Magnetawan 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, including the Magnetawan 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.

The Magnetawan River is a large watershed with a complex system of dams for water level management, governed by the Magnetawan River Water Control Operating Plan. For the downstream portion of the Magnetawan River, flow is mainly controlled by two dams at the Ahmic Lake outlet. A south branch of the Magnetawan River flows into the Naiscoot River, and another portion of the south branch flows back into the main branch of the Magnetawan River at Miner Lake. It has been documented that flow rates can fluctuate dramatically from year to year, and within each year. The fluctuation of water levels has led to concern from Magnetawan First Nation, EGBSC, and Ministry of Natural Resources and Forestry (MNRF) staff over the potential impact on Walleye reproductive success and recruitment.

EGBSC's 2016 Magnetawan River habitat assessment built upon other Walleye studies and reports that recommended follow up monitoring of water level and flow fluctuations. In addition, the area and extent of Walleye habitat at Deadman's Rapids, the first set of rapids upstream from Georgian Bay, had not been documented, which was also a part of this study. Past habitat assessments have ended at Two Foot Rapids, as evidence suggests that Walleye would be unable to get past this site to other spawning areas upstream. In the summer of 2016, EGBSC documented habitat at two potential spawning areas upstream of Two Foot Rapids – Four Foot and Fourteen Foot Rapids.

EGBSC's spawning habitat assessment focused on Deadman's Rapids, due to site accessibility. The site was visited thirteen (13) times between April 17 and June 8. Depth and velocity measurements taken during this period show large fluctuations in water levels at the upstream end and south shore of Deadman's Rapids, and significant declines in water velocity over the spawning and egg incubation period. The water level at the upstream end of the rapids dropped by 116.5 cm, and the two stations on the south shore dropped by 51 cm and 112.5 cm. Although high velocities were measured at certain stations at Deadman's Rapids, there was enough variation in flow throughout the rapids that velocity would not pose a barrier to fish moving farther upstream. Basic water chemistry measurements of water temperature, dissolved oxygen, pH, and conductivity were within the expected range, and did not present any concerns.

Evidence of Walleye spawning on both the south shore and the north shore was observed. Despite a large drop in water levels on the south shore, there were no observations of stranded eggs. In total, 559 Walleye eggs and three Sucker eggs were counted on egg mats. A small number of Walleye eggs were observed at the base of the rapids on the north shore. Four night surveys revealed a very low number of Walleye and White Sucker moving through Deadman's Rapids. However, due to the depth and water velocity at the rapids, visual observations were limited to certain areas of the spawning bed, and it would not have been possible to see all fish moving through the site. Snorkel surveys documented Redhorse Sucker species, but no Lake Sturgeon were observed. Other fish species observed during night surveys and snorkelling were Muskellunge, Smallmouth Bass, Rock Bass, Logperch, and Rosyface Shiner.

EGBSC conducted plankton sampling during the time when fry would be hatching. Based on sampling, there was a low abundance of plankton, indicating a potential lack of food for larval fish.

During the summer, EGBSC conducted surveys to document the location and extent of spawning areas at Deadman's Rapids and rapids farther upstream. Based on these assessments, there is good quality spawning substrate available at Deadman's Rapids, but the depth is outside of the ideal range for Walleye and Lake Sturgeon. There was a limited amount of spawning habitat at Spud Rapids, and a limited amount and poorer quality habitat at Pine Rapids. Two Foot Rapids had a higher quantity and quality of spawning habitat; however, there have been concerns raised by Magnetawan First Nation and Henry Kujala (former MNR) of egg stranding as water levels drop during the egg incubation period. It is thought that Walleye would not be able to swim past Two Foot Rapids due to high velocities, but it is unknown whether Sucker species and Lake Sturgeon can. Farther upstream, Four Foot and Fourteen Foot Rapids were both assessed as having spawning habitat.

Surveys were also conducted to assess the amount of nursery, rearing, and foraging habitat available downstream of Deadman's Rapids. Bathymetry and side scan sonar data were collected from Deadman's Rapids to the outlet of the Magnetawan River into Georgian Bay. Aerial photos were collected of the shoreline from Deadman's Rapids to Wright's Marina, approximately 6.5 kilometres downstream. In that area, 62% of the shoreline is natural (unaltered), and 38% of the shoreline is altered. Types of alterations identified included mown grass, buildings, retaining walls, artificial or cleared beach, roads, and docks.

Underwater surveys were taken for 100 m, spaced approximately 1 km apart from Deadman's Rapids to Georgian Bay. The surveys showed a prevalence of bedrock shoreline, although 60% of the surveys had soft substrate, and 90% of surveys had moderate to abundant levels of aquatic vegetation. Overall, there was limited wood structure (logs, branches, sticks) recorded in the underwater surveys.

Based on the 2016 assessment, there is suitable spawning habitat along the Magnetawan River for spawning populations of Lake Sturgeon, Sucker species, and Walleye. However, there are remaining questions and concerns regarding depth of spawning and potential egg stranding that may impact successful reproduction and recruitment. No habitat restoration has been recommended from this study. Instead, EGBSC recommends the following:

- Conduct detailed assessments upstream of Deadman's Rapids at Spud Rapids, Pine Rapids, Two Foot Rapids, Four Foot Rapids, and Fourteen Foot Rapids to assess spawning and collect data on flow, depth, and egg deposition. Due to the difficulty associated with accessing these sites during the spawning period, there may need to be a designated team that would camp in this area during this time.
- Gain a better understanding of whether Lake Sturgeon are spawning upstream of Deadman's Rapids and investigate the potential for restoration or the possibility of stocking. The collection of depth and flow data would help to figure out if water level fluctuations upstream would be a limiting factor for successful Lake Sturgeon reproduction.
- Conduct further, detailed analysis of the side scan sonar data to supplement the observations from underwater surveys.

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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 Magnetawan River is located north of Parry Sound and Pointe au Baril (Figure 1). The river and its watershed are situated in the ancestral and traditional territory of the Anishinabek people.

Figure 1. Location of the Magnetawan River outlet into Georgian Bay

The Magnetawan River watershed is a large, tertiary watershed draining an area of 6,025.5 km^2 (Figure 2) (Phair et al., 2005). The watershed is comprised of roughly 50% Crown land, 40% private land, and 10% First Nations land (Phair et al., 2005). The Magnetawan river flows 175 km from its source at Magnetawan Lake inside Algonquin Park to empty into Georgian Bay at the community of Britt on Byng Inlet. Flow management on the Magnetawan River is a complex system. Flow affecting spawning areas in the downstream portion of the Magnetawan River is mainly controlled by two dams at the outlet of Ahmic Lake. The Magnetawan River bifurcates downstream of Trout Lake and Sand Bay, further complicating the drainage pattern. However, these bifurcations would not have nearly the same impact on flow and water levels as the dams at Ahmic Lake. The south branch of the river splits again with one branch flowing further south and draining into Harris Lake (which drains into the Naiscoot River and then Georgian Bay), and the other flowing north and rejoining the main branch of the Magnetawan River at Miner Lake.

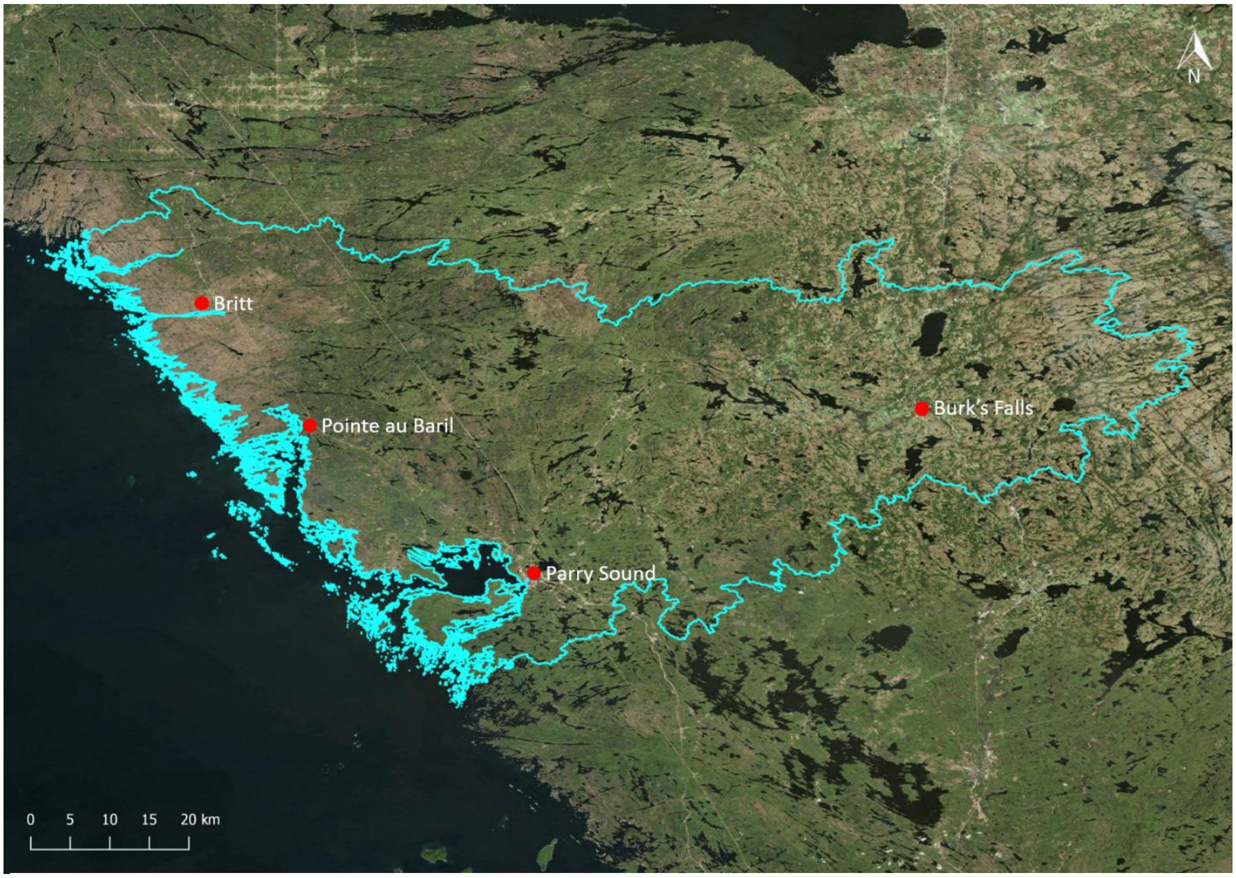


Figure 2. Magnetawan River tertiary watershed

EGBSC conducted a literature search on the Magnetawan River in 2011 which summarized all Ministry of Natural Resources and Forestry (MNRF) documents written up until that point (McIntyre, 2011a). The literature search highlighted a lack of documentation on the Magnetawan River Walleye population prior to 1980. Creel surveys in 1980 and 1981 showed a high percentage of two-year-old fish, indicating successful reproduction and recruitment. From 1980 to 1984, MNRF carried out lodge creel surveys, from which they concluded that the Walleye sport fishery in Britt was one of the best in eastern Georgian Bay. However, in 1986, the Britt-Byng Inlet Anglers Association wrote a letter to MNRF about the significant decline in Walleye fishing for three years, and in 1988, the Britt-Byng Anglers Association began stocking Walleye in the Magnetawan River. Stocking continued up until 1991. By 1988, fish length data collected during a spring trap netting assessment indicated a range of age classes but poor reproduction and recruitment. Spring trap netting was repeated in 1989 and the results suggested the same reproduction and recruitment issues as in 1988. In addition, the two years of spring trap netting only resulted in a combined catch of 103 Walleye for 139 nights of net sets, indicating a low abundance of Walleye. A creel survey conducted in 1992 showed a high proportion of Walleye aged one to three and a very low number of adult Walleye, further signalling population declines.

No further MNRF fisheries assessments were done on the Magnetawan River until a Muskellunge study in 2002 which resulted in the capture of 5,459 fish (seventeen (17) species), indicating good productivity in the river. A total of 153 Muskellunge were captured. In the same study, sixty-three (63) Walleye were captured, and data showed reproduction and recruitment continued to occur. Four thousand sixty-one (4,061) Redhorse Sucker species were also caught during that survey. A second Muskellunge assessment was completed in 2010. During that assessment, a total of 2,281 fish (seventeen (17) species) were captured. Sixty-eight (68) Muskellunge, twenty-four (24) Walleye, and 1,226 Redhorse Sucker species were caught during the study (McIntyre, 2011a).

In 2011, EGBSC partnered with Magnetawan First Nation and MNRF to carry out end of spring net trap netting (McIntyre, 2011b). The sampling was cut short due to high winds, but a total of eighteen (18) net sets were completed over twenty-four (24) net nights. EGBSC caught fifteen (15) different fish species, but the catch-per-unit-effort (CPUE) was well below the Georgian Bay mean, denoting a low abundance of fish overall. The abundance of Redhorse Sucker, Channel Catfish, and Muskellunge was high. The abundance of Smallmouth Bass and Longnose Gar was average, and the abundance of Walleye and Northern Pike was low. The abundance of White Sucker, Largemouth Bass, Bowfin, Yellow Perch, Pumpkinseed, and Carp was considered very low. The report noted that although Walleye were low in abundance, there was still evidence of some successful reproduction and recruitment. The report concluded that the fish community in the Magnetawan River was similar to other areas of Georgian Bay, where two thirds of the fish caught were comprised of non-sport fish (of which Redhorse Sucker species comprised 49%) and the other third were sport fish.

Anishinabek/Ontario Fisheries Research Centre (A/OFRC) staff have carried out fish sampling on the Magnetawan River on six different occasions, in 1999, 2005, 2008, 2009, 2010, and 2014. Thirteen (13) Walleye were caught in 1999 (A/OFRC, 2010), and seven Walleye were caught in 2005. No Walleye were caught in 2008 or 2009 (A/OFRC, 2010). A total of nineteen (19) Walleye were caught in 2010 (A/OFRC, 2010), and twenty-seven (27) in 2014 (A/OFRC, 2014). A/OFRC documented one Lake Sturgeon during the 2009 assessment (A/OFRC, 2015). Lake Sturgeon are not documented in any other reports.

Three Magnetawan River habitat assessments were completed prior to EGBSC's work in 2016. In 1987, Henry Kujala (MNR) visited rapids in the lower Magnetawan River, from Deadman's Rapids to Fourteen Foot Rapids. He noted that residents, community members from Magnetawan First Nation, and tourist operators believed the Walleye population was declining. Based on night observations, he reported a lack of ideal habitat for Walleye spawning at an appropriate depth at both Deadman's Rapids and Two Foot Rapids, and that Four Foot Rapids and Fourteen Foot Rapids had the most potential for spawning, but that Walleye were unable to move upstream of Two Foot Rapids. Based on his work, Kujala estimated the spawning area at Deadman's Rapids at roughly 30,000 ft^2, and at Two Foot Rapids, approximately 1,000 ft^2. During his site visits, Kujala noted that the south side of Two Foot Rapids had the greatest degree of spawning. Kujala did not believe that harvest was having an impact on Walleye success, and noted that Magnetawan First Nation set a limit of five fish per day, per person. Based on his field work, Kujala suggested that water level and flow fluctuations from upstream dam management were the biggest impairment to reproductive success. He reported that there seemed to be a strong year class from 1982, when the discharge from Ahmic Lake was maintained at 80 cfs or more from April 23 to May 20 (Kujala, 1987).

As part of the 1987 habitat assessment, nine visual surveys were completed. At Deadman's Rapids, Kujala observed Walleye (no more than ten (10) in one survey), Rainbow Smelt, and Suckers (over forty (40) in one survey). At Two Foot Rapids, he observed Walleye (no more than twenty-six (26) in one night), and Suckers. The Sucker spawning peaked in May, with over 1,000 observed in one survey. Six to eight Redhorse Sucker species were observed during the same time period (Kujala, 1987).

