Mississippi Valley Conservation Authority

Shirley’s Brook 2016 Summary Report

Monitoring Activity in the City of Ottawa

In 2012, Mississippi Valley Conservation Authority (MVCA) and the Friends of the Carp River (FCR) collaborated to undertake a broad scale assessment of potential restoration and stewardship opportunities along the Carp River and to test the implementation of a citizen science based volunteer monitoring program. The following year, with funding from Shell Canada, MVCA initiated a pilot City Stream Watch Program (CSW) which uses a combination of detailed monitoring, education and outreach, and targeted rehabilitation to improve the overall understanding of and guardianship over the health of the watershed. Volunteer “citizen scientists” are trained to collect technical information on creek conditions. Volunteers also participate in special stewardship initiatives that include shoreline planting, fish habitat enhancement projects, stream clean-up and invasive species removal events.

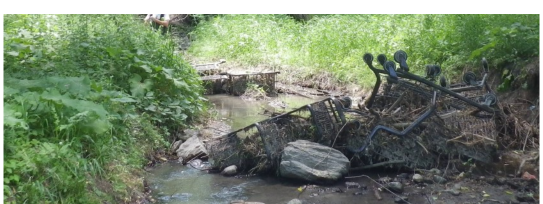
The City Stream Watch Program has three broad goals:

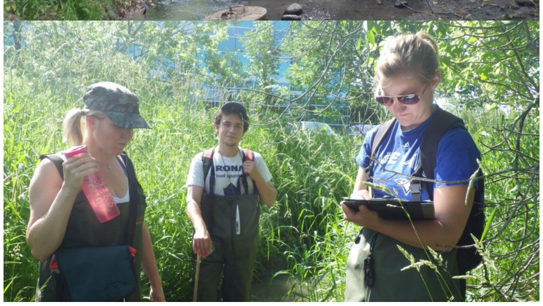
- To provide long-term documentation of the aquatic and riparian conditions in our watershed
- To enhance public awareness about the condition and value of freshwater streams
- To use the information collected to encourage community driven restoration projects

Since adopting the City Stream Watch program in 2013, MVCA staff and volunteers have surveyed more than 360 sections in 10 streams. This information has fed into the planning of 13 riparian planting sites, 4 habitat improvements, a stream garbage pick-up in Poole Creek and the Carp River and invasive species removal events. This year (2016), three streams were surveyed, Shirley’s Brook, Kizell Drain and Carp C Tributary, for a total of 8.4kms. Separate reports are available for each stream on our website.

MVCA will continue to expand the City Stream Watch Program by implementing a 3 year monitoring and reporting rotation on a number of main tributaries within the City.

Figure 1 shows the location of the Shirley’s Brook subwatershed within MVCA’s City Stream Watch program area.





