# Shebeshekong 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 Shebeshekong 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 Shebeshekong River has never been identified as a Lake Sturgeon spawning river.

During the 2016 spawning season, EGBSC visited Dillon Rapids (the first set of rapids upstream) sixteen (16) times between April 15 and June 8. Young's Rapids (the second set of rapids upstream) was visited four times, and an unnamed set of rapids (referred to as Lockett Lake Rapids) upstream of Young's was visited once. Basic water chemistry measurements (water temperature, dissolved oxygen, pH, conductivity) were recorded on twelve (12) site visits at Dillon Rapids and were within the expected range. In 2017, Dillon and Young's Rapids were visited seventeen (17) times, and Lockett Lake Rapids was visited three times.

The Shebeshekong River drains a small watershed. Consequently, water velocity and water levels diminish quickly. Five stations were set up at Dillon Rapids to measure water velocity and water level fluctuations in 2016. Based on depth measurements, aerial photograph comparison, and physical characteristics of Dillon Rapids, it was apparent that there were large fluctuations in water level and velocity, and a large portion of the east side of the rapids went dry by May 12, 2016. Water levels dropped by 32.5 - 51.5 cm at three of the five stations. Two of the water velocity measurement locations went dry. Velocity measurements were repeated at the same stations at Dillon Rapids in 2017. At Young's Rapids, velocity measurements were taken twice in 2016, and four times in 2017.

In 2016, only twenty-eight (28) Walleye eggs and thirty-four (34) Sucker eggs were counted on the egg mats at Dillon Rapids (three of the four mats were removed by unknown individuals). In 2017, egg mats were set at Dillon, Young's, and Lockett Lake Rapids, and no eggs were deposited on any of the mats. Egg deposition was observed along the south shore and at the base of Dillon Rapids in 2016 and 2017. In 2016, most of the eggs that were observed were stranded out of water once water levels dropped. In 2017, there was less egg stranding due to higher water levels, but stranding was observed again along the south shore. Visual observations were done sixteen (16) times (day and night) at Dillon in 2016. At most, eleven (11) Walleye were observed in one night in 2016, of which ten (10) were harvested. At Dillon in 2017, the most Walleye observed in one night was eight. At Young's Rapids, approximately 100 White Sucker were observed in one evening, and in 2017, White Sucker were observed again, but in much smaller numbers.

| Site | Egg Mat Totals | | Egg Stranding Observed | | Visual Observations | |
|---|---|---|---|---|---|---|
| | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 |
| Dillon Rapids | 28 Walleye<br>34 Sucker | No eggs | Yes | Yes – less than 2016 | Most Walleye observed in one night – 11 | Most Walleye observed in one night – 8 |
| Young's Rapids | No egg mats set | No eggs | None observed | None observed | ~100 White Sucker in one evening | Fewer White Sucker than in 2016 |
| Lockett Lake Rapids | No egg mats set | No eggs | None observed | None observed | No night surveys | No night surveys |

Four plankton samples were taken and visually compared to samples collected from the other tributaries being assessed in 2016 – Magnetawan River, Shawanaga River, Seguin River, and Sucker Creek. Plankton density at the Shebeshekong River was considered moderate relative to the other tributaries.

Data collected suggests that there is limited ideal spawning habitat at Dillon and Young's Rapids. Furthermore, some of the areas that were identified as having both ideal depth and substrate are likely areas where eggs would be left stranded as water levels drop throughout the egg incubation period. Based on observations, Lockett Lake Rapids was considered to have more favourable spawning habitat for Walleye and Sucker species.

Surveys were conducted to assess nursery, rearing, and foraging habitat available downstream of Young's and Dillon Rapids. Bathymetry and side scan sonar data were collected downstream of the spawning bed. The shoreline is entirely natural from Lockett Lake Rapids to Young's Rapids, almost completely natural from Young's Rapids to Dillon Rapids, and mainly natural with some areas of alteration from Dillon Rapids to the outlet.

Underwater surveys were taken for 100 m, spaced approximately 1 km apart from below Young's Rapids to the outlet. Based on these surveys, there appeared to be mainly soft substrate in the nearshore area with some sections also having small boulders, cobble, and/or gravel. Density of aquatic vegetation ranged from sparse to abundant with most surveys having moderate or abundant vegetation. One third of the surveys had a moderate amount of wood structure while the rest had none or only sparse wood structure.

Historical information from surrounding landowners and from First Nation community members was invaluable to understanding the changes that had occurred in the river due to historical activities. Rock had been blasted out of both Dillon and Young's Rapids for driving logs, which dramatically changed the way water moved into, and within, the sites. Road development at Dillon Rapids directly impacted the east side of the rapids, which was the area that fish used to use to navigate past Dillon Rapids. Historically, Walleye would swim past Dillon and Young's Rapids, up to Lockett Lake Rapids and beyond where there is much better spawning habitat that is less vulnerable to water level fluctuations. Based on anecdotal information and two years of data collection and observation, EGBSC concluded that there was a critically low number of Walleye moving into Dillon Rapids from Georgian Bay to spawn, very little successful reproduction occurring due to site stressors, and that restoration was needed at both Dillon and Young's Rapids to restore access to historical spawning areas.

Based on a more detailed site assessment of Dillon and Young's Rapids completed by Biotactic Inc. in 2017, Biotactic drafted a restoration design for Dillon and Young's Rapids to improve fish passage. In fall 2017, EGBSC completed the restoration work, with Biotactic on-site to guide the efforts. Post-restoration monitoring began in spring 2018 and will continue for multiple years to determine the success and functionality of the restoration work, and assess whether future modifications are needed.

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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
- Opportunities 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 Shebeshekong River is located northwest of Parry Sound, in Carling Township, Parry Sound District (Figure 1). The river and its watershed are situated in the ancestral and traditional territory of the Anishinabek people.

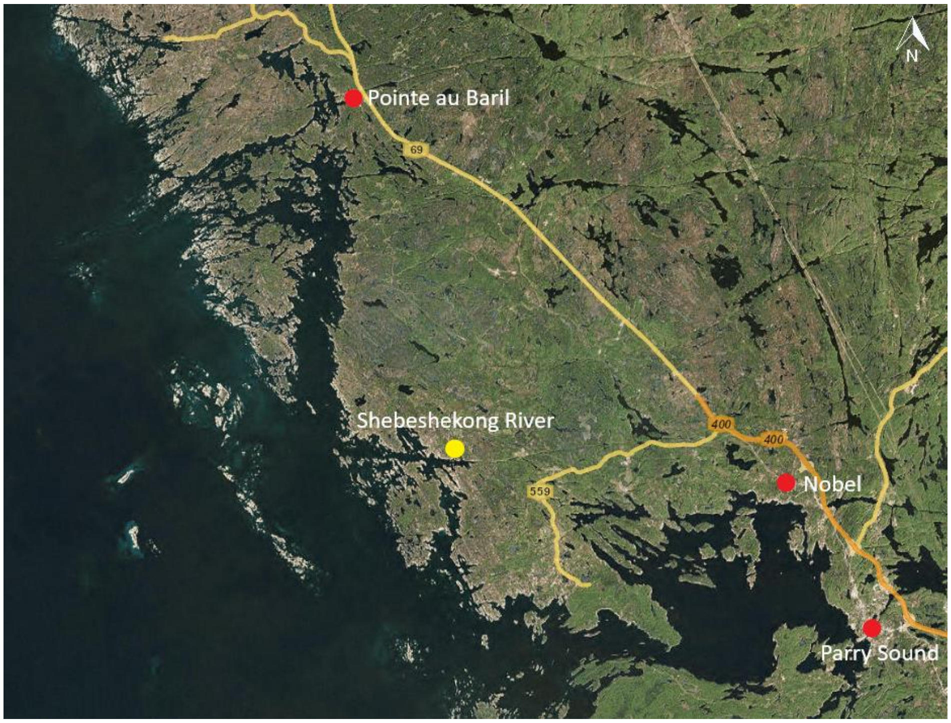



**Figure 1.** Location of Shebeshekong River outlet in relation to the nearest towns

The Shebeshekong River watershed is a small watershed draining an area of 194 $km^2$ (Figure 2). The headwaters start at Shebeshekong Lake and the river meanders approximately 15 km before reaching Georgian Bay. There are no water control structures on the river.

Many landowners in Dillon, and community members from Wasauksing First Nation and Shawanaga First Nation, shared information with EGBSC on changes to the Shebeshekong River and its fish populations over time. Based on this information, Walleye and Sucker species moving into Shebeshekong River from Georgian Bay would historically swim past two sets of rapids (Dillon and Young's) to spawn at higher quality rapids farther upstream. Figure 3 shows the location of each set of rapids. Dillon Rapids is located 1.8 km upstream of Georgian Bay, Young's Rapids is located 1.5 km upstream of Dillon Rapids, and an unnamed set of rapids (referred to as Lockett Lake Rapids for this project) is located 1.5 km upstream of Young's Rapids (Figure 4).


Watershed, Quaternary [computer file]. Peterborough, ON: Ontario Ministry of Natural Resources, 2012. Available: Scholars GeoPortal http://geo2.scholarsportal.info/ (February 6, 2017).

**Figure 2.** Shebeshekong River watershed


**Figure 3.** Locations of Dillon, Young’s, and Lockett Lake Rapids

**Figure 4.** Historical spawning area referred to as Lockett Lake Rapids

Historical changes from the logging industry (prior to 1920) to both Young's and Dillon Rapids have made it difficult for Walleye to navigate and swim past each site. At Dillon Rapids, an area of bedrock on the west side of the rapids was blasted and removed to help facilitate driving logs downstream. In more recent history, when the old iron bridge that used to cross Dillon Rapids was replaced, the new bridge cut off a portion of the rapids on the east side, which is the side fish used to use to swim up Dillon Rapids (Figure 5). Both modifications have greatly reduced the size of the rapids and have changed the hydrology at the site, resulting in more flow being directed on the west side of the rapids, where there is a steeper gradient for fish to attempt to navigate. The east side is now much shallower and depth is not always sufficient for passage.

It is reported that the spawning Walleye population in the Shebeshekong River was "flourishing" during the late 1800s and early 1900s (MNR, 1991b). However, Ministry of Natural Resources (MNR) news releases document changes from the logging industry and bridge development, and cite a dwindling Walleye population (MNR, 1991a). There have been past attempts to restore the spawning population through stocking and habitat restoration. A news release from March 1991 refers to completing spawning bed restoration work at Dillon Rapids in 1989, and stocking efforts by the local Community Fisheries Involvement Program (CFIP) group starting in 1987 (MNR, 1991a). The purpose of the news release was to notify the public of a Walleye closure all year, in order to help the population rebuild (MNR, 1991a). A July news release that same year states that over 42,000 Walleye fingerlings had been planted at Dillon. It also notes that "a few male Walleye" were observed on the enhanced habitat in 1990. A short MNR record refers to additional spawning habitat restoration work in 1993 (Thurston, 1993).

There is no written documentation on the project, but EGBSC was informed that the MNR attempted to create a channel within Dillon Rapids to help get Walleye upstream. They used a substance called Dexpan which is a non-explosive demolition agent which cracks the bedrock slowly. Due to the drilling pattern used, the bedrock at the top and bottom of the channel did not fracture and was not able to be removed (Figure 6).

**Figure 5.** Dashed white line indicates the area of Dillon Rapids filled in from road development

**Figure 6.** White arrow indicates a channel created with Dexpan at Dillon Rapids

At Young's Rapids (second set of rapids, upstream of Dillon Rapids), prior to changes from the logging industry, sufficient water would flow through a naturally existing channel adjacent to the main rapids (referred to as the bypass channel) during the spring freshet. Walleye used this channel to bypass Young's Rapids and move farther upstream to spawn. This channel only functioned during high flows. When a large piece of bedrock was blasted and removed from the rapids to make it easier to drive logs down the river, this caused more water to flow over the main rapids. Log jams and settling debris and sediment have since filled in the top portion of the bypass channel. Remnants of the old channel were still visible and pooling was observed in the channel during the spring freshet in 2017 (Figures 7 and 8).


**Figure 7.** Young's Rapids bypass channel: (a) top of the channel that has filled in over many years; (b) looking down the bypass channel from the top at the material that has filled in over time; (c) immediately below the blocked area where the channel is still somewhat defined.


**Figure 8.** Young's Rapids bypass channel: (a) and (b) rocky portion of the channel; (c) bottom of bypass channel where sediment and grass have covered the former bedrock base of the channel.

Landowners and First Nation community members refer to a time when Walleye, White Sucker, and Redhorse Sucker species were extremely abundant in Shebeshekong River. There are no records of Lake Sturgeon spawning in the Shebeshekong River, either in MNR records or from anecdotal information.

The Ministry of Natural Resources and Forestry's (MNRF) Upper Great Lakes Management Unit (UGLMU) surveyed Shebeshekong River in 1997 and identified the status of the Walleye stock as "overfished to crashed". More recently, UGLMU has completed two years of broadscale monitoring and smallfish assessments (2015 and 2016) near the mouth of the Shebeshekong River. However, these assessments do not speak to the size of the current Walleye spawning population.

# Spring Spawning Assessments

In 2016, EGBSC focused spring spawning assessments on Dillon Rapids, the first set of rapids that fish from Georgian Bay reach. EGBSC began spring field work at the Shebeshekong River on April 15. At that time, the water temperature was already 7˚C, double the temperature of the other rivers being studied during the same period. For example, on the same day (April 15), temperature at the Seguin River in Parry Sound was 3.5˚C. Dillon Rapids was visited thirteen (13) times in 2016, approximately every three to four days whenever possible. Towards the end of the Walleye and Sucker spawning period (end of May), site visits were less frequent.

Young's Rapids was discovered in the middle of the 2016 spring field season, after discussions with landowners. As such, only three site visits were made to Young's Rapids during 2016 (April 22, 26, 29).

Based on the 2016 broad scale field assessment at Dillon Rapids, it was evident that there were not only very few Walleye spawning in the Shebeshekong River, but also that there were issues with fish passage and water level fluctuations. EGBSC identified the site as requiring restoration. EGBSC hired Biotactic Inc., a consulting firm that specializes in fisheries research and fish passage, to do a more detailed study at Dillon and Young's Rapids in 2017 and to come up with a restoration design, with input from community members.

In addition to Biotactic's detailed study, EGBSC also undertook field work at Dillon and Young's Rapids in 2017, with a focus on velocity measurements and fish passage issues. Equipment was installed on April 10 and field work continued until May 19, once fish movement had stopped. During this time, EGBSC was also completing broad habitat assessments on three other rivers using the same equipment. As a result, less water chemistry and velocity data were collected at Shebeshekong River in 2017. Most of the flow data used for the restoration design was taken by Biotactic during the 2017 field season.

## 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). Water temperature also influences the speed and success of egg incubation. Optimal water temperature for egg incubation is 12.2˚C for Walleye, 15˚C for White Sucker, and 12.5˚C for Longnose Sucker (Hasnain et al., 2010).

As illustrated in Figure 9, water temperature fluctuated throughout the spawning and egg incubation period in 2016. Between April 15 and 20, water temperature increased by 5.8˚C up to 12.8˚C. Water temperature then declined to 10˚C by April 26 and fluctuated between 10˚C and 16˚C until May 23, when it increased to 18.6˚C.

Based on night surveys, Walleye were present at Dillon Rapids between April 18 and 22. White Sucker were present on site visits between April 20 and 26. At Young's Rapids, White Sucker were present on April 22.

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 9, dissolved oxygen levels dropped consistently throughout the study period. The highest level was recorded on April 15 (12.86 mg/L) and the lowest on May 23 (7.77 mg/L).

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. Four of the pH measurements recorded at the Shebeshekong River spawning bed were below 6.0 (Figure 9). The highest pH was 6.68, which was recorded on April 29. The lowest pH was recorded on April 15 (5.45). These pH readings are mildly acidic and typical for Canadian Shield watersheds.

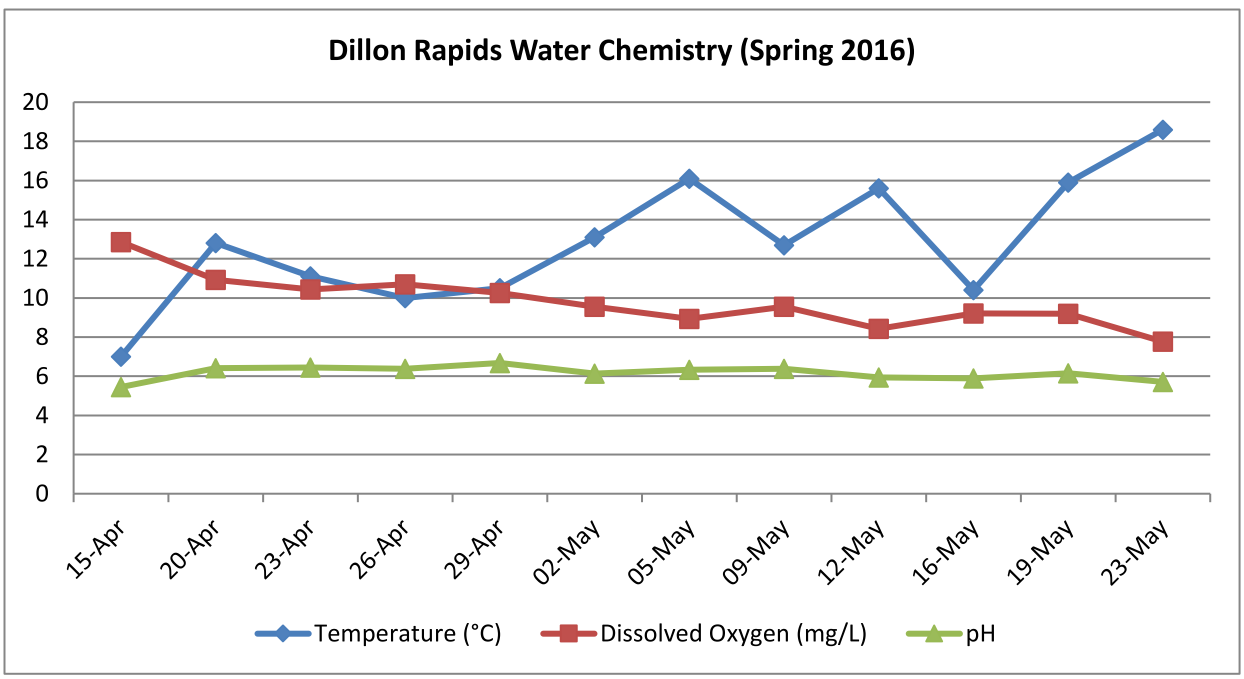



**Figure 9.** Water temperature (°C), dissolved oxygen (mg/L), and pH measurements at Dillon Rapids in spring 2016

Conductivity was also measured in 2016. 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 15 and May 23. Conductivity was consistently low throughout the study period, ranging from 32.8 uS/cm on May 16 to 46.9 uS/cm on May 23 (Figure 10).

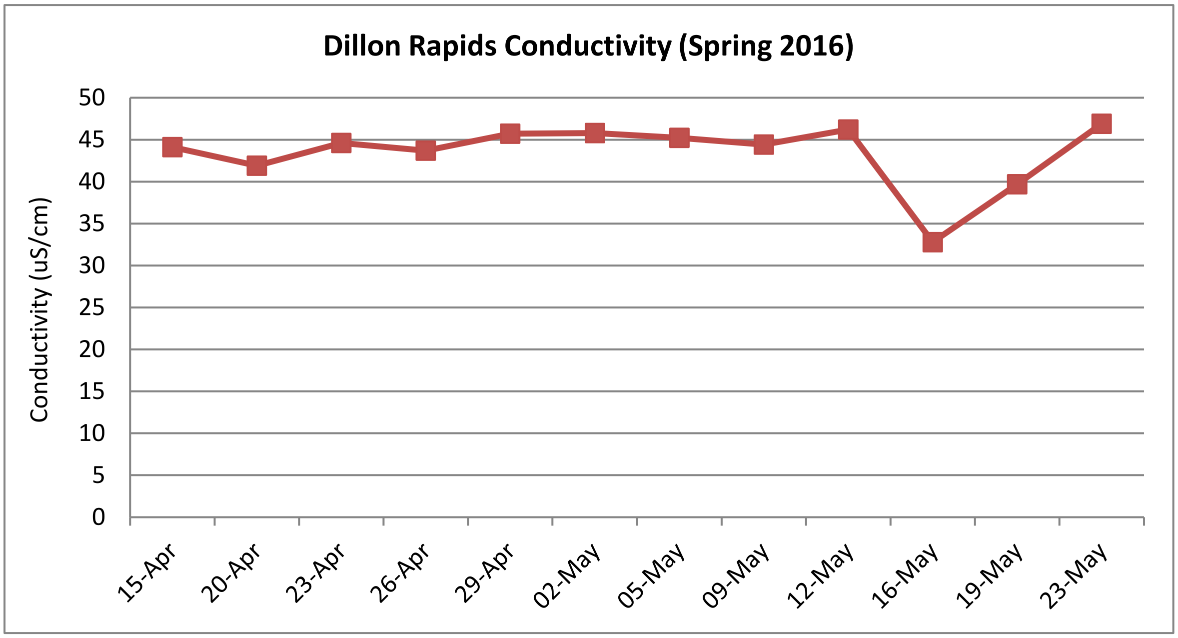



**Figure 10.** Conductivity measurements (uS/cm) at Dillon Rapids in spring 2016

In 2017, EGBSC monitored water chemistry when the YSI metre was available. Table 1 shows temperature, dissolved oxygen, pH, and conductivity measurements at Dillon, Young's, and Lockett Lake Rapids. Overall, there were only slight differences between the sites. Water chemistry measurements were only taken at Lockett Lake Rapids twice due to high flows and water levels which made accessing the site by canoe unsafe on most occasions.

For complete water chemistry data, refer to Appendix A.

**Table 1.** Spring 2017 water chemistry measurements at Dillon, Young's, and Lockett Lake Rapids (n/a indicates that the YSI was not available and only temperature could be taken with a separate thermometer)

| Date | Site | Water Temp (°C) | DO (mg/L) | pH | Conductivity (uS/cm) |
|---|---|---|---|---|---|
| Apr 10/17 | Dillon | 8.1 | 11.45 | 5.35 | 42.1 |
| Apr 11/17 | Dillon | 7.2 | 11.50 | 5.51 | 45.2 |
| Apr 11/17 | Young's | 7.4 | 11.17 | 5.66 | 47.6 |
| Apr 14/17 | Lockett | 7.8 | 11.74 | 5.44 | 52.5 |
| Apr 14/17 | Young's | 8.4 | 12.06 | 5.86 | 52.3 |
| Apr 15/17 | Dillon | 8.1 | 11.55 | 5.92 | 50.0 |
| Apr 17/17 | Young's | 8.2 | 11.66 | 5.93 | 47.5 |
| Apr 17/17 | Dillon | 8.2 | 11.72 | 6.05 | 42.6 |
| Apr 19/17 | Dillon | 9.4 | n/a | n/a | n/a |
| Apr 24/17 | Young's | 10.3 | n/a | n/a | n/a |
| Apr 24/17 | Dillon | 10.0 | n/a | n/a | n/a |
| Apr 29/17 | Young's | 13.9 | 9.59 | 6.09 | 52.1 |
| Apr 29/17 | Dillon | 13.7 | 9.64 | 6.17 | 49.2 |

| Date | Site | Water Temp (°C) | DO (mg/L) | pH | Conductivity (uS/cm) |
|---|---|---|---|---|---|
| May 19/17 | Lockett | 17.9 | 8.32 | 6.59 | 59.0 |
| May 19/17 | Young's | 18.4 | 8.23 | 6.53 | 58.0 |
| May 19/17 | Dillon | 17.4 | 9.64 | 5.94 | 52.6 |

## 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), while White Sucker generally spawn in velocities ranging from 0.14 m/s to 0.9 m/s (Twomey et al., 1984). Water velocity was measured with a Marsh McBirney Flo-mate 2000 flow meter.

### Dillon Rapids

Five stations were established at Dillon Rapids in 2016 to collect information on water velocity and depth from April 20 to May 23 (Figure 11).