Kujala's report included several recommendations. One recommendation was to investigate the potential to build a reservoir of water in larger headwater lakes farther upstream on the system (Lake Bernard, Eagle Lake, and Sand Lake) to ten (10) inches above summer levels to better manage water flow and fluctuation (prolong and maintain flow at 100 cfs or more). Kujala thought this would benefit thirty (30) Walleye spawning sites along the Magnetawan River. Other recommendations included: carrying out a water level audit from Ahmic Lake between April 23 and June 10, in the years from 1979 to 1983 to determine how much water flow comes from the Ahmic Lake dam; assessing the population at Britt to determine size, summer range, and year class strength, and comparing that to water level and flow fluctuations; and stocking fingerlings for five years, if needed. He also suggested investigating restoration work at Deadman's Rapids (pool on the south side) and Two Foot Rapids (removing bedrock to increase spawning bed depth and the amount of suitable spawning substrate).

The next habitat assessment on the Magnetawan River was completed by EGBSC in 2011, in partnership with Magnetawan First Nation, following the literature search (McIntyre, 2011c). EGBSC completed a site visit at Deadman's Rapids in May 2011 with representatives from Magnetawan First Nation, A/OFRC, and MNRF to take photographs and assess potential spawning habitat for Walleye. Due to depth and water velocity, spawning habitat could not be determined, but the report noted that the steeply sloped granite shoreline would make the spawning habitat less susceptible to eggs being stranded out of water as water levels declined over the egg incubation period. The report noted a more detailed study and analysis would be needed in order to determine the extent of Walleye spawning habitat.

In July 2011, a follow up site visit was conducted with EGBSC and Richard Noganosh from Magnetawan First Nation. Spawning substrate at a group of small islands at the downstream end of Deadman's Rapids was assessed by snorkel survey. This area would be the farthest upstream that a barge could be brought in for habitat restoration purposes. Based on the snorkel survey, depths exceeded 3 m in the locations where flow would be suitable for spawning. The report concluded that this site would not be suitable for restoration, as it would require a considerable amount of rock material to create what would be a small area of spawning habitat. A snorkel survey farther upstream at the Pine Rapids was also completed. From this survey, it was concluded that the site was mainly bedrock with very little, and poor quality, spawning habitat present (mainly on the north shore). The report noted that fish would be able to bypass this set of rapids to spawn farther upstream. At Two Foot Rapids, a snorkel survey revealed an abundance of high-quality spawning substrate for Walleye. Based on the site characteristics, the report noted that it would be unlikely that Walleye could bypass this site, especially in years with low water levels (McIntyre, 2011c).

The 2011 site inspection report concluded that there was likely good spawning habitat present at Deadman's Rapids, although it was unconfirmed due to depth and flow, and that there was good spawning habitat present at Two Foot Rapids. In order to restore Walleye populations, the report suggested that the Upper Great Lakes Management Unit (UGLMU) review all studies that had been done on the Magnetawan River to date, and consider Walleye stocking and strict harvest control (McIntyre, 2011c). The report also recommended follow-up monitoring at Two Foot Rapids over the egg incubation period to investigate any areas of egg stranding, as this was a problem mentioned by Richard Noganosh, and documented in Henry Kujala's site assessment in 1987. Future flow monitoring to help ascertain effects of fluctuating water flows and levels at the spawning areas was also recommended. It was suggested that the data be incorporated in the Magnetawan River Operating Plan to help manage flow regimes that would enhance reproductive success for Walleye (McIntyre, 2011c).

In partnership with Magnetawan First Nation, the A/OFRC completed a follow up habitat study, where A/OFRC staff assessed the shoreline and littoral habitat in, and directly downstream of, Deadman's Rapids. The study involved bathymetry mapping and assessing shoreline substrate as it pertains to

Walleye habitat requirements. The bathymetry mapping results concluded that depth in the lower area of the Magnetawan River ranged from 0-13.9 m, which met the depth requirements for Walleye.

A/OFRC's shoreline substrate mapping documented a mix of substrate including bedrock, sand, clay, cobble, and boulder. However, a large portion of the shoreline substrate was comprised of 90% clay and 10% sand, which would not meet the ideal substrate requirements for Walleye spawning. As illustrated in Figure 3, there was one area of shoreline comprised of 90% boulder and 10% cobble that would be more appropriate for Walleye spawning.

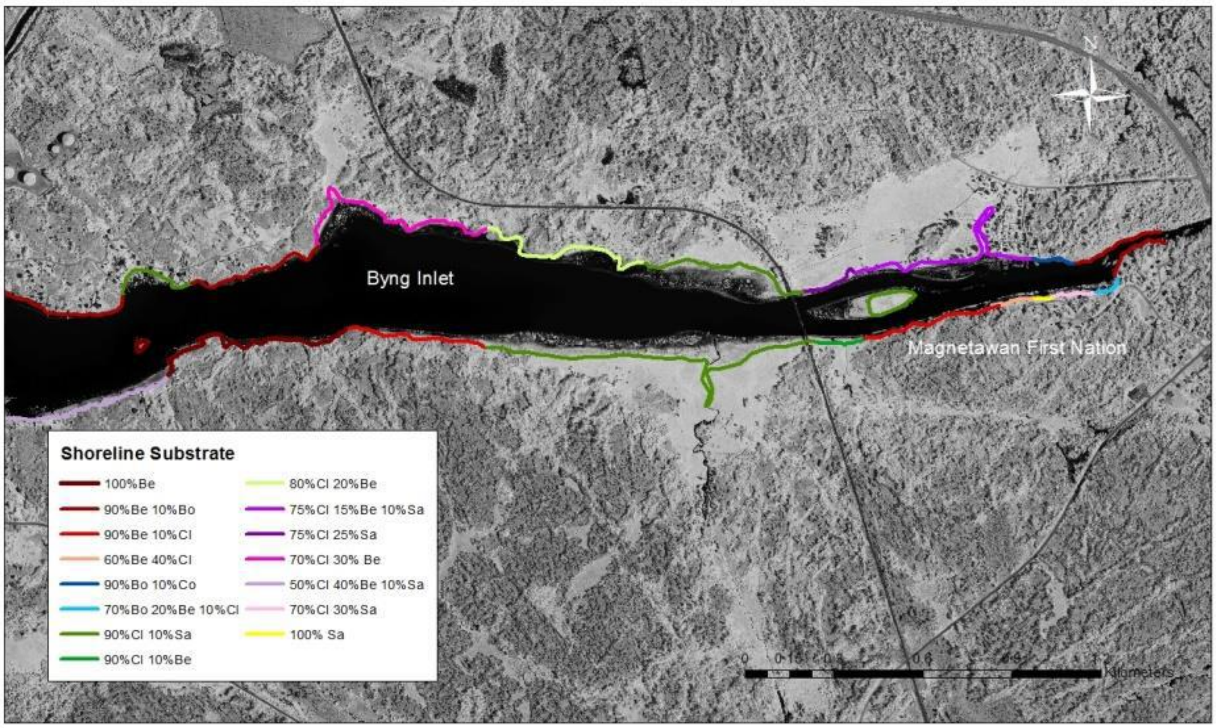


Figure 3. Magnetawan River shoreline substrate map (A/OFRC, unpublished)

A/OFRC's littoral substrate mapping showed a range of substrate more suitable to Walleye spawning. The littoral zone mainly consisted of one main area with 30% cobble, 30% sand, 30% clay, and 10% gravel. Another area was comprised of 60% sand, 30% clay, and 10% bedrock (Figure 4). The report concluded that the lower reaches of the Magnetawan River have the appropriate depth and types of substrate to support Walleye in various life stages and that further investigation should focus on changes in water flow and water levels.

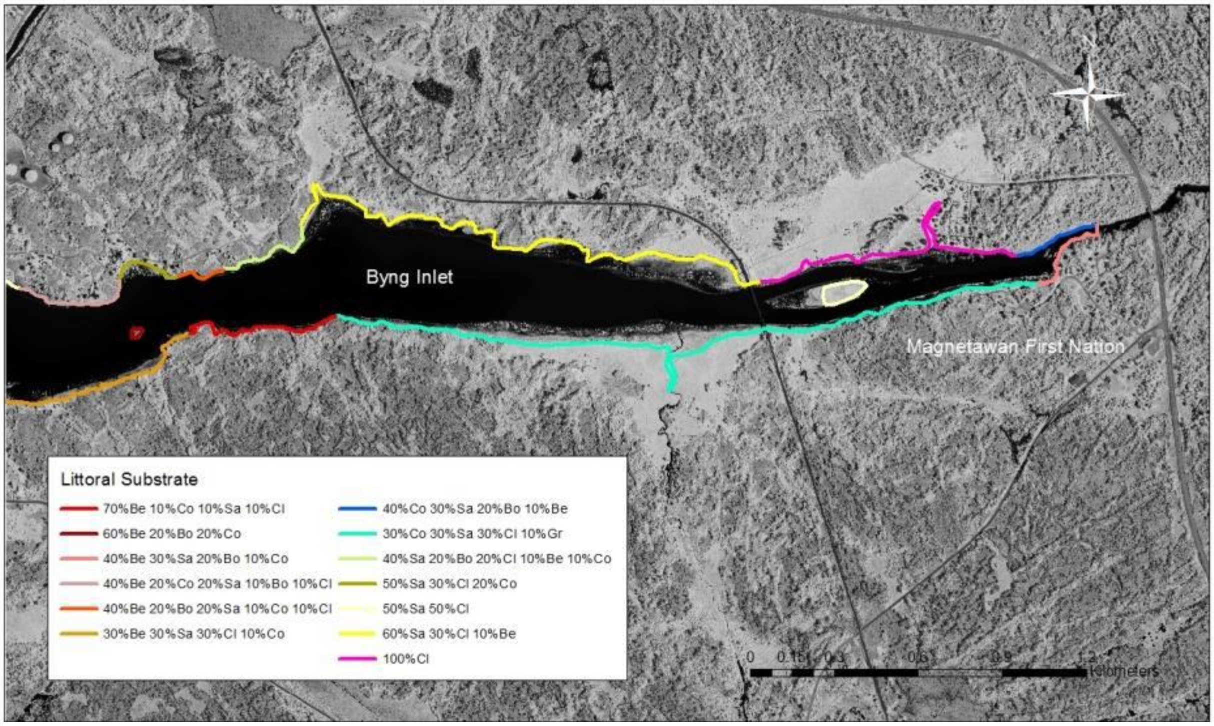


Figure 4. Magnetawan River littoral zone substrate (A/OFRC, unpublished)

Walleye is an extremely important fish species to Magnetawan First Nation. For many years, the community has noted declines in the Walleye spawning population and voiced concerns over water level and flow management as it pertains to Walleye reproductive success and recruitment. They have also noted declines in Lake Sturgeon. Community members have noted that Walleye are able to swim up to Two Foot Rapids, which also provides spawning habitat, although it may be more subject to water level fluctuations than Deadman's Rapids.

In summary, the surveys and anecdotal accounts suggest low Magnetawan River Walleye population abundance with a low level of recruitment. Habitat studies have all concluded that there is existing spawning habitat, and concerns focused more on water flow, levels, and harvest restrictions.

Spring Spawning Assessments

In 2016, EGBSC studied the first set of rapids upstream of the Magnetawan River outlet into Georgian Bay, situated 11 km from the river mouth. There is no physical barrier at the first set of rapids (Deadman's Rapids) to prevent fish from moving farther upstream. Beyond Deadman's Rapids, there are five additional sets of rapids upstream (Figure 5). Past studies have noted that Two Foot Rapids would likely present a barrier to spawning Walleye. The fifth set of rapids (14 Foot Rapids) presents a definite physical barrier to fish. Due to site accessibility in the spring, EGBSC was only able to focus on Deadman's Rapids for regular measurements. Accessing the rapids farther upstream by boat during the spring freshet is unsafe and there is no road access.

EGBSC worked with Magnetawan First Nation to organize the field work in 2016. EGBSC began spring field work at the Magnetawan River on April 17 and ended on June 8. During that period, the site was visited thirteen (13) times, approximately every three to four days whenever possible. Towards the end of the Walleye, Lake Sturgeon, and Sucker spawning period (end of May), site visits were less frequent.

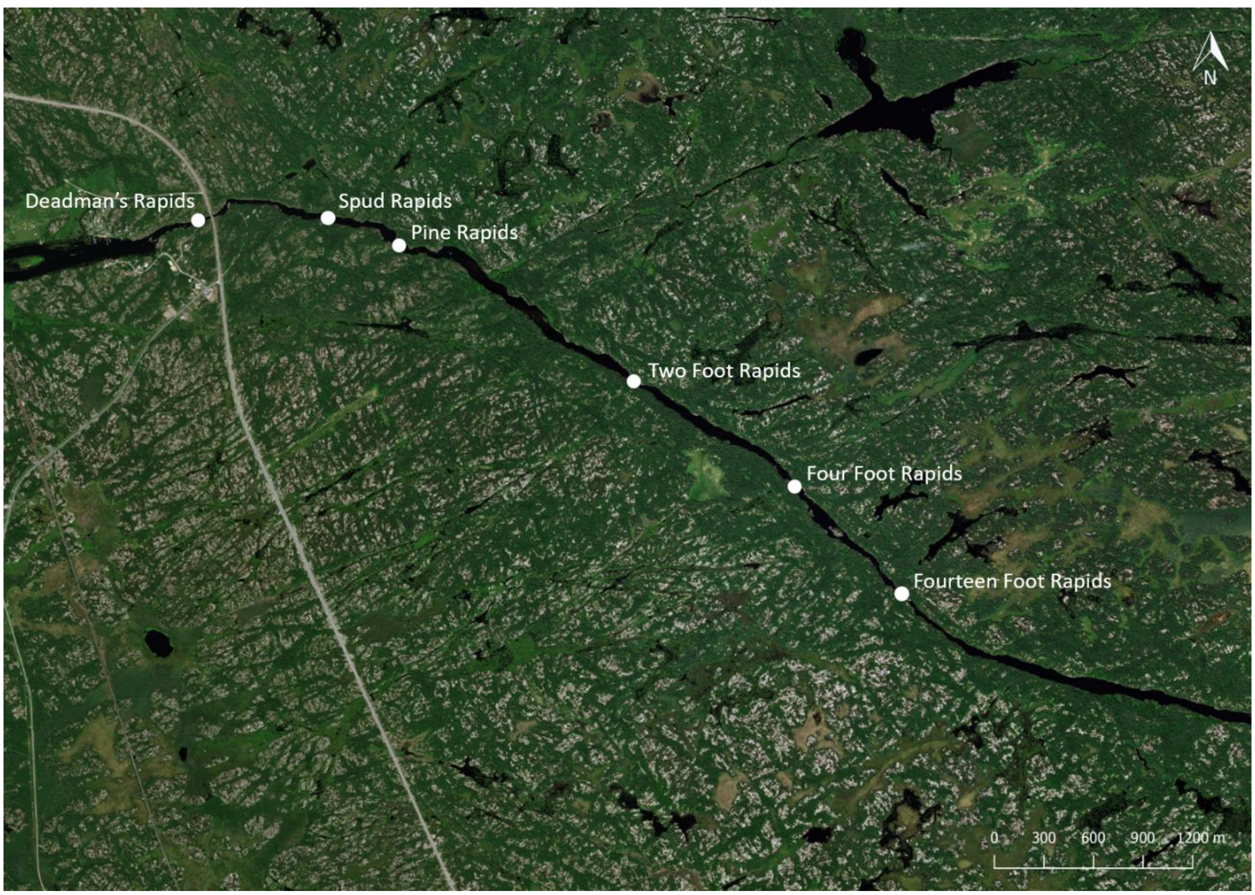


Figure 5. Location of rapids along the Magnetawan River

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).

As illustrated in Figure 6, water temperature slowly increased from 4.1˚C on April 17 to 18.3˚C on June 8. Walleye and White Sucker were observed during night surveys between April 29 and May 5. Redhorse Sucker species were observed on May 24. No Lake Sturgeon were observed.