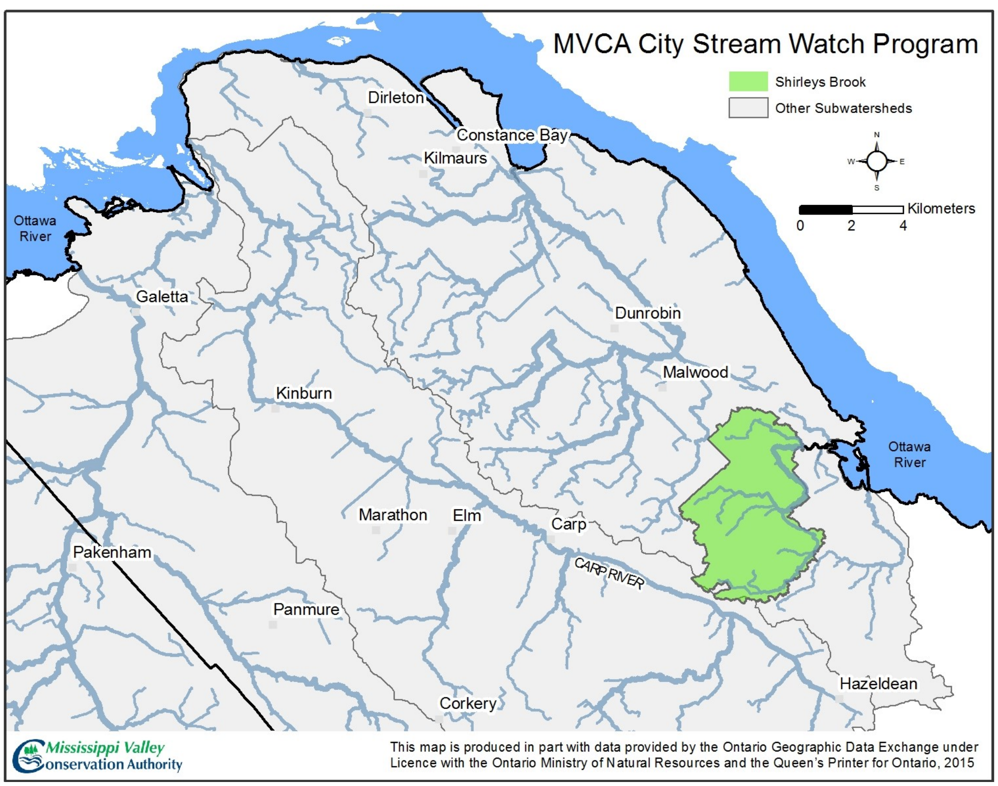


Figure 1: *MVCA’s City Stream Watch area highlighting the location of the Shirley's Brook subwatershed.*

Shirley's Brook

Located in the west end of the City of Ottawa, Shirley's Brook is a tributary to the Ottawa River. It has a length of 13 kilometers (km) and drains an area of 26.2 square kilometers (km^2).

Shirley's Brook's headwaters originate in the South March Highlands west of Terry Fox Drive. From there it flows east and then north through the March Road industrial area, the Marshes Golf Club, through urban residential areas, and lastly through the Connaught Range before entering Shirley's Bay in the Ottawa River.

Table 1 presents a summary of some key features of the Shirley's Brook subwatershed.

Table 1: Subwatershed Features

Area	26.2 square kilometers
Land Use	28.4% wooded area 26.3% agriculture 17.5% wetlands 10.4% urban land-use 7.7% roads 6.6% rural land-use 0.1% water 0% aggregate sites
Surficial Geology	52.6% bedrock 24.7% clay 11% sand 6.6% organic deposits 5.1% diamicton 0% gravel
Watercourse Length and Type	*Total Length:* 13 kilometers *Watercourse Type:* 79% natural 21% channelized *Flow Type:* Permanent

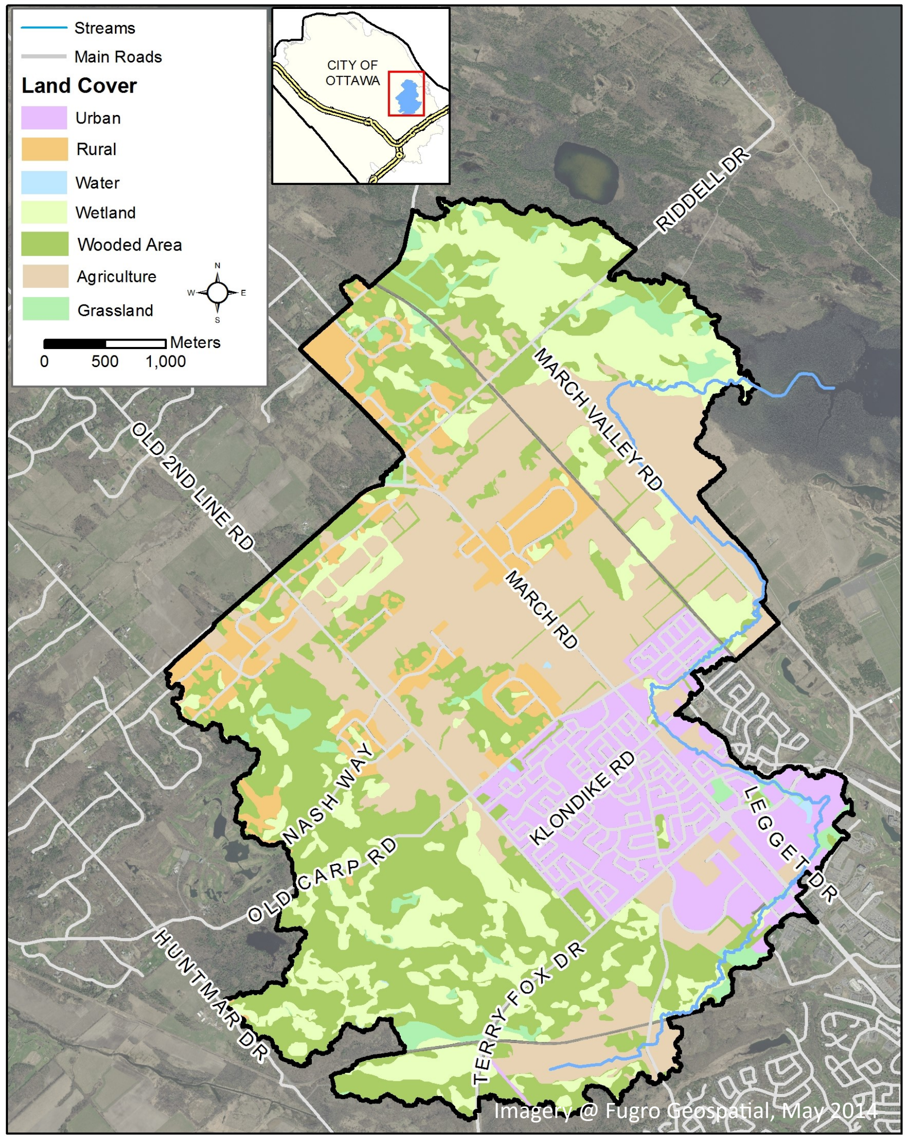


Figure 2: Land Use in the Shirley's Brook subwatershed.