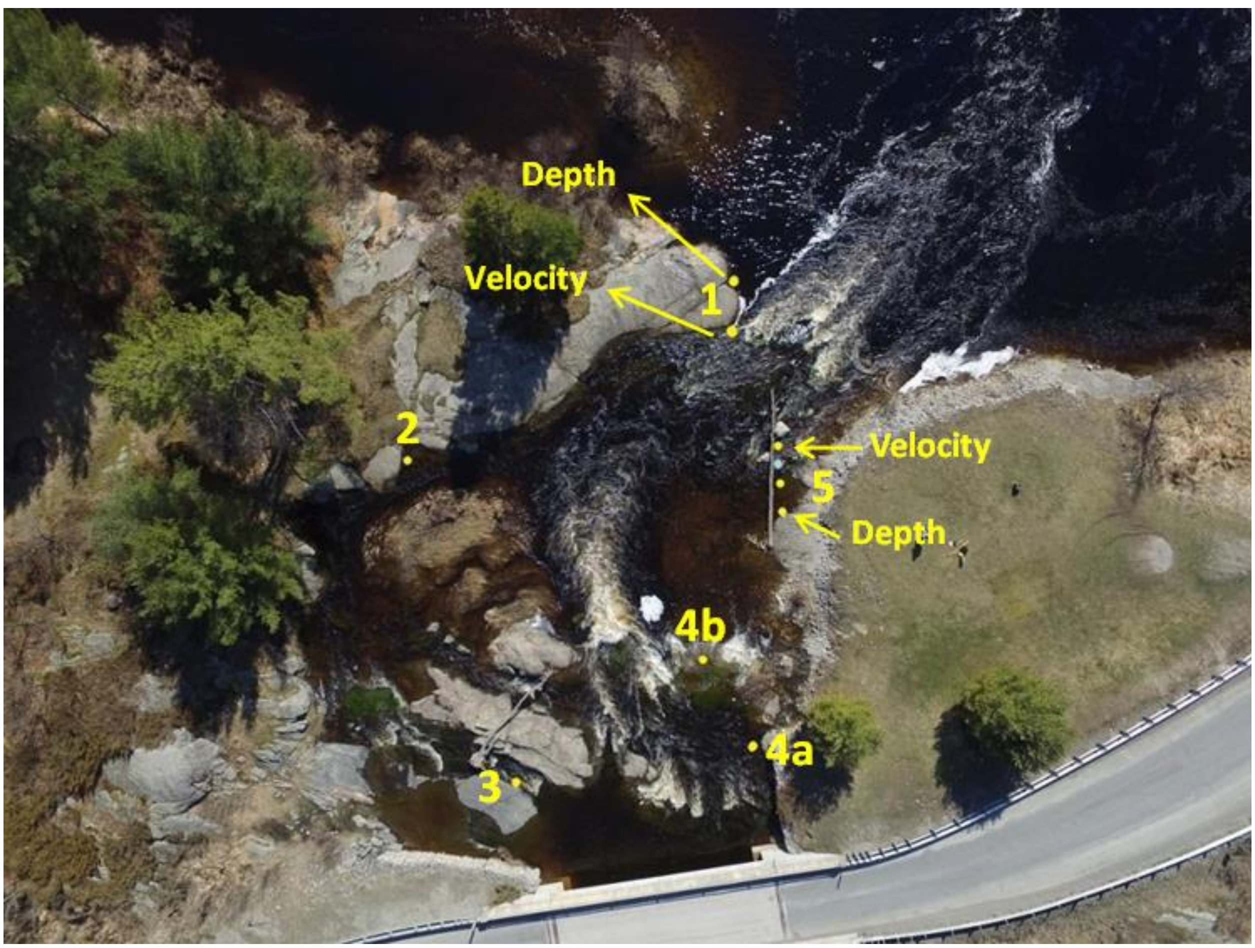



**Figure 11.** Water velocity and depth stations at Dillon Rapids

Water velocity is typically high during the spawning period and declines over time. Velocity measurements were taken 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. Figure 12 displays velocity measurements recorded at each station between April 20 and May 23.

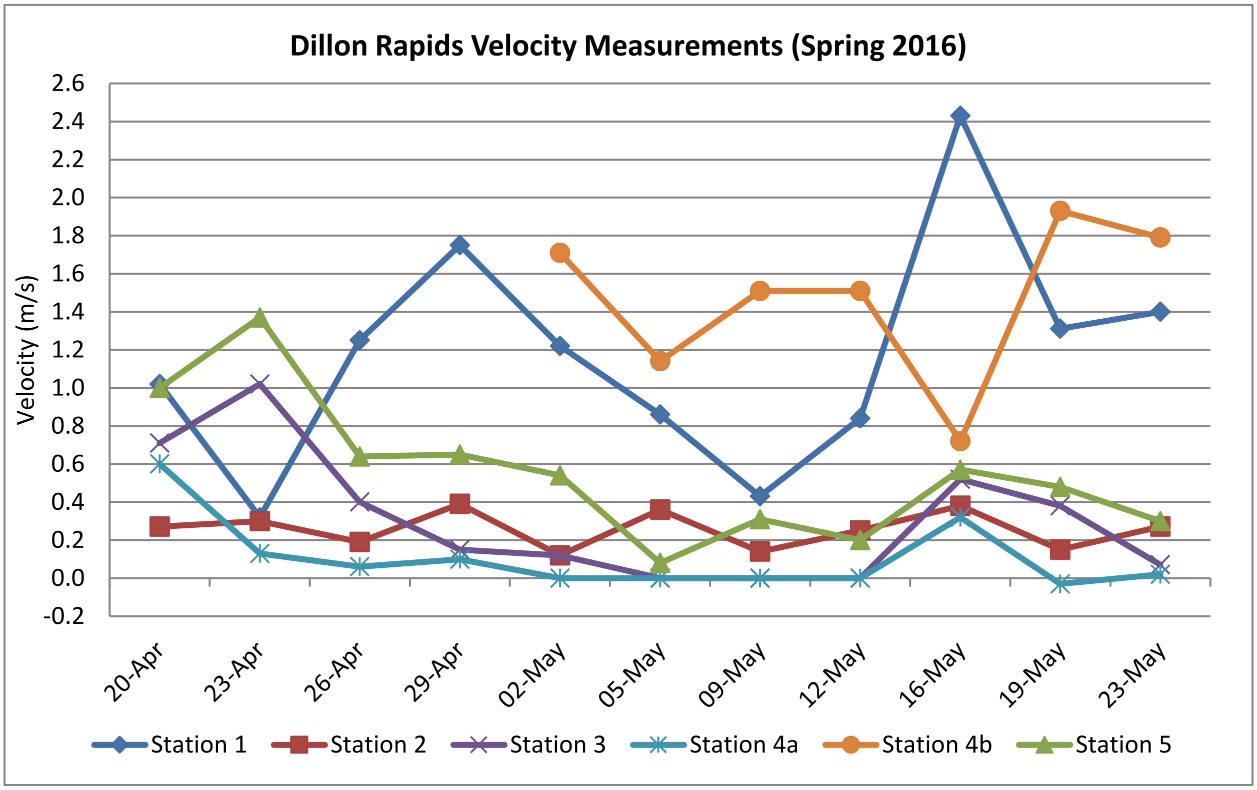



**Figure 12.** Water velocity measurements at Dillon Rapids in spring 2016

Station 1 was measured from April 20 until May 23. Aside from station 4b, station 1 had the highest velocity of all the stations. The highest velocity recorded was 2.43 m/s on May 16, and the lowest velocity recorded was 0.43 m/s on May 9. Between April 29 and May 9, velocity decreased consistently, until a rain event occurred on May 14, resulting in a sudden increase in velocity on May 16. After May 16, velocity started to decline again. At station 2, the highest velocity recorded was 0.39 m/s on April 29, and the lowest velocity recorded was 0.12 m/s on May 2. Overall, velocity at station 2 was quite low and fluctuated fairly consistently. At station 3, the highest velocity recorded was 1.03 m/s on April 23. This site went dry between May 5 and May 12, and velocity could not be recorded during that time. At station 4a, the highest velocity recorded was 0.6 m/s on April 20. Velocity consistently declined after April 20 and the station went dry by May 2. The rain event on May 14 raised water levels, and this site was monitored again beginning on May 16. The lowest velocity recorded was -0.03 on May 19, after flows had dropped. The negative value indicates that the station had become a back eddy, and water was flowing in the opposite direction. Because station 4a went dry, EGBSC added another station farther downstream where water was still flowing, which became station 4b. Because this station was added later in the season, there was no velocity recorded at this site until May 2. This station is located in the area of the rapids that receives the most flow. The highest velocity recorded was 1.93 m/s on May 19. The lowest velocity recorded was 0.72 m/s on May 16. At station 5, the highest velocity recorded was 1.37 m/s on April 23 and the lowest velocity recorded was 0.08 m/s on May 5.

High velocities at station 4, combined with an abrupt bedrock ledge to ascend, would likely prevent Walleye from swimming through this area of the rapids. While the velocity reading at station 1 on May

16 was quite high (2.43 m/s), the other side of the rapids remained accessible to Walleye and White Sucker with the velocity at station 5 measuring 0.57 m/s. Several areas went dry during the 2016 field season which would have prevented fish passage. This issue is discussed further under the Fish Observations section.

In 2017, EGBSC monitored the same flow stations established in 2016, with the exception of 4b (Figure 11). Unlike 2016, the spring of 2017 was cold and rainy, with higher water levels and velocities throughout the spawning and egg incubation period. As such, station 4b could not be accessed safely. Water velocity was measured on four different site visits – April 11, 14, 17, and 29 (Figure 13).

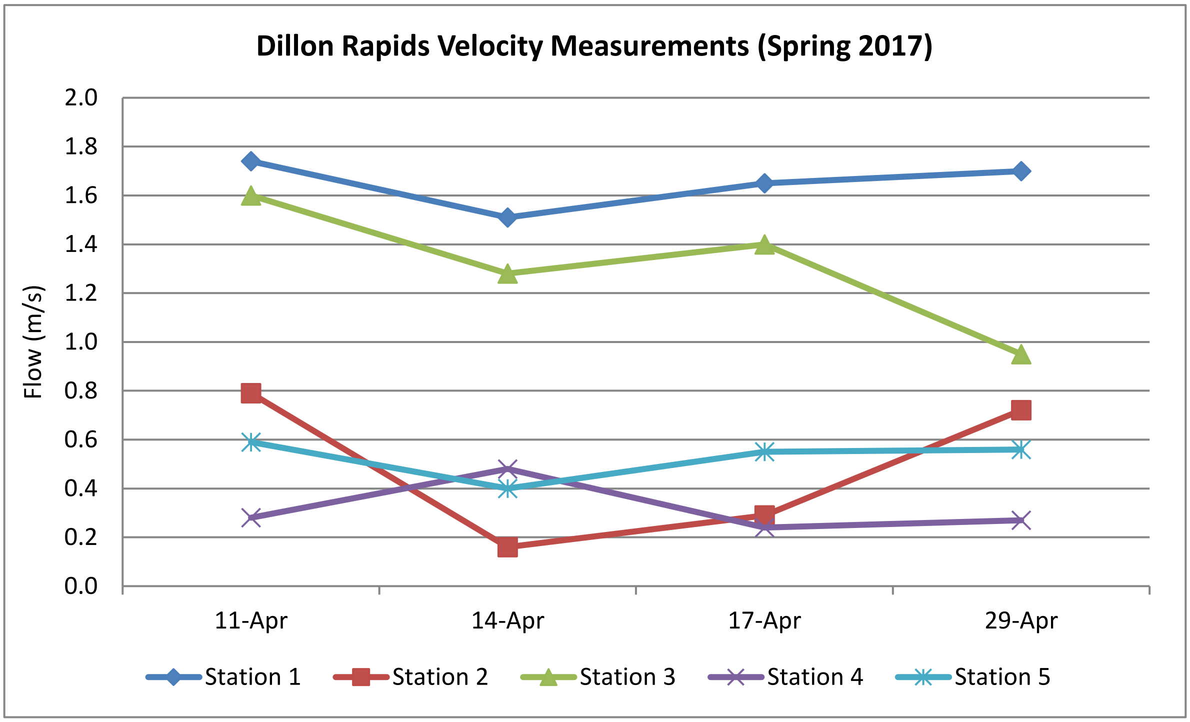



**Figure 13.** Water velocity measurements at Dillon Rapids in spring 2017

In 2017, the highest velocities at stations 1 (1.74 m/s), 2 (0.79 m/s), 3 (1.6 m/s), and 5 (0.59 m/s) were recorded on April 11. The highest velocity at station 4 (0.48 m/s) was recorded on April 14. Velocity readings were lowest at stations 1 (1.51 m/s), 2 (0.16 m/s), and 5 (0.4 m/s) on April 14. At station 3, the lowest recorded velocity was 0.95 m/s on April 29. At station 4, the lowest recorded velocity was 0.24 m/s on April 17. Overall, station 3 had consistently higher velocities in April 2017 compared to April 2016. Station 4a had similar velocities between 2016 and 2017. Station 5 had fairly consistent velocity measurements that fluctuated between 0.48 and 0.59 m/s. Velocity was only recorded in April in 2017, therefore, no comparisons can be made for the month of May.

It is important to note that 2016 was a drought spring with very little precipitation. Conversely, 2017 was a cold, wet spring with a significant amount of precipitation. For the month of April, due to more consistent precipitation and higher water levels in 2017, there were less extreme fluctuations in velocity. None of the flow stations went dry in April or May in 2017. For complete water velocity data, refer to Appendix B.

## Young’s Rapids

Given the sampling focus on Dillon Rapids in 2016, fewer velocity measurements were taken at Young’s Rapids that year. Velocity measurements were recorded on two site visits, April 26 and 29. Figure 14 illustrates the locations of the four stations.

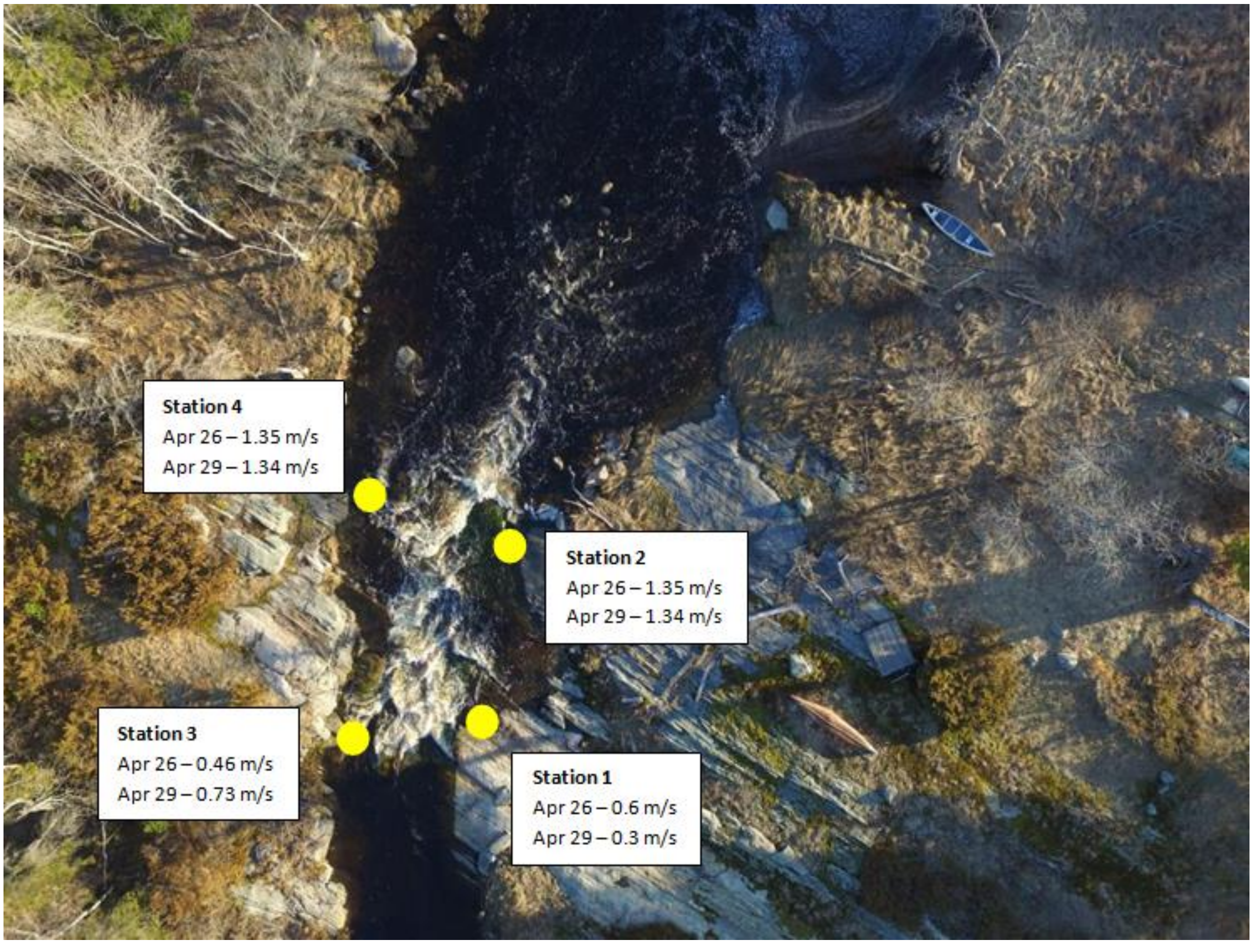



**Figure 14.** Water velocity stations at Young’s Rapids in 2016

Stations 2 and 4 had velocity measurements greater than 1.0 m/s on both site visits. With the combination of higher velocities and a considerable slope to ascend Young’s Rapids, Walleye would likely not be able to swim up past Young’s Rapids. The velocity preference for White Sucker has been documented to be between 0.14 m/s and 0.9 m/s. Velocity measurements at stations 2 and 4 exceeded the ideal velocity range; however, White Sucker were observed moving past Young’s Rapids.

In 2017, new velocity stations were established based on 2016 fish passage observations and the location of underwater infrared cameras installed by Biotactic to help assess fish passage. Figure 15 shows the location of stations in 2017. Underwater infrared cameras were located near stations 2 and 3.

**Figure 15.** Water velocity stations at Young's Rapids in 2017

All velocity data recorded between April 10 and 29 (Figure 16) were within the acceptable range for Walleye and White Sucker. However, the steep slope of the rapids would likely exclude Walleye from passing through the rapids and moving upstream. White Sucker were observed successfully ascending the rapids in 2016. No successful attempts to ascend the rapids were observed in 2017. Furthermore, no White Sucker were recorded on the infrared cameras above the rapids. For complete water velocity data, refer to Appendix B.

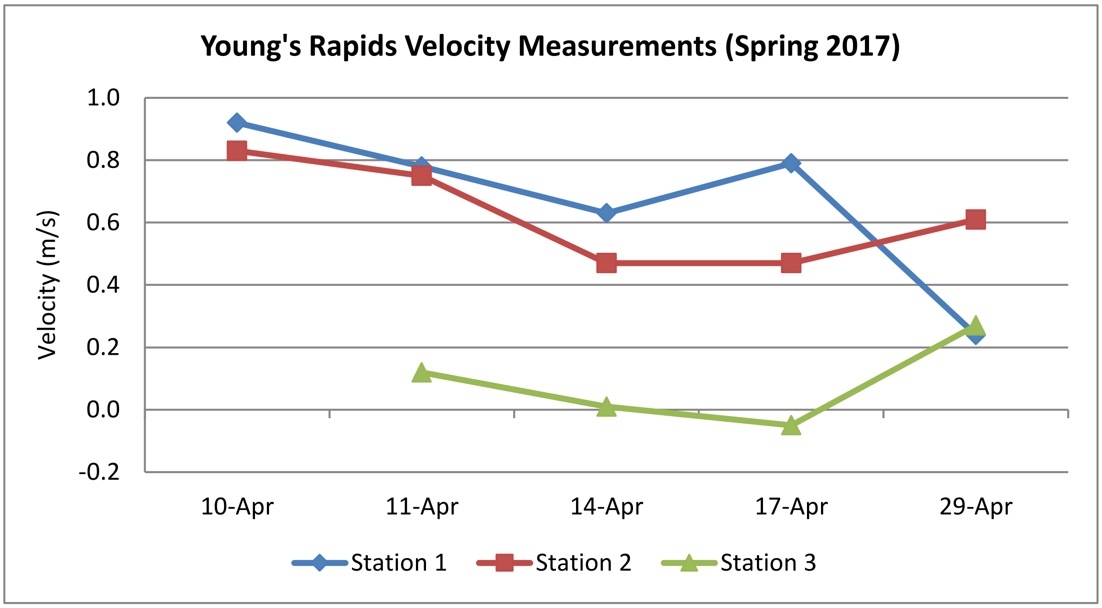



**Figure 16.** Water velocity measurements at Young's Rapids in spring 2017

## Water Level Fluctuations

Water level information was recorded at several stations to better understand how water levels 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.

### Dillon Rapids

Water levels and velocity did not diminish consistently at Dillon Rapids throughout the 2016 spawning and egg incubation period (Figure 17). A sharp increase in water level was observed on May 16 due to a large rain event on May 14. After May 16, water levels began to drop at each station with the exception of station 1. Water level fluctuated the least at station 1, which was located at the downstream end of the spawning bed and very close to, or at, Georgian Bay water level (Figure 11). Stations 4a and 5 experienced a small rise in water level on April 23 and then declined until May 16, when there was a significant increase in water level following the May 14 rain event. Water level dropped at stations 2 and 3 from April 20 until the May 14 rain event. After May 16 water level began to drop again at stations 2, 3, 4a, and 5. The breaks in the data series presented in Figure 17 reflect instances when water level measurements were not possible. At station 3, this reflects the period of time when that channel was dry.

Overall, station 1 experienced little fluctuation in water level and stations 4a and 5 experienced more dramatic fluctuations (refer to Appendix B for complete water level data). Throughout the site visits, it became evident that Dillon Rapids is vulnerable to water level fluctuations. This was especially evident on the east side of the spawning bed where large areas of the spawning bed went dry, and where there was water, depth was less than 5 cm, which would prevent fish passage. This is discussed further in the Fish Observations section.

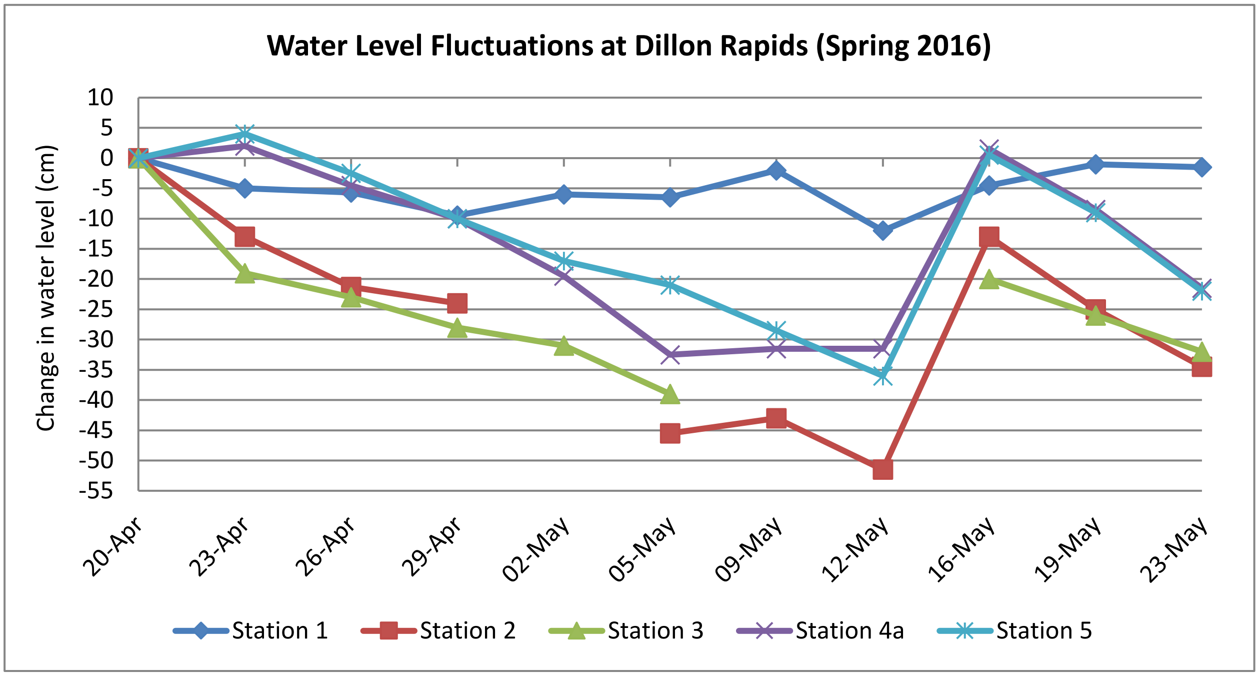



**Figure 17.** Water level fluctuations at Dillon Rapids as measured at five stations in 2016. Measurements on the first site visit served as the benchmark against which future measurements were compared (i.e., water level up or down compared to the first site visit).

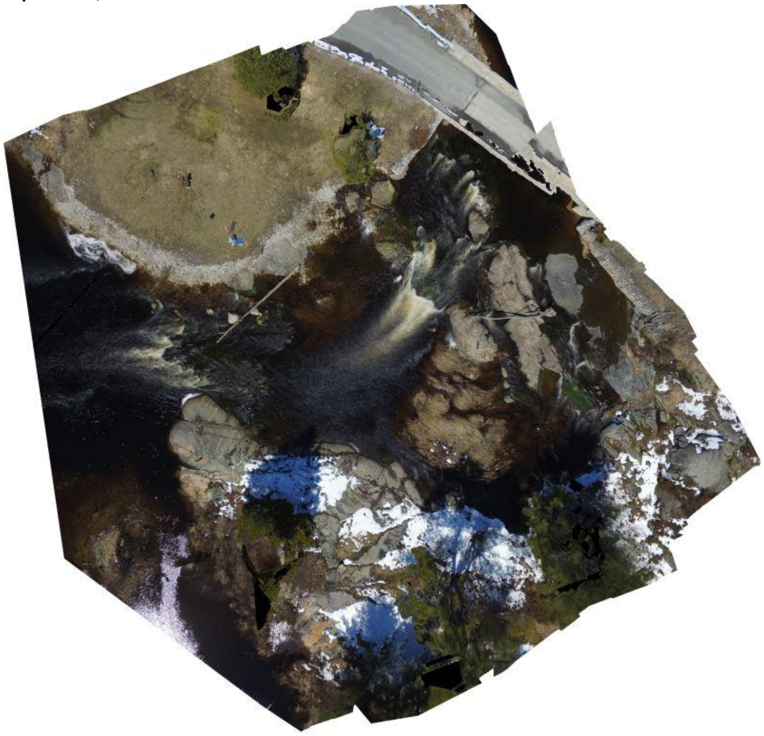
## Aerial Photographs

An important component of the habitat assessment was to take 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 beds.