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. As shown in Figure 6, dissolved oxygen levels dropped consistently throughout the study period. The highest level was recorded on April 17 (14.4 mg/L) and reached a low of 9.6 mg/L on May 24.

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 (Kerr et al., 1997). All pH levels recorded at Deadman's Rapids were above 6.0. The highest pH level was 7.07 on April 24, and the lowest pH recorded was 6.64 on May 9 and 12. 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.

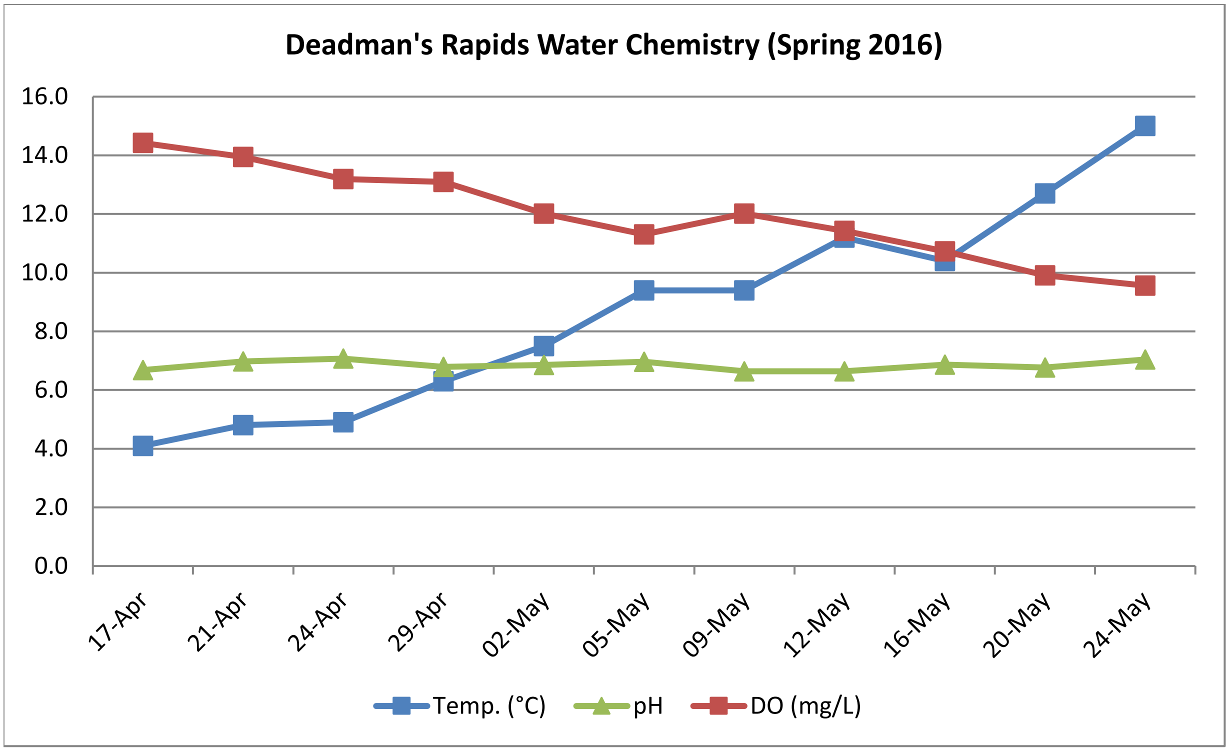


Figure 6. Water temperature (°C), dissolved oxygen (mg/L), and pH measurements taken at Deadman's Rapids in spring 2016

Conductivity was also measured at Deadman's Rapids in 2016 (Figure 7). 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. Conductivity was recorded between April 17 and May 24. Conductivity fluctuated slightly throughout the study period but remained fairly consistent. The highest conductivity reading was taken on April 17 (37.1 uS/cm). The lowest reading was taken on May 24 (34.9 uS/cm).

For complete water chemistry data, refer to Appendix A.

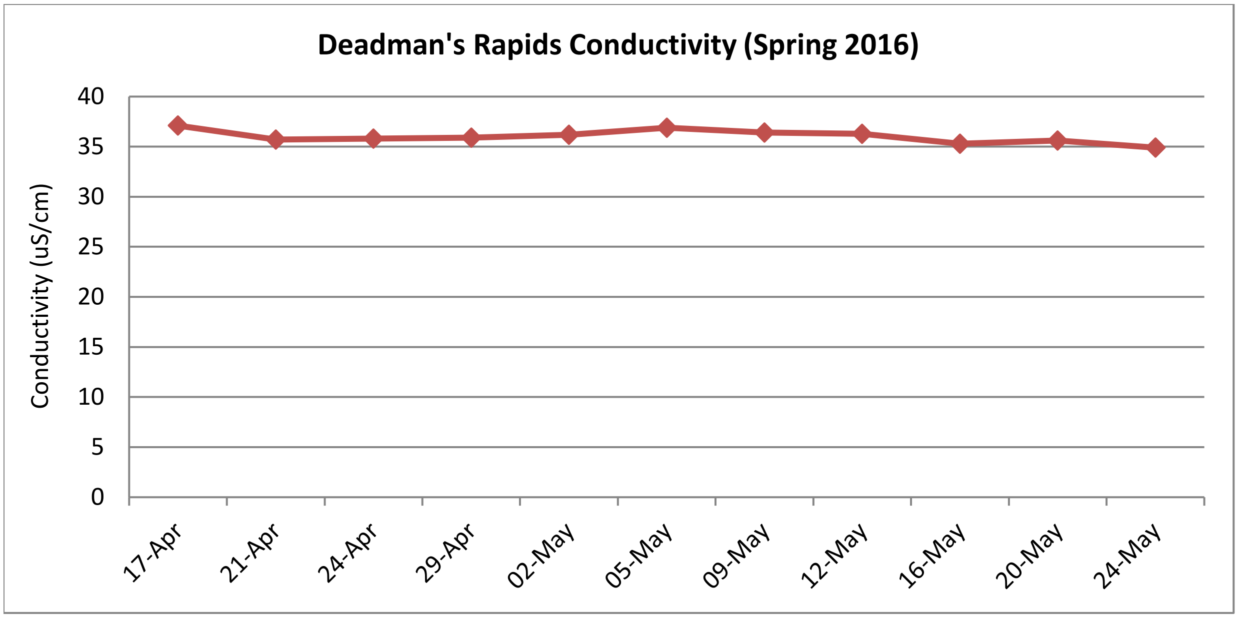


Figure 7. Conductivity measurements (uS/cm) at Deadman's Rapids in spring 2016

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 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.

Seven stations were established along Deadman's Rapids to collect information on water velocity from April 21 to June 8 (Figure 8). Station locations were based on site accessibility. Many areas of the rapids, especially on the north shore, were not accessible due to steep rock faces. Station 6 began as a depth and flow station, but the station went dry on May 9. EGBSC continued to measure water level at this station using a measuring tape and level. The water velocity station, on the other hand, had to be moved 5 m downstream and became station 6b (original station location became 6a). Figure 9 illustrates velocity measurements recorded at each station between April 21 and June 8.

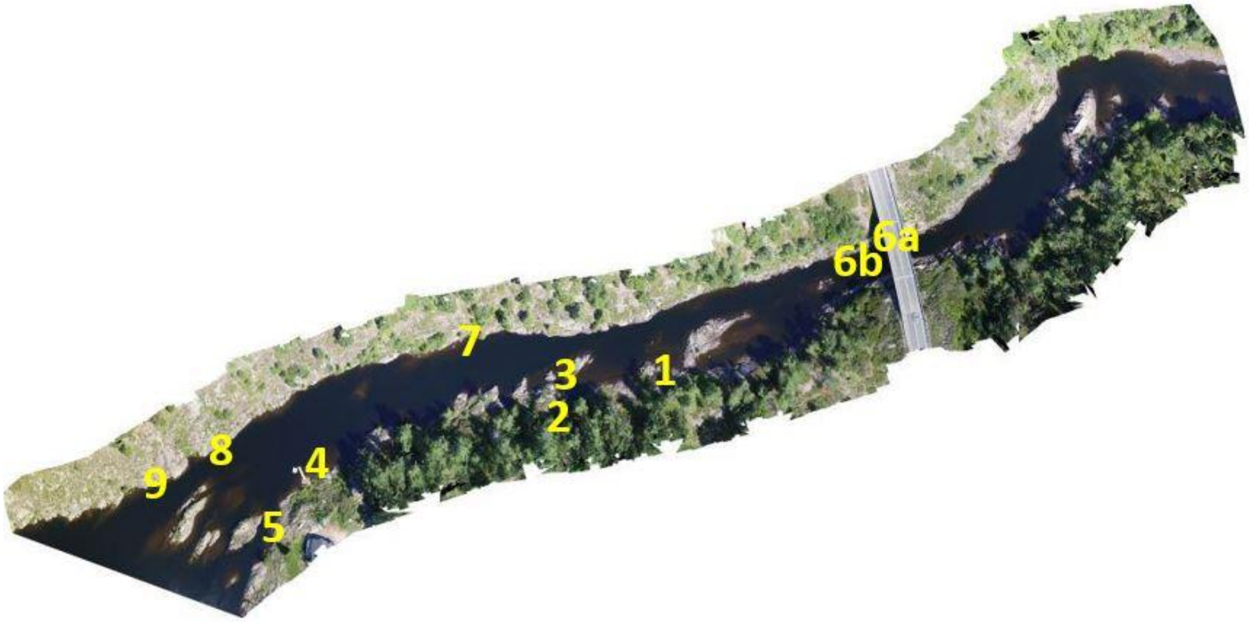


Figure 8. Water velocity (1, 3-6b, 7-9) and depth stations (1, 2, 4, 6a, 7-9) at Deadman's Rapids

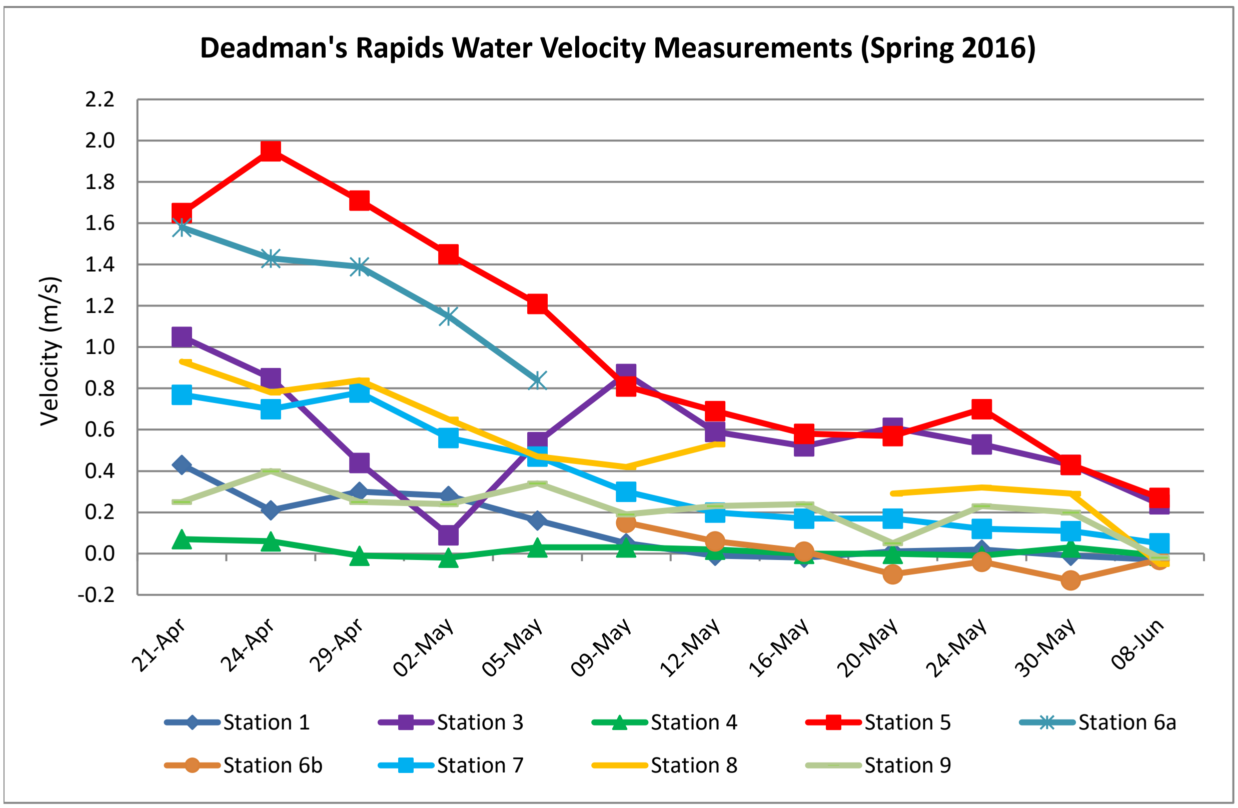


Figure 9. Water velocity measurements at Deadman's Rapids in spring 2016

Overall, stations 5 and 6a had the highest velocity, peaking at 1.95 m/s. Station 5 was located at the base of the rapids (where the river breaks into various channels around bedrock islands) between one of the bedrock islands and the bedrock shore. This area creates a narrow chute for the water to flow through, resulting in higher velocities. Station 6a was located underneath the Highway 69 bridge where the river narrows between the concrete bridge footings (Figure 10). The highest velocity recorded at Station 6a was 1.58 m/s. This velocity would not prevent fish from moving upstream, and there were no steep climbs that fish would need to ascend.

Figure 10. Station 6a located underneath the Highway 69 bridge

Stations 3, 5, and 6a experienced the most significant variations in water velocity. Water velocity at station 3 declined significantly from April 21 to May 5, but increased sharply on May 9. After May 9, velocity at station 3 declined more steadily. Stations 1, 4, and 9 all had lower velocities, and did not exceed 0.43 m/s for any measurements between April 21 and June 8. Station 4 had very low flow, peaking at 0.07 m/s and changing into a back eddy on four occasions over the monitoring period. All stations aside from 3, 4, and 5 declined fairly steadily between April 21 and June 8.

Water Level Fluctuations

Water levels were recorded at stations 1, 2, 4, 6a, and 7-9 (Figure 8) from April 23 to June 8 to understand how water levels change along the spawning bed throughout spawning and egg incubation. 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.

Stations 1, 2, and 6a experienced substantial water level fluctuations. Between April 21 and May 12, station 1 declined by 112.6 cm and station 6a declined by 116.5 cm. Station 2 declined by 51.5 cm between April 21 and May 9. Stations 1 and 2 were located on the south shore of the river, outside of the main flow. During the latter part of the steep decline in water levels at stations 1 and 2, eggs were deposited on egg mats located near stations 1 and 2. While no Walleye eggs were observed out of water near these stations, it is possible that egg stranding could take place at these locations. Station 6a was located the farthest upstream. Due to high velocities at station 6a, it is unlikely that eggs would settle out and be prone to stranding in this area. Stations 1, 2, and 6a were dry on May 16.

Water level fluctuated very little at stations 4, 7, 8, and 9. Stations 4, 7, and 8 declined steadily until around May 9 and then increased steadily to June 8. Station 9 had little fluctuation and for the most part, water level increased steadily between April 21 and June 8. Of all of the stations, stations 4, 8, and 9 would have been most influenced by increasing Georgian Bay water levels, as those stations were located at the downstream end of the rapids. Figure 11 illustrates water level fluctuations from April 21 to June 8. Refer to Appendix B for complete water level and velocity data.