The Shirley's Brook Subwatershed

As seen in Figure 2, the Shirley's Brook subwatershed is quite large and contains both urban and rural development. Crossing a mixture of wetland, woodland, rural and urban, residential areas, recreational areas, commercial and industrial, the brook provides a natural corridor and habitat for a range of aquatic and terrestrial species.

The main branch which primarily flows through the urban area was the focus of our study. The north branch, which flows through the rural area and joins the main branch just south of Old Carp Road, has been previously studied using other protocols.

Fish species found in Shirley's Brook: Blacknose Shiner, Brook Stickleback, Central Mudminnow, Creek Chub, Dace sp., Finescale Dace, Iowa Darter, Northern Redbelly Dace, Spottail Shiner, White Sucker, Bluntnose Minnow, Fathead Minnow.

Monitoring in Shirley's Brook

In 2016, permission was granted to survey 52 sections of Shirley's Brook, shown on Figure 3, which cover approximately 5.2 km of the main channel. The portions of the brook that were not sampled represent the wetland areas that could not be assessed using the macro stream assessment protocol, the golf course and areas where permission was not granted.

This report presents a summary of the observations made along the 45 sampled sections. While these sections provide a good representation of the overall condition of Shirley's Brook it should be noted that there are a few sections of the brook that are not represented in this assessment. These areas provide an additional diversity of habitat with valuable natural functions.

Methodology

The macro stream assessment is completed using a protocol that divides the entire length of the creek into 100 meter (m) sections. Starting at the downstream end, a monitoring crew wades the creek and completes a detailed assessment at the end of each 100 meter section. If a section of the creek is un-wadeable, that section is bypassed and the assessment is continued once the creek becomes wadeable again. The parameters that are assessed include general land use, in-stream morphology, human alterations, water chemistry, plant life, and other features presented in this report.

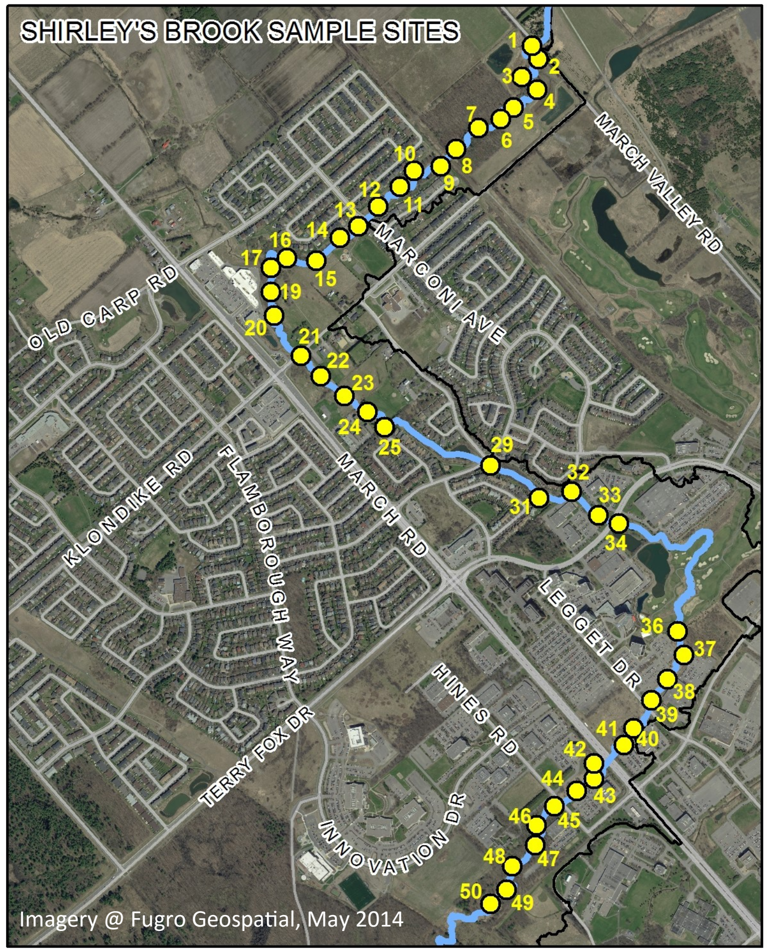


Figure 3: *Locations of the monitoring sites along Shirley's Brook.*

Table 2 shows some basic assessment measurements for Shirley's Brook. The surveyed sections had an average stream width of 2.53 m and an average depth of 0.20 m. When the field survey took place, the average water temperature was 18.2 °C.

