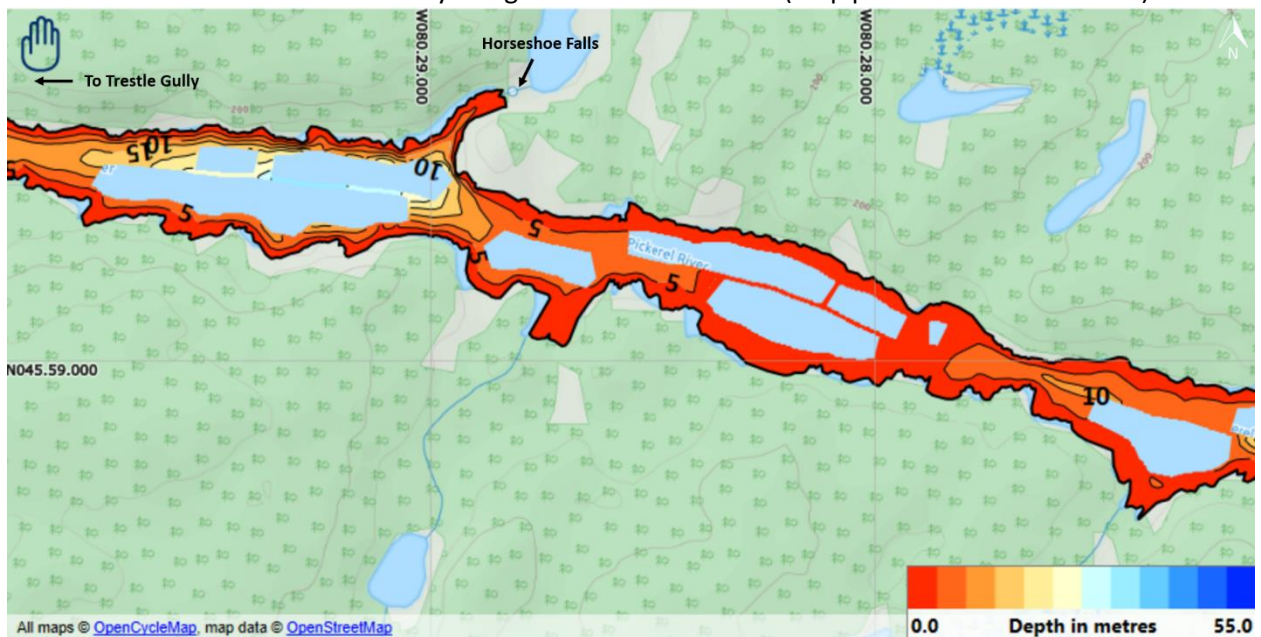


Appendix E – Bathymetry Maps

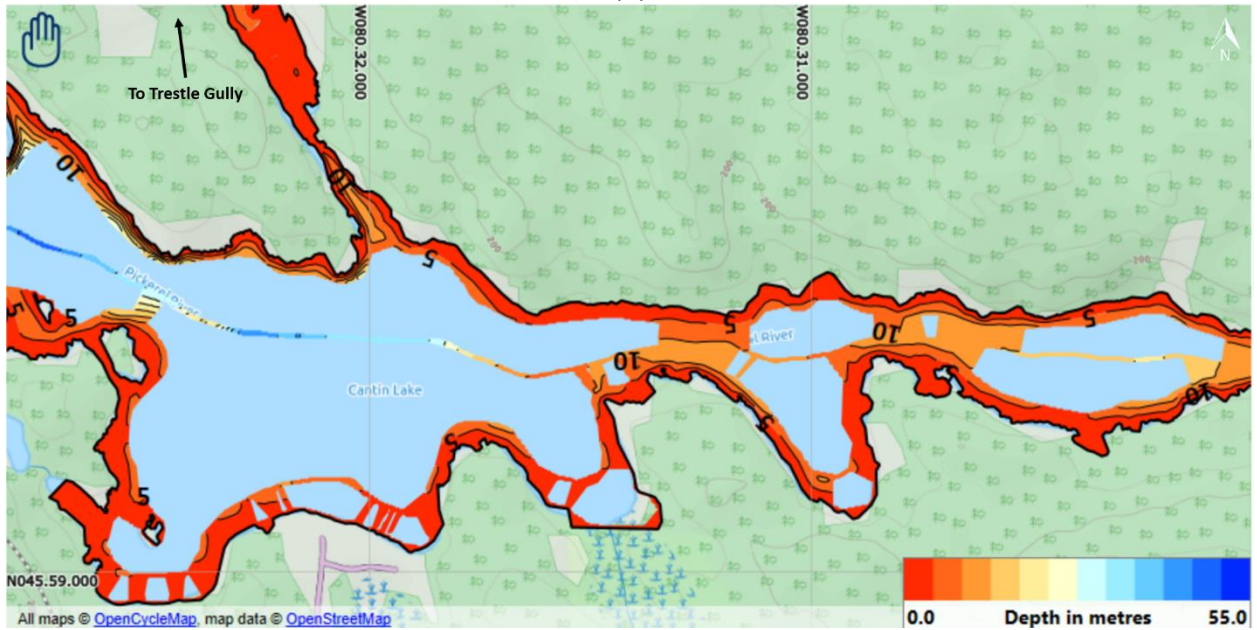
Pickrel River downstream of Bailey Bridge (map produced in ReefMaster)