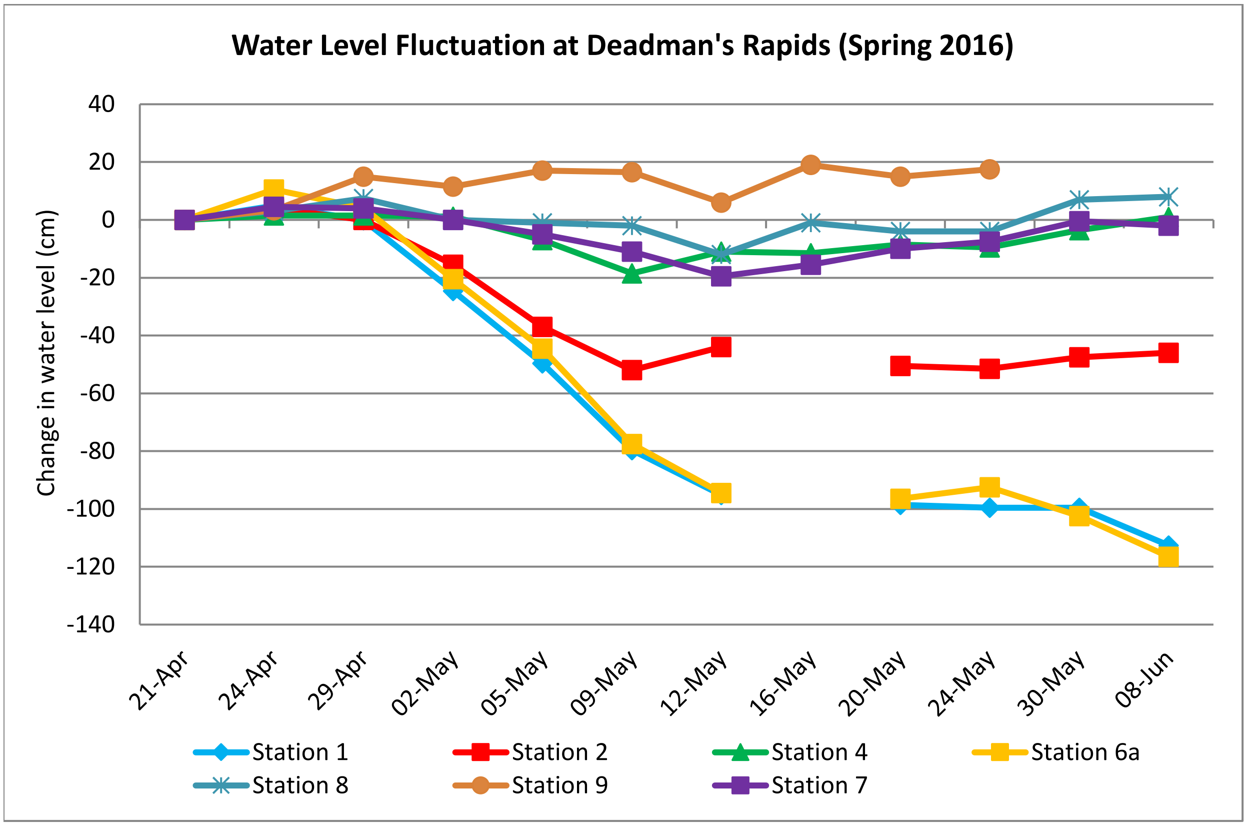


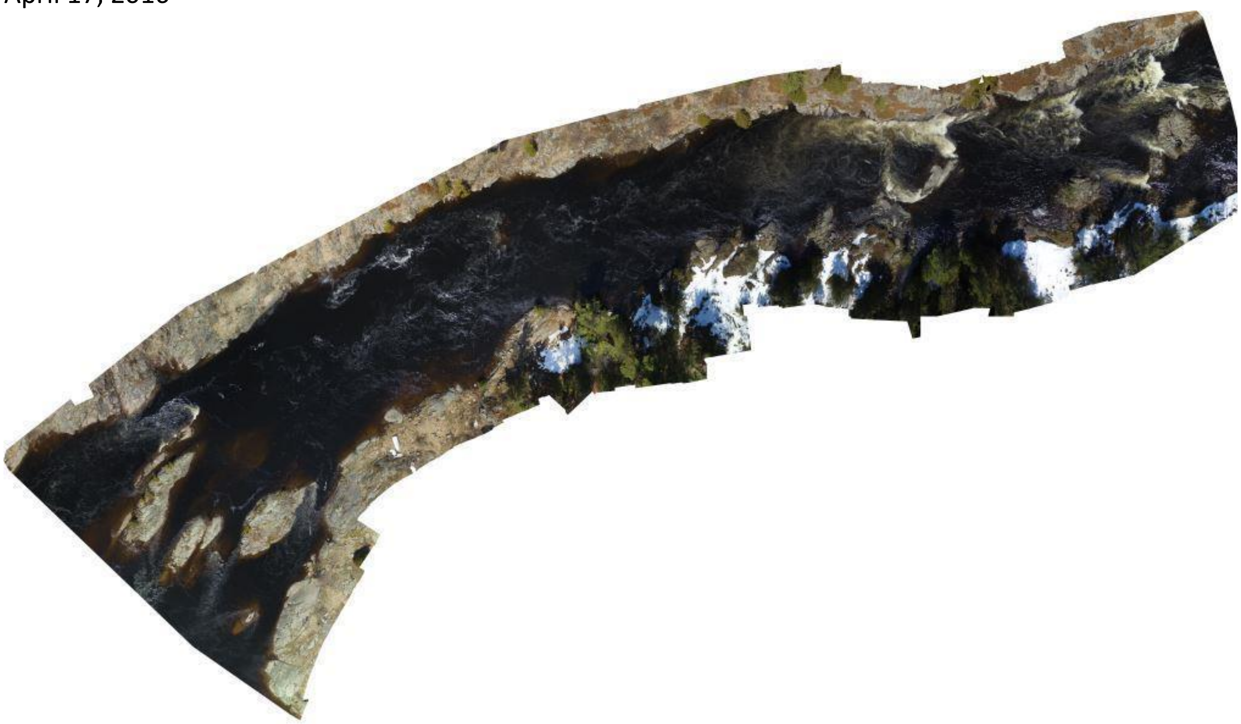
Figure 11. Water level fluctuations at Deadman's Rapids. Measurements on the first site visit served as the benchmark against which future measurements were compared (i.e., water level up or down compared to the first site visit).

As previously mentioned, flow and water level control for the lower Magnetawan River is complex and largely influenced by the two dams at Ahmic Lake. EGBSC's report from 2011 noted the dramatic fluctuations in water volume not only year to year, but also within years. In 1987, Kujala reported a 76 cm drop in water level at Two Foot Rapids, and data collected at Deadman's Rapids in 2016 show variations in water levels that exceed 1 m. Past studies have documented concerns regarding the potential impact of this fluctuation on reproductive success during the egg incubation period.

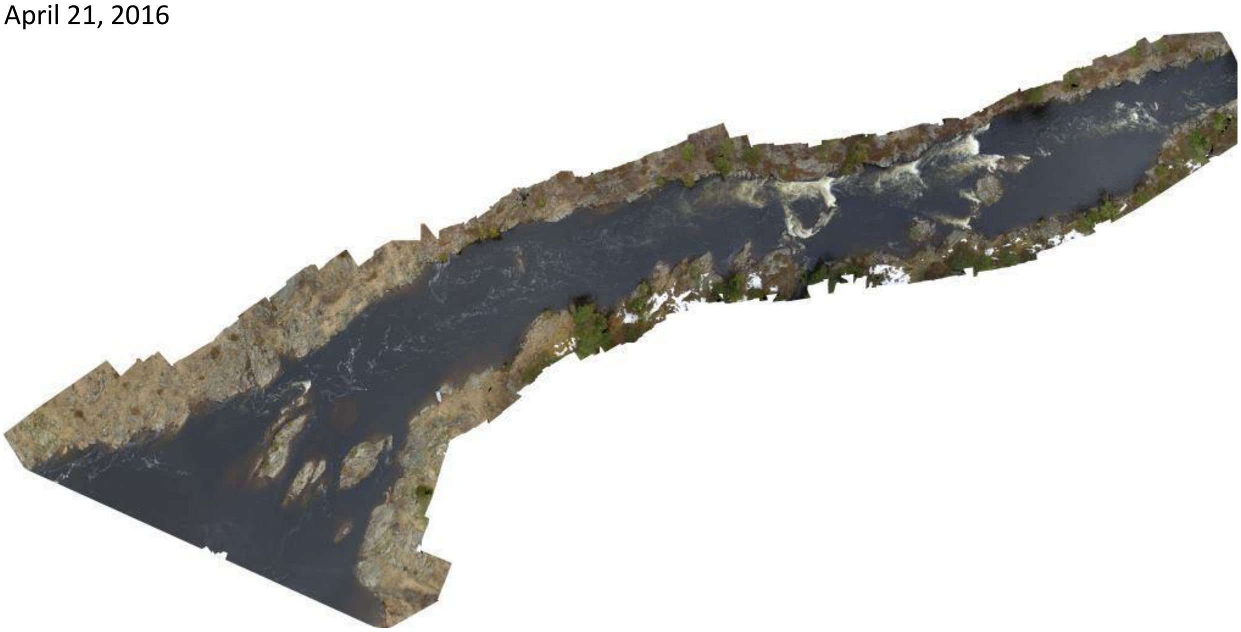
Aerial Photographs

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 the spawning bed from April 21 to June 8. The orthomosaics show that there is little change in water level over the spawning bed at the lower end of the rapids. Changes in water levels can be seen in the upper end of the rapids, especially along the south shore. The majority of the spawning habitat remained underwater, which is crucial for successful egg incubation. There were no observations of eggs being stranded out of water.