Table 2: Shirley's Brook Assessment Facts

	Minimum	Maximum	Average
Air Temperature (°C)	15.5	30.4	22.8
Water Temperature (°C)	13.0	25.3	18.2
Wetted Width (m)	0.60	11.00	2.53
Stream Depth (m)	0.00	0.75	0.20

General Land Use Adjacent to Shirley's Brook

General land use along each surveyed section of Shirley's Brook is considered from the beginning to the end of each survey section (100 m) and extending outward 100 m on each side of the creek. Land use outside of this area is not included in the surveys but is nonetheless part of the subwatershed and will influence the creek (Castelle et al, 1994).

The categories of land use include infrastructure, active agriculture, pasture, abandoned agricultural fields, residential, forests, scrubland, meadow, and wetland. Figure 4 shows the overall percent of land use that was observed adjacent to Shirley's Brook.

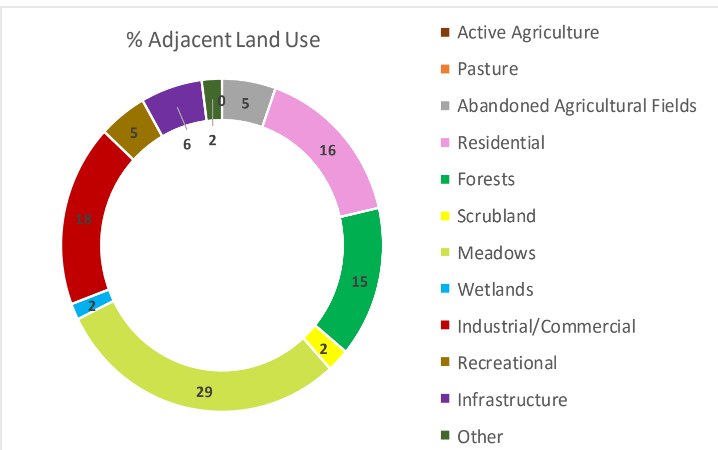


Figure 4: *Land use alongside Shirley's Brook.*

Of the eleven categories, active agriculture and pasture land were not found to be present. At 29%, meadow represents the most prominent category of land use followed by industrial at 18%, and residential at 16%.

The land use in the overall subwatershed area is a mix of urban, urban fringe, rural and natural. This results in the lands adjacent to the brook not being dominated by one type but rather distributed between residential, forest, meadow, and industrial/commercial. This is reflected well in the percentages seen in Figure 4. In particular we see a high percentage of meadow, which is a result of the tall grass riparian zones within the light industrial zone, and a high percentage of forest which is protected in the downstream City park lands. There is only one farm property remaining adjacent to the brook but the lands have been left fallow for many years.

Human Alterations to Shirley's Brook

In this assessment, human alterations refer to artificial changes to the actual channel of the watercourse either by straightening or relocation. Such alterations can be made in streams and rivers for many reasons including to accommodate development, such as road crossings and culverts, to make more land available for agriculture, to allow navigation of large boats, and to minimize natural erosion caused by the meandering pattern of flowing water. As seen in Figure 5, 69% of Shirley's Brook was found to be natural (with minor alterations), 22% was altered (with considerable human impact), and 9% was highly altered.

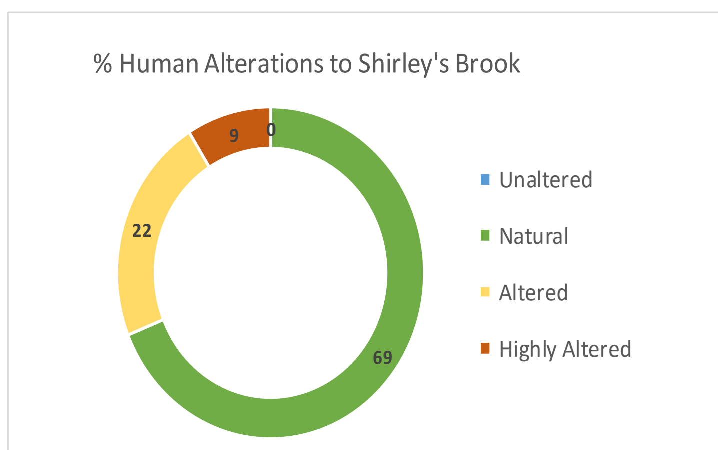


Figure 5: *Extent of human alterations to Shirley's Brook.*

It is a positive attribute that so much of the creek is natural and has not been channelized, with large parts of the stream corridor contained within City of Ottawa park lands. There are also large sections that have significant alterations. Such as numerous road crossings, parking lots with direct storm water outlets, adjacent and online storm water ponds, and a highly landscaped golf course property.