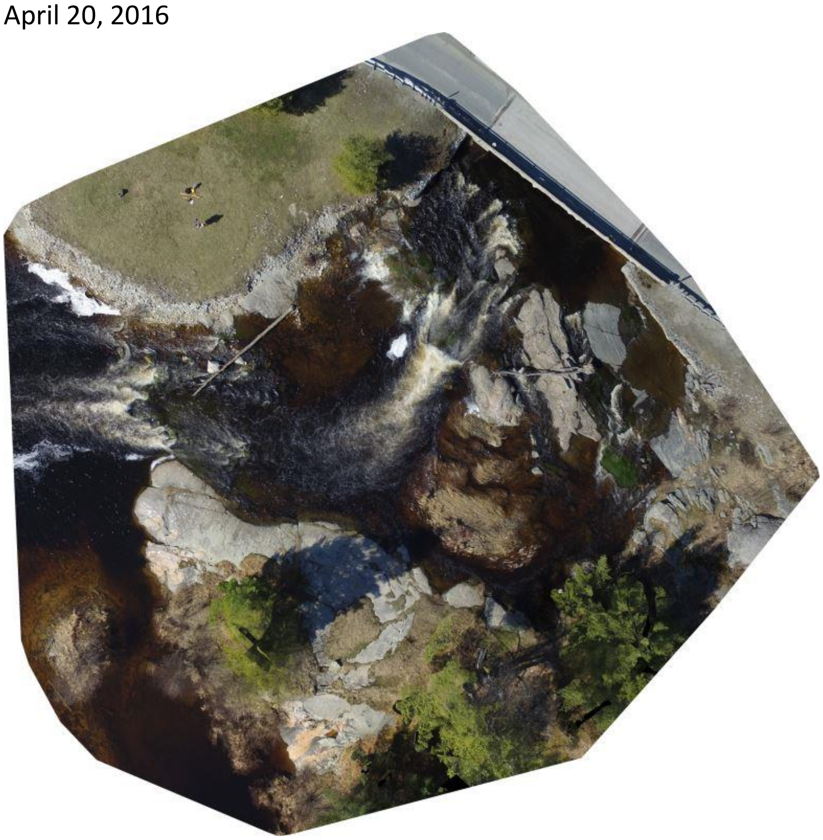
### Dillon Rapids 2016

The following aerial photo orthomosaics illustrate changes in water levels at Dillon Rapids in 2016 from April 15 to May 23. As the photos show, there are dramatic changes in water level fluctuations over the rapids during this time period. Most of the Walleye eggs that were observed ended up stranded out of water.

April 15, 2016



April 20, 2016

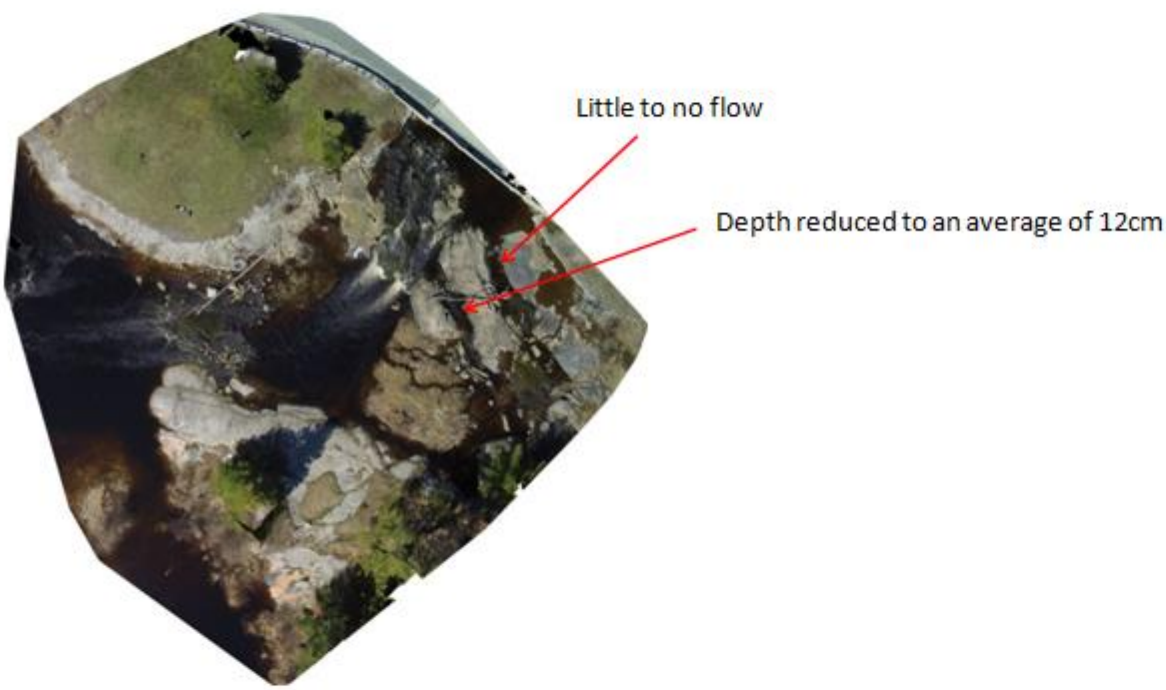


April 22, 2016 – unable to fly drone

April 26, 2016

April 29, 2016 – water levels and velocities reduced on east side of rapids

May 2, 2016 – significant change in water level and velocity throughout site; Walleye eggs observed stranded out of water



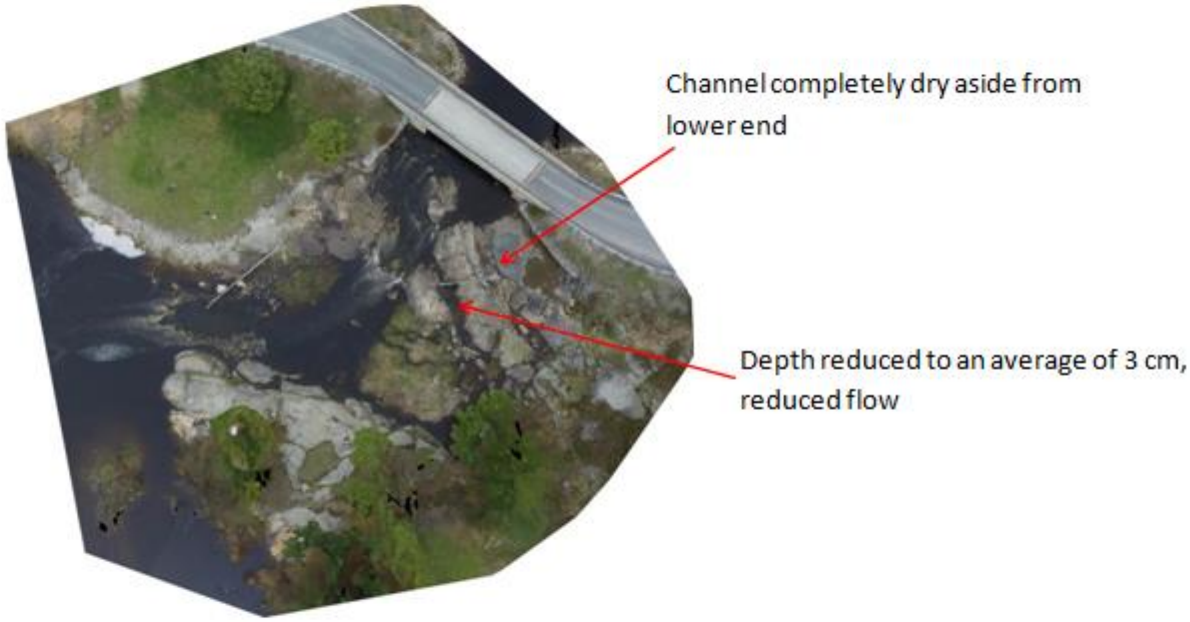
May 5, 2016 – small patch of cobble out of water at bottom end of rapids where Walleye eggs were deposited; significant reduction in water depth and velocity on east side of the rapids


May 9, 2016 – unable to fly drone; large reduction in water levels on west side of rapids

Station 3 channel beginning to dry, unable to take flow measurements

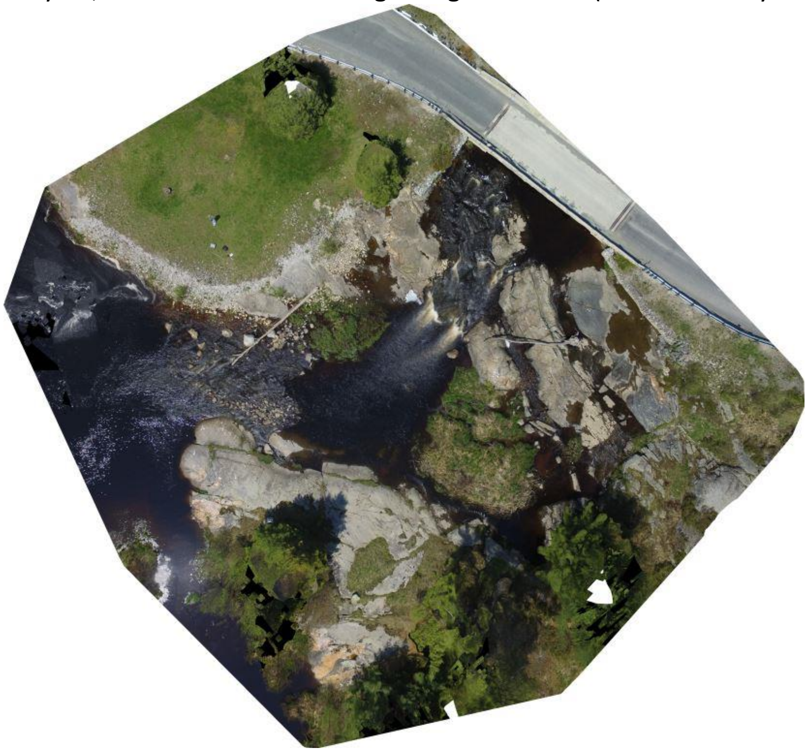
Entire east side of rapids drying up

May 12, 2016 – east side of rapids almost completely dry




May 19, 2016 – water levels back up (close to April 29 levels) following large rain event

May 23, 2016 – water levels beginning to decline (similar to May 2 levels)



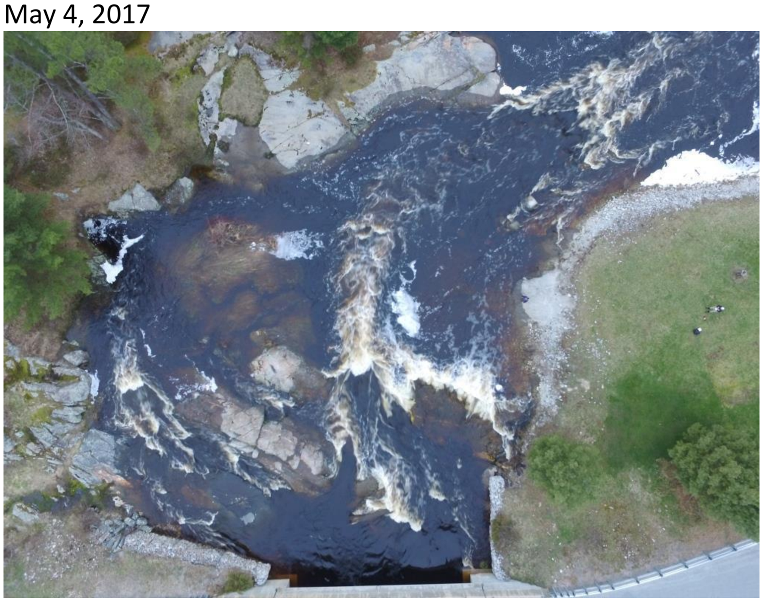
## Dillon Rapids 2017

EGBSC staff flew a drone to capture photos of Dillon Rapids on four occasions in 2017 – April 11, April 17, May 4, and May 19. The following aerial photos illustrate the changes in water levels at the rapids in 2017. Due to the high amount of precipitation in spring 2017, there were less dramatic water level fluctuations, and the east side of the rapids did not dry up, as it had in 2016. Walleye eggs were still observed stranded out of water, but not to the extent that they were in 2016.

April 11, 2017

April 17, 2017

May 4, 2017



May 19, 2017 – beginning to see exposed cobble at the base of the rapids and water levels and velocity reduced on the east side of the rapids

## Young's Rapids 2016

EGBSC staff flew a drone to capture photos of Young's Rapids on April 26 and April 29.

April 26, 2016

April 29, 2016

## Young's Rapids 2017

EGBSC staff flew a drone to capture photos of Young's Rapids on three occasions – April 17, May 4, and May 19. The following photos illustrate changes in water levels at the rapids in 2017.

April 17, 2017

May 4, 2017 – reduction in water level at the perimeter of the rapids and some cobble visible at the base of the rapids

May 19, 2017 – no major change in water levels from May 4

## Lockett Lake Rapids 2017

EGBSC staff flew a drone to capture photos of Lockett Lake Rapids on April 14 and May 19.

April 14, 2017

May 19, 2017

## Fish Observations

EGBSC carried out visual observations (night and day) at Dillon Rapids to help ascertain fish movement and spawning activity. In 2016, visual observations were carried out for a total of fifteen (15) days between April 15 and May 31. Both Walleye and White Sucker were observed in very low numbers. The highest number of Walleye observed in one night was eleven (11). The highest number of White Sucker observed at one time was also eleven (11). White Sucker were observed below, in, and above Dillon Rapids. Walleye were only observed on the south shore of the rapids, and were not observed above the rapids. Over fifty (50) Logperch were observed in a sandy pool part way up the rapids between April 29 and May 5.

In the same field season, EGBSC carried out observations at Young's Rapids for a total of four days. On April 22, over 100 White Sucker were observed attempting to ascend Young's Rapids. No other fish were observed on the other visits, and no eggs were found at the site.

In 2017, EGBSC hired Biotactic Inc. to help study fish passage and develop a restoration plan for the Shebeshekong River. Biotactic carried out night and day surveys and set up three underwater infrared cameras to record videos of fish passage. Cameras were set upstream of Dillon Rapids, at the base of Young's Rapids, and at the top of Young's Rapids. The cameras were installed on April 10 and April 11. During the camera installation at Young's Rapids on April 11, two Northern Pike were observed. Later, on April 12, EGBSC was collecting velocity data at Dillon Rapids and observed several Common White Sucker, in addition to Yellow Perch and Northern Pike.

Walleye started to move into Dillon Rapids on April 13, 2017. The last night Walleye were observed at Dillon Rapids was April 17. EGBSC carried out night and day surveys, between Tumbling Rock (downstream of Dillon Rapids) and Dillon Rapids. Between April 13 and April 17, the highest number of Walleye observed in one night was eight. As in 2016, Walleye were only observed at the downstream end of the rapids. None were observed passing through the rapids. No Walleye were captured on the underwater infrared cameras located upstream of Dillon Rapids. A small number of stranded Walleye eggs were observed again on the south shore of Dillon Rapids.

White Sucker were observed below Dillon Rapids, and careful observations confirmed that the two middle channels within Dillon Rapids were the pathways White Sucker were using to get upstream. While White Sucker were moving through the site, their numbers were not as high as what would be expected. No more than thirty (30) were observed in a single night survey. White Sucker were also observed below and part way up Young's Rapids (Figures 18 and 19). Visual observations and underwater infrared videos confirmed the presence of other fish species in the river: Northern Pike, Muskellunge, Yellow Perch, Central Mudminnow, Logperch, and Bluntnose Minnow. Mudpuppies were observed downstream of Dillon Rapids. Appendix C lists the dates and species observed during the 2016 and 2017 spring spawning season.


**Figure 18.** White Sucker at Young's Rapids on April 11, 2017


**Figure 19.** White Sucker at Young's Rapids on April 19, 2017

In summary, Walleye were observed between Tumbling Rock and Dillon Rapids in 2017 between April 13 and April 16 only. No Walleye were recorded on the underwater infrared cameras upstream of Dillon Rapids. White Sucker were able to pass through Dillon Rapids using the two middle channels (Figure 20). Based on visual observations, it was not clear if White Sucker were able to move past Young's Rapids as they did in 2016. Increased velocities in 2017 may have limited their ability to get beyond Young's Rapids. No Sucker species were recorded on the underwater infrared camera at the top of Young's Rapids. Nevertheless, it is possible that fish may have gotten up the left side of the channel without being detected by the camera. The majority of fish, however, were attempting to ascend the rapids on the right side of the channel due to channel morphology.

Figure 20 depicts the locations of visual observations of Walleye, White Sucker, and eggs at Dillon Rapids in both 2016 and 2017. It also shows the two main pathways that White Sucker use to ascend Dillon Rapids. The red line indicates the area where Walleye eggs were stranded out of water due to receding water levels in 2016 and 2017. Most eggs observed along the south shore in 2016 were left stranded when water levels receded. Some Walleye eggs (fewer than in 2016) were observed along the south shore within the bedrock crevices in 2017; however, despite high water levels and less severe water level fluctuations, most of these eggs were left stranded before incubation was completed.

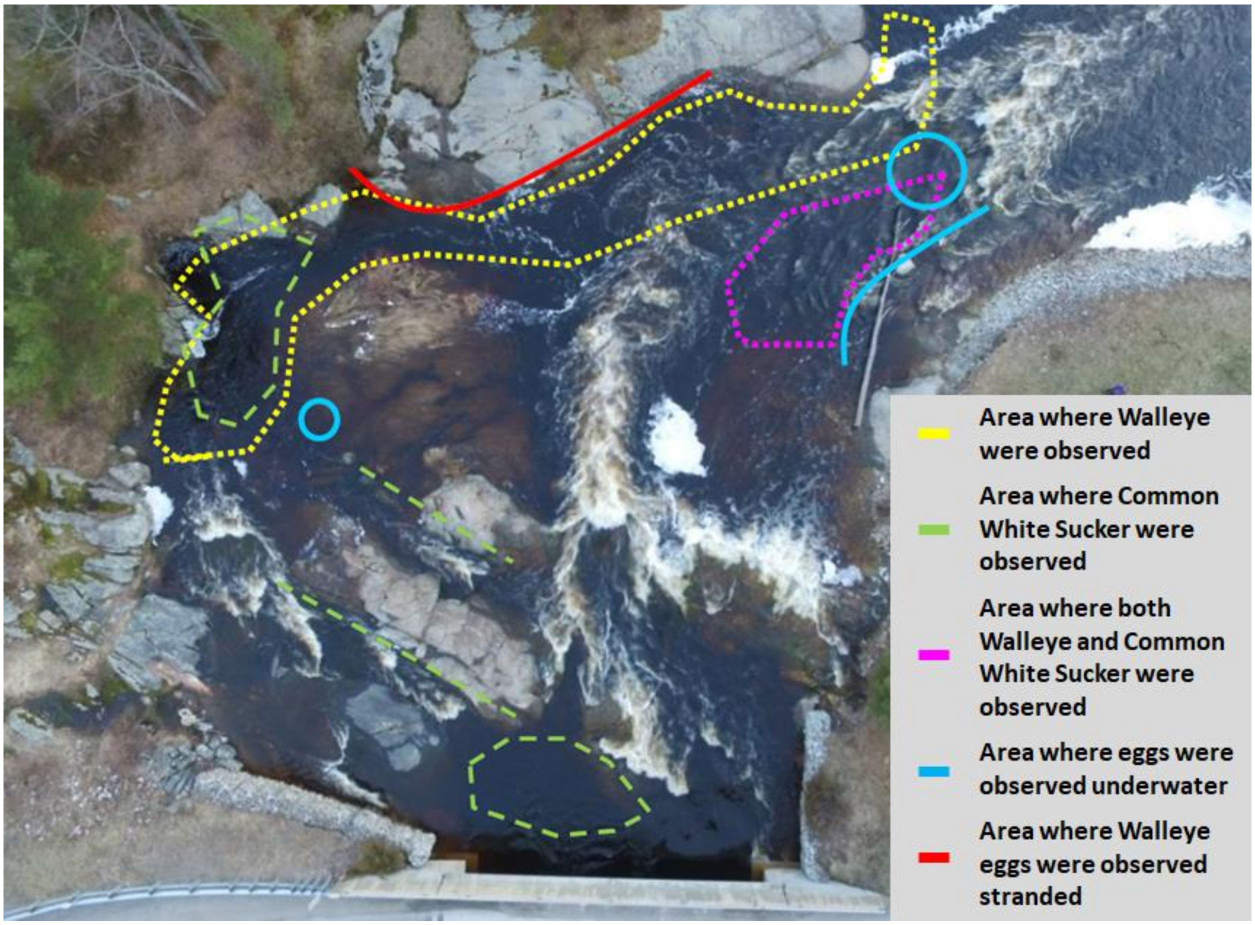



**Figure 20.** Locations of Walleye, Sucker, and egg observations at Dillon Rapids in 2016 and 2017

Based on visual observations, very few Walleye were spawning in Shebeshekong River in 2016 and 2017. Dillon Rapids does not appear to be an ideal location for spawning due to fluctuating water levels. In both years, the spawning window was early and very short, despite very different conditions between those years. The landowner adjacent to Tumbling Rock reported that spawning in Shebeshekong River is usually finished by mid-April. This appears to be true based on visual surveys in both 2016 (Walleye observed April 18-22) and 2017 (Walleye observed April 13-17). Temperature data also supports this observation. Based on water temperature data from the other seven tributaries assessed as part of this project, the Shebeshekong River warms up roughly twice as quickly as other rivers in the area.

## Egg Deposition

### Dillon Rapids

EGBSC set four egg mats at Dillon Rapids on April 15, 2016. Three of the four egg mats were removed from the water by someone other than EGBSC staff at some point after April 15. Two half mats were set on April 26. Figure 21 shows the locations of the original four eggs mats installed (1-4), and the two half mats (5 and 6). EGBSC counted twelve (12) Walleye eggs and two Sucker eggs on egg mat 5 (half mat) on April 29. On May 2, two Walleye eggs and thirty-two (32) Sucker eggs were counted on egg mat 1 (set since April 15). No eggs were found on egg mat 6. In total, EGBSC counted twenty-eight (28) Walleye eggs and thirty-four (34) Sucker eggs at Dillon Rapids in 2016. In addition to egg mats, EGBSC recorded the locations of Walleye egg deposition, both underwater and stranded out of water.


**Figure 21.** Location of egg mats installed at Dillon Rapids in 2016. Egg mats 1-4 were set on April 15 and egg mats 5 and 6 were set on April 26.

Due to high water levels and velocities in 2017, EGBSC was very limited in the timing and location of egg mat placement. At Dillon Rapids, only one spot was safely accessible for installing an egg mat within the appropriate spawning window (Figure 22). The egg mat was set on April 14 and checked throughout the spawning season. No eggs were observed on the mat at any point. The egg mat was removed on May 19.

**Figure 22.** Egg mat location at Dillon Rapids in 2017

## Young's Rapids

No egg mats were installed at Young's Rapids in 2016 and no eggs were observed in the channel.

In 2017, only two locations were safely accessible for egg mat placement (Figure 23). The first opportunity EGBSC had to safely set an egg mat was April 24. No eggs were observed, and the egg mats were removed on May 19.


**Figure 23.** Egg mat locations at Young's Rapids in 2017

## Lockett Lake Rapids

High flows in the spring of 2017 made accessing Lockett Lake Rapids by canoe unsafe for a large part of the spawning window. EGBSC was able to access the site on April 24 and install one egg mat (Figure 24). Due to water velocity and depth, no additional locations were identified as being safely accessible. The egg mat was checked periodically but no eggs were observed before the mat was removed on May 19.


**Figure 24.** Egg mat location at Lockett Lake Rapids in 2017

## 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 Dillon Rapids, EGBSC conducted four plankton tows using a 12" diameter, 153 micron plankton net. The plankton sampling locations are illustrated in Figure 25.

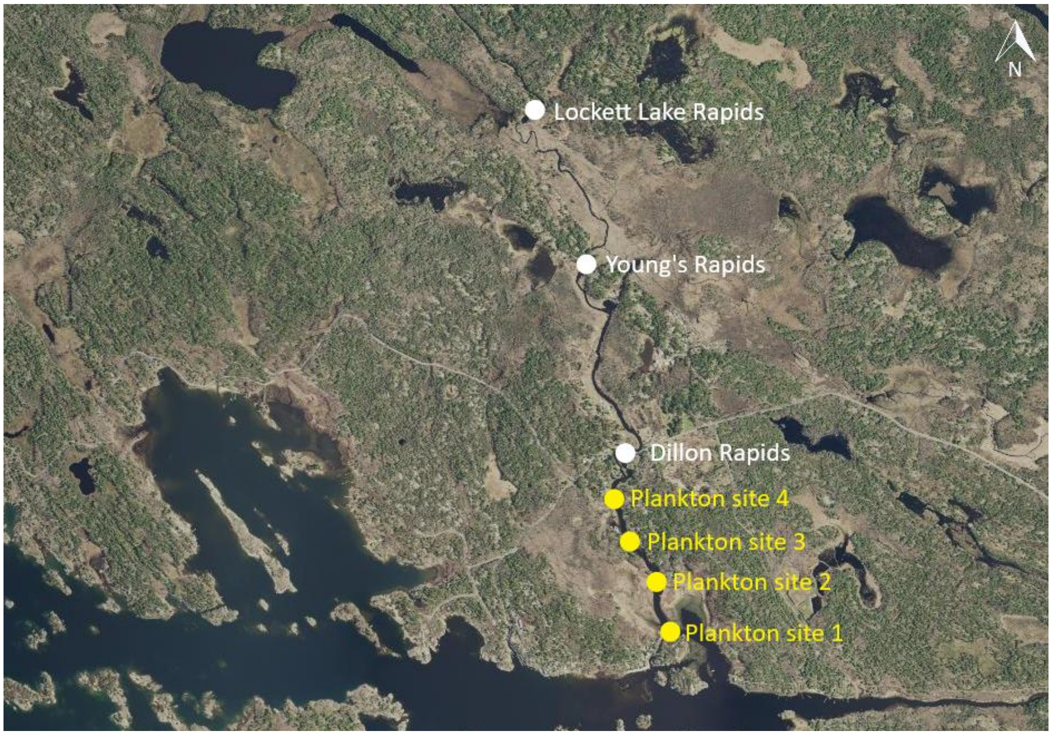



**Figure 25.** Plankton sampling locations on the Shebeshekong River in 2016

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 at the Shebeshekong River is shown in Figure 26. Relative to the samples from the other four rivers sampled in 2016, the Shebeshekong River had moderate plankton density (less than Shawanaga River, more than Magnetawan River).