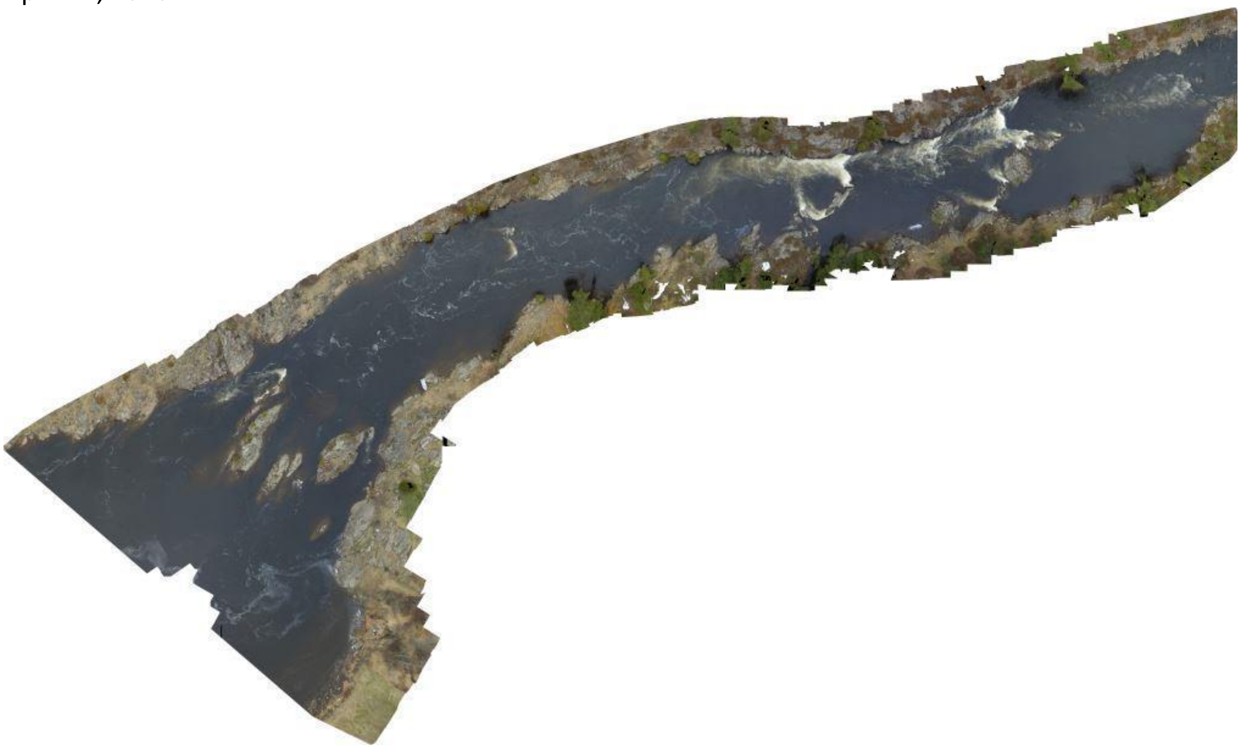
April 17, 2016



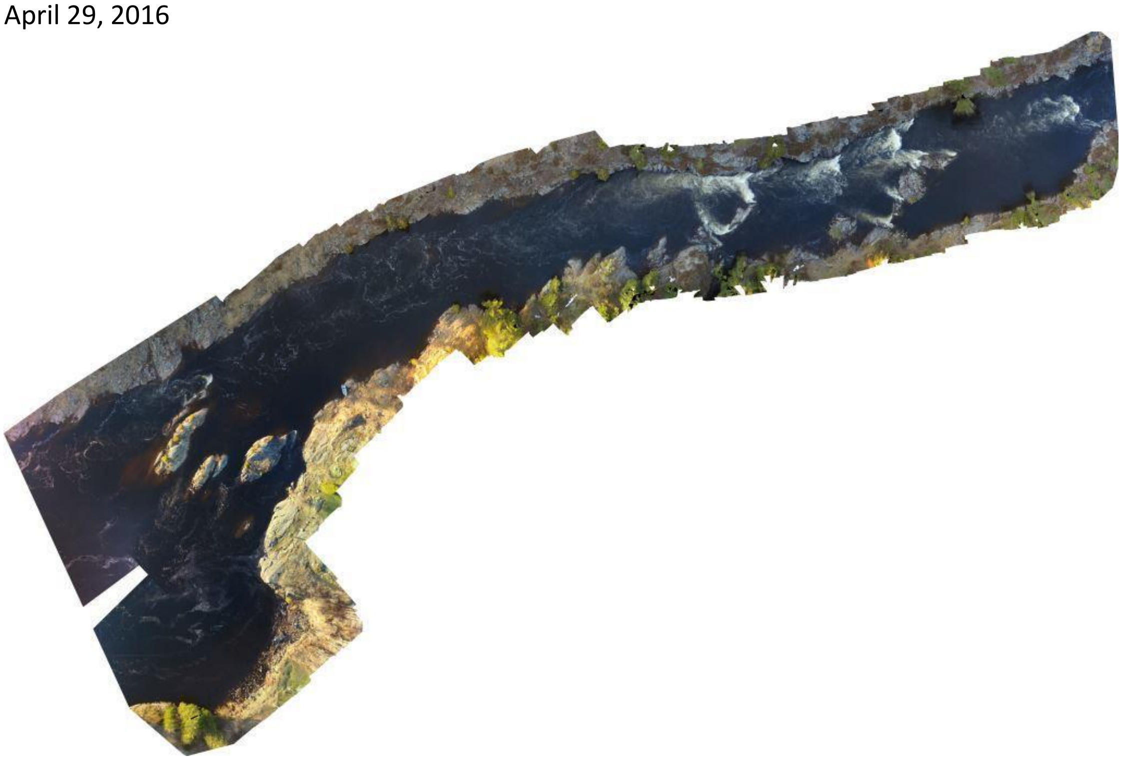
April 21, 2016



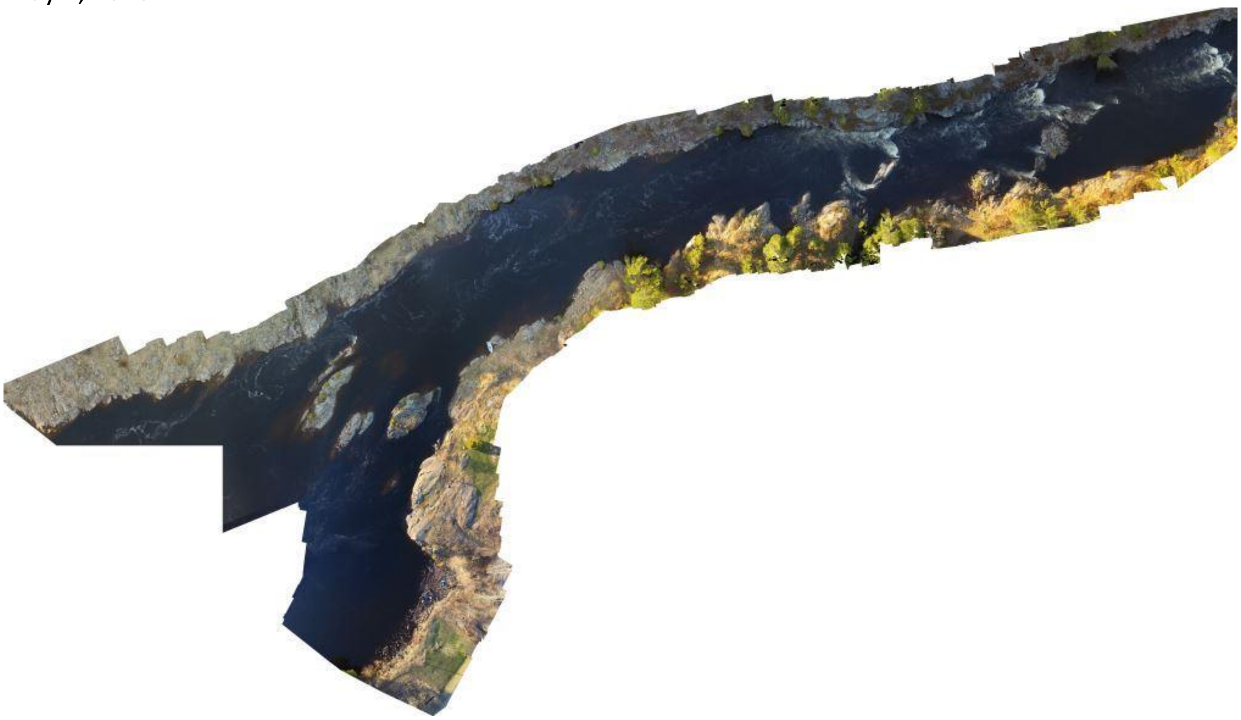
April 24, 2016



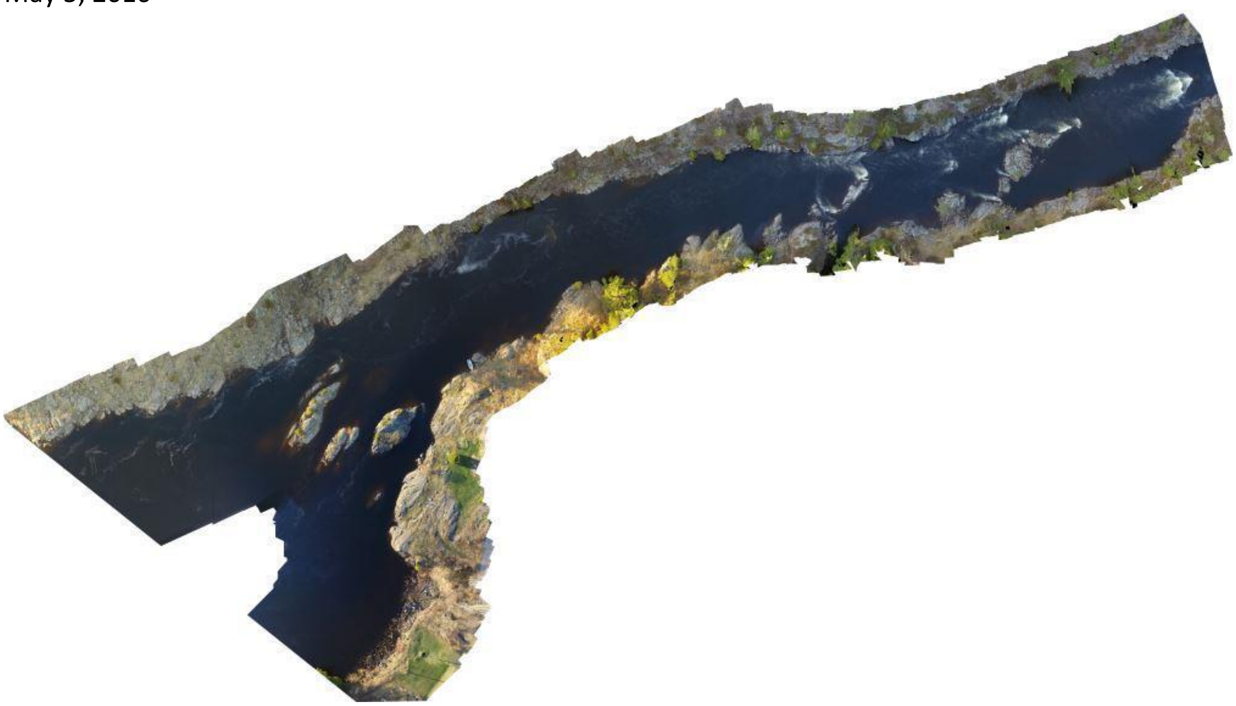
April 29, 2016



May 2, 2016



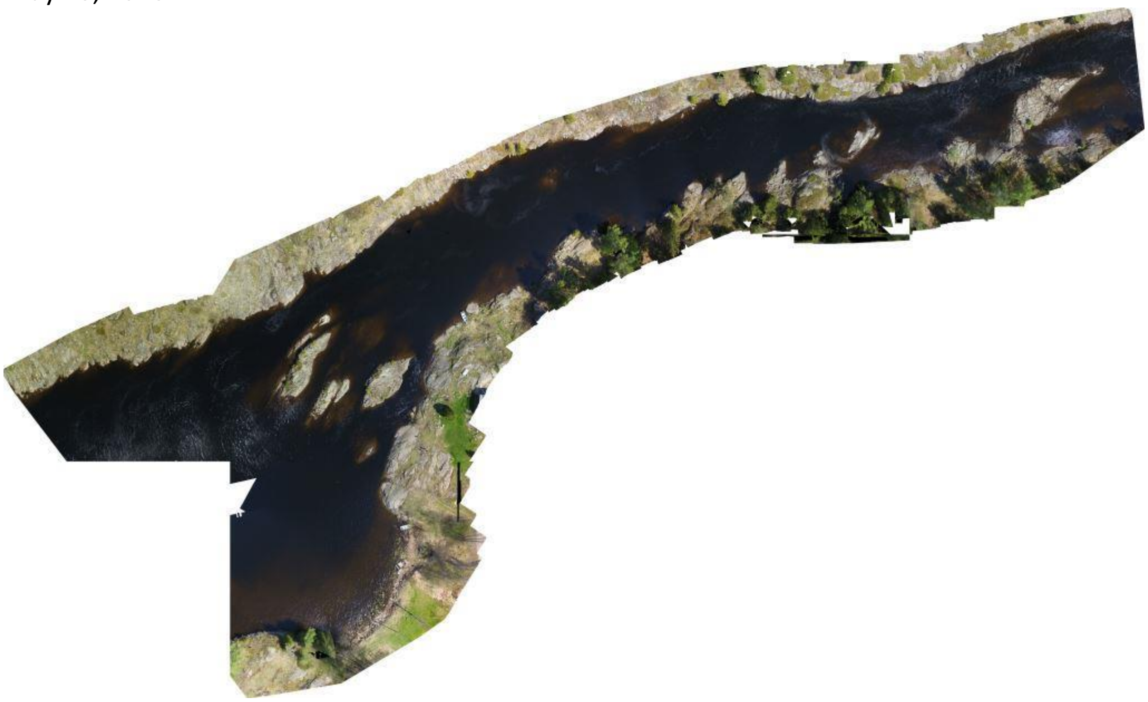
May 5, 2016



May 12, 2016

May 16, 2016

May 20, 2016



May 24, 2016

Fish Observations

EGBSC carried out visual observations (night and day) and took underwater videos at the spawning bed to help ascertain fish movement and spawning activity. Deadman's Rapids was a challenging spawning bed for visual observations due to the depth and velocity of the water. In addition, certain areas of the rapids have steep, bedrock cliffs for banks and EGBSC was unable to walk along these areas of the shoreline to look for Walleye or eggs (Figure 12).

Figure 12. Limited safe access to Deadman's Rapids

No fish were observed from shore during day visits. Four night surveys were carried out on April 23, 29, May 2, and May 5. Both Walleye and White Sucker were observed on April 29, May 2, and May 5, but in very low numbers. Again, this was likely due to a lack of visibility throughout most of the rapids as a result of depth and velocity.

Snorkel surveys were carried out on two occasions once velocities diminished to look for Redhorse Sucker species and Lake Sturgeon. Redhorse Sucker species were observed on May 24. No Redhorse Sucker were present during the May 30 snorkel survey. On May 30, Logperch, Rosyface Shiner, and one Smallmouth Bass were observed. No Lake Sturgeon were observed at any time. Table 1 lists the species seen on each date. All fish and egg observations are detailed in Appendix C.

Table 1. Fish observations during night and snorkel surveys

Date	Observation	Number
23-Apr	Nothing	0
29-Apr	Walleye	3
	White Sucker	3
02-May	White Sucker	1
	Walleye	1
05-May	White Sucker	20
	Walleye	2
	Muskellunge	1
	Bass	1
	Rock Bass	2

24-May	Redhorse Sucker	~12
30-May	Logperch	Many
	Smallmouth Bass	1
	Rosyface Shiner	Large school

Egg Deposition

EGBSC set egg mats at Deadman's Rapids to help assess the amount and location of egg deposition. Due to fast flows, depth, and difficulty with access, EGBSC was limited to setting two egg mats (Figures 13-15). Egg mats were only placed on a small 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, but it was not possible to identify the Sucker eggs to species level. Had Lake Sturgeon eggs been deposited, they would also have been distinguishable by size and colour.

Figure 13. Location of egg mats installed at Deadman's Rapids in 2016

Figure 14. Egg mat 1 at Deadman's Rapids installed on May 5, 2016

Figure 15. Egg mat 2 at Deadman's Rapids installed on May 5, 2016

Egg mats were installed on May 5 and checked on May 9. EGBSC counted 335 Walleye eggs on egg mat 1 and sixty-one (61) Walleye eggs on egg mat 2. Mats were reset on May 9 and checked again on May 12. EGBSC counted 112 Walleye eggs on egg mat 1 and fifty-one (51) eggs on egg mat 2. In total, egg mat 1 had 447 Walleye eggs, and egg mat 2 had a total of 112 Walleye eggs (559 eggs overall). Three Sucker eggs were counted on egg mat 1 on May 12.

On May 12, EGBSC discovered another area of Walleye egg deposition on the north shore. Eggs had been deposited in cracks along bedrock shelves near the bottom end of the rapids. As eggs are usually deposited in substrate sized from small cobble to small boulder, this was not a location where egg deposition would be expected. In years with lower Georgian Bay water levels, the area where the eggs were observed would be out of water. Figure 16 shows the shoreline where the eggs were observed, and Figure 17 shows a close-up of the egg deposition. As demonstrated in these figures, the eggs were collected in very shallow areas which make them prone to stranding.

Figure 16. Shoreline where egg deposition was observed on May 12, 2016

Figure 17. Close up of Walleye egg deposition observed on May 12, 2016

Figure 18 focuses on the area of Walleye egg deposition on the north shore. Based on aerial photos and orthomosaics, the area of egg deposition remained underwater throughout the monitoring period.

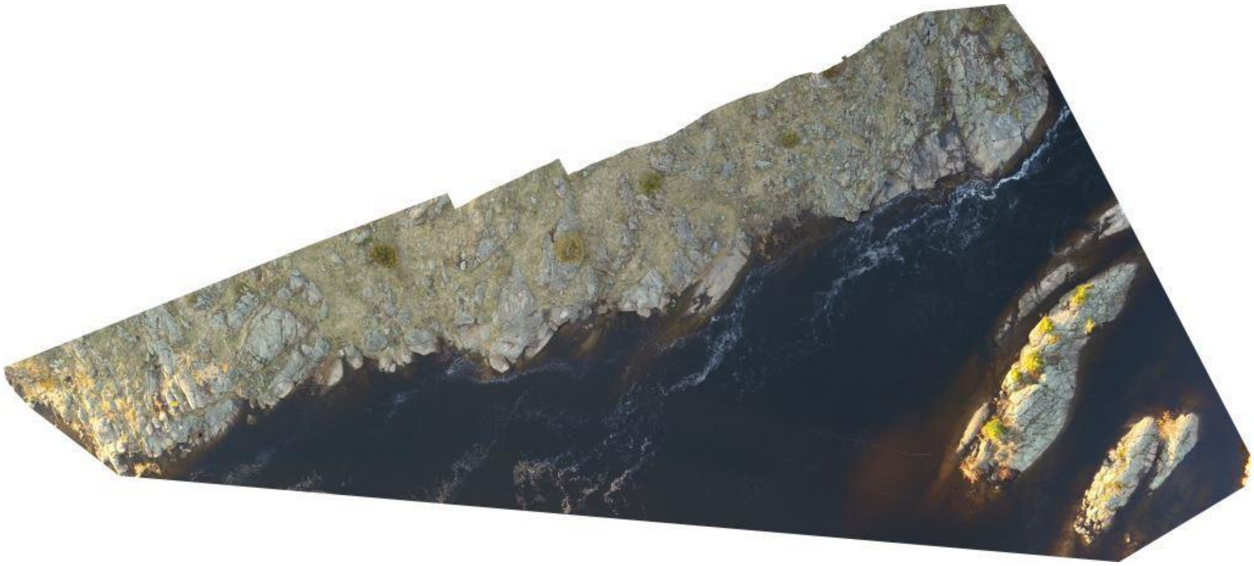


Figure 18. Orthomosaic showing the area of Walleye egg deposition on May 12, 2016

In 2016, egg mats were set at four other spawning areas, Shawanaga River, Sucker Creek, Shebeshekong River, and Seguin River. The highest total Walleye egg counts for those sites were 57,900, 248, twenty-eight (28), and 144, respectively. Although the number of Walleye eggs counted at Deadman's Rapids was the second highest of the five rivers, 559 Walleye eggs is considered a low amount. In 2016, the number of Sucker eggs counted at the Shawanaga River, Sucker Creek, Shebeshekong River, and Seguin River was 756, 208, thirty-four (34), and 185, respectively. Only three Sucker eggs were observed at Deadman's Rapids. As previously mentioned, the area where egg deposition could be assessed was extremely limited at Deadman's Rapids, and there could have been a much higher degree of egg deposition than what was counted. Additionally, there was nothing at Deadman's Rapids to prevent fish from passing by the rapids and swimming upstream to other spawning areas.

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 Deadman's Rapids, EGBSC conducted four plankton tows on May 30 using a 12" diameter, 153 micron plankton net. No plankton were visible in the samples collected. EGBSC sampled for plankton a second time on June 8 at five locations (Figure 19). Some plankton were visible in the samples.

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 four other rivers sampled in 2016. An example of a sample taken downstream of Deadman's Rapids is shown in Figure 20.