Riparian Buffer along Shirley's Brook

The riparian buffer refers to the amount of vegetated area along the edges of the stream banks. It can consist of a variety of vegetation types including trees, shrubs, grasses and other plants. Vegetated buffers are important for protecting water quality and creating healthy aquatic habitats. They intercept sediments and contaminants as well as protect the stream banks against erosion. Buffers also improve habitat for aquatic species by shading and cooling the water and providing protection for birds and other wildlife that need to be near water for feeding or rearing young. Riparian buffers along the creek corridor also provide a natural area for wildlife movement and dispersal. While riparian buffer is not the only factor affecting stream health, studies assessing adjacent land use largely show a positive relationship between buffer size and stream health (Stanfield and Kilgour, 2012).

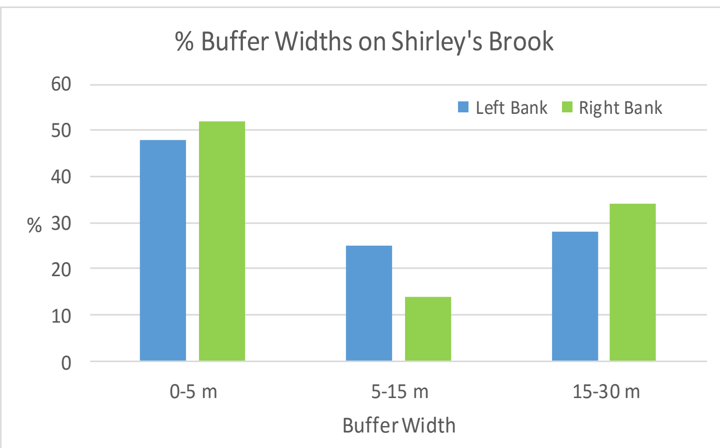


Figure 6: Riparian buffer widths along Shirley's Brook.

Environment Canada's Guideline: *How Much Habitat is Enough?* recommends a minimum 30m wide vegetated buffer along at least 75% of the length of both sides of a watercourse. Therefore, for this assessment, we record the width of the riparian buffer within 30m of either side of the watercourse. As summarized in Figure 6, we found that on the sections of Shirley`s Brook that were surveyed, 52% of the left banks and 48% of the right banks have a buffer width of 5m or greater. Conversely 48% of the left banks and 52% of the right banks have less than a 5m buffer, with two sections being mowed right to the edge, as seen in the top right photo.

Figure 7 shows the differences in riparian buffer widths along Shirley`s Brook. The best buffers were seen along the surveyed sections in the south and the north where the stream flows through forested park space. The red and orange represent reaches where the brook flows through highly landscaped business park properties.