**Figure 26.** Plankton sample from Shebeshekong River in 2016

# Spawning Bed Measurements

Reproductive success for Walleye 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). 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).

In the fall of 2016, transects were measured across both Dillon Rapids and Young's Rapids to help ascertain where the "ideal" spawning locations would be for each species. 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.

EGBSC completed nineteen (19) transects at Dillon Rapids and seven transects at Young's Rapids, spaced roughly 6 m apart. 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.

Data collected suggests that there is a concentrated amount of spawning habitat at specific locations at both Dillon and Young's Rapids. While there are areas with a combination of substrate within the optimal range and appropriate depths for Walleye, these areas make up a small portion of the total area. There was very little optimal sized spawning substrate for White Sucker at Dillon, and none measured at Young's Rapids.

At Dillon Rapids, the area was split in three sections as there are distinct channels within the rapids, and in certain areas, the flow splits around bedrock features or vegetated islands and flows in a slightly different direction. Figure 27 shows the locations of the transects and areas where ideal depth and substrate are located (refer to Appendix D for complete transect data).

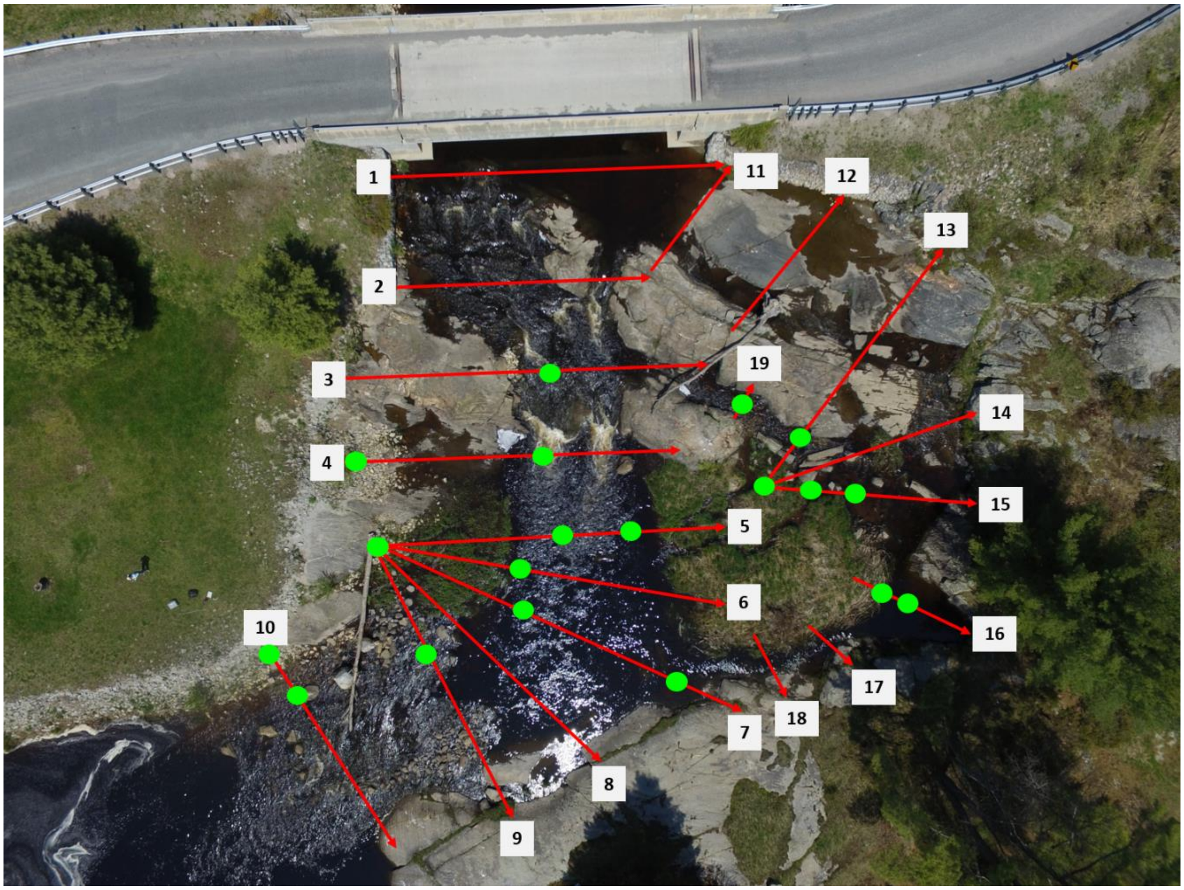



**Figure 27.** Spawning bed measurement transects at Dillon Rapids. Green dots indicate ideal depth and the presence of at least some ideal substrate for Walleye spawning.

In total, across the nineteen (19) transects, 114 points were measured for depth and substrate. For Walleye, 70% of the points met the optimal depth, but only 22% of the points met the optimal substrate type. Overall, only 18% of the points measured (20 of the 114) had both the ideal depth and the ideal substrate size. Transects 4 to 7 and 10, 15, and 16 had the highest amount of both ideal depth and substrate for Walleye.

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 Dillon Rapids were ideal for White Sucker. A total of only 0.04% of the points measured had the ideal substrate (5 of the 114 points). White Sucker substrate was found on transects 4, 6, 12, and 15. Along transect 15, two of the six points were the ideal type and sized substrate for White Sucker, and on transects 4, 6, and 12, only one point had the ideal substrate.

Based on visual observations and the transect data, much of the substrate at Dillon Rapids is bedrock, which is not an ideal spawning substrate for Walleye or Sucker species. There is more appropriate substrate concentrated at the lower end of the rapids and a small pocket on the east side of the rapids, but because Dillon Rapids is so vulnerable to water level fluctuations, it is not an ideal spawning site due to the high potential for egg stranding. Many of the ideal spawning points along the transects at the edges of the rapids go dry before eggs would successfully incubate.

The locations of the seven transects completed at Young's Rapids are shown in Figure 28. The points measured with ideal substrate for Walleye are highlighted in green.


**Figure 28.** Spawning bed measurement transects at Young's Rapids. Green dots indicate ideal depth and substrate for Walleye spawning.

In total, across the seven transects, forty-two (42) points were measured for depth and substrate (refer to Appendix E for complete transect data). For Walleye, 71% of the points met the optimal depth, but only 26% of the points met the optimal substrate type. Overall, 24% of the points measured (10 of the 42) had both the ideal depth and the ideal substrate size. Transects 4 to 7 had both ideal depth and substrate for Walleye. There was no ideal sized substrate for White Sucker along the points measured.

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.

# 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 Dillon and Young's Rapids to determine if there is habitat – nursery, rearing, and foraging – for Walleye and Sucker fry. To assess nursery, rearing, and foraging habitat, EGBSC combined bathymetry and side scan sonar data, aerial photos, and underwater survey 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, 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 likely varies 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. Finally, the fourth challenge was integrating all of the data collected.

## Underwater Surveys

Bathymetry and side scan sonar data could only be collected from the mouth of the Shebeshekong River upstream to a point on the river referred to as Tumbling Rock (approximately 200 m downstream of Dillon Rapids). A shallow bedrock shelf across the rapids at Tumbling Rock prevented boat navigation farther upstream. Underwater videos were collected from this point up to Young's Rapids by canoe. Underwater videos were taken on a GoPro camera for approximately 100 m every 1 km. In total, EGBSC carried out nine underwater surveys. Underwater survey locations between Dillon Rapids and the outlet of the Shebeshekong River are identified in Figure 29. Survey locations between Dillon Rapids and Young's Rapids are shown in Figure 30. See Appendix F for bathymetry maps.

**Figure 29.** Underwater survey locations between the mouth of the Shebeshekong River and Dillon Rapids

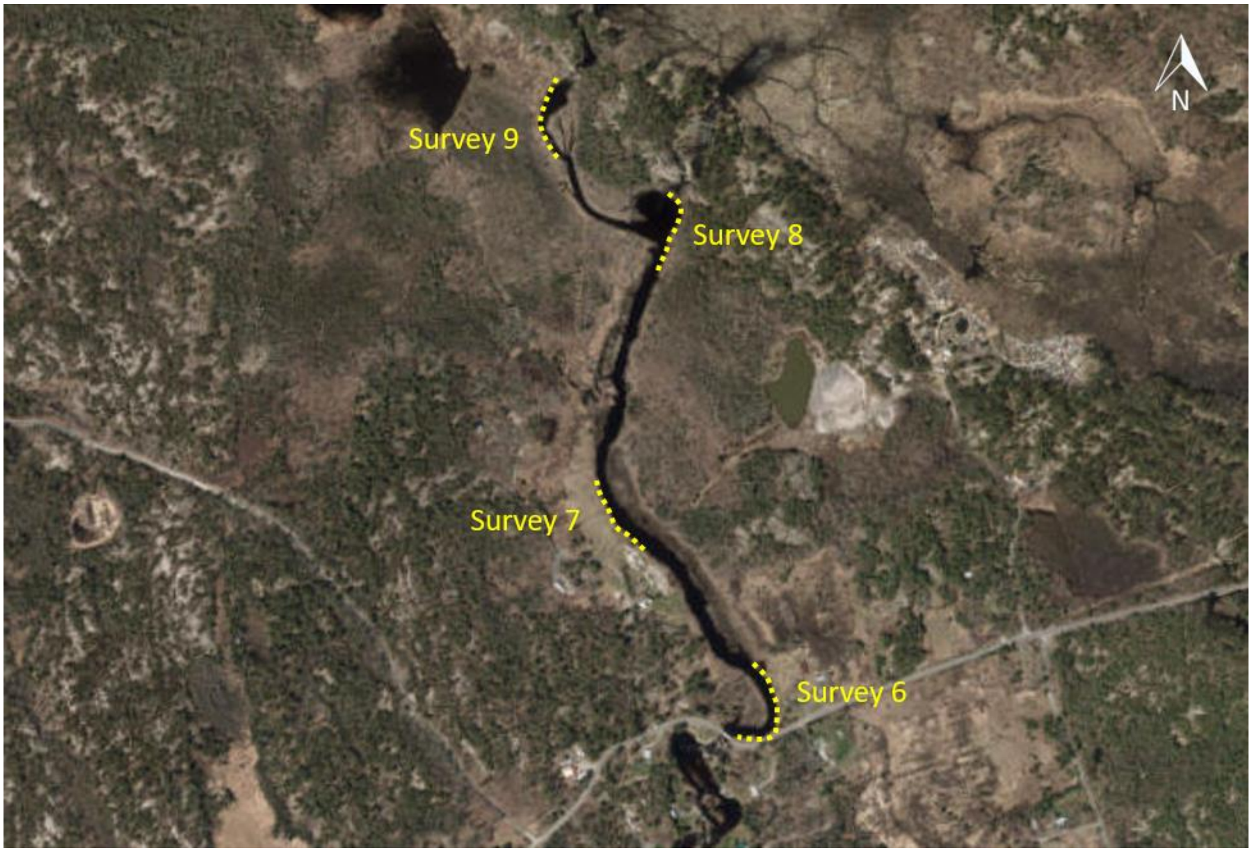



**Figure 30.** Underwater survey locations between Dillon Rapids and Young's Rapids

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 nine 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 | Substrate | Woody Debris | Aquatic Vegetation | Shoreline Characteristics |
|---|---|---|---|---|
| 1 | Soft | None | Abundant | Large marsh, another branch connecting to Georgian Bay |
| 2 | Soft | None | Abundant | Large marsh |
| 3 | Soft | None | Abundant | Marsh changing into upland |
| 4 | Soft | Sparse | Moderate | Buildings with mowed grass, small natural buffer |

| Survey | Substrate | Woody Debris | Aquatic Vegetation | Shoreline Characteristics |
| --- | --- | --- | --- | --- |
| 5 | Soft substrate with clusters of cobble and boulder | Moderate | Ranges from sparse to abundant | Started as a marshy instream island and ended with a short, forested buffer between the river and the road and residential area |
| 6 | Soft substrate with cobble and small boulders, some large gravel | Sparse | Moderate | Started at the upstream end of Dillon bridge with riprap and the edge of the road as shoreline, residence with mowed grass |
| 7 | Mainly soft with patches of cobble and small boulders, two very large boulders | Moderate | Moderate for 3/4 of the survey, sparse for 1/4 of the survey | Natural meadow shoreline, undercut banks provide good fish habitat |
| 8 | Soft | Moderate | Moderate for 3/4 of the survey, abundant for 1/4 of the survey | Wetland with dead trees, forest set farther back |
| 9 | Clay | Sparse | Sparse | Bedrock and meadow, wetland with dead trees and forest set farther back from shoreline, undercut banks provide good fish habitat |

The following list of aquatic vegetation (submergent, emergent, and floating) was recorded from the nine surveys: Tapegrass, Richardson's Pondweed, Potamogeton spp. (several), White Water Lily, Juncus spp., Pickerelweed, algae, Canada Waterweed, Smartweed spp., Wild Rice, Sweet Gale, Common Cattail, Sedge spp., Blue Flag Iris, Buttonbush, Coontail, Arrowhead, and Fringed Sedge. The most abundant species were Tapegrass, Richardson's Pondweed, Wild Rice, Pickerelweed, Sedge spp., and algae.

## Shoreline Characteristics

Along each of the nine underwater surveys, shoreline characteristics were also recorded and photographed. Between the mouth of the river and Dillon Rapids, the shoreline is a mix of both natural and altered shoreline (84% natural, 16% altered) (Figure 31). Observed alterations included the road at Dillon bridge and houses with mown grass close to the shoreline and/or cleared beaches. In this stretch, the shoreline varies between patchy bedrock and forest. Closer to the river outlet, there is an extensive wetland area. Approximately 900 m upstream of the outlet, wetlands gives way to a mix of bedrock and forested areas.

Between Dillon and Young's Rapids, aside from two buildings and an area of mown grass, the shoreline is mainly natural with very few alterations. The shoreline is primarily wet meadow with forest set farther back from the shoreline (Figure 32) and a few areas with bedrock outcrops at the shoreline.

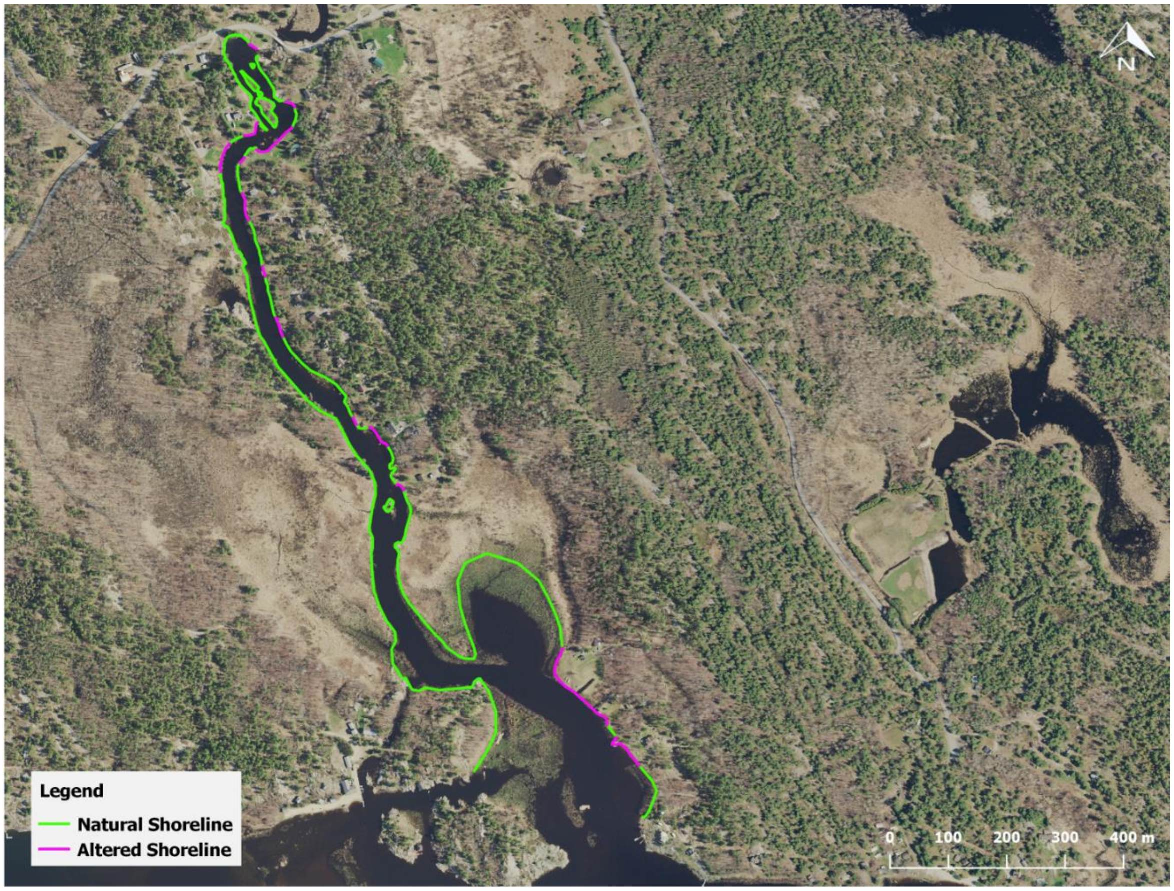


**Figure 31.** Natural and altered shoreline downstream of Dillon Rapids


**Figure 32.** View of Shebeshekong River upstream of Dillon Rapids showing wet meadow shoreline with forest set farther back

Overall, shoreline along four of the nine surveys had some type of alteration, some of which were very minor. Types of alterations identified were mown grass (one survey), buildings (two surveys), rip rap (two surveys), road (two surveys), and docks (two surveys). Types of natural shoreline that were observed were wetland (three surveys), forest with a wetland fringe (four surveys), wet meadow (three surveys), and bedrock with patchy vegetation (two 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 of the shoreline from each survey can be found in Appendix G. It is also important to note that surveys did not cover the entire length of the shoreline, therefore, not all alterations along the shoreline were recorded.

Two of the surveys had a low shoreline with soft substrate (wetland areas), four of the surveys had soft substrate, and three of the surveys had a mix of bedrock, cobble, boulder and soft substrate. In addition to substrate, shoreline vegetation was recorded for each survey. The following list of species was identified from the surveys:

- Sedge spp.
- Sweet Gale
- Meadowsweet
- Grass spp.
- Bracken Fern
- Sensitive Fern
- Royal Fern
- Red Oak
- White Pine
- Maple
- Alder spp.
- Goldenrod spp.
- Aster spp.
- White Birch
- Common Elderberry
- Spruce
- Buttonbush
- Wild Red Raspberry
- Spotted Joe-Pye Weed
- St. John's Wort
- Woolgrass
- Juncus spp.
- Tall Meadowrue
- Nodding Bur-Marigold
- Steeplebush
- Cardinal Flower
- Wild Clematis
- Blue Vervain

No invasive species were observed in the survey locations (aquatic or terrestrial).

# 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.

Flow in the Shebeshekong River during the spring spawning and egg incubation period is dependent on natural phenomena – winter snow load, rainfall, and air temperature affecting melting rate during the freshet. There are no upstream water control structures in the Shebeshekong River watershed. Because it is a very small watershed, it responds quickly to localized conditions and weather events. Run-off and water levels diminish quickly. Dramatic fluctuations in water levels were observed at Dillon Rapids in 2016, and in years with less rainfall, there is very little water running through the rapids in late summer and fall.

Between day and night visual observations in 2016 and 2017, there were very few Walleye seen. Additionally, Walleye were not observed moving upstream of Dillon Rapids. Underwater infrared cameras set upstream of Dillon Rapids recorded other fish species, including White Sucker, but did not capture any video of Walleye. White Sucker were observed passing through Dillon Rapids and Young's Rapids. In 2016, White Sucker were successful in passing through Young's Rapids, but they did not seem to be successful in 2017. No White Sucker were recorded on the camera set at the top of Young's Rapids in 2017.

A very low number of Walleye and Sucker eggs were counted on the egg mats at Dillon Rapids in 2016. In addition, three of the four mats were removed and could not be counted. There were no eggs deposited on any of the mats in 2017, but due to high water levels, egg mats were set late, likely after Walleye had spawned. Based on visual observations of eggs, there is some egg deposition that occurs on the south shore of Dillon Rapids; however, these eggs are prone to stranding. There is an area of cobble and small boulder at the base of the spawning bed where there was also some egg deposition. A small portion of the area is vulnerable to egg stranding. EGBSC conducted extensive night surveys in 2017 that started before Walleye moved into the river and ended a few weeks after they were last observed. Based on observations and the amount of egg deposition seen, there were very few Walleye that moved into Shebeshekong River to spawn and very little successful reproduction occurring at the site.

Based on information gathered from landowners and First Nation community members, both Dillon and Young's Rapids have been modified by human activities. Those modifications have changed the hydrology at both sites and have made it more difficult for Walleye and White Sucker to access historical spawning areas farther upstream of Young's Rapids.

There is a small area of spawning habitat available at Dillon Rapids. In some locations where spawning habitat was added as part of past restoration efforts, there are now two patches of vegetation that were not present in aerial photos from the 1980s. In addition to a lack of high-quality spawning habitat, the vulnerability of Dillon Rapids to water level fluctuations makes it a poor spawning site.

There is a greater amount of spawning habitat at Young's Rapids, but the spawning habitat at Lockett Lake Rapids and farther upstream is much better quality. At Lockett Lake Rapids the morphology of the spawning bed (long, rectangular, and deeper) makes it less vulnerable to egg stranding. Because of these site characteristics, EGBSC recommended that fish passage up to Lockett Lake Rapids be improved.

Based on the underwater surveys and visual observations, the shoreline from Lockett Lake Rapids to Young's Rapids is all natural, and the area surrounding the river is an extensive wetland with areas of bedrock outcrops and patchy vegetation. From Young's Rapids downstream towards Dillon, the shoreline is natural and is mainly wet meadow with forested areas set farther back. This area provides important habitat for wildlife. A diversity of species, especially bird species, were observed during each site visit. Further downstream, human impacts begin just above Dillon Rapids including grass mown close to the water's edge, and buildings. From Dillon Rapids to the outlet of the river, there is more human activity and alterations (buildings, docks, mown grass close to the water's edge, artificial beach), and more bedrock and forest. At the outlet of the Shebeshekong River, there is an extensive wetland which provides important habitat for many species, and based on underwater surveys in 2016, provides habitat for many prey fish.

In 2017, Biotactic provided EGBSC with a restoration design to restore fish passage to Lockett Lake Rapids. The plan included the modification of the channel started by MNRF at Dillon Rapids in the 1980s, as well as, recreating the bypass channel at Young's Rapids. The restoration plan was carried out in October 2017. Follow up monitoring took place in spring 2018 and will continue in the future in order to assess whether the restoration is functioning as intended, whether access to Lockett Lake Rapids has been restored, or if further modifications are needed.

One recommendation from EGBSC's work is to survey the area immediately above and below Tumbling Rock to map habitat. Landowners and First Nation community members told EGBSC that in years with low Georgian Bay water levels, spawning is limited to Tumbling Rock, and it is unknown whether sufficient habitat is present at this site. It is possible that a future restoration project could ensure there is accessible spawning habitat in the Shebeshekong River in years with both lower and higher Georgian Bay water levels.

# Acknowledgements

We would like to thank the many neighbours living around the Shebeshekong River for their help and input during this project, including Terry Christenson, Caroline Holm, Roy and Earl Milligan, and Bill Davis.