Figure 19. Magnetawan River plankton sampling locations in 2016

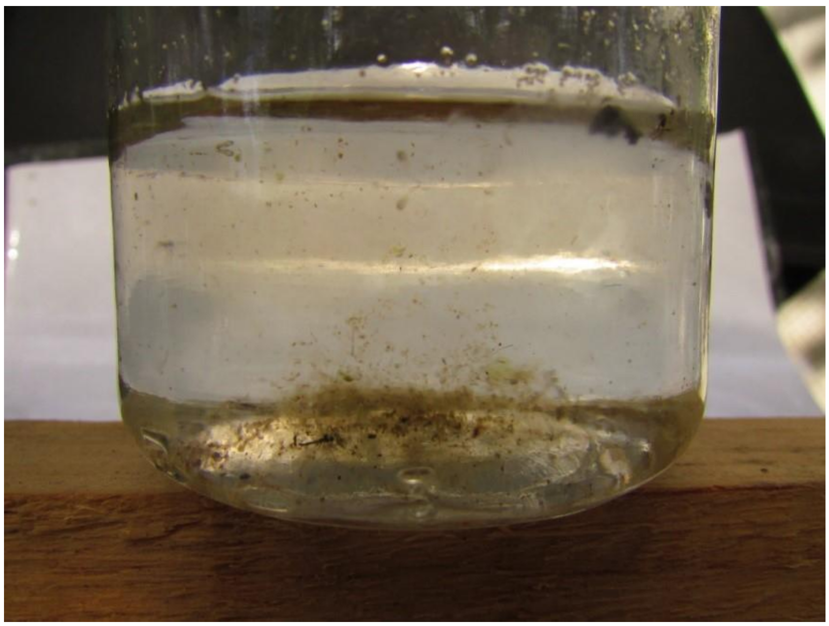


Figure 20. Magnetawan River plankton sample

Spawning Habitat

Because of the water depth at Deadman's Rapids, it was not possible to complete transects to record depth and substrate. Instead, EGBSC, UGLMU staff, and a volunteer completed snorkel surveys of the rapids on August 8 (Figure 21). A grid was used to help confirm substrate size where possible, and a GoPro camera was used to take photos of the habitat. Figure 22 shows where suitable spawning habitat (gravel, cobble, and boulder) are located within the rapids. Most of the habitat is located along the edges of the rapids, and in larger pockets on the south shore, where water velocity is slower.

Figure 21. Snorkel survey at Deadman's Rapids

Figure 22. Location and extent of suitable spawning substrate at Deadman's Rapids

Deadman's Rapids has an abundance of suitable spawning substrate. The range of substrate included coarse gravel, cobble (5 to 25 cm diameter), boulder (26 to 40 cm diameter), and large boulder (>40 cm diameter). 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). Substrate of these sizes was present at the site.

Much of the spawning substrate at Deadman's Rapids was in depths of two to over four metres during EGBSC's early August visit. During the spring freshet, some of these areas would be under another metre of water. Optimal depth for spawning Walleye ranges from 30 cm to 100 cm (Kerr et al., 1997). Optimal depth for Lake Sturgeon spawning ranges from 10 cm to 200 cm (Golder Associates Ltd., 2011). Based on the snorkel surveys, many areas of the habitat would exceed the optimal spawning depth for Walleye, and some areas would exceed the optimal spawning depth for Lake Sturgeon.

Reproductive success for Walleye, Lake Sturgeon, and White Sucker is optimized when water depth, flow, and appropriately sized substrate are present at the same location within a spawning area. Data collected at the site suggests that some spawning habitat within the optimal range was present for all three species along the rapids and that velocities were suitable for both fish passage and spawning. However, it is unknown what effect water depth would have on reproductive success. After looking through the aerial photography, velocity data, and depth data for Deadman's Rapids, Scott Finucan, Aquatic Ecosystem Science Specialist with MNRF suggested that Deadman's Rapids was a fairly typical bedrock channel that had high variation in flow volume and water levels. Because it is a highly scoured channel, he thought any type of restoration to support a larger spawning run would require major modifications to that channel (S. Finucan, personal communication, 2016).

Morphometry

The morphometry (shape) of a riverine spawning bed influences the success of spawning. Long, narrow spawning beds are considered a preferred shape. Fish that spawn in flowing conditions are generally broadcast spawners whose eggs are spread by water current and deposited downstream where obstacles (typically rocky substrate) and/or diminishing flow allow them to sink and settle into the cracks and crevices between rocks and boulders. The long, narrow shape of Deadman's Rapids provides good opportunity for eggs to be deposited; however, with high velocities and deep water, it is difficult to know how far eggs would be carried before settling into the substrate.

Additional Spawning Habitat Upstream

There are five additional sets of rapids upstream of Deadman's Rapids (Figure 5). Between August 8 and 10, EGBSC and staff from the UGLMU investigated upstream to record the locations, and take photographs of, the rapids and potential spawning habitat upstream. Spawning habitat was identified from shore making it difficult to assess habitat in areas with white water. Anecdotal information from two Magnetawan First Nation community members suggests that Walleye do not spawn at the Spud or Pine Rapids, but that spawning does take place at Two Foot Rapids. There is no other information that references Spud or Pine Rapids as spawning areas, but spawning at Two Foot Rapids has been documented in the past (McIntyre, 2011c). Kujala identified spawning habitat potential at the Four Foot and Fourteen Foot Rapids, but he stated that Walleye were unable to pass Two Foot Rapids and could not access Four Foot or Fourteen Foot Rapids (Kujala, 1987). An initial investigation of Two Foot Rapids by EGBSC in 2011 agreed with Kujala's perspective (McIntyre, 2011c).

Spud Rapids is the first set of rapids upstream of Deadman's Rapids, located approximately 950 m upstream. EGBSC visited Spud Rapids on August 10 and again on August 29 with Magnetawan First Nation staff and community member Richard Noganosh. Figure 23 shows Spud Rapids and suitable spawning substrate locations. Spud Rapids is a small set of rapids with little change in elevation; however, it is a location where the river narrows, which makes water velocity through this section much faster during the spring freshet. There is no documented spawning information for this site which suggests it is not a significant spawning area.

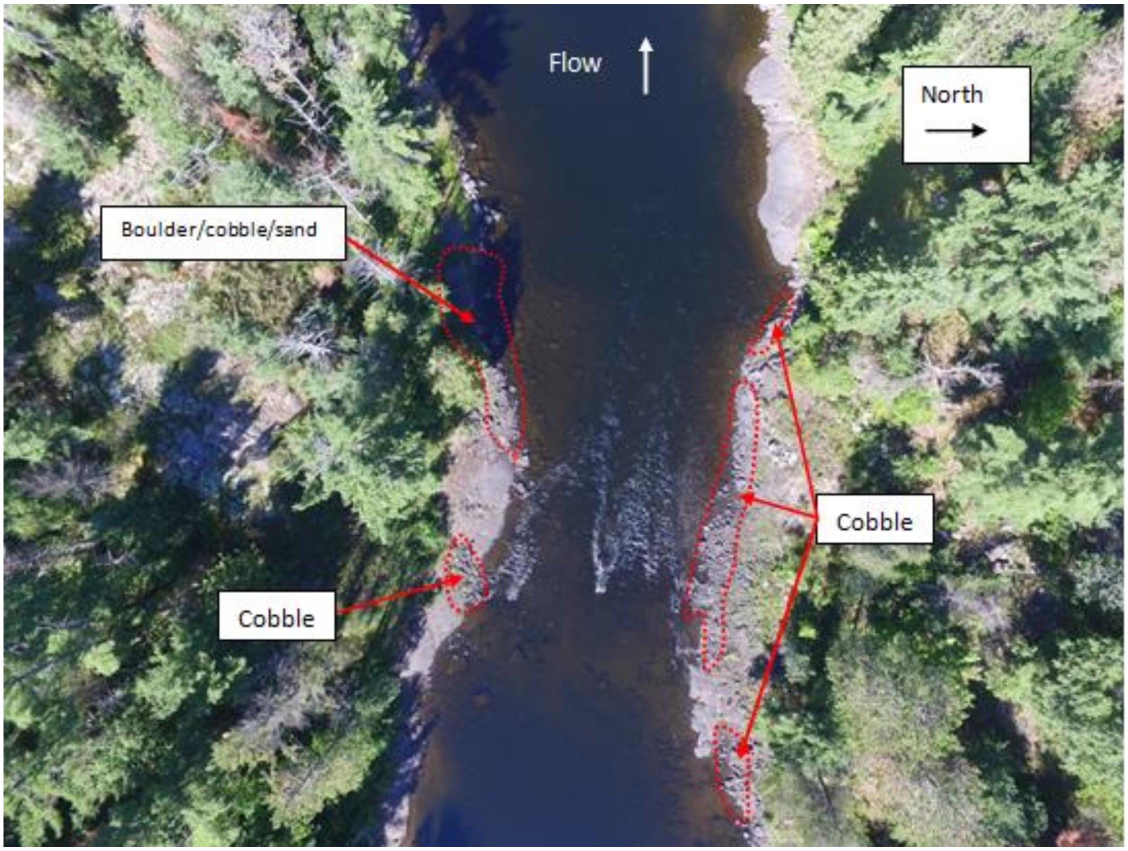


Figure 23. Suitable spawning substrate locations at Spud Rapids

Pine Rapids is located approximately 240 m upstream of Spud Rapids. Pine Rapids is larger than Spud Rapids, but also has a fairly small area of suitable spawning habitat, and some of that habitat is of poor quality. Habitat areas have been outlined in Figure 24. Alike Spud Rapids, there has been no documentation of spawning at Pine Rapids.

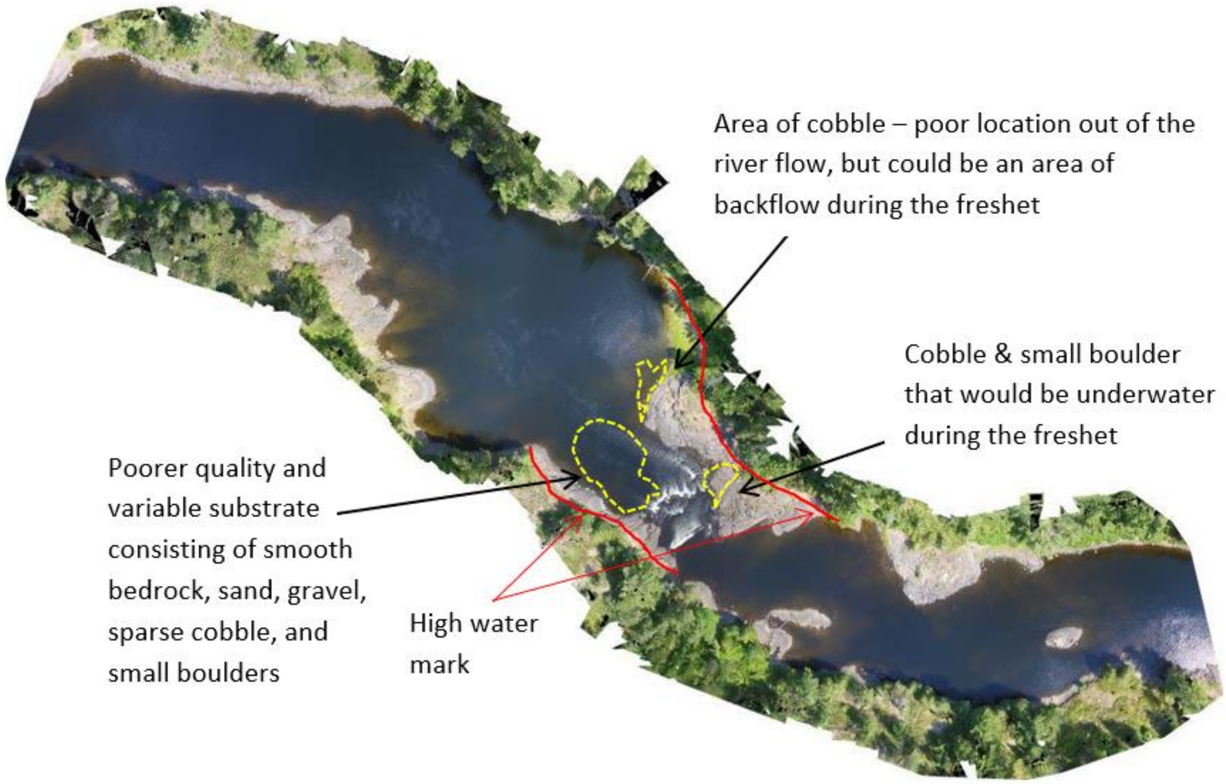


Figure 24. Description of habitat at Pine Rapids

Two Foot Rapids is located approximately 1.7 km upstream of Pine Rapids. Two Foot Rapids is gorge-like with steep shorelines (Figure 25). The high water mark extends almost to the tree line on the south shore. High quality spawning substrate (large gravel, cobble, and boulder) was present at the site in four different areas (Figure 26). EGBSC was unable to investigate the faster flowing areas of the rapids, and therefore, the area with suitable spawning habitat was likely underestimated. EGBSC's study in 2011 agreed with Kujala's report in stating that due to the site characteristics and higher flows that would be present during the spring freshet, it is likely that there would be little opportunity for Walleye to find areas of lower velocity to pass by this site. Because EGBSC could not investigate this site until after the spring freshet, it could not be confirmed that fish are, in fact, unable to migrate further upstream. In addition, the past reports from Kujala and EGBSC were focused on Walleye, and it is unknown as to whether this site would be a barrier to Sucker species or Lake Sturgeon, which can typically handle faster velocities than Walleye.

Figure 25. Two Foot Rapids looking downstream

Figure 26. Two Foot Rapids showing areas of high-quality spawning substrate in yellow

Four Foot Rapids is located approximately 1.2 km upstream of Two Foot Rapids. Figures 27 and 28 provide upstream and downstream views of the rapids and Figure 29 illustrates the variety of substrate at the site. Figure 30 shows the location and extent of spawning habitat at Four Foot Rapids.

Figure 27. Four Foot Rapids looking upstream

Figure 28. Four Foot Rapids looking downstream

Figure 29. Variety of spawning substrate at Four Foot Rapids

Figure 30. Location and extent of spawning habitat at Four Foot Rapids

Fourteen Foot Rapids is located approximately 790 m upstream of Four Foot Rapids. There is an island halfway between Four Foot and Fourteen Foot Rapids that also offers a small amount of spawning substrate (more available on the north side of the island than the south side) (Figure 31).

Figure 31. Island between Four and Fourteen Foot Rapids (south side shown on left, north side shown on right)

Fourteen Foot Rapids, as illustrated in Figures 32 and 33, presents a definite barrier to migration for Walleye, Sucker species, and Lake Sturgeon. Due to flow and white water, it was difficult to assess all potential areas for spawning habitat. Observations were limited to the littoral areas and the downstream end of the rapids (Figure 34).

Figure 32. Fourteen Foot Rapids looking upstream

Figure 33. Fourteen Foot Rapids looking downstream

Figure 34. Location and extent of spawning habitat at Fourteen Foot Rapids

As previously stated, the five sets of rapids upstream of Deadman's Rapids were not investigated during the spring freshet. Accordingly, it is not possible to confirm if Two Foot Rapids would present a barrier to Walleye, Lake Sturgeon, and Sucker species. However, there is spawning habitat present at Two Foot Rapids. Of the five rapids, Two Foot Rapids, Four Foot Rapids, and Fourteen Foot Rapids had the best quality habitat, but further investigation would be needed during the spring freshet to determine whether water level fluctuations would impact that habitat.

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 Deadman's Rapids 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 each spawning bed 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

While snorkelling, underwater videos were taken using a GoPro camera for 100 m approximately every 1 km. In total, EGBSC carried out ten (10) underwater surveys. Each survey location has been identified in Figure 35. Bathymetry maps are presented in Appendix D.