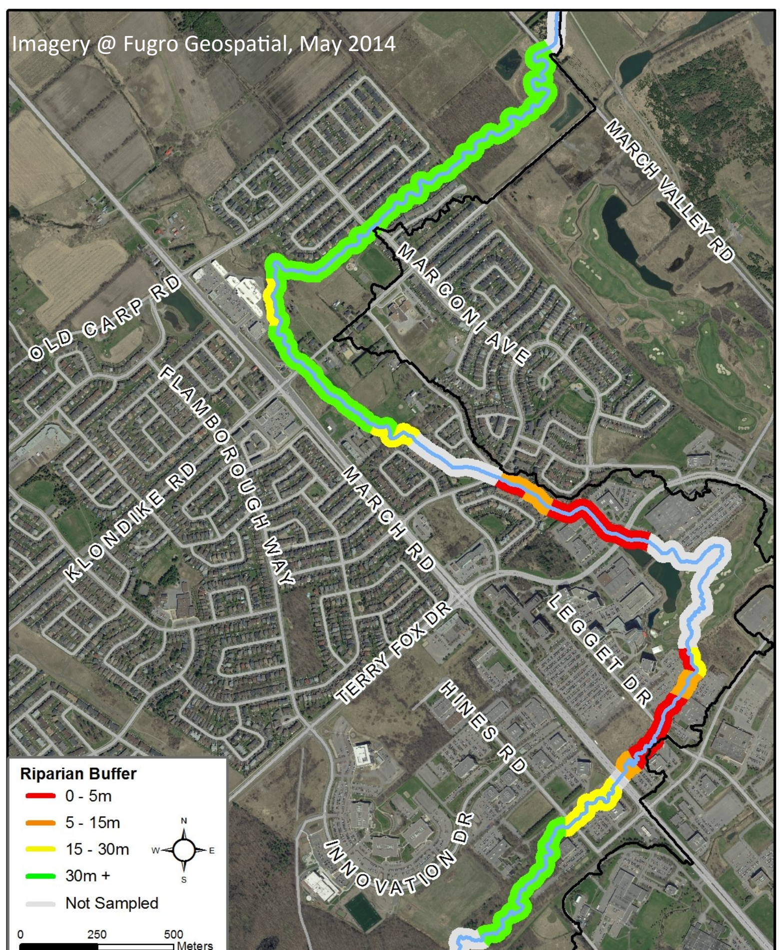


Figure 7: Vegetated buffer width along Shirley's Brook.

Overhanging Trees and Branches

Overhanging branches and trees, a byproduct of a good riparian buffer, provide crucial nutrients, in the form of coarse particulate organic matter (leaves, insects, seeds etc.), to small streams (Vannote et al. 1980). This organic matter is broken down and eaten by aquatic insects, phytoplankton and zooplankton, which are important prey items of fish and wildlife. Overhanging branches also provide stream shading, and fallen logs create excellent habitat for fish.

Overall, Shirley`s Brook has a broad mixture of habitats providing some degree of overhanging trees and branches, as seen in Figure 8. In some areas this reflects the surrounding natural vegetative community, where the creek passes through sections of forest, or areas dominated by ponds or tall grasses, and in some areas it reflects clearing of the vegetation close to the creek.

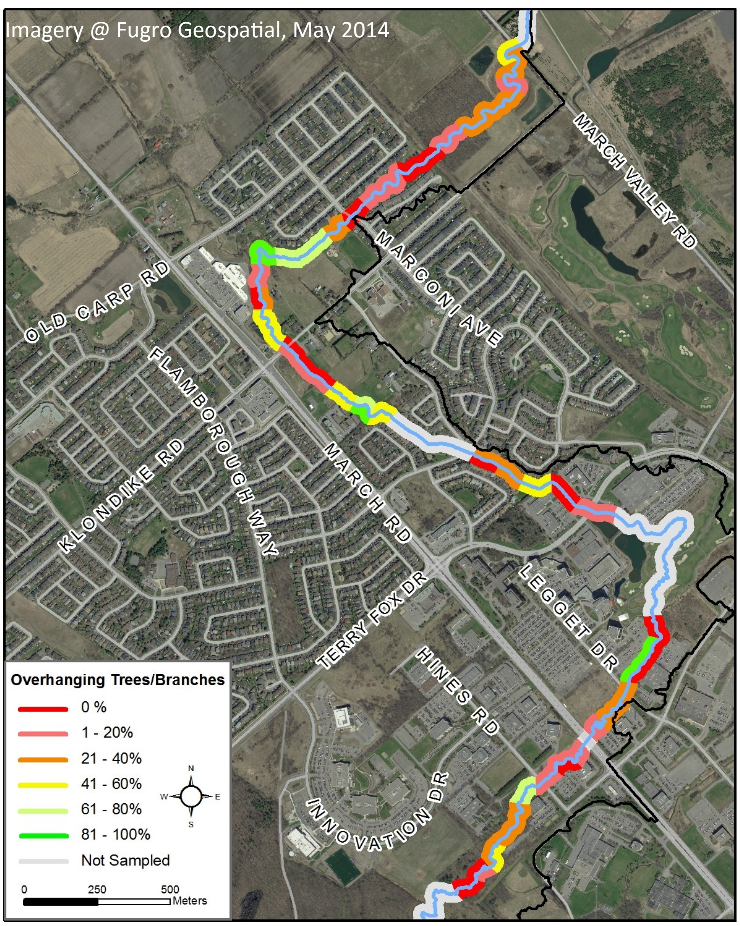


Figure 8: *Overhanging trees and branches along Shirley`s Brook.*

Figure 9 shows the data quantified as the percent of creek sections classified according to the various amounts of overhanging trees and branches. For example, 20-24% of the 45 surveyed stream sections were classified as having zero overhanging trees and branches while the rest of the brook has a good diversity of mixed open and covered reaches.