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- 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

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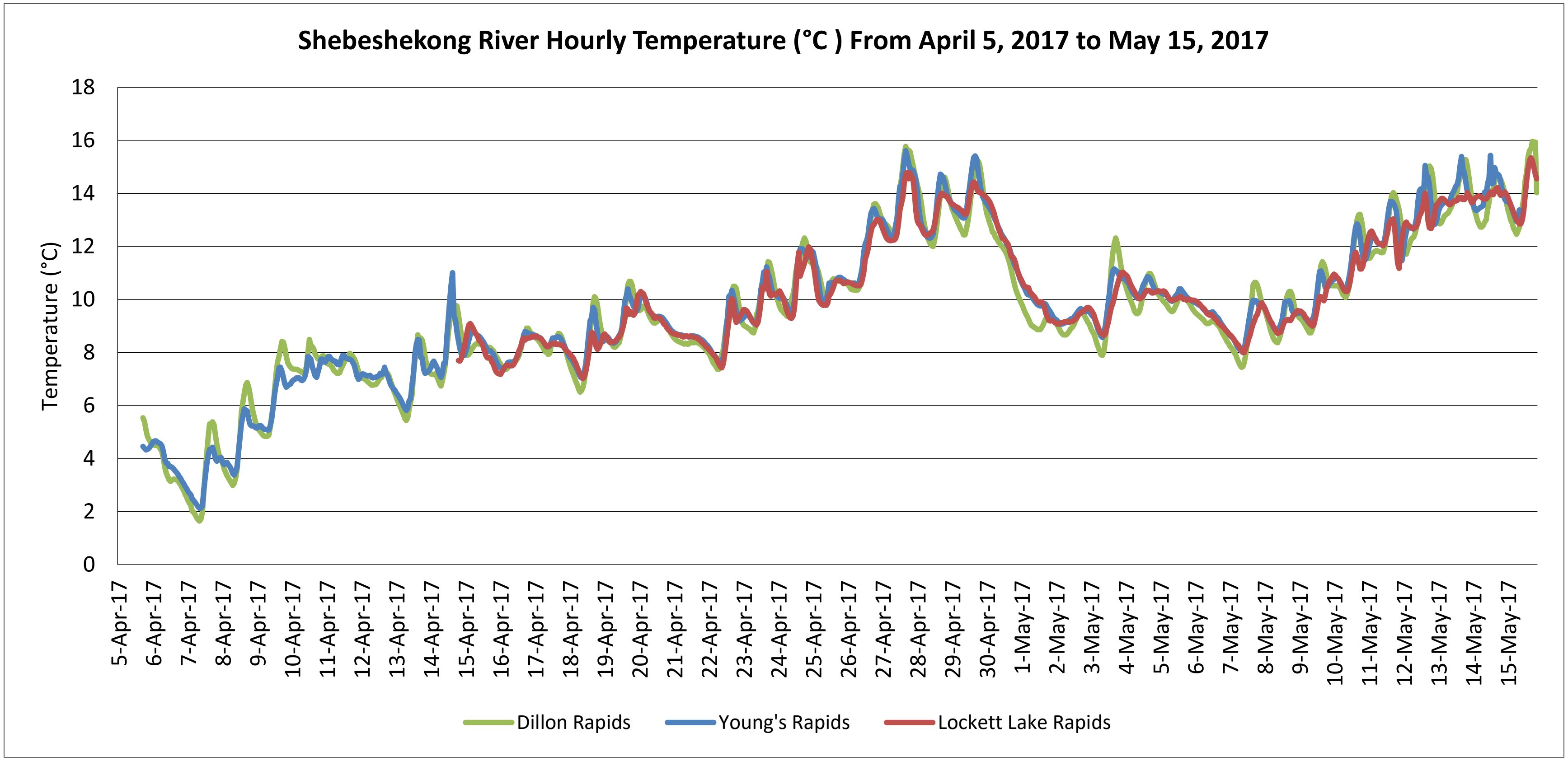
# Appendix A – Water Chemistry

**Water Chemistry – Dillon Rapids, 2016**

| Date | Time | Temperature (°C) | DO (mg/L) | DO (%) | pH | Conductivity |
|---|---|---|---|---|---|---|
| 15-Apr | 14:30 | 7 | 12.86 | 106.7 | 5.45 | 44.1 |
| 20-Apr | 17:46 | 12.8 | 10.93 | 102.9 | 6.41 | 41.9 |
| 23-Apr | 13:50 | 11.1 | 10.44 | 94.5 | 6.45 | 44.6 |
| 26-Apr | 18:00 | 10 | 10.7 | 94.9 | 6.39 | 43.7 |
| 29-Apr | 15:01 | 10.5 | 10.25 | 91.8 | 6.68 | 45.7 |
| 02-May | 15:30 | 13.1 | 9.55 | 91 | 6.13 | 45.8 |
| 05-May | 17:15 | 16.1 | 8.94 | 91.1 | 6.33 | 45.2 |
| 09-May | 14:30 | 12.7 | 9.56 | 91 | 6.39 | 44.4 |
| 12-May | 14:30 | 15.6 | 8.42 | 84.5 | 5.94 | 46.2 |
| 16-May | 13:12 | 10.4 | 9.21 | 82.2 | 5.89 | 32.8 |
| 19-May | 15:22 | 15.9 | 9.2 | 93 | 6.16 | 39.7 |
| 23-May | 14:50 | 18.6 | 7.77 | 83.1 | 5.72 | 46.9 |

**Water Chemistry – All Sites, 2017**

| Site | Date | Temperature ˚C | DO mg/L | DO % | pH | Conductivity |
|---|---|---|---|---|---|---|
| Dillon | Apr 10/17 | 8.1 | 11.45 | 96.4 | 5.35 | 42.1 |
| Dillon | Apr 11/17 | 7.2 | 11.5 | 94.9 | 5.51 | 45.2 |
| Young's | Apr 11/17 | 7.4 | 11.17 | 93 | 5.66 | 47.6 |
| Lockett | Apr 14/17 | 7.8 | 11.74 | 98.8 | 5.44 | 52.5 |
| Young's | Apr 14/17 | 8.4 | 12.06 | 102.7 | 5.86 | 52.3 |
| Tumbling Rock | Apr 14/17 | 7.5 | n/a | n/a | n/a | n/a |
| Dillon | Apr 15/17 | 8.1 | 11.55 | 97.6 | 5.92 | 50 |
| Tumbling Rock | Apr 16/17 | 7.8 | n/a | n/a | n/a | n/a |
| Young's | Apr 17/17 | 8.2 | 11.66 | 98.8 | 5.93 | 47.5 |
| Dillon | Apr 17/17 | 8.2 | 11.72 | 99.5 | 6.05 | 42.6 |
| Dillon | Apr 19/17 | 9.4 | n/a | n/a | n/a | n/a |
| Young's | Apr 24/17 | 10.25 | n/a | n/a | n/a | n/a |
| Dillon | Apr 24/17 | 10 | n/a | n/a | n/a | n/a |
| Young's | Apr 29/17 | 13.9 | 9.59 | 92.6 | 6.09 | 52.1 |
| Dillon | Apr 29/17 | 13.7 | 9.64 | 93 | 6.17 | 49.2 |
| Lockett | May 19/17 | 17.9 | 8.32 | 88 | 6.59 | 59 |
| Young's | May 19/17 | 18.4 | 8.23 | 87.7 | 6.53 | 58 |
| Dillon | May 19/17 | 17.4 | 9.64 | 100.5 | 5.94 | 52.6 |




Note: The Young’s Rapids temperature logger was found out of water and adjusted on April 14.

# Appendix B – Water Level and Velocity

**Water Level Data – Dillon Rapids, 2016**

| Benchmark | Date | Depth (cm) |
|---|---|---|
| 1 | 20-Apr | 19 |
| 1 | 23-Apr | 24 |
| 1 | 26-Apr | 24.7 |
| 1 | 29-Apr | 28.5 |
| 1 | 02-May | 25 |
| 1 | 05-May | 25.5 |
| 1 | 09-May | 21 |
| 1 | 12-May | 31 |
| 1 | 16-May | 23.5 |
| 1 | 19-May | 20 |
| 1 | 23-May | 20.5 |
| 2 | 20-Apr | 16 |
| 2 | 23-Apr | 29 |
| 2 | 26-Apr | 37.3 |
| 2 | 29-Apr | 40 |
| 2 | 02-May | 0 |
| 2 | 05-May | 61.5 |
| 2 | 09-May | 59 |
| 2 | 12-May | 67.5 |
| 2 | 16-May | 29 |
| 2 | 19-May | 41 |
| 2 | 23-May | 50.5 |
| 3 | 20-Apr | 5.05 |
| 3 | 23-Apr | 24 |
| 3 | 26-Apr | 28 |
| 3 | 29-Apr | 33 |
| 3 | 02-May | 36 |
| 3 | 05-May | 44 |
| 3 | 09-May | 0 |
| 3 | 12-May | 0 |
| 3 | 16-May | 25 |
| 3 | 19-May | 31 |
| 3 | 23-May | 37 |
| 4a | 20-Apr | 14.5 |
| 4a | 23-Apr | 12.5 |
| 4a | 26-Apr | 19 |
| 4a | 29-Apr | 24.5 |
| 4a | 02-May | 34 |
| 4a | 05-May | 47 |
| 4a | 09-May | 46 |
| 4a | 12-May | 46 |
| 4a | 16-May | 13 |
| 4a | 19-May | 23 |
| 4a | 23-May | 36 |
| 4b | 20-Apr | n/a |

| | | |
|---|---|---|
| 4b | 23-Apr | n/a |
| 4b | 26-Apr | n/a |
| 4b | 29-Apr | n/a |
| 4b | 02-May | n/a |
| 4b | 05-May | n/a |
| 4b | 09-May | n/a |
| 4b | 12-May | n/a |
| 4b | 16-May | n/a |
| 4b | 19-May | n/a |
| 4b | 23-May | n/a |
| 5 | 20-Apr | 24 |
| 5 | 23-Apr | 20 |
| 5 | 26-Apr | 26.5 |
| 5 | 29-Apr | 34 |
| 5 | 02-May | 41 |
| 5 | 05-May | 45 |
| 5 | 09-May | 52.5 |
| 5 | 12-May | 60 |
| 5 | 16-May | 23.5 |
| 5 | 19-May | 33 |
| 5 | 23-May | 46 |

**Velocity Data (m/s) – Dillon Rapids, 2016**

| Date | Station 1 | Station 2 | Station 3 | Station 4a | Station 4b | Station 5 |
|---|---|---|---|---|---|---|
| 20-Apr | 1.02 | 0.27 | 0.71 | 0.6 | no flow | 1 |
| 23-Apr | | 0.3 | 1.02 | 0.13 | no flow | 1.37 |
| 26-Apr | 1.25 | 0.19 | 0.4 | 0.06 | no flow | 0.64 |
| 29-Apr | 1.75 | 0.39 | 0.15 | 0.1 | no flow | 0.65 |
| 02-May | 1.22 | 0.12 | 0.12 | no flow | 1.71 | 0.54 |
| 05-May | 0.86 | 0.36 | no flow | no flow | 1.14 | 0.08 |
| 09-May | 0.43 | 0.14 | no flow | no flow | 1.51 | 0.31 |
| 12-May | 0.84 | 0.25 | no flow | no flow | 1.51 | 0.2 |
| 16-May | 2.43 | 0.38 | 0.52 | 0.32 | 0.72 | 0.57 |
| 19-May | 1.31 | 0.15 | 0.38 | -0.03 | 1.93 | 0.48 |
| 23-May | 1.4 | 0.27 | 0.07 | 0.02 | 1.79 | 0.3 |

**Velocity Data – Young's Rapids, 2016**

| Station | Date | Velocity (m/s) |
|---|---|---|
| 1 | 26-Apr | 0.46 |
| 1 | 29-Apr | 0.73 |
| 2 | 26-Apr | 0.95 |
| 2 | 29-Apr | 0.56 |
| 3 | 26-Apr | 1.35 |
| 3 | 29-Apr | 1.34 |
| 4 | 26-Apr | 0.60 |
| 4 | 29-Apr | 0.30 |

**Velocity Data – Dillon Rapids, 2017**

| Station | Date | Velocity (m/s) |
|---|---|---|
| 1 | 11-Apr | 1.74 |
| 2 | | 0.79 |
| 3 | | 1.6 |
| 4 | | 0.28 |
| 5 | | 0.59 |
| 1 | 14-Apr | 1.51 |
| 2 | | 0.16 |
| 3 | | 1.28 |
| 4 | | 0.48 |
| 5 | | 0.4 |
| 1 | 17-Apr | 1.65 |
| 2 | | 0.29 |
| 3 | | 1.4 |
| 4 | | 0.24 |
| 5 | | 0.55 |
| 1 | 29-Apr | 1.7 |
| 2 | | 0.72 |
| 3 | | 0.95 |
| 4 | | 0.27 |
| 5 | | 0.56 |

**Velocity Data – Young's Rapids, 2017**

| Station | Date | Velocity (m/s) |
|---|---|---|
| 1 | 10-Apr | 0.92 |
| 2 | | 1.04 |
| 3 | | 0.17 |
| 1 | 14-Apr | 0.69 |
| 2 | | 0.57 |
| 3 | | 0.2 |
| 1 | 17-Apr | 0.82 |
| 2 | | 0.64 |
| 3 | | -0.05 |
| 1 | 29-Apr | 0.28 |
| 2 | | 0.61 |
| 3 | | 0.27 |

# Appendix C – Visual Observations

**Visual Observations – Dillon Rapids, 2016**

| Date | Day/Night | Water Temp (°C) | Walleye Observed | Common White Sucker Observed | Logperch Observed |
|---|---|---|---|---|---|
| 15-Apr | Day | 7 | 0 | 0 | 0 |
| 18-Apr | Night | n/a | 11 - south shore | 0 | 0 |
| 20-Apr | Night | 12.8 | 0 | 7 - under bridge | 0 |
| 22-Apr | Night | n/a | 1 - south shore | 5 - under bridge | 0 |
| 23-Apr | Day | 11.1 | 0 | 5 - under bridge | 0 |
| 26-Apr | Both | 10 | 0 | 11 - south shore (9), under bridge (2) | 0 |
| 29-Apr | Day | 10.5 | 0 | 0 | 30 or more |
| 02-May | Day | 13.1 | 0 | 0 | 50 or more |
| 05-May | Day | 16.1 | 0 | 0 | 50 or more |
| 09-May | Day | 12.7 | 0 | 0 | n/a |
| 12-May | Day | 15.6 | 0 | 0 | n/a |
| 16-May | Day | 10.4 | 0 | 0 | n/a |
| 19-May | Day | 15.9 | 0 | 0 | n/a |
| 23-May | Day | 18.6 | 0 | 0 | 10 or more |
| 31-May | Day | n/a | 0 | 0 | n/a |

**Visual Observations – Young's Rapids, 2016**

| Date | Day/Night | Water Temp (°C) | Walleye Observed | Common White Sucker Observed |
|---|---|---|---|---|
| 22-Apr | Night | 10.5 | 0 | ~100 |
| 26-Apr | Night | 9 | 0 | 0 |
| 29-Apr | Night | 11.0 | 0 | 0 |
| 09-May | Day | n/a | 0 | 0 |

**Visual Observations – All Sites, 2017**

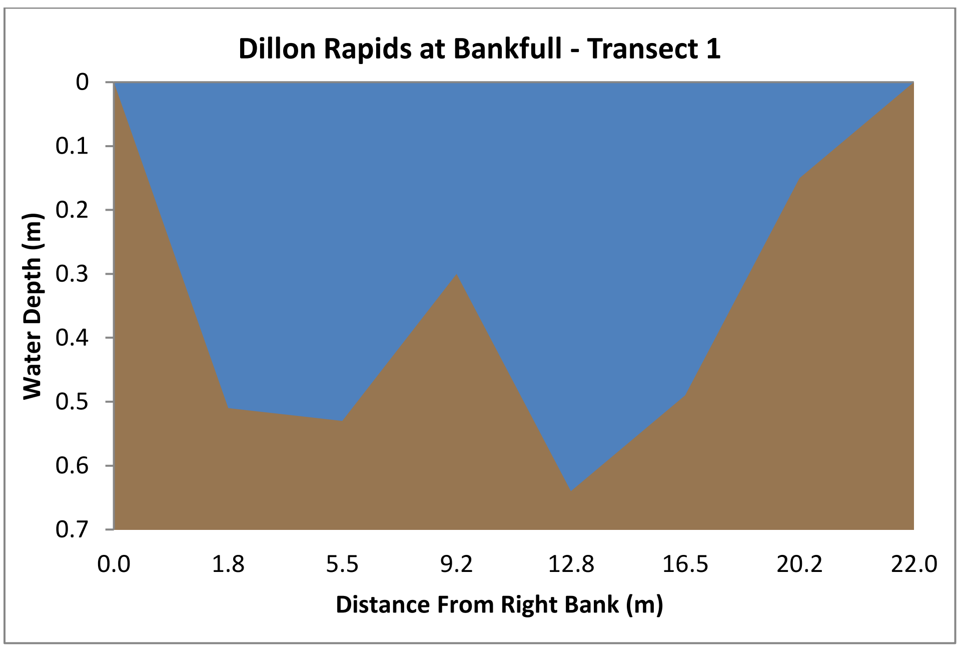
| Date | Species Observed |
|---|---|
| Apr 11/17 | 2 Northern Pike at Young's |
| Apr 11/17 | Yellow Perch, Northern Pike, several Common White Sucker |
| Apr 13/17 | 2 Common White Sucker, 1 small Norther Pike, 1 Walleye |
| Apr 14/17 | 5 Walleye at Tumbling Rock, 3 Walleye at Dillon |
| Apr 16/17 | 4 Walleye at Tumbling Rock, none observed at Dillon; several Common White Sucker |
| Apr 17/17 | No fish observed |
| Apr 18/17 | Several Common White Sucker, no Walleye |
| Apr 19/17 | Common White Sucker but no Walleye (Biotactic's observations) |
| Apr 21/17 | Common White Sucker but no Walleye, Northern Pike |
| Apr 24/17 | A few Common White Sucker at Dillon using Dexpan channel, no Walleye |
| Apr 29/17 | Common White Sucker at Young's trying to swim up rapids but no successful attempts observed |

# Appendix D – Dillon Rapids Transect Data

**Transect 1**

| Point | Depth (m) | | Particle sizes | Aquatic vegetation present |
|---|---|---|---|---|
| | Bankfull | Present | | |
| (1) 1.83 | 0.51 | 0.08 | 100% bedrock | none |
| (2) 5.50 | 0.53 | 0.14 | 100% bedrock | |
| (3) 9.17 | 0.3 | 0.05 | 100% bedrock | none |
| (4) 12.84 | 0.64 | 0.38 | 100% bedrock | none |
| (5) 16.51 | 0.49 | 0.18 | 100% bedrock | none |
| (6) 20.18 | 0.15 | 0 | 100% bedrock | none |

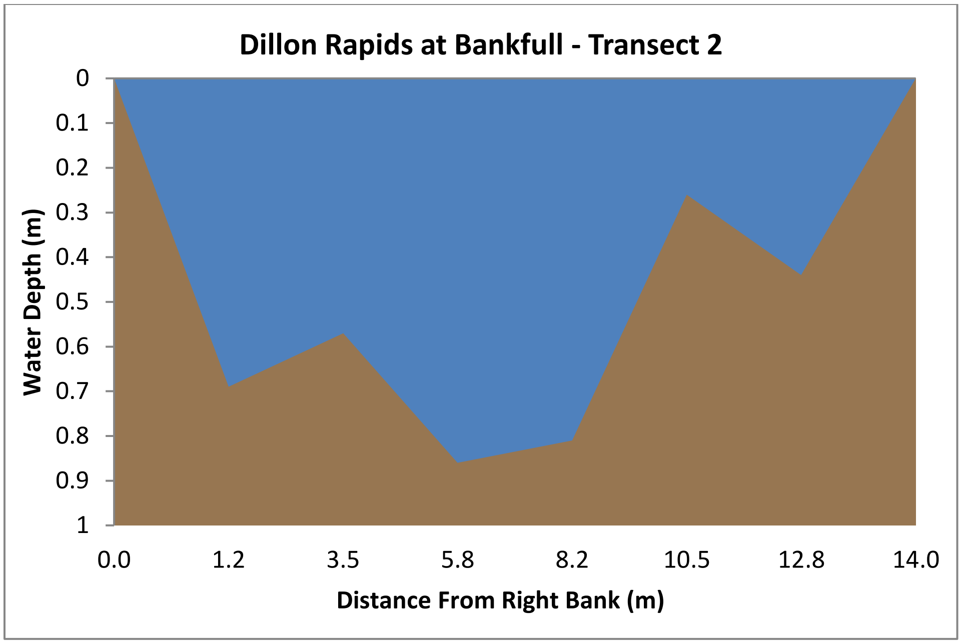
| **Walleye** | | **Point 1** | **Point 2** | **Point 3** | **Point 4** | **Point 5** | **Point 6** |
|---|---|---|---|---|---|---|---|
| Optimal depth (m) | 0.3 - 1.0 | | | | | | |
| Optimal substrate (cm) | 0.2 - 25 | | | | | | |
| **Sucker species** | | | | | | | |
| Optimal depth (m) | | | | | |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



**Transect 2**

| Point | Depth (m) | | Particle sizes | Aquatic vegetation present |
|---|---|---|---|---|
| | Bankfull | Present | | |
| (1) 1.17 | 0.69 | 0.02 | 100% bedrock | very sparse algae |
| (2) 3.50 | 0.57 | 0 | 100% bedrock | none |
| (3) 5.83 | 0.86 | 0.21 | 100% bedrock | none |
| (4) 8.16 | 0.81 | 0.2 | 100% bedrock | none |
| (5) 10.49 | 0.26 | 0 | 100% bedrock | none |
| (6) 12.82 | 0.44 | 0 | 100% bedrock | 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 | | | | | | |
| **Sucker species** | | | | | | | |
| Optimal depth (m) | | | | | | | |
| Optimal substrate (cm) | 0.2 - 1.6 | | | | | | |

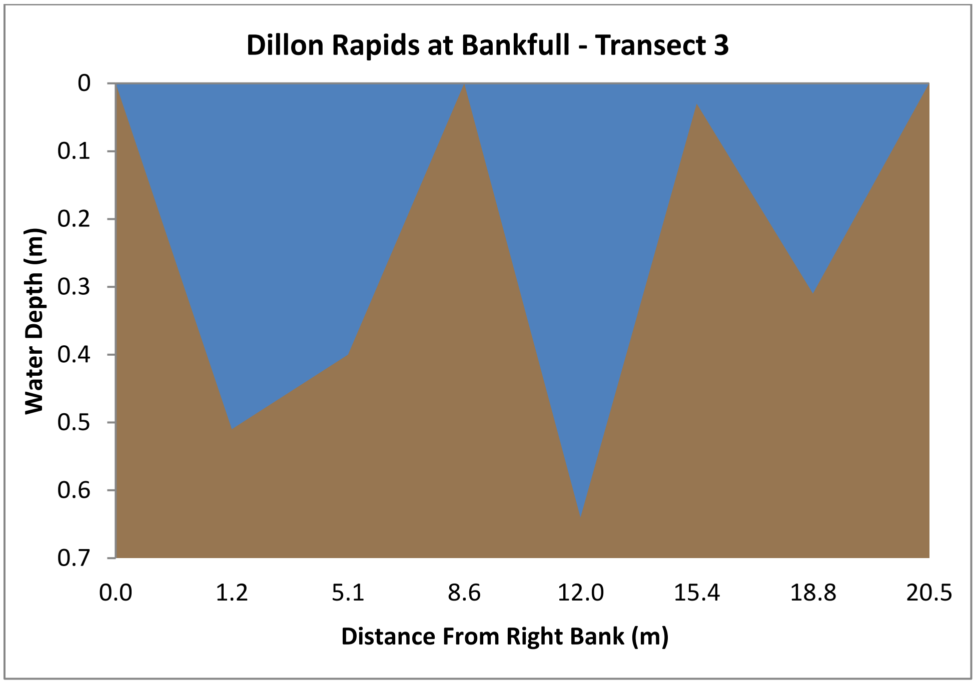



**Transect 3**

| Point | Depth (m) | | Particle sizes | Aquatic vegetation present |
|---|---|---|---|---|
| | Bankfull | Present | | |
| (1) 1.17 | 0.51 | 0 | 100% bedrock | none |
| (2) 5.13 | 0.4 | 0 | 100% bedrock | none |
| (3) 8.55 | 0 | 0 | 100% bedrock | none |
| (4) 11.97 | 0.64 | 0.04 | 50% bedrock, 50% cobble | none |
| (5) 15.39 | 0.03 | 0.39 | 60% bedrock, 40% cobble (unclear, no photo) | none |
| (6) 18.81 | 0.31 | 0 | 100% bedrock | 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 | | | | * | * | |
| **Sucker species** | | | | | | | |
| Optimal depth (m) | | | | | | | |
| Optimal substrate (cm) | 0.2 - 1.6 | | | | | | |