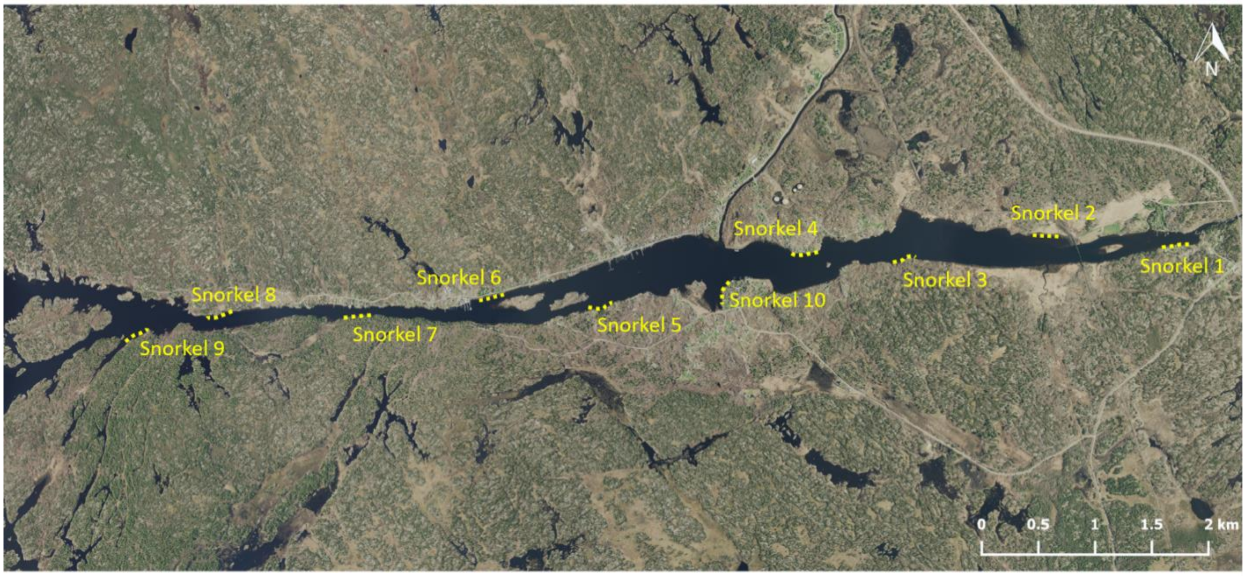


Figure 35. Underwater survey locations downstream of Deadman's Rapids

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 nine underwater surveys

Survey	Shoreline Substrate	Substrate	Woody Debris	Aquatic Vegetation
1	Soft	Soft, with gravel	Sparse	Moderate with patches of abundant
2	Soft with bedrock outcrop	Soft	Moderate	Abundant
3	Soft with bedrock outcrop	Bedrock with boulders, cobble and soft substrate	Sparse	Sparse for 1/3, moderate for 1/3 and abundant for 1/3
4	Bedrock with boulder	Soft with cobble	Sparse	Abundant
5	Soft with bedrock outcrop	Soft	Sparse	Abundant
6	Soft	Soft	None	Abundant for 2/3, moderate for 1/3with patches of moderate
7	Bedrock with boulder	Bedrock with boulders, cobble and soft substrate	Sparse	Abundant vegetation, changing to moderate and then sparse

Survey	Shoreline Substrate	Substrate	Woody Debris	Aquatic Vegetation
8	Bedrock with sand	Soft	None	Abundant
9	Bedrock	Soft	Sparse	Sparse vegetation in beginning with patches of abundant veg (varies with shade)- White Water Lily, Yellow Water Lily, Tapegrass, two Potamogeton spp., Richardson's Pondweed, abundant algae
10	Soft	Soft	Sparse	Abundant

The following list of aquatic vegetation (submergent, emergent, and floating) was recorded from the 10 surveys: Common Cattail, Bulrush spp., Tapegrass, Canada Waterweed, Potamogeton spp., Richardson's Pondweed, Yellow Water Lily, White Water Lily, Pickerelweed, Freshwater Sponge, agae, Coontail, Pipewort, Sedge spp., and *Phragmites australis.* Tapegrass and White Water Lily were the most dominant species, present in all ten (10) surveys. Potamogeton species were also abundant, present in all but one survey. Algae was noted in six of ten (10) surveys.

Shoreline Characteristics

Along each of the underwater surveys, shoreline characteristics were also recorded and photographed. The shoreline along Magnetawan River, downstream of Deadman's Rapids to the outlet, is roughly 62% natural and 38% altered (Figure 36). The town of Britt is located along the north shore, and Magnetawan First Nation is located along the south shore, immediately adjacent to Deadman's Rapids. The remaining shoreline on the south shore is a mix of private property and conservation reserve. There are significant patches of wetland areas along the shore, interspersed with patches of bedrock outcrops and forest.

Of the ten (10) surveys that were completed, six had some type of alteration, some of which were minor. Types of alterations identified were mown grass (six surveys), buildings (four surveys), retaining walls (two surveys), artificial or cleared beach (one survey), road (two surveys), and docks (five surveys). Business development along the river includes one marina, two cottage resorts, and a restaurant/general store. Types of natural shoreline that were observed were wetland (two surveys), forest with a wetland fringe (four surveys), forest (two surveys), and bedrock with patchy vegetation (seven surveys). It is important to note that some surveys had more than one type of natural vegetation and more than one type of alteration. Photos from each survey can be found in Appendix E.

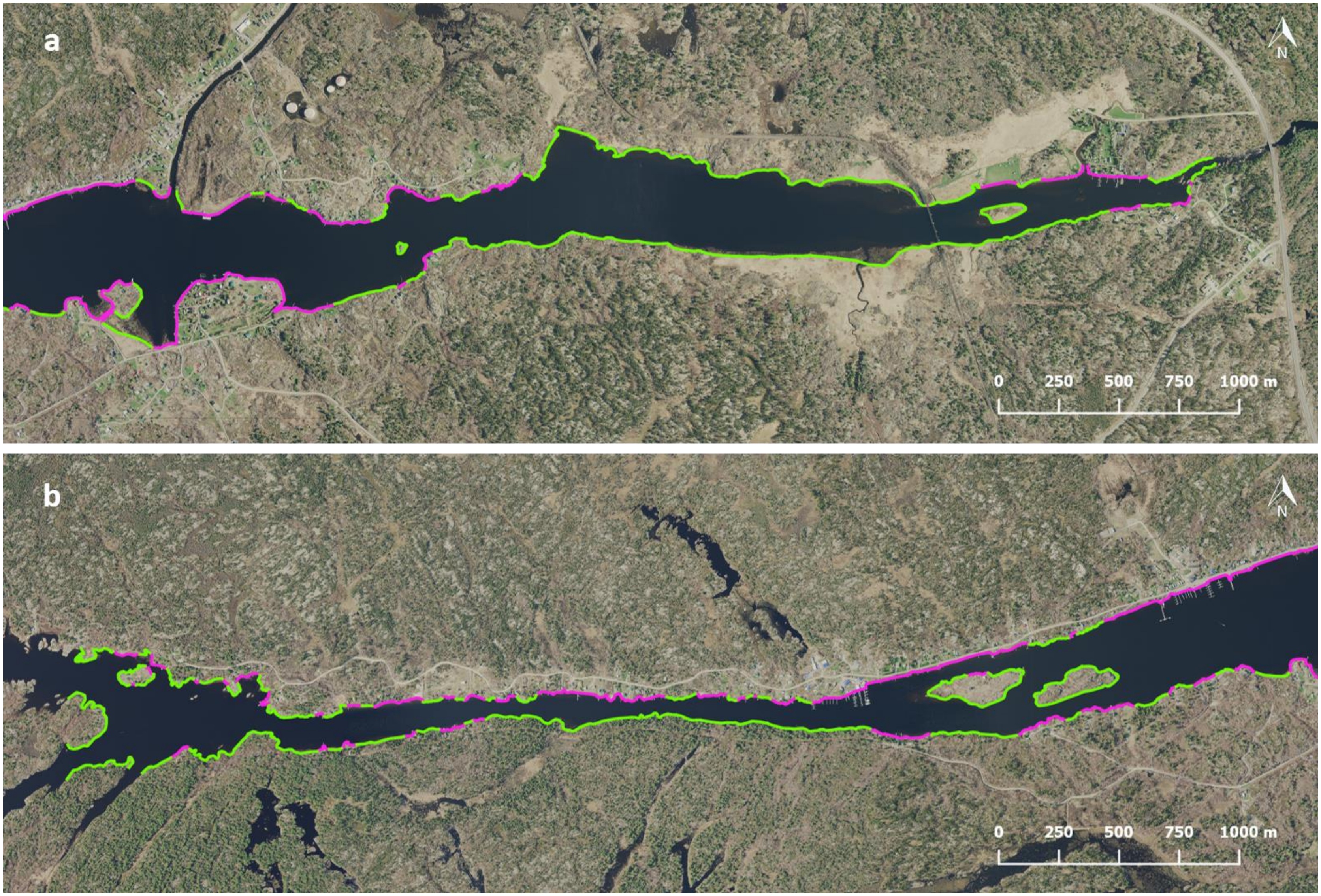


Figure 36. Natural and altered shoreline downstream of Deadman's Rapids (a. Deadman's Rapids downstream to Britt, b. Britt downstream to the outlet)

Shoreline substrate was also recorded and photographed for each of the surveys. Only the shoreline substrate that was visible was recorded. Four of the ten surveys had a bedrock shoreline, three of the surveys had a low sloped shoreline with softer substrate, and three of the surveys had a mix of soft substrate with bedrock outcrops. Table 4 lists the shoreline characteristics of each survey.

Table 4. Shoreline characteristics along underwater survey routes

Survey	Shoreline Characteristics
1	Sloped bedrock, gentle at the beginning and gradually becoming steeper
2	Bedrock steeply sloping into the water, with boulders at the water's edge
3	Low sloping bedrock shoreline
4	Bedrock shoreline with broken boulders into water
5	Bedrock shoreline with sparse vegetation
6	Low sloped shoreline
7	Low sloped shoreline
8	Rocky shore with bedrock outcrops, mainly bedrock and boulder
9	Steep bedrock slope at the beginning, becoming more gradual farther along
10	Low sloped shoreline with soft substrate and small boulders on immediate shoreline behind vegetation

In addition to substrate, shoreline vegetation that could be identified was recorded for each survey. Sweet Gale, Meadowsweet, Alder spp., and Ground Juniper were recorded for multiple surveys, as were trees such as White Pine, White Birch, White Cedar, and Jack Pine. The following list of species was identified from the surveys:

- Canada Bluejoint Grass
- Meadowsweet
- Alder spp.
- Poplar
- White Birch
- Red Oak
- White Cedar
- White Pine
- Common Juniper
- Grass spp.
- Trembling Aspen
- Willow spp.
- Staghorn Sumac
- Goldenrod spp.
- Blue Vervain
- Spruce
- Jack Pine
- Sweet Gale
- Common Mullein

A potential patch of invasive *Phragmites australis* was observed in survey 3. No other invasive species were observed.

Discussion and Recommendations

Water chemistry measurements that were monitored (water temperature, dissolved oxygen, pH, and conductivity) were all normal and typical of what one would expect from a Canadian Shield watershed. There was no indication of water quality having any adverse effects on fish spawning or egg incubation.

Certain areas of Deadman’s Rapids experience dramatic changes in water levels over the spawning and egg incubation period but the actual spawning habitat was unaffected by water level fluctuations. No eggs were observed stranded. However, this situation may vary annually, as the eggs that were observed were quite close to shore.

Based on visual observations, egg deposition on egg mats, and snorkel surveys, the number of spawning Walleye, White Sucker, and Redhorse Sucker species appeared to be very low at Deadman’s Rapids in 2016. There were no observations of Lake Sturgeon. Limited observations could be reflective of small spawning populations of these species, or possibly, due to fish moving farther upstream to spawn and going undetected. Given poor visibility and a lack of accessible observation points along Deadman’s Rapids, fish could have moved upstream without being observed. However, members of Magnetawan First Nation also indicated the number of fish at upstream spawning sites was low in 2016. Although the 2016 study cannot definitively conclude that the spawning populations of these species are low, there is a considerable amount of background information that has reported similar findings. In addition to seeing a low number of fish and a small amount of egg deposition, there was also very low plankton abundance in the samples collected, a crucial food source for larval Walleye.

While there was a good amount of spawning habitat documented at Deadman’s Rapids, the depth of that habitat in many places is greater than the “ideal” depth for Walleye, and in some cases, Lake Sturgeon. Spawning fish are able to pass by Deadman’s Rapids and move upstream to good quality spawning habitat available at Two Foot Rapids. However, there may be more issues with water level fluctuations at Two Foot Rapids, based on Kujala’s 1987 report.

EGBSC recommends assessing the rapids upstream of Deadman’s Rapids using the same methods employed in the 2016 assessment. Specifically, EGBSC recommends completing focused studies of the Spud, Pine, Two Foot, Four Foot, and Fourteen Foot Rapids. Due to site access, this would require a field team to focus on two or three sites in one year, and stay at the sites to collect frequent data, including flow and depth measurements, frequent aerial photographs, egg mats to assess egg deposition, and potential snorkel surveys, once flows diminish. Studying the upstream rapids would help confirm if any of the species in question can swim farther upstream than Two Foot Rapids, document water level and flow changes to help ascertain areas that may be prone to egg stranding, and help confirm the species that may be moving upstream to spawn, including Lake Sturgeon.

After completing habitat assessments upstream, it would be advantageous to host a meeting with staff from Magnetawan First Nation, A/OFRC, EGBSC, and MNRF to discuss potential issues and opportunities for improving the spawning population of Walleye, Lake Sturgeon, and Sucker species in the Magnetawan River.

Other recommendations for future research stemming from the 2016 assessment include:

- Gain a better understanding of where Redhorse Sucker species spawn.
- Gain a better understanding of whether Lake Sturgeon are spawning upstream and investigate the potential for restoration or the possibility of stocking. The collection of depth and flow data would help to figure out if water level fluctuations upstream would be a limiting factor for successful Lake Sturgeon reproduction.
- Investigate the patch of potential *Phragmites australis* identified during the bathymetry data collection, and if confirmed, organize a cut and removal day.
- Conduct further, detailed analysis of the side scan sonar data to supplement the observations from underwater surveys.

EGBSC also recommends undertaking efforts to improve education on shoreline naturalization and planting native species in the areas of greatest shoreline alteration between Deadman's Rapids and the outlet of the river into Georgian Bay.