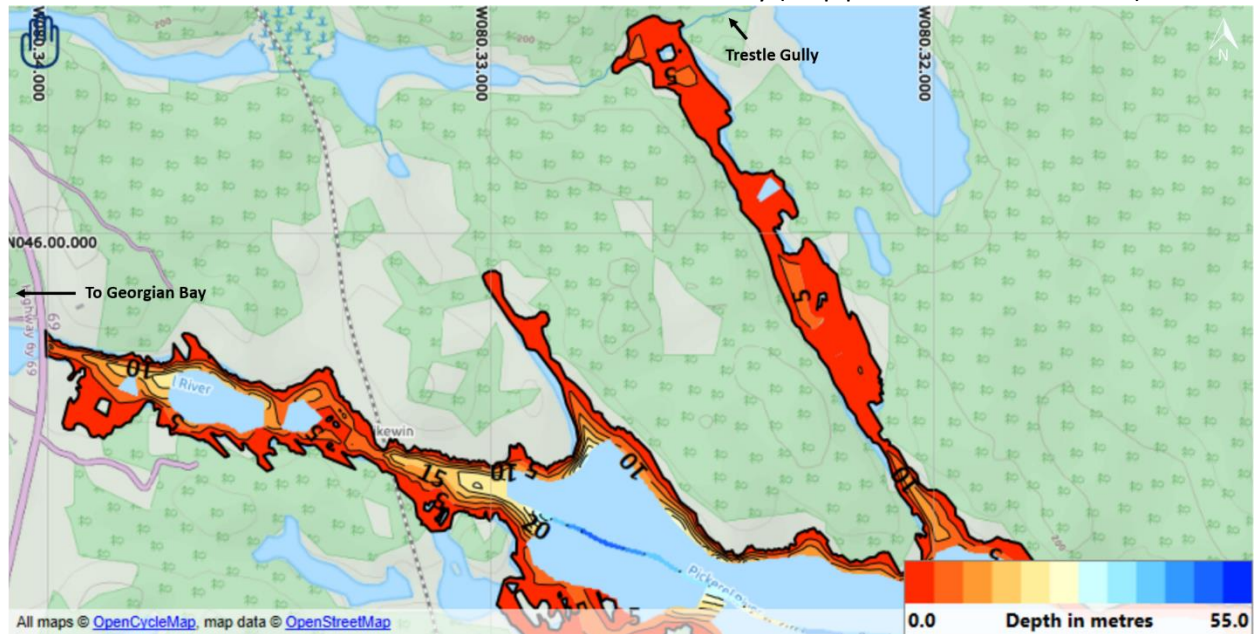
Pickrel River downstream of Bailey Bridge and Horseshoe Falls (map produced in ReefMaster)



Pickrel River downstream of Horseshoe Falls (map produced in ReefMaster)



Pickrel River downstream of Horseshoe Falls and Trestle Gully (map produced in ReefMaster)



Appendix F – Shoreline Photos

Underwater Surveys – shoreline photos

Survey 1



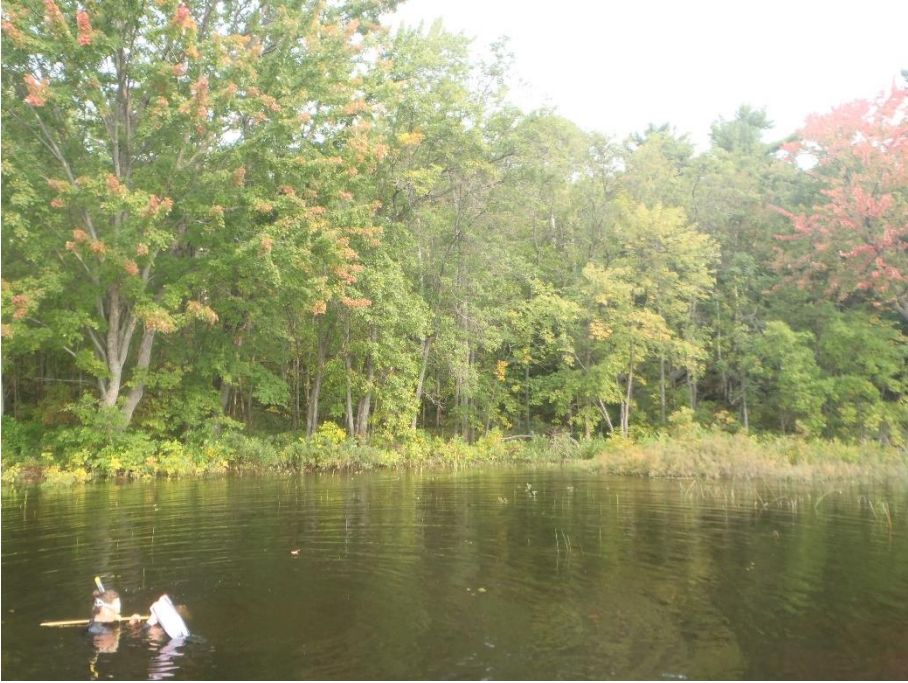
Survey 2



Survey 3



Survey 4



Survey 5



Survey 6



Survey 7



Survey 8



Survey 9



Survey 10



Survey 11



Survey 12



Horseshoe Falls Survey 1



Trestle Gully Survey 1



Trestle Gully Survey 2



Bailey Bridge Survey 1



Bailey Bridge Survey 2