*mixed substrate, some optimal

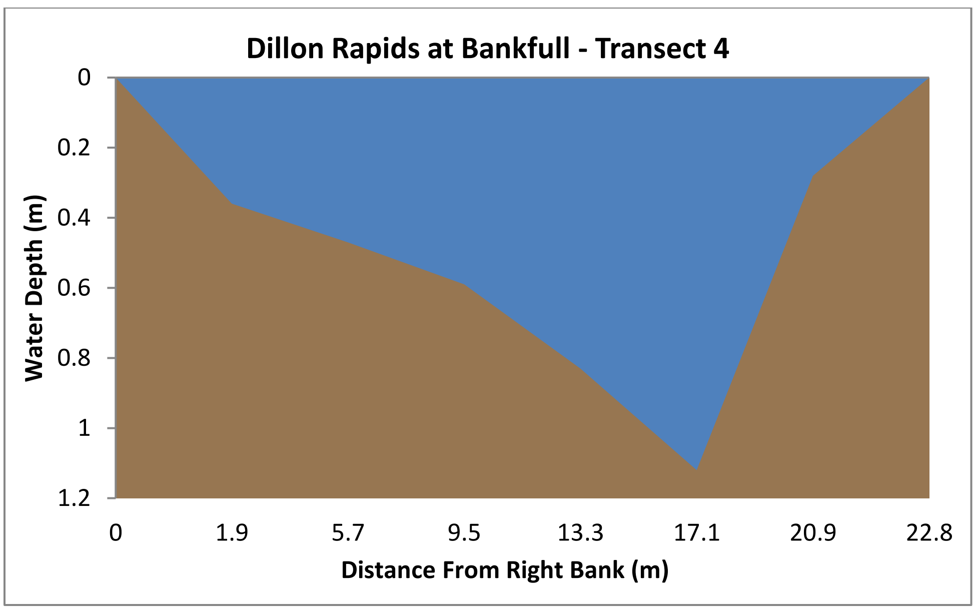



**Transect 4**

| Point | Depth (m) | | Particle sizes | Aquatic vegetation present |
|---|---|---|---|---|
| | Bankfull | Present | | |
| (1) 1.90 | 0.36 | 0 | 80% cobble, 20% sm stone | terrestrial veg (largely grasses) |
| (2) 5.70 | 0.47 | 0 | 50% vegetated, 50% bedrock | terrestrial veg (largely grasses) |
| (3) 9.50 | 0.59 | 0.14 | 70% soil/veg, 20% bedrock, 10% sm boulder | terrestrial veg (largely grasses) |
| (4) 13.30 | 0.83 | 0.39 | 60% bedrock, 40% cobble | none |
| (5) 17.10 | 1.12 | 0.62 | Unclear | none |
| (6) 20.90 | 0.28 | 0 | 100% vegetated | terrestrial veg (largely grasses) |

| **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 | | | | * | | |
| **Sucker species** | | | | | | | |
| Optimal depth (m) | | | | | | | |
| Optimal substrate (cm) | 0.2 - 1.6 | * | | | | | |

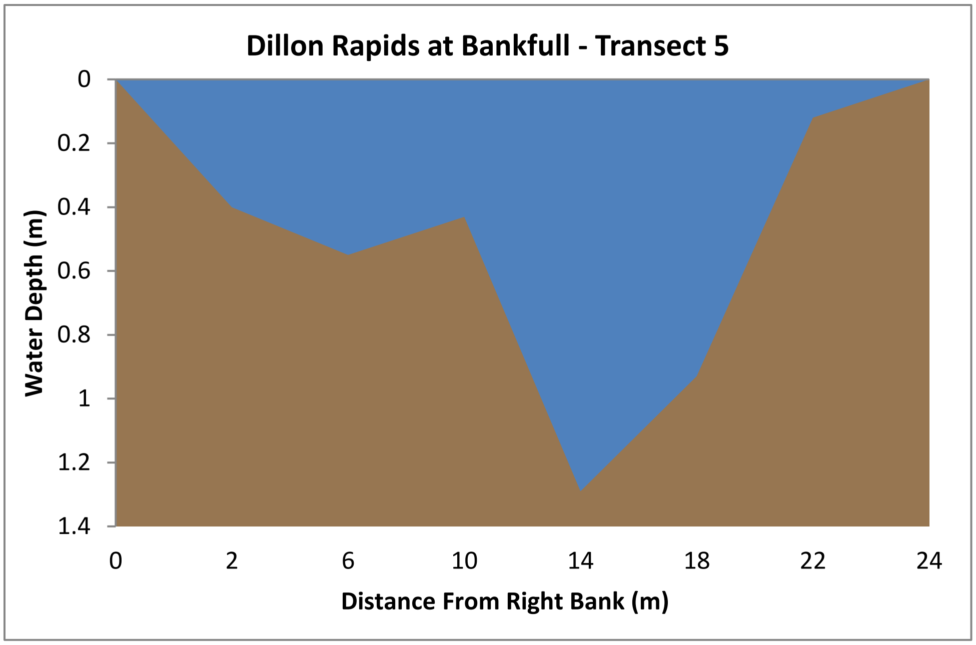
*mixed substrate, some optimal



**Transect 5**

| Point | Depth (m) | | Particle sizes | Aquatic vegetation present |
|---|---|---|---|---|
| | Bankfull | Present | | |
| (1) 2.0 | 0.4 | 0 | 100% cobble in veg | terrestrial veg |
| (2) 6.0 | 0.55 | 0.08 | 30% sm boulder, 70% soil | terrestrial veg |
| (3)10.0 | 0.43 | 0.06 | 100% soil/veg | see p. 106 and 107, terrestrial veg and reeds |
| (4) 14.0 | 1.29 | 1.04 | unclear, feels like cobble | none |
| (5) 18.0 | 0.93 | 0.66 | 100% cobble | none |
| (6) 22.0 | 0.12 | 0 | 100% vegetated | 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 | | | | | | |
| **Sucker species** | | | | | | | |
| Optimal depth (m) | | | | | | | |
| Optimal substrate (cm) | 0.2 - 1.6 | | | | | | |



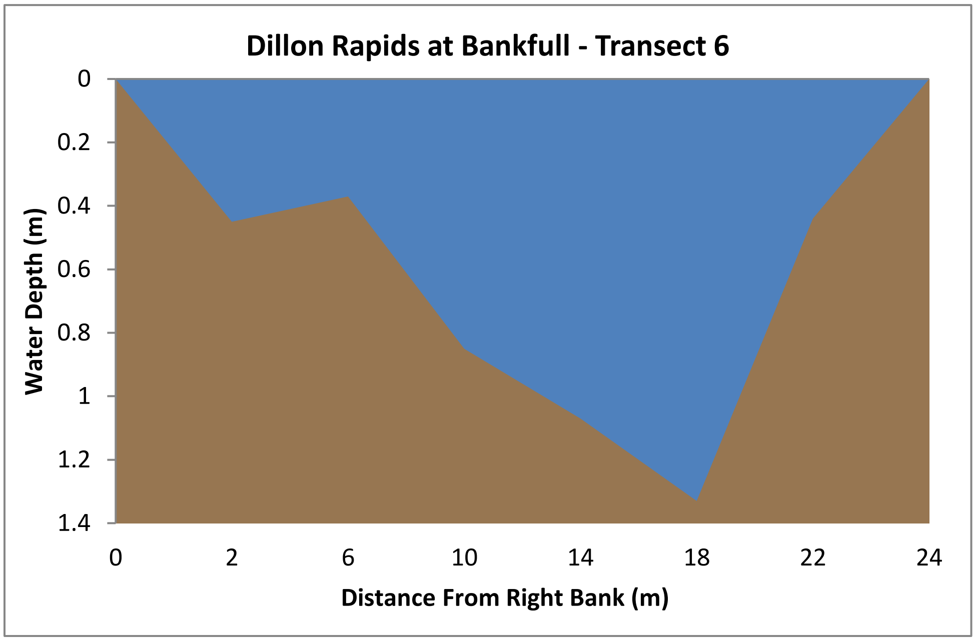

**Transect 6**

| Point | Depth (m) | | Particle sizes | Aquatic vegetation present |
|---|---|---|---|---|
| | Bankfull | Present | | |
| (1) 2.0 | 0.45 | 0 | 90% cobble, 10% soil | terrestrial veg (see substrate photo) |
| (2) 6.0 | 0.37 | 0 | 100% vegetated | terrestrial veg (see substrate photo) |
| (3)10.0 | 0.85 | 0.46 | 70% cobble, 30% soil | see substrate photo |
| (4) 14.0 | 1.07 | 0.67 | 100% cobble, too deep for photo | none |
| (5) 18.0 | 1.33 | 0.87 | 100% cobble | none |

| | | | | |
|---|---|---|---|---|
| (6) 22.0 | 0.44 | 0 | 100% vegetated | see substrate photo |

| 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 | | | * | | | |
| **Sucker species** | | | | | | | |
| Optimal depth (m) | | | | | | | |
| Optimal substrate (cm) | 0.2 - 1.6 | | | * | | | |

*mixed substrate, some optimal

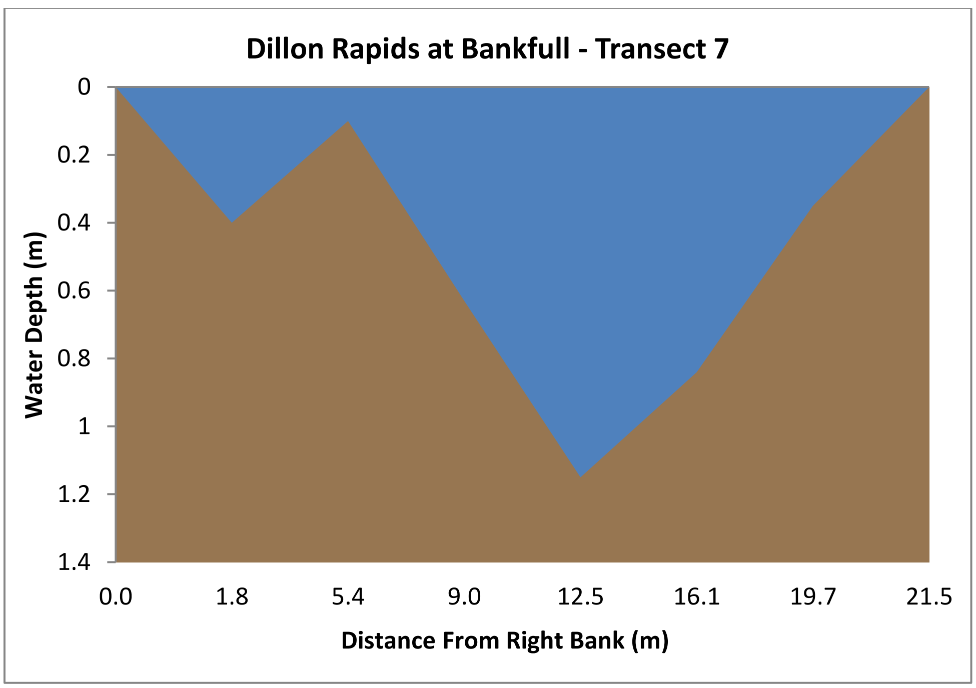



**Transect 7**

| Point | Depth (m) | | Particle sizes | Aquatic vegetation present |
|---|---|---|---|---|
| | Bankfull | Present | | |
| (1) 1.79 | 0.4 | 0 | 50% bedrock, 50% vegetated | terrestrial veg (see substrate photo) |
| (2) 5.37 | 0.1 | 0 | 50% lg boulder, 50% sm boulder | see substrate photo |
| (3)8.95 | 0.63 | 0.41 | 100% cobble | none |
| (4) 12.53 | 1.15 | 0.92 | 100% cobble | none |
| (5) 16.11 | 0.84 | 0.63 | 60% cobble, 40% bedrock | none |
| (6) 19.69 | 0.35 | 0 | 100% bedrock | 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 | | | | | * | |
| **Sucker species** | | | | | | | |
| Optimal depth (m) | | | | | | | |
| Optimal substrate (cm) | 0.2 - 1.6 | | | | | | |

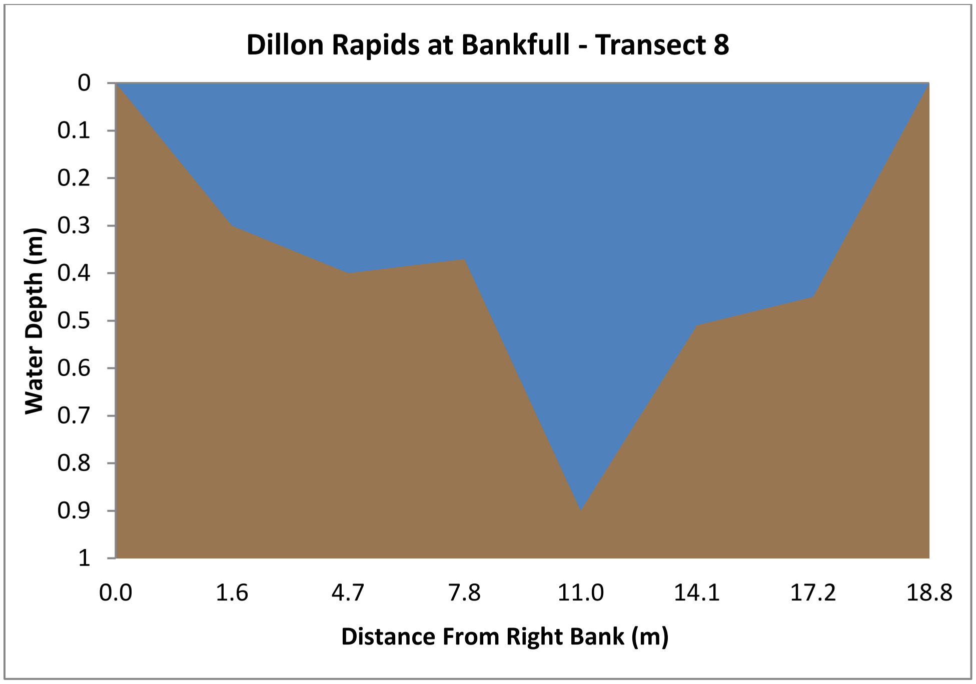
*mixed substrate, some optimal



**Transect 8**

| Point | Depth (m) | | Particle sizes | Aquatic vegetation present |
|---|---|---|---|---|
| | Bankfull | Present | | |
| (1) 1.57 | 0.3 | 0 | 100% bedrock | none |
| (2) 4.70 | 0.4 | 0.03 | 100% sm boulder | see substrate photo |
| (3) 7.83 | 0.37 | 0.05 | 100% lg boulder | none |
| (4) 10.96 | 0.9 | 0.64 | 100% lg boulder | debris caught up on boulders |
| (5) 14.09 | 0.51 | 0.21 | 100% bedrock, unclear no photo | debris caught up on boulders |
| (6) 17.22 | 0.45 | 0.04 | 100% bedrock, unclear no photo | 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 | | | | | | |
| **Sucker species** | | | | | | | |
| Optimal depth (m) | | | | | | | |
| Optimal substrate (cm) | 0.2 - 1.6 | | | | | | |

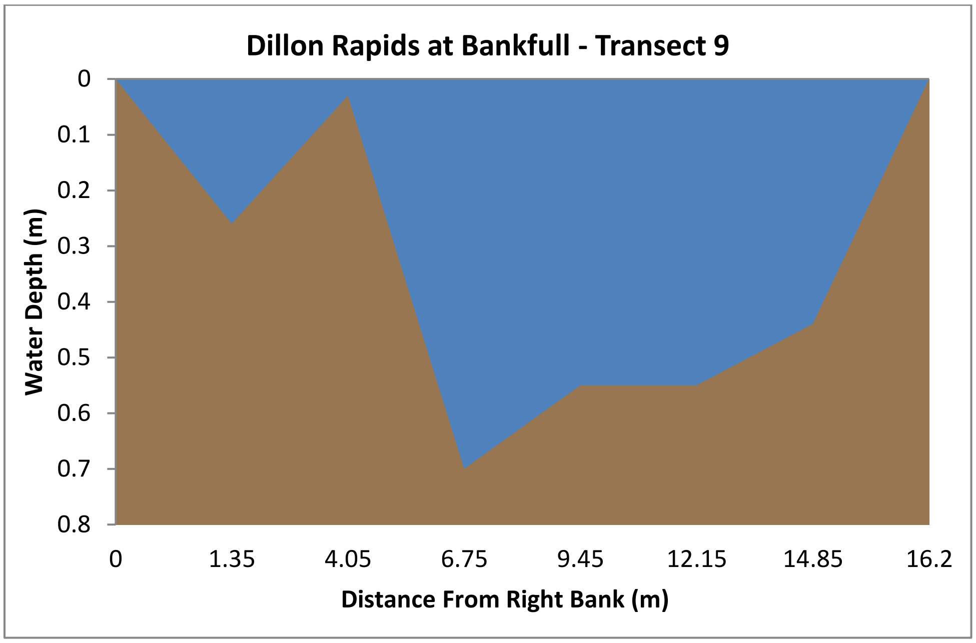



**Transect 9**

| Point | Depth (m) | | Particle sizes | Aquatic vegetation present |
|---|---|---|---|---|
| | Bankfull | Present | | |
| (1) 1.35 | 0.26 | 0 | 100% bedrock | none |
| (2) 4.05 | 0.03 | 0 | 100% lg boulder | none |
| (3) 6.75 | 0.7 | 0.31 | 90% cobble, 10% sm boulder | none |
| (4) 9.45 | 0.55 | 0.2 | 100% bedrock | none |
| (5) 12.15 | 0.55 | 0 | 50% lg boulder, 50% sm boulder, | none |
| (6) 14.85 | 0.44 | 0.02 | 100% bedrock | 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 | | | * | | | |
| **Sucker species** | | | | | | | |
| Optimal depth (m) | | | | | | | |
| Optimal substrate (cm) | 0.2 - 1.6 | | | | | | |

*mixed substrate, some optimal

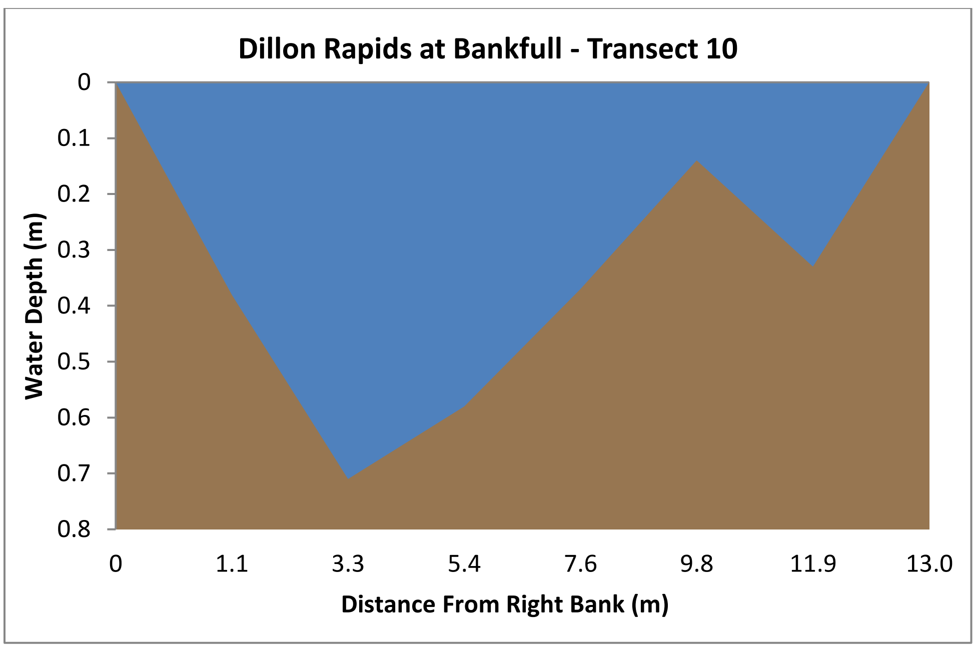



**Transect 10**

| Point | Depth (m) | | Particle sizes | Aquatic vegetation present |
|---|---|---|---|---|
| | Bankfull | Present | | |
| (1) 1.08 | 0.38 | 0 | 20% sm boulder, 30% bedrock, 50% cobble | terrestrial veg - grasses |
| (2) 3.25 | 0.71 | 0.31 | 100% cobble | none |
| (3) 5.42 | 0.58 | 0.26 | 60% sm boulder, 40% lg boulder | none |
| (4) 7.59 | 0.37 | 0.03 | 100% bedrock | none |
| (5) 9.76 | 0.14 | 0 | 100% lg boulder | none |
| (6) 11.93 | 0.33 | 0 | 100% bedrock | 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 | * | | | | | |
| **Sucker species** | | | | | | | |
| Optimal depth (m) | | | | | | | |
| Optimal substrate (cm) | 0.2 - 1.6 | | | | | | |

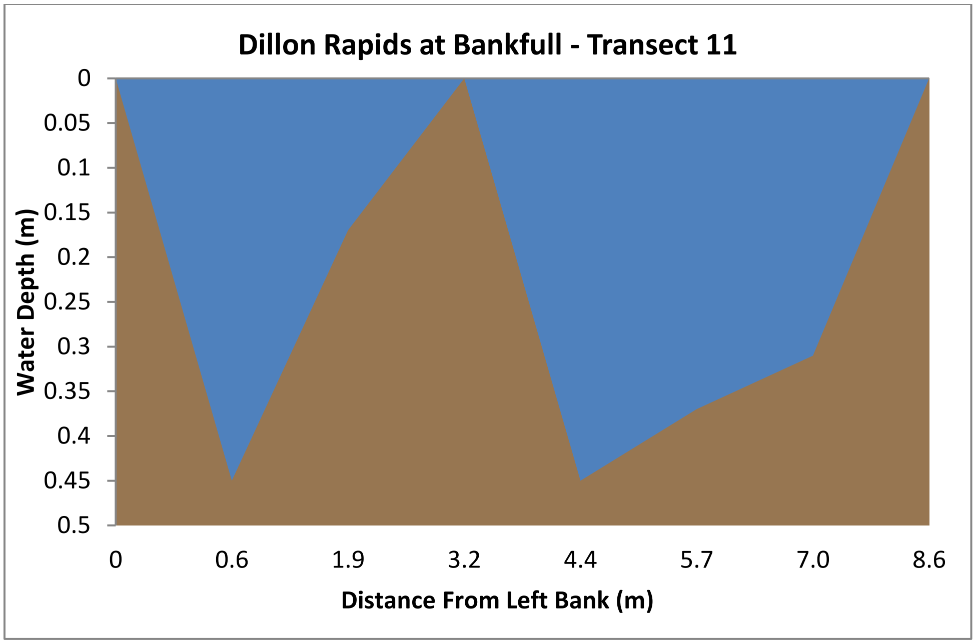
*mixed substrate, some optimal



**Transect 11**

| Point | Depth (m) | | Particle sizes | Aquatic vegetation present |
|---|---|---|---|---|
| | Bankfull | Present | | |
| (1) 0.63 | 0.45 | 0.06 | 100% bedrock | none |
| (2) 1.90 | 0.17 | 0 | 100% bedrock | none |
| (3) 3.17 | 0 | 0 | 100% bedrock | none |
| (4) 4.44 | 0.45 | 0 | 100% bedrock | none |
| (5) 5.71 | 0.37 | 0.02 | 100% bedrock | none |
| (6) 6.98 | 0.31 | 0.04 | 100% bedrock | 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 | | | | | | |
| **Sucker species** | | | | | | | |
| Optimal depth (m) | | | | | | | |
| Optimal substrate (cm) | 0.2 - 1.6 | | | | | | |

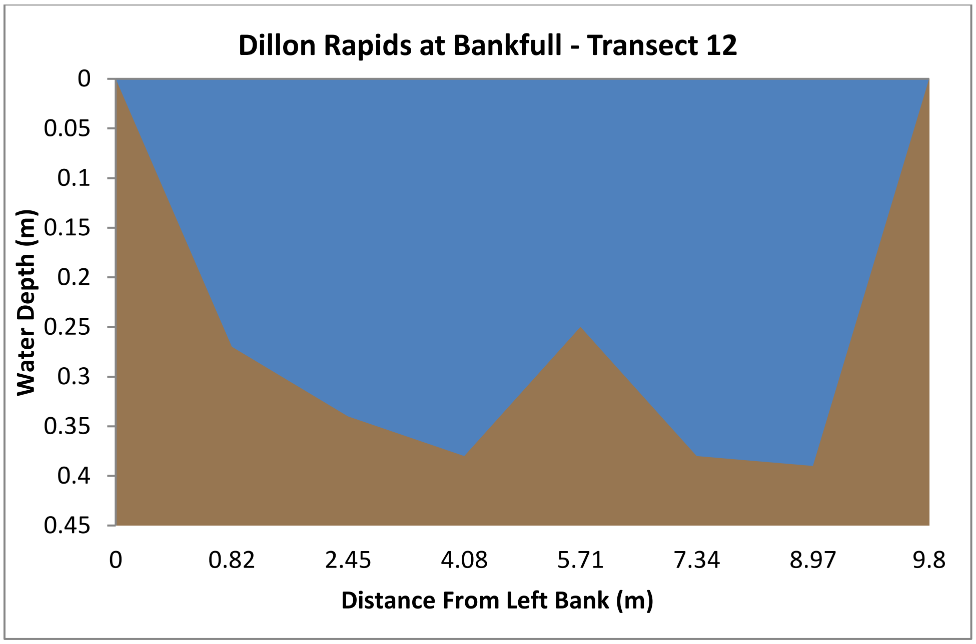



**Transect 12**

| Point | Depth (m) | | Particle sizes | Aquatic vegetation present |
|---|---|---|---|---|
| | Bankfull | Present | | |
| (1) 0.82 | 0.27 | 0 | 50% bedrock, 50% sand | none |
| (2) 2.45 | 0.34 | 0.08 | 100% bedrock | none |
| (3) 4.08 | 0.38 | 0.13 | 100% bedrock | none |
| (4) 5.71 | 0.25 | 0 | 100% bedrock | none |
| (5) 7.34 | 0.38 | 0 | 100% bedrock | none |
| (6) 8.97 | 0.39 | 0.01 | 100% bedrock | 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 | * | | | | | |
| **Sucker species** | | | | | | | |
| Optimal depth (m) | | | | | | | |
| Optimal substrate (cm) | 0.2 - 1.6 | * | | | | | |