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- Karl Schiefer – Aquatic Biologist consultant and EGBSC member
- David Bywater – Environmental Scientist, Georgian Bay Biosphere Reserve
- David Sweetnam – Executive Director, Georgian Bay Forever

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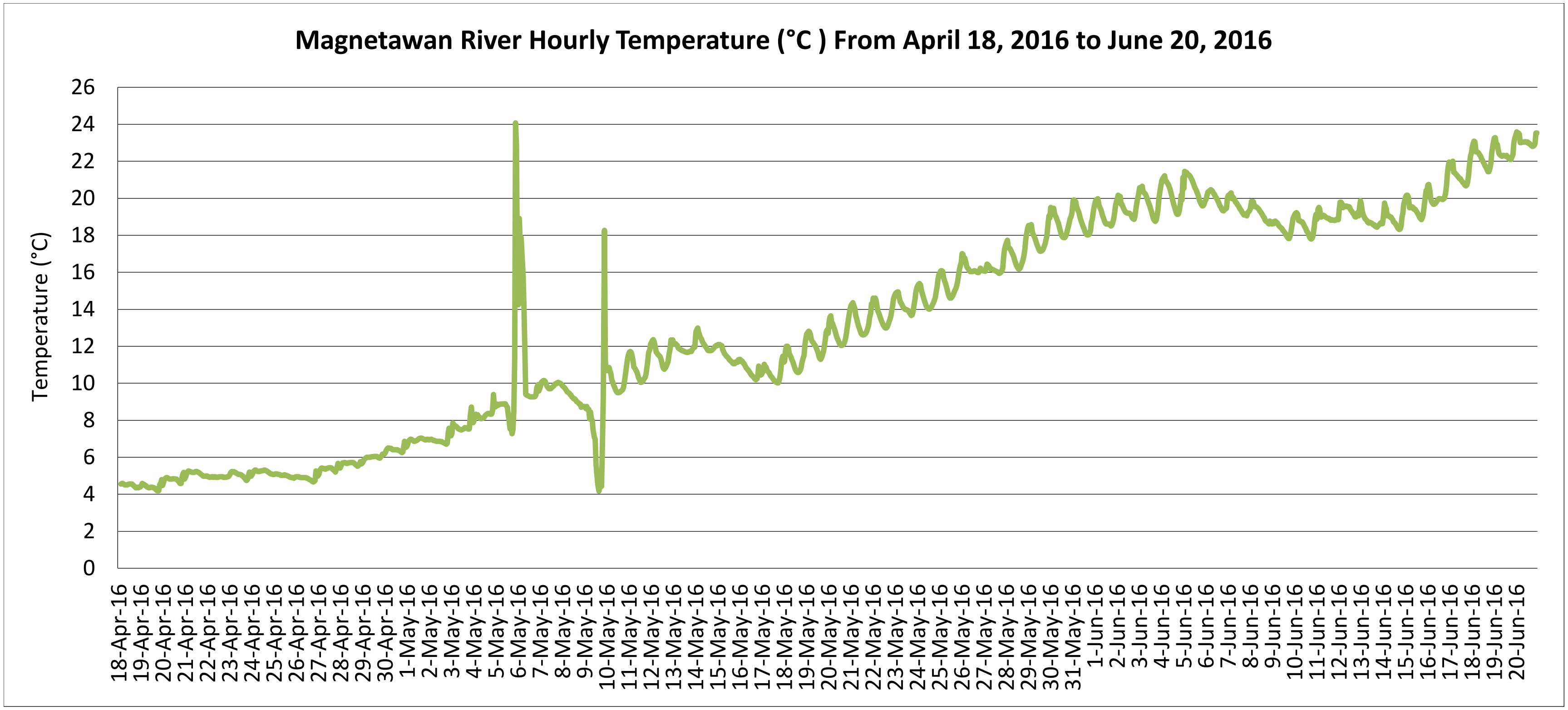
Appendix A – Water Chemistry

Date	Time	Temperature (°C)	DO (mg/L)	DO (%)	pH	Conductivity
17-Apr	12:45	4.1	14.4	110.4	6.68	37.1
21-Apr	11:50	4.8	14.0	108.6	6.98	35.7
24-Apr	18:20	4.9	13.2	103.2	7.07	35.8
29-Apr	19:40	6.3	13.1	105.7	6.79	35.9
02-May	19:20	7.5	12.0	100.1	6.86	36.2
05-May	19:45	9.4	11.3	99.3	6.96	36.9
09-May	11:15	9.4	12.0	100.1	6.64	36.4
12-May	10:00	11.2	11.4	104.1	6.64	36.3
16-May	15:45	10.4	10.7	96.0	6.87	35.3
20-May	10:55	12.7	9.9	94.3	6.77	35.6
24-May	13:15	15	9.6	95.3	7.04	34.9
08-Jun	14:00	18.3	n/a	n/a	n/a	n/a


Magnetawan River Hourly Temperature (°C) From April 18, 2016 to June 20, 2016
Temperature (°C)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
18-Apr-16
19-Apr-16
20-Apr-16
21-Apr-16
22-Apr-16
23-Apr-16
24-Apr-16
25-Apr-16
26-Apr-16
27-Apr-16
28-Apr-16
29-Apr-16
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1-May-16
2-May-16
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25-May-16
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27-May-16
28-May-16
29-May-16
30-May-16
31-May-16
1-Jun-16
2-Jun-16
3-Jun-16
4-Jun-16
5-Jun-16
6-Jun-16
7-Jun-16
8-Jun-16
9-Jun-16
10-Jun-16
11-Jun-16
12-Jun-16
13-Jun-16
14-Jun-16
15-Jun-16
16-Jun-16
17-Jun-16
18-Jun-16
19-Jun-16
20-Jun-16

Appendix B – Water Level and Velocity

Benchmark	Date	Depth (cm)
1	21-Apr	75.4
1	24-Apr	70.5
1	29-Apr	75.5
1	02-May	100
1	05-May	125
1	09-May	155
1	12-May	170.5
1	16-May	
1	20-May	174
1	24-May	175
1	30-May	175
1	08-Jun	188
2	21-Apr	34
2	24-Apr	30
2	29-Apr	34
2	02-May	49.5
2	05-May	71
2	09-May	86
2	12-May	78
2	16-May	
2	20-May	84.5
2	24-May	85.5
2	30-May	81.5
2	08-Jun	80
4	21-Apr	17.5
4	24-Apr	16
4	29-Apr	16
4	02-May	16.4
4	05-May	24.5
4	09-May	36
4	12-May	28.5
4	16-May	29
4	20-May	26
4	24-May	27
4	30-May	21
4	08-Jun	16.5
6a	21-Apr	15.5
6a	24-Apr	5
6a	29-Apr	11.4
6a	02-May	36
6a	05-May	60
6a	09-May	93
6a	12-May	110
6a	16-May	
6a	20-May	112
6a	24-May	108

6a	30-May	118
6a	08-Jun	132
7	21-Apr	25
7	24-Apr	20.5
7	29-Apr	21
7	02-May	25
7	05-May	30
7	09-May	36
7	12-May	44.5
7	16-May	40.5
7	20-May	35
7	24-May	32.5
7	30-May	25.5
7	08-Jun	27
8	21-Apr	35
8	24-Apr	32
8	29-Apr	27.6
8	02-May	35
8	05-May	36
8	09-May	37
8	12-May	47
8	16-May	36
8	20-May	39
8	24-May	39
8	30-May	28
8	08-Jun	27
9	21-Apr	25
9	24-Apr	21.7
9	29-Apr	10
9	02-May	13.5
9	05-May	8
9	09-May	8.5
9	12-May	19
9	16-May	6
9	20-May	10
9	24-May	7.5
9	30-May	
9	08-Jun	

Date	Velocity (m/s)								
	Station 1	Station 3	Station 4	Station 5	Station 6a	Station 6b	Station 7	Station 8	Station 9
21-Apr	0.43	1.05	0.07	1.65	1.58		0.93	0.25	0.77
24-Apr	0.21	0.85	0.06	1.95	1.43		0.78	0.4	0.7
29-Apr	0.3	0.44	-0.01	1.71	1.39		0.84	0.25	0.78
02-May	0.28		-0.02	1.45	1.15		0.65	0.24	0.56
05-May	0.16	0.54	0.03	1.21	0.84		0.47	0.34	0.47
09-May	0.05	0.87	0.03	0.81		0.15	0.42	0.19	0.3
12-May	-0.01	0.59	0.02	0.69		0.06	0.53	0.23	0.2
16-May	-0.02	0.52	0	0.58		0.01		0.24	0.17
20-May	0.01	0.61	0	0.57		-0.1	0.29	0.05	0.17
24-May	0.02	0.53	-0.01	0.7		-0.04	0.32	0.23	0.12
30-May	-0.01	0.43	0.03	0.43		-0.13	0.29	0.2	0.11
08-Jun	-0.03	0.24	-0.01	0.27		-0.03	-0.05	-0.02	0.05

Appendix C – Visual Observations

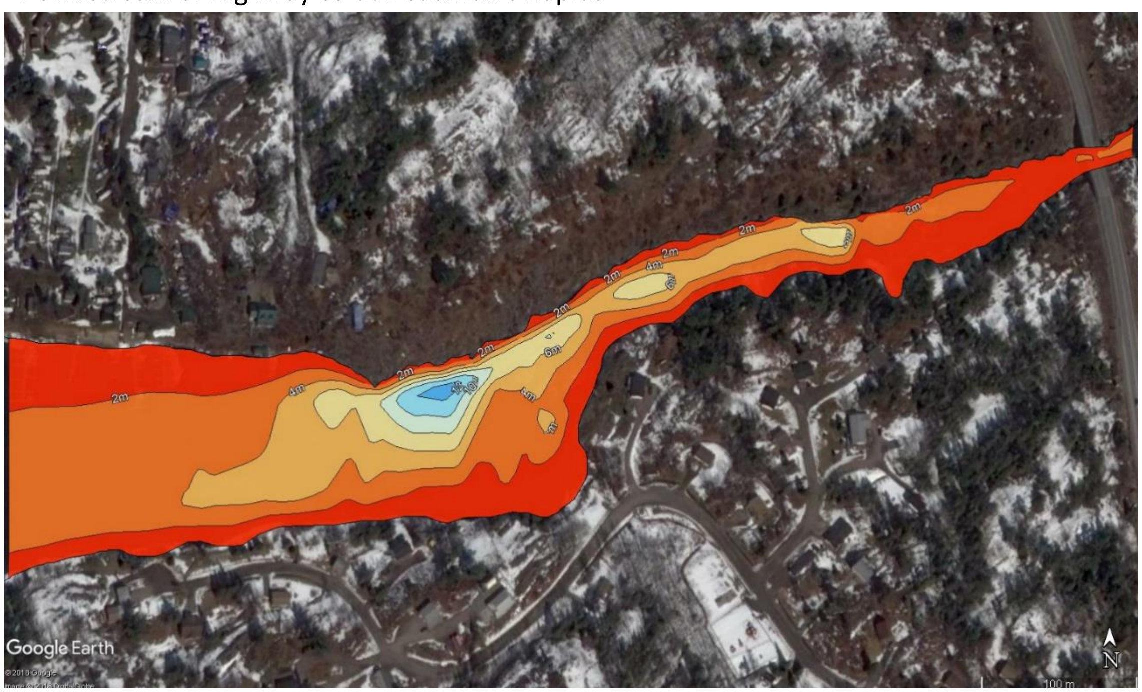
Date	Observation	Number	Location
23-Apr	nothing		
29-Apr	Walleye	3	2 on north shore (across from Dave's boat), 1 speared on south shore
	Common White Sucker	3	North shore - 2 us and 1 ds of Bench 7 (immediate vicinity)
02-May	Common White Sucker	1	Around Bench 1 and inlet (us of inlet)
	Walleye	1	North shore - across from Dave's boat
05-May	Common White Sucker	20	Inlet after 1st pine and before major inlet
	Walleye	2	1 US from Dave's boat
	Muskellunge	1	Immediately US from Dave's boat - good size
	Bass	1	Inlet after 1st pine and before major inlet
	Rock Bass	2	Same as above
24-May	Redhorse Sucker	~12	DS of Bench 1
30-May	Logperch	Lots	
	Smallmouth Bass	1	
	Rosyface Shiner	Large school	

Egg Mat	Date Set	Date Counted	Sucker Eggs	Walleye Eggs	Notes
1	05-May	09-May	0	335	reset in same location
2	05-May	09-May	0	61	reset in same location
1	09-May	12-May	3	112	large stoneflies on mats
2	09-May	12-May	0	51	mats much cleaner in comparison with other rivers (easier to see eggs and count)
		TOTAL	**3**	**559**	

Appendix D – Bathymetry Maps

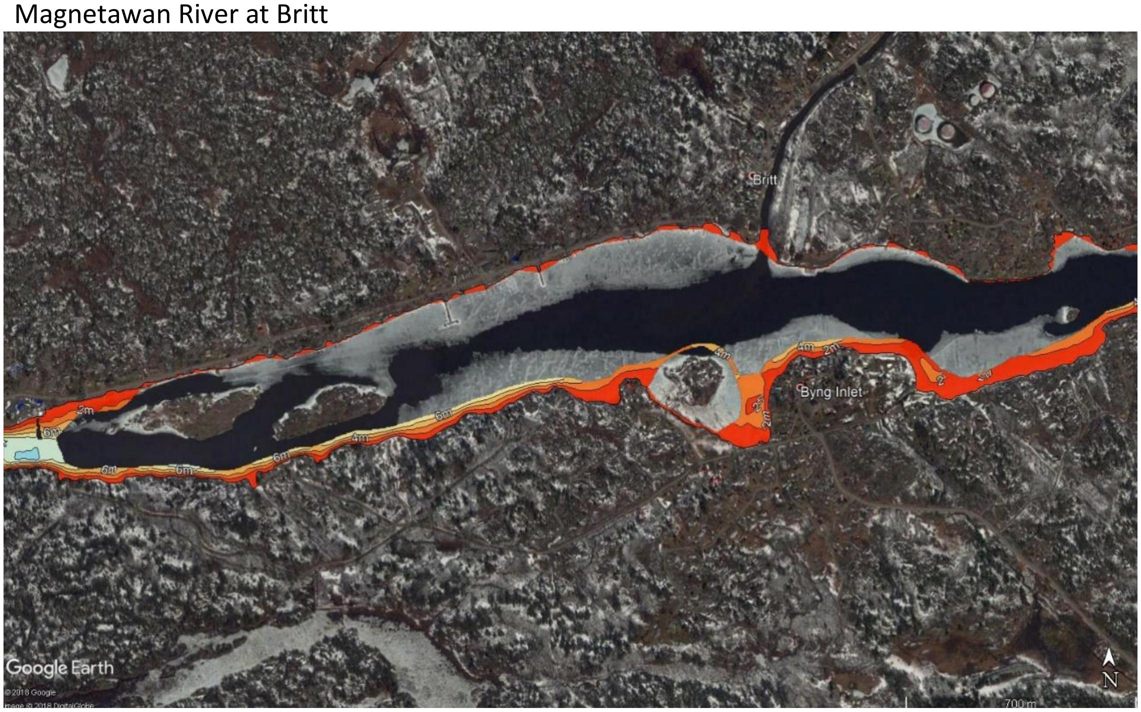
Upstream of Highway 69 and Deadman's Rapids

Downstream of Highway 69 at Deadman's Rapids

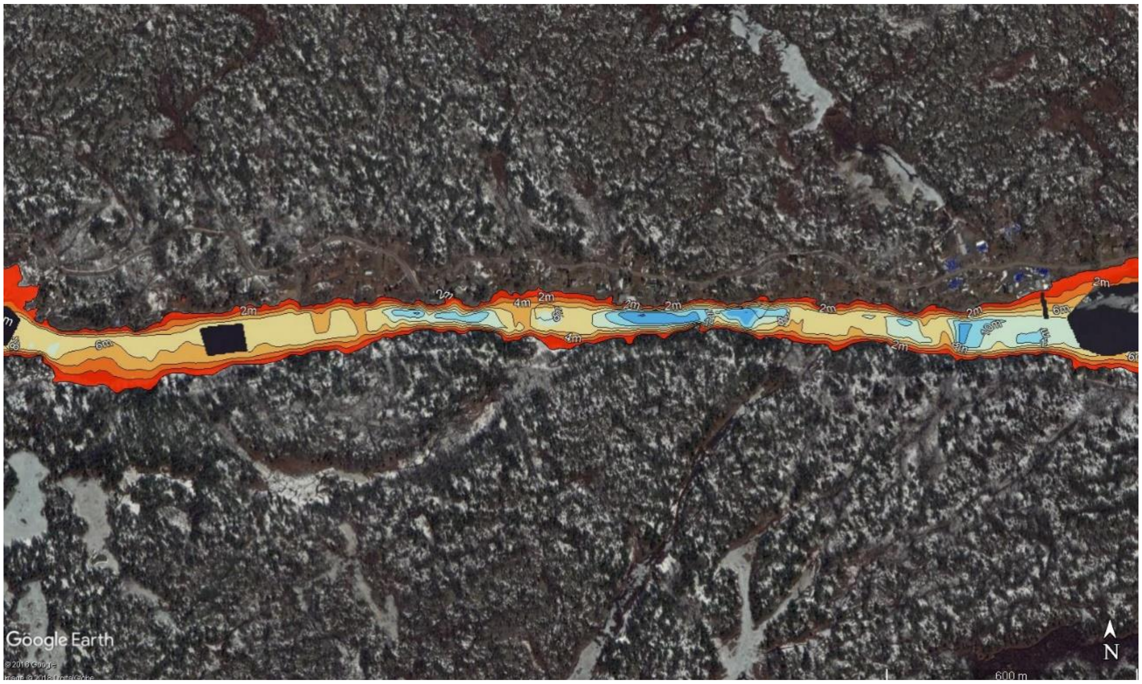


Downstream of Deadman's Rapids

Magnetawan River at Britt



Magnetawan River downstream of Britt



Appendix E – 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