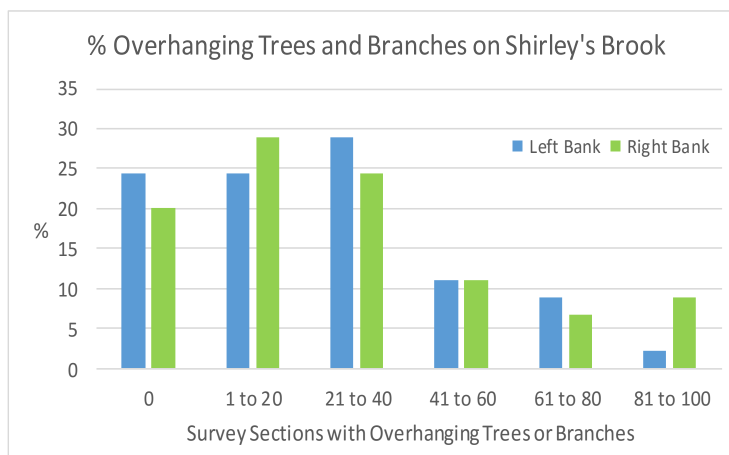


Figure 9: *Percentage of each surveyed section of Shirley`s Brook with overhanging trees and branches.*

Stream Shading

Shade is important in moderating stream temperature, contributing to food supply and helping with nutrient reduction within a stream. Grasses, shrubs and trees can all provide shading to a stream, with trees providing more full coverage and grasses providing much needed shade directly along the edges where shading from trees may not be available.

Figure 10 shows the variability in the amount of stream shading along different sections of Shirley's Brook. We can see that the shading is extremely variable. This is due to the diversity of riparian vegetation along the creek, with sections of meadow interspersed with areas of forest, a reach of highly mowed riparian grass, as well as wide unshaded pond features.

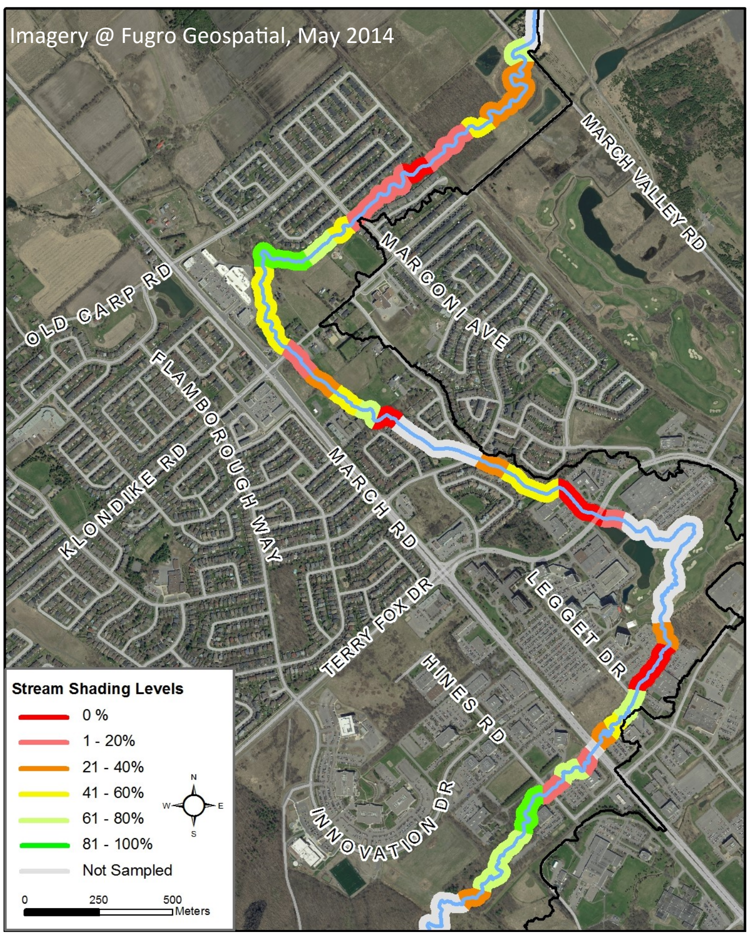


Figure 10: *Stream Shading along Shirley`s Brook.*

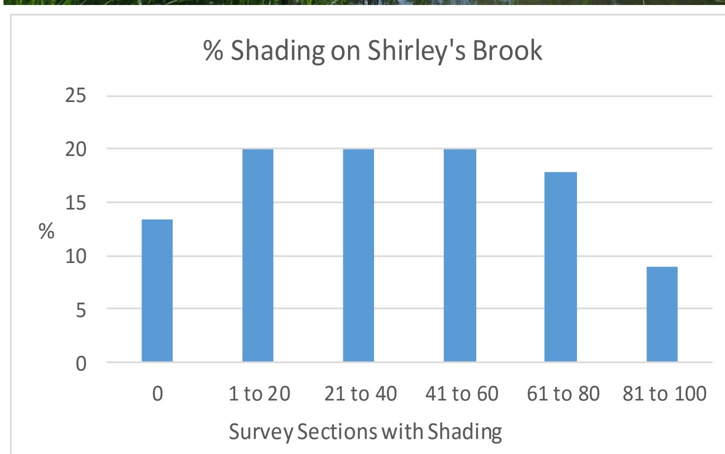


Figure 11: *Shading along Shirley`s Brook.*

Figure 11 shows the data quantified as the percent of creek sections classified according to the various levels of shading. For example, 60% of the 45 stream sections that were surveyed were classified as having low to moderate amounts of shade (1 to 60% shading/ 100m section).