*mixed substrate, some optimal

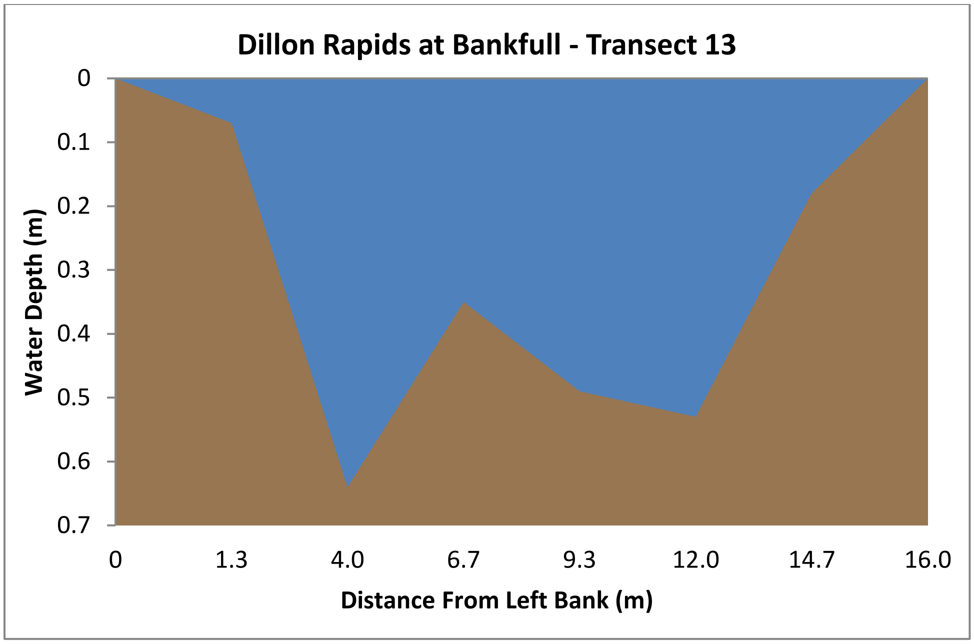



### Transect 13

| Point | Depth (m) | | Particle sizes | Aquatic vegetation present |
|---|---|---|---|---|
| | Bankfull | Present | | |
| (1) 1.33 | 0.07 | 0 | 100% bedrock | none |
| (2) 4.0 | 0.64 | 0.16 | 80% bedrock, 20% cobble | none |
| (3) 6.67 | 0.35 | 0 | 100% bedrock | none |
| (4) 9.34 | 0.49 | 0 | 100% bedrock | none |
| (5) 12.01 | 0.53 | 0.1 | 100% bedrock | see p 142 |
| (6) 14.68 | 0.18 | 0 | 100% vegetated | 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 | | * | | | | |
| **Sucker species** | | | | | | | |
| Optimal depth (m) | | | | | | | |
| Optimal substrate (cm) | 0.2 - 1.6 | | | | | | |

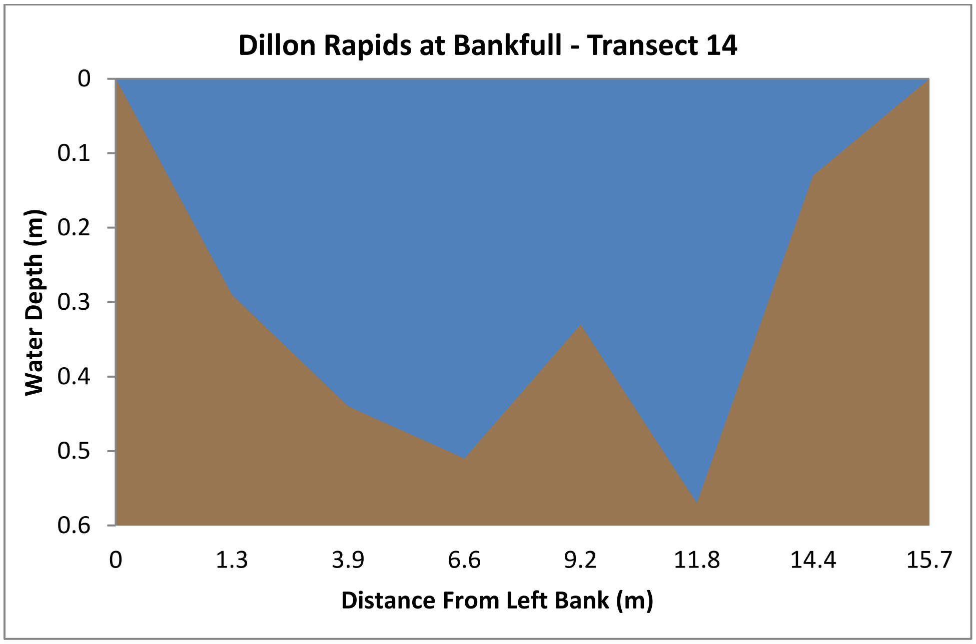
*mixed substrate, some optimal




**Transect 14**

| Point | Depth (m) | | Particle sizes | Aquatic vegetation present |
|---|---|---|---|---|
| | Bankfull | Present | | |
| (1) 1.31 | 0.29 | 0 | 100% bedrock | none |
| (2) 3.93 | 0.44 | 0 | 100% bedrock | none |
| (3) 6.55 | 0.51 | 0 | 75% bedrock, 25% soil | see p 145 |
| (4) 9.17 | 0.33 | 0 | 100% bedrock | none |
| (5) 11.79 | 0.57 | 0.23 | 100% bedrock | none |
| (6) 14.41 | 0.13 | 0 | 100% vegetated | 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 | | | | | | |
| **Sucker species** | | | | | | | |
| Optimal depth (m) | | | | | | | |
| Optimal substrate (cm) | 0.2 - 1.6 | | | | | | |

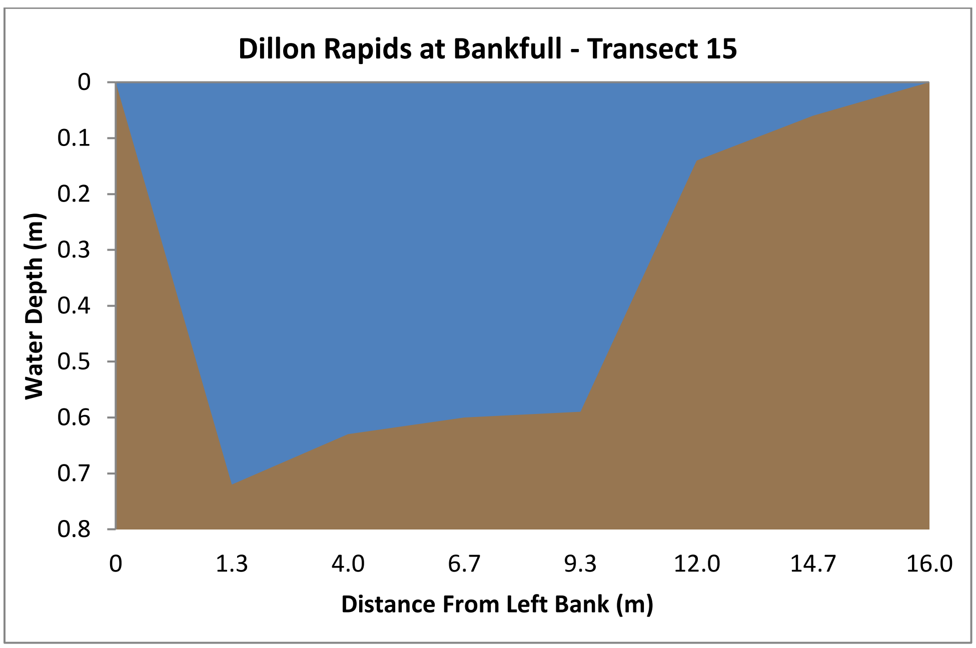



**Transect 15**

| Point | Depth (m) | | Particle sizes | Aquatic vegetation present |
|---|---|---|---|---|
| | Bankfull | Present | | |
| (1) 1.33 | 0.72 | 0.39 | 70% cobble, 30% bedrock | none |
| (2) 4.0 | 0.63 | 0.31 | 80% bedrock, 20% sand | none |
| (3) 6.67 | 0.6 | 0.27 | 100% sand | none |
| (4) 9.34 | 0.59 | 0.21 | 60% sand/soil, 40% bedrock | none |
| (5) 12.01 | 0.14 | 0 | 100% vegetated | terrestrial veg |
| (6) 14.68 | 0.06 | 0 | 50% lg boulder, 50% soil/veg | 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 | * | * | | | | |
| **Sucker species** | | | | | | | |
| Optimal depth (m) | | | | | | | |
| Optimal substrate (cm) | 0.2 - 1.6 | | * | * | | | |

*mixed substrate, some optimal

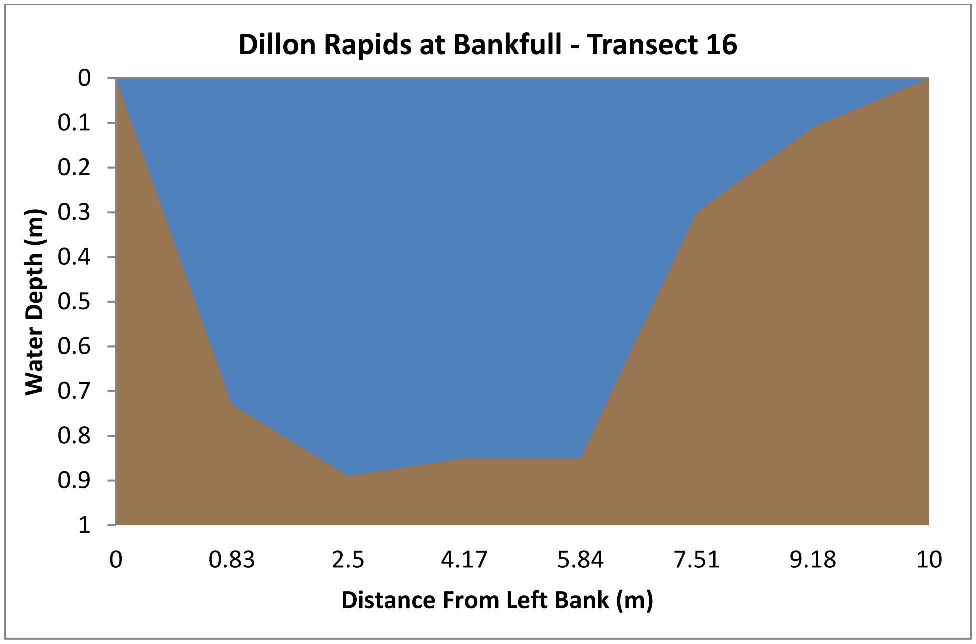


**Transect 16**

| Point | Depth (m) | | Particle sizes | Aquatic vegetation present |
|---|---|---|---|---|
| | Bankfull | Present | | |
| (1) 0.83 | 0.73 | 0.35 | 50% lg boulder, 50% bedrock | none |
| (2) 2.50 | 0.89 | 0.5 | 60% cobble, 40% lg stone | none |
| (3) 4.17 | 0.85 | 0.47 | 80% bedrock, 20% cobble, too murky for photo | none |
| (4) 5.84 | 0.85 | 0.46 | 100% bedrock | none |
| (5) 7.51 | 0.3 | 0 | 100% vegetated | reeds |
| (6) 9.18 | 0.11 | 0 | 100% vegetated | reeds |

| **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 | | | * | | | |
| **Sucker species** | | | | | | | |
| Optimal depth (m) | | | | | | | |
| Optimal substrate (cm) | 0.2 - 1.6 | | | | | | |

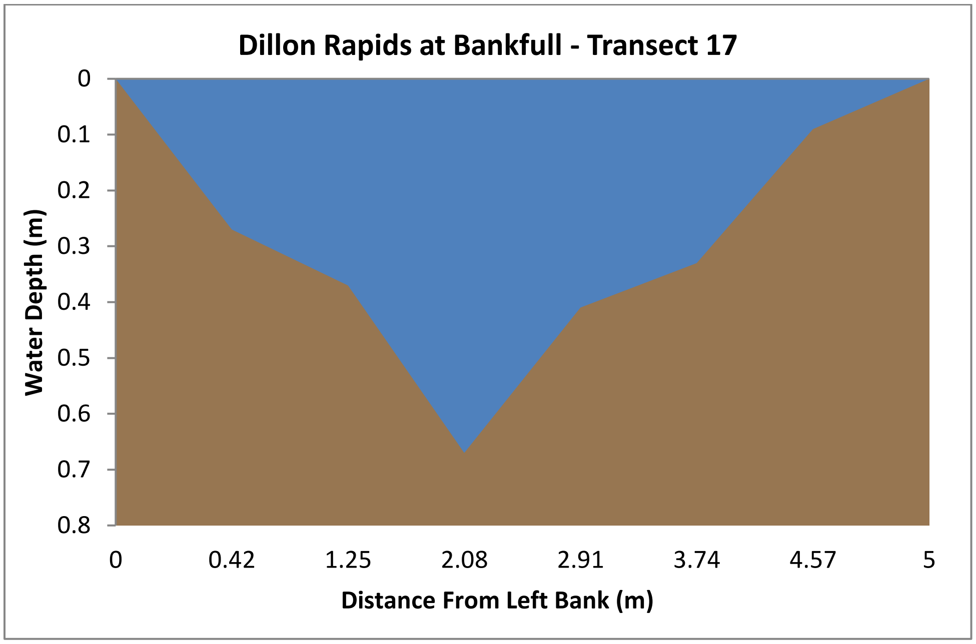
*mixed substrate, some optimal




**Transect 17**

| Point | Depth (m) Bankfull | Depth (m) Present | Particle sizes | Aquatic vegetation present |
|---|---|---|---|---|
| (1) 0.42 | 0.27 | 0 | 100% bedrock | none |
| (2) 1.25 | 0.37 | 0 | 100% bedrock | none |
| (3) 2.08 | 0.67 | 0.26 | 100% bedrock | none |
| (4) 2.91 | 0.41 | 0 | 100% vegetated | see p 152 |
| (5) 3.74 | 0.33 | 0 | 100% vegetated | see p 153 |
| (6) 4.57 | 0.09 | 0 | 100% vegetated | see p 154 |

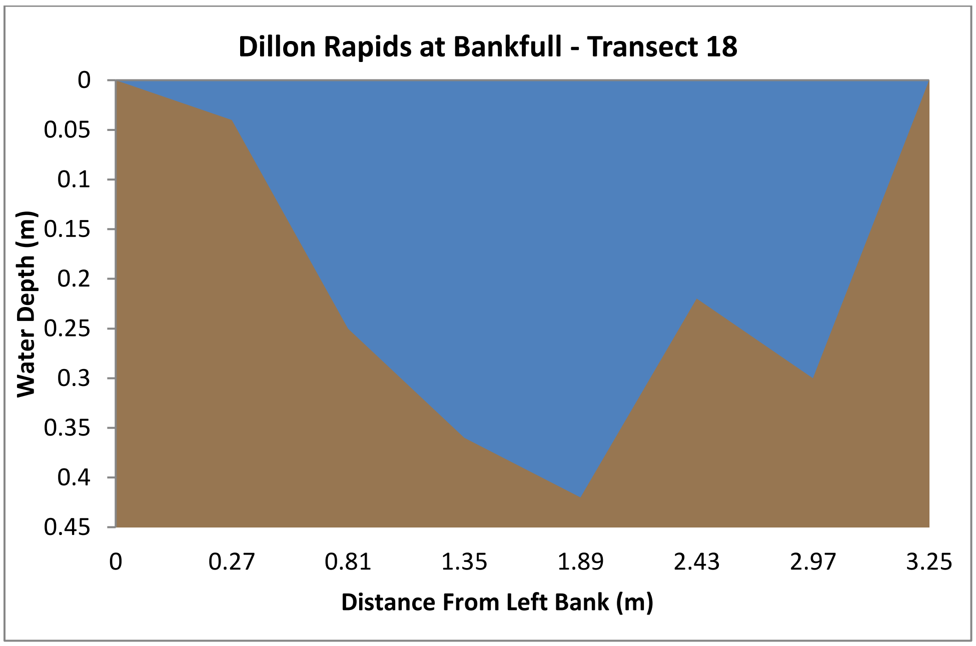
| **Walleye** | | **Point 1** | **Point 2** | **Point 3** | **Point 4** | **Point 5** | **Point 6** |
|---|---|---|---|---|---|---|---|
| Optimal depth (m) | 0.3 - 1.0 | | | | | | |
| Optimal substrate (cm) | 0.2 - 25 | | | | | | |
| **Sucker species** | | | | | | | |
| Optimal depth (m) | | | | | |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




**Transcect 18**

| Point | Depth (m) | | Particle sizes | Aquatic vegetation present |
|---|---|---|---|---|
| | Bankfull | Present | | |
| (1) 0.27 | 0.04 | 0 | 100% bedrock | none |
| (2) 0.81 | 0.25 | 0 | 100% bedrock | none |
| (3) 1.35 | 0.36 | 0.07 | 100% bedrock | none |
| (4) 1.89 | 0.42 | 0.12 | 100% bedrock | none |
| (5) 2.43 | 0.22 | 0 | 100% vegetated | see p 161 |
| (6) 2.97 | 0.3 | 0 | 100% vegetated | see p 162 |

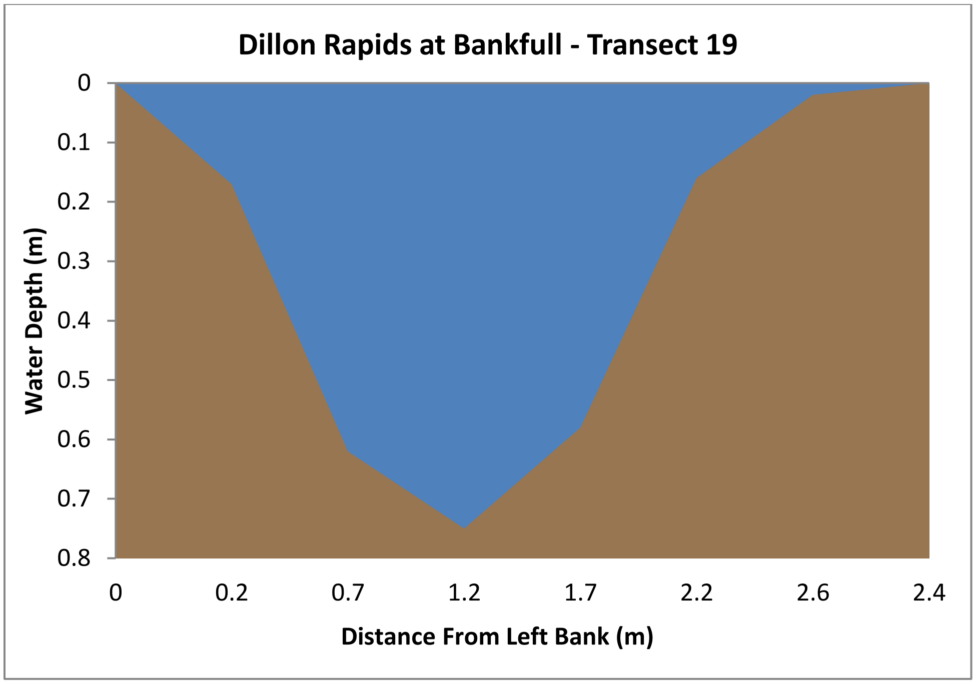
| **Walleye** | | **Point 1** | **Point 2** | **Point 3** | **Point 4** | **Point 5** | **Point 6** |
|---|---|---|---|---|---|---|---|
| Optimal depth (m) | 0.3 - 1.0 | | | | | | |
| Optimal substrate (cm) | 0.2 - 25 | | | | | | |
| **Sucker species** | | | | | | | |
| Optimal depth (m) | | | | | |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



**Transect 19**

| Point | Depth (m) | | Particle sizes | Aquatic vegetation present |
|---|---|---|---|---|
| | Bankfull | Present | | |
| (1) 0.24 | 0.17 | 0 | 100% bedrock | none |
| (2) 0.72 | 0.62 | 0.16 | 100% bedrock | none |
| (3) 1.20 | 0.75 | 0.28 | 100% cobble | none |
| (4) 1.68 | 0.58 | 0.12 | 100% bedrock | none |
| (5) 2.16 | 0.16 | 0 | 100% bedrock | none |
| (6) 2.64 | 0.02 | 0 | 100% bedrock | 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 | | | | | | |
| **Sucker species** | | | | | | | |
| Optimal depth (m) | | | | | | | |
| Optimal substrate (cm) | 0.2 - 1.6 | | | | | | |

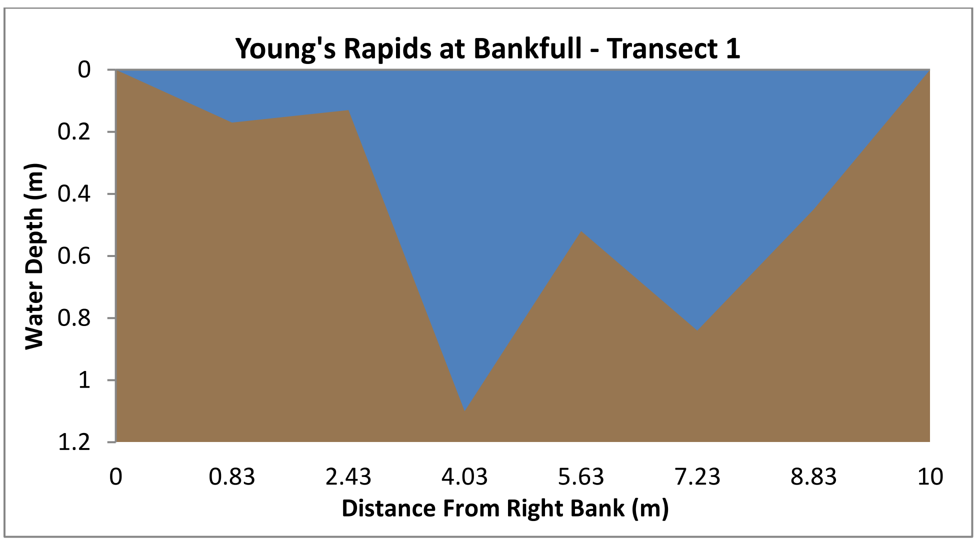

Dillon Rapids at Bankfull - Transect 19
Water Depth (m)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0
0.2
0.7
1.2
1.7
2.2
2.6
2.4
Distance From Left Bank (m)

# Appendix E – Young's Rapids Transect Data

**Transect 1**

| Point | Depth (m) | | Particle sizes | Aquatic vegetation present |
|---|---|---|---|---|
| | Bankfull | Present | | |
| (1) 0.83 | 0.17 | 0 | 100% bedrock | none |
| (2) 2.43 | 0.13 | 0 | 100% bedrock | none |
| (3) 4.03 | 1.1 | 0.63 | 100% bedrock | none |
| (4) 5.63 | 0.52 | 0.02 | 100% bedrock | none |
| (5) 7.23 | 0.84 | 0.23 | 100% bedrock | none |
| (6) 8.83 | 0.45 | 0 | 100% bedrock | none |

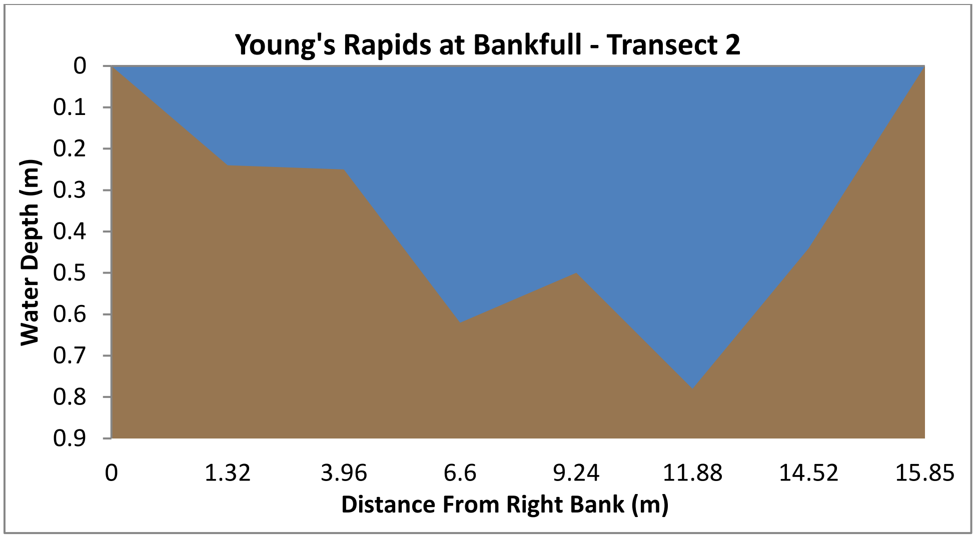
| **Walleye** | | **Point 1** | **Point 2** | **Point 3** | **Point 4** | **Point 5** | **Point 6** |
|---|---|---|---|---|---|---|---|
| Optimal depth (m) | 0.3 - 1.0 | | | | | | |
| Optimal substrate (cm) | 0.2 - 25 | | | | | | |
| **Sucker species** | | | | | | | |
| Optimal depth (m) | | | | | |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



**Transect 2**

| Point | Depth (m) | | Particle sizes | Aquatic vegetation present |
|---|---|---|---|---|
| | Bankfull | Present | | |
| (1) 1.32 | 0.24 | 0 | 100% bedrock | none |
| (2) 3.96 | 0.25 | 0 | 100% bedrock | none |
| (3) 6.60 | 0.62 | 0 | 100% bedrock | none |
| (4) 9.24 | 0.5 | 0.02 | 100% bedrock | none |
| (5) 11.88 | 0.78 | 0.35 | 100% bedrock | none |
| (6) 14.52 | 0.44 | 0 | 100% bedrock | 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 | | | | | | |
| **Sucker species** | | | | | | | |
| Optimal depth (m) | | | | | | | |
| Optimal substrate (cm) | 0.2 - 1.6 | | | | | | |

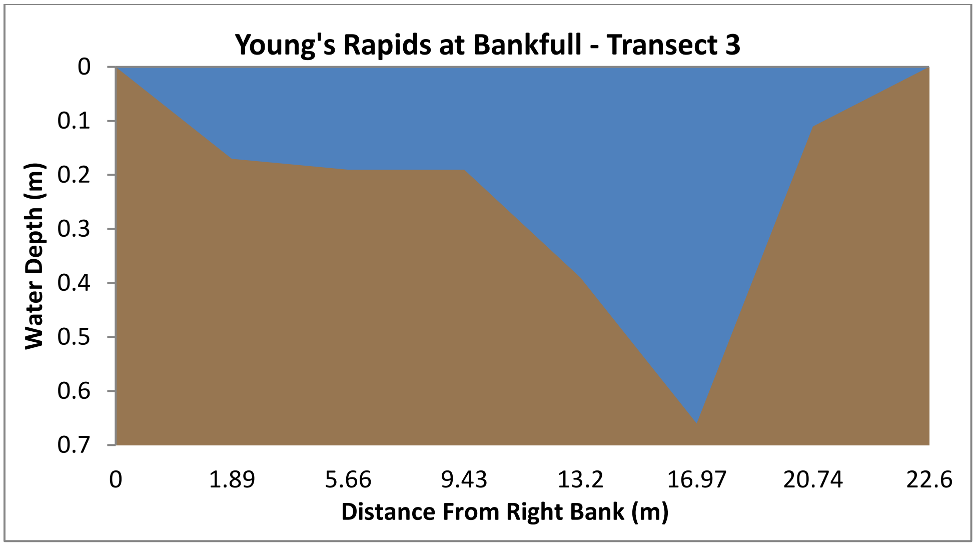



**Transect 3**

| Point | Depth (m) | | Particle sizes | Aquatic vegetation present |
|---|---|---|---|---|
| | Bankfull | Present | | |
| (1) 1.89 | 0.17 | 0 | 100% bedrock | none |
| (2) 5.66 | 0.19 | 0 | 100% bedrock | none |
| (3) 9.43 | 0.19 | 0 | 100% bedrock | none |
| (4) 13.20 | 0.39 | 0.08 | 90% bedrock, 10% lg boulder | none |
| (5) 16.97 | 0.66 | 0.10 | 90% bedrock, 10% lg boulder | none |
| (6) 20.74 | 0.11 | 0 | 100% bedrock | 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 | | | | | | |

| **Sucker species** | | | | | | | |
|---|---|---|---|---|---|---|---|
| Optimal depth (m) | | | | | | | |
| Optimal substrate (cm) | 0.2 - 1.6 | | | | | | |



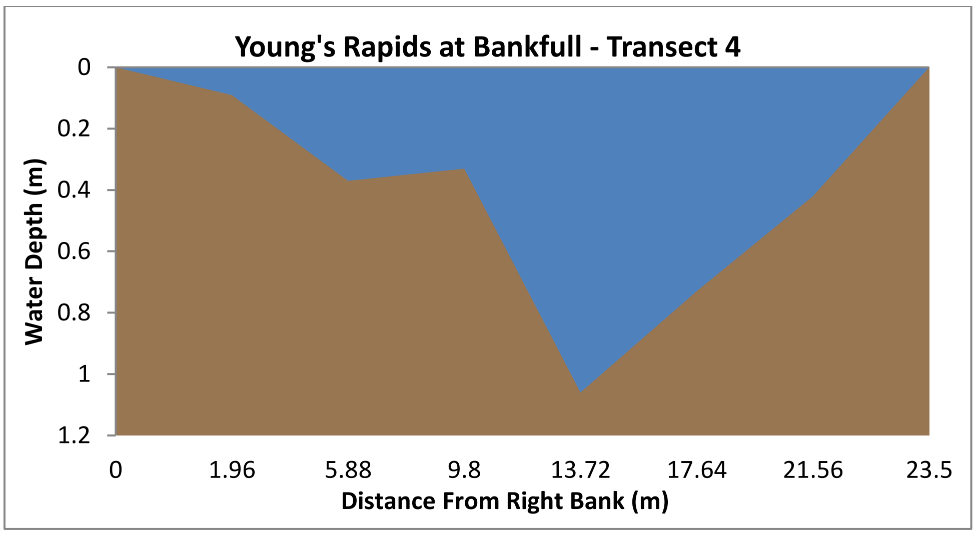

**Transect 4**

| Point | Depth (m) | | Particle sizes | Aquatic vegetation present |
|---|---|---|---|---|
| | Bankfull | Present | | |
| (1) 1.96 | 0.09 | 0 | 100% bedrock | none |
| (2) 5.88 | 0.37 | 0 | 100% bedrock | none |
| (3) 9.80 | 0.33 | 0 | 100% bedrock | none |
| (4) 13.72 | 1.06 | 0.42 | 30% lg boulder, 10% sm boulder, 10% cobble, 50% bedrock | none |

| | | | | |
|---|---|---|---|---|
| (5) 17.64 | 0.73 | 0.23 | 30% lg boulder, 10% sm boulder, 10% cobble, 50% bedrock | none |
| (6) 21.56 | 0.42 | 0 | 100% bedrock | 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 | | | | * | * | |
| **Sucker species** | | | | | | | |
| Optimal depth (m) | | | | | | | |
| Optimal substrate (cm) | 0.2 - 1.6 | | | | | | |

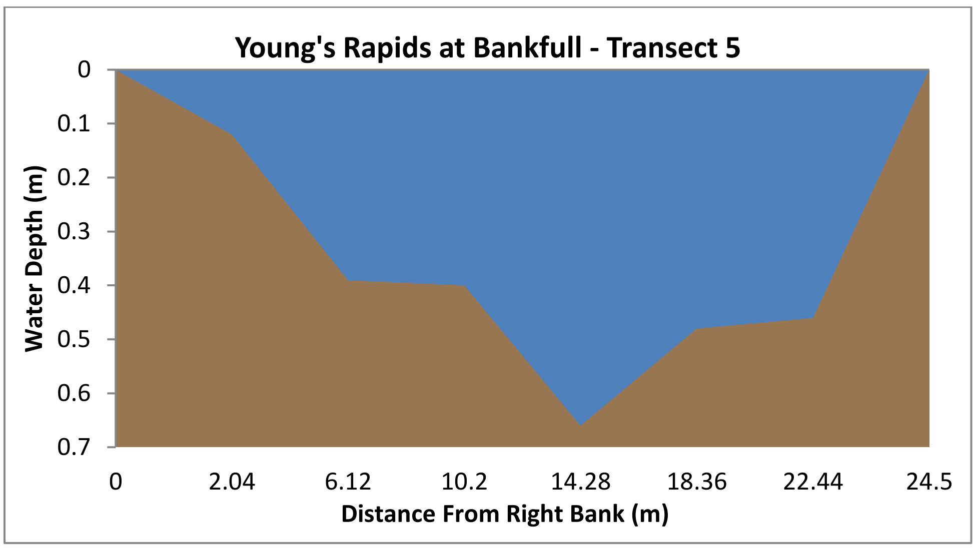
*mixed substrate, some optimal




**Transect 5**

| Point | Depth (m) | | Particle sizes | Aquatic vegetation present |
|---|---|---|---|---|
| | Bankfull | Present | | |
| (1) 2.04 | 0.12 | 0 | Soil overlaying bedrock | see p 67 |
| (2) 6.12 | 0.39 | 0 | 100% bedrock | none |
| (3) 10.20 | 0.4 | 0.07 | 100% sm boulder | none |
| (4) 14.28 | 0.66 | 0.47 | 33% sm boulder, 33% lg boulder, 33% cobble | none |
| (5) 18.36 | 0.48 | 0.30 | 100% lg boulder | none |
| (6) 22.44 | 0.46 | 0.22 | 50% lg boulder, 50% sm boulder | 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 | | | | | | |
| **Sucker species** | | | | | | | |
| Optimal depth (m) | | | | | | | |
| Optimal substrate (cm) | 0.2 - 1.6 | | | | | | |

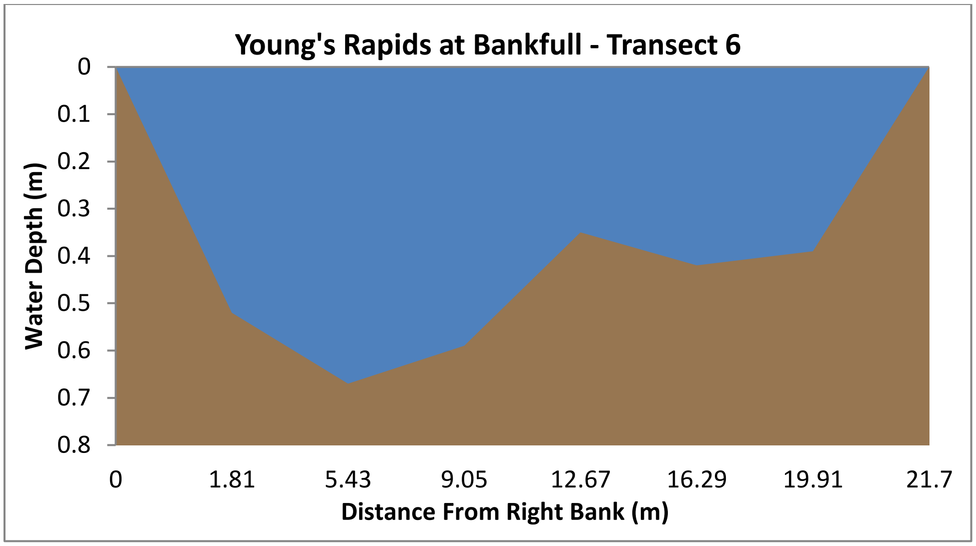


**Transect 6**

| Point | Depth (m) | | Particle sizes | Aquatic vegetation present |
|---|---|---|---|---|
| | Bankfull | Present | | |
| (1)1.81 | 0.52 | 0.29 | 80% bedrock, 10% lg boulder, 10% cobble | none |
| (2) 5.43 | 0.67 | 0.46 | 100% cobble | none |
| (3) 9.05 | 0.59 | 0.35 | 50% lg boulder, 50% sm boulder | none |
| (4) 12.67 | 0.35 | 0.19 | 100% lg boulder | none |
| (5) 16.29 | 0.42 | 0.21 | 80% lg boulder, 20% sm boulder | none |
| (6) 19.91 | 0.39 | 0.15 | 50% lg boulder, 50% sm boulder | Herbaceous veg overhanging /getting caught in flow |

| **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 | * | | | | | |
| **Sucker species** | | | | | | | |
| Optimal depth (m) | | | | | | | |
| Optimal substrate (cm) | 0.2 - 1.6 | | | | | | |

*mixed substrate, some optimal

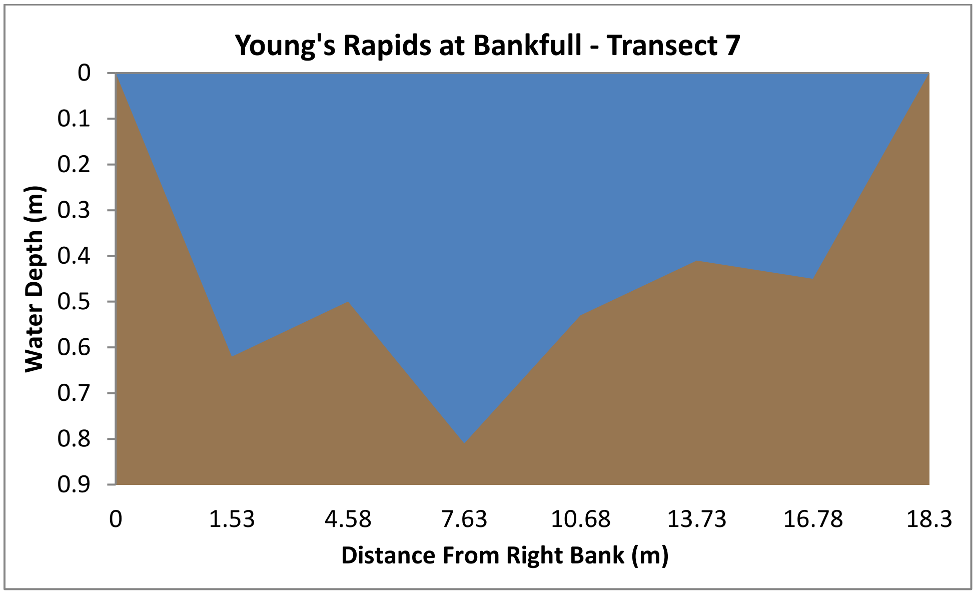



**Transect 7**

| Point | Depth (m) | | Particle sizes | Aquatic vegetation present |
|---|---|---|---|---|
| | Bankfull | Present | | |
| (1)1.53 | 0.62 | 0.34 | 30% bedrock, 50% lg boulder, 20% cobble | none |
| (2) 4.58 | 0.5 | 0.26 | 100% cobble | none |
| (3) 7.63 | 0.81 | 0.61 | 80% bedrock, 10% lg boulder, 10% cobble | none |
| (4) 10.68 | 0.53 | 0.32 | 60% sm boulder, 40% cobble | Same veg in p 67 |
| (5) 13.73 | 0.41 | 0.17 | 30% sm boulder, 70% cobble | none |
| (6) 16.78 | 0.45 | 0.14 | 10% sm boulder, 90% 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 | * | | * | * | * | * |
| **Sucker species** | | | | | | | |
| Optimal depth (m) | | | | | | | |
| Optimal substrate (cm) | 0.2 - 1.6 | | | | | | |

*mixed substrate, some optimal




# Appendix F – Bathymetry Maps



Image © 2017 DigitalGlobe
506 ft
2009
Google Earth
Imagery Date: 5/26/2013 17 T 553447.61 m E 5031310.21 m N elev 590 ft eye alt 2773 ft

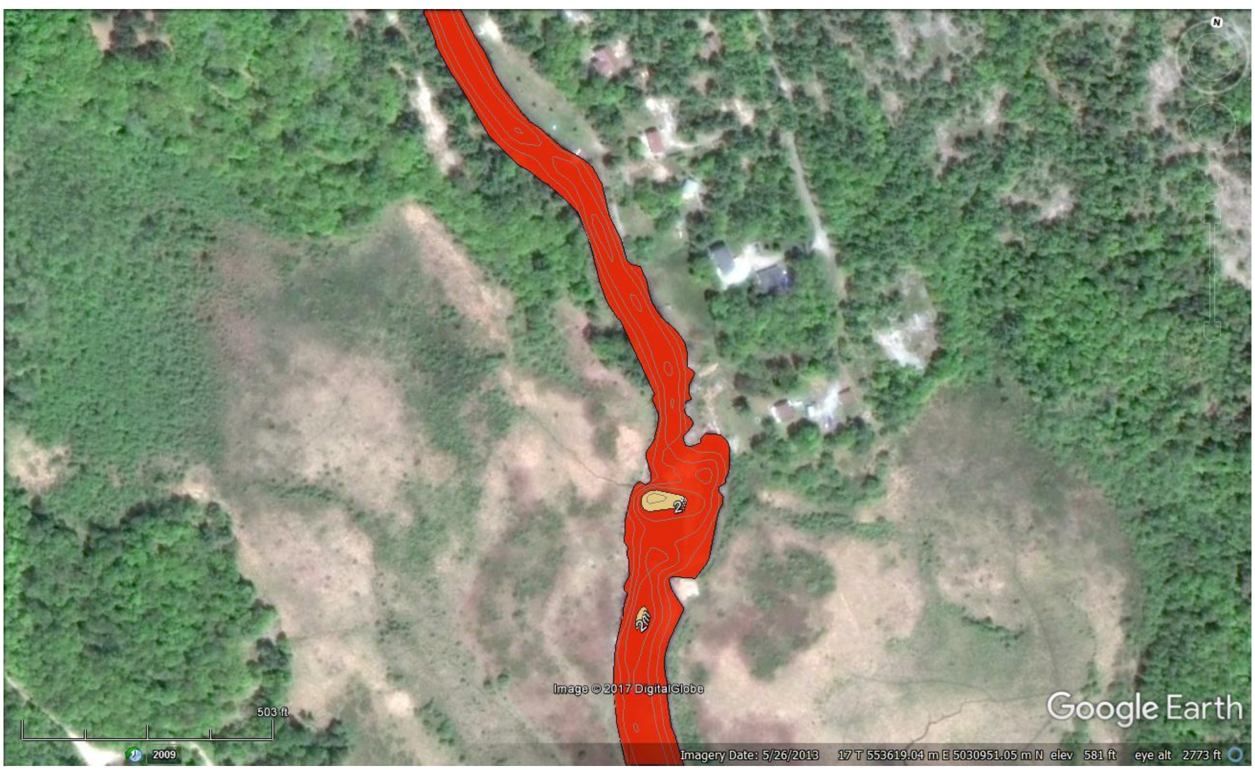
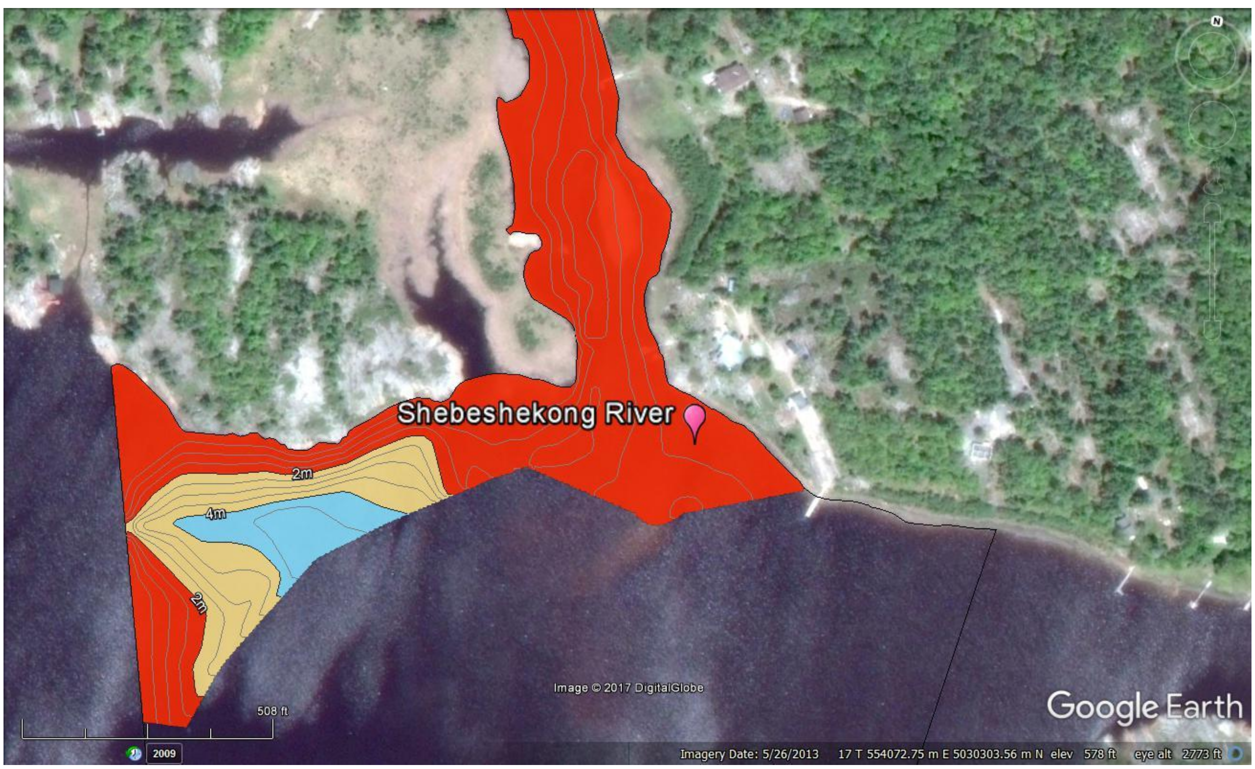


Image © 2017 DigitalGlobe
503 ft
2009
Google Earth
Imagery Date: 5/26/2013 17 T 553619.04 m E 5030951.05 m N elev 581 ft eye alt 2773 ft


2m
2
Image © 2017 DigitalGlobe
506 ft
2009
Google Earth
Imagery Date: 5/26/2013 17 T 553848.05 m E 5030615.41 m N elev 578 ft eye alt 2773 ft


Shebeshekong River
2m
4m
2m
Image © 2017 DigitalGlobe
508 ft
2009
Google Earth
Imagery Date: 5/26/2013 17 T 554072.75 m E 5030303.56 m N elev 578 ft eye alt 2773 ft

# Appendix G – Underwater Surveys

Underwater Surveys – shoreline photos, underwater photos, and drone orthomosaics

**Survey 1**

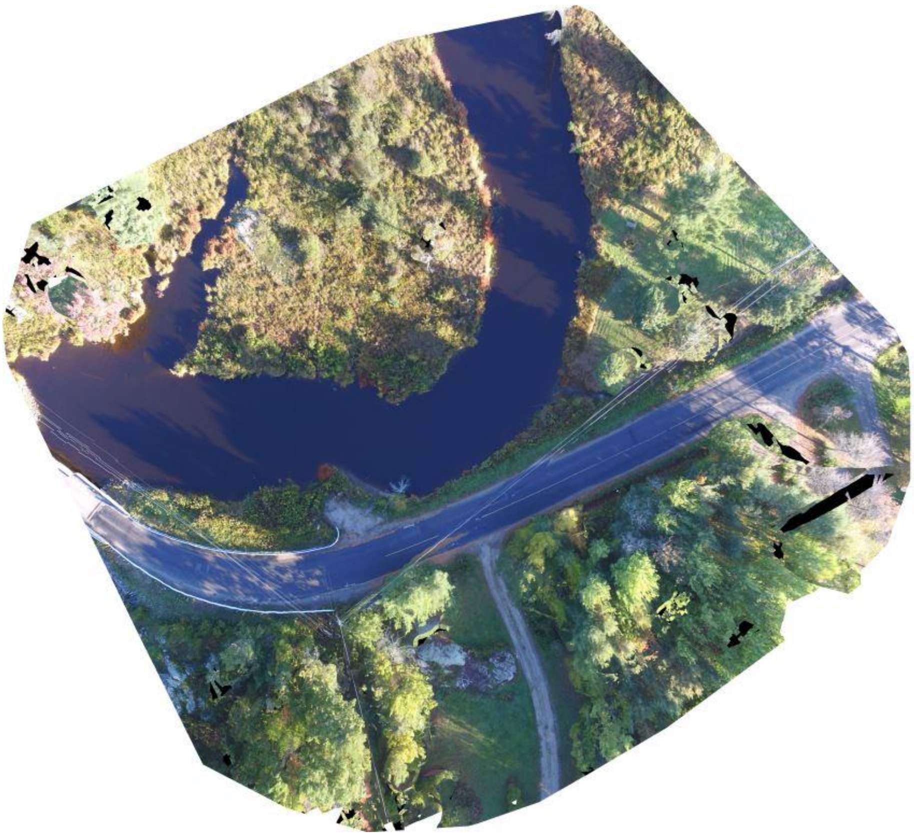
**Survey 2**

**Survey 3**

**Survey 4**

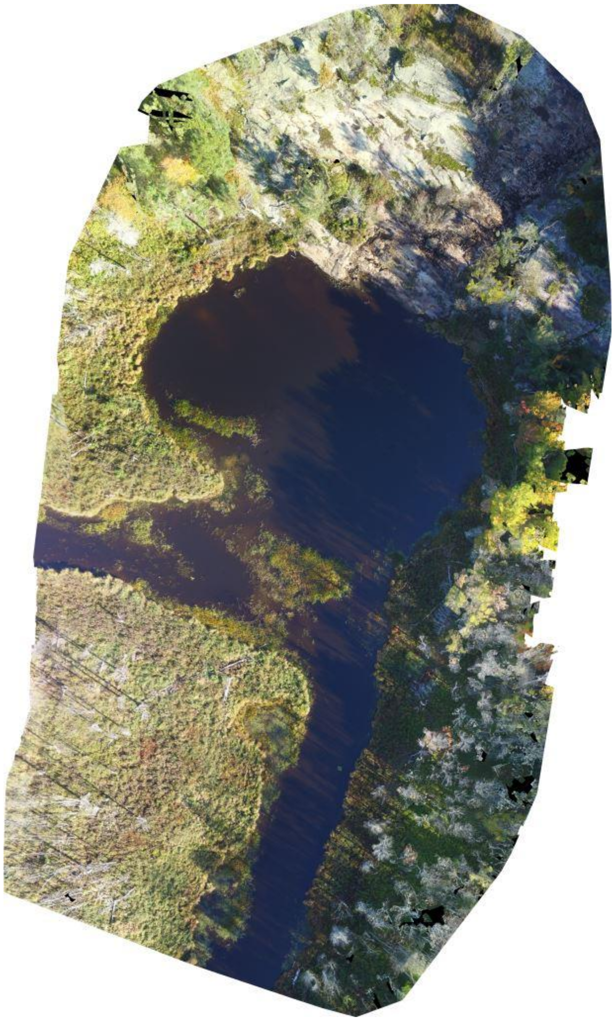
**Survey 5**

**Survey 6**

**Survey 7**

**Survey 8**



**Survey 9**