Erosion and Streambank Undercutting

Rivers and streams are dynamic hydrologic systems, which are constantly changing in response to changes in the watershed. Streambank erosion is a natural process that can produce beneficial outcomes by helping to regulate flow and shape a variety of habitat features. When the natural rate of erosion is accelerated or changed through human activities, such as stream straightening and over-clearing of catchment and stream bank vegetation, the system is thrown off balance. The acceleration of the natural erosion process can lead to stream channel instability, land loss, sedimentation, habitat loss and other adverse effects that negatively impact water quality and important fish and wildlife habitat.

Erosion also has the ability to create undercut stream banks. While some undercutting of stream banks can be a normal stream function and can provide excellent refuge for fish, too much undercutting can become harmful if it is causing instability, erosion and sedimentation.

Figure 12 shows the percentage of undercut stream banks along each surveyed section of Shirley`s Brook. Overall, the sections of Shirley`s Brook that were surveyed were found to have very little undercutting, most with either less than 20% or with no undercutting at all.

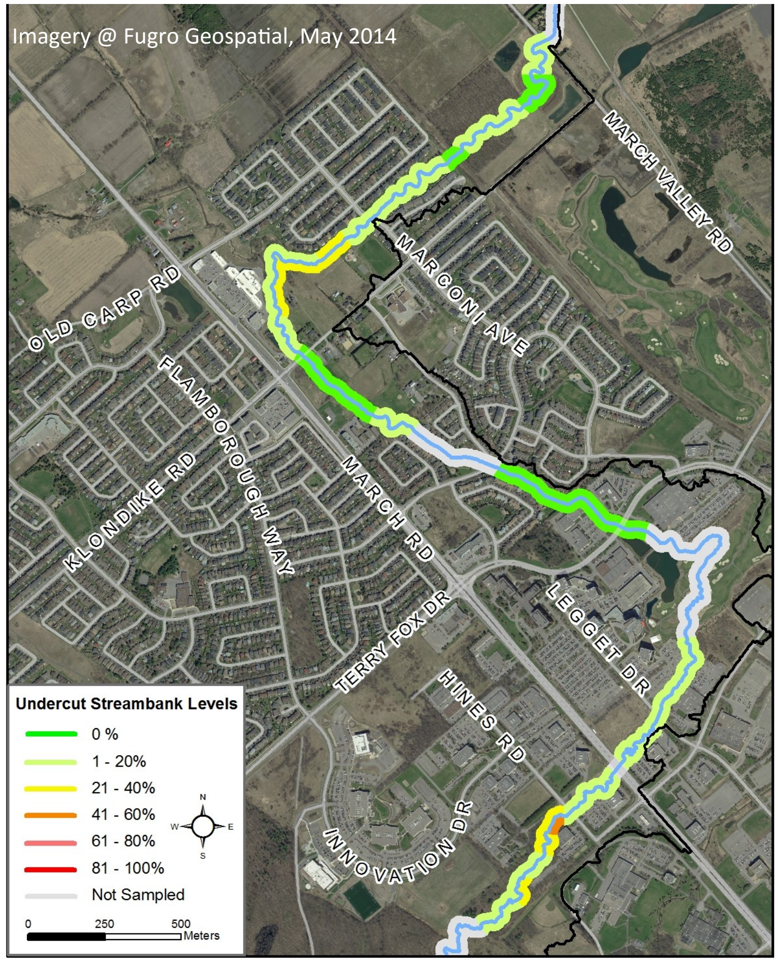


Figure 12: *Undercut stream banks along Shirley`s Brook.*

In-stream Morphology

In-stream morphology is categorized as pools, riffles, and runs. Pools and riffles are both particularly important for fish habitat. Pools, which are deeper and usually slower flowing sections in the stream, provide shelter for fish, especially when water levels drop or when water temperatures increase. Riffles are sections of agitated and fast moving water that add dissolved oxygen to the stream and provide spawning habitat for some species of fish. Runs are areas along a creek that are typically shallow and have un-agitated water surfaces. The in-stream morphology for Shirley`s Brook can be seen in Figure 13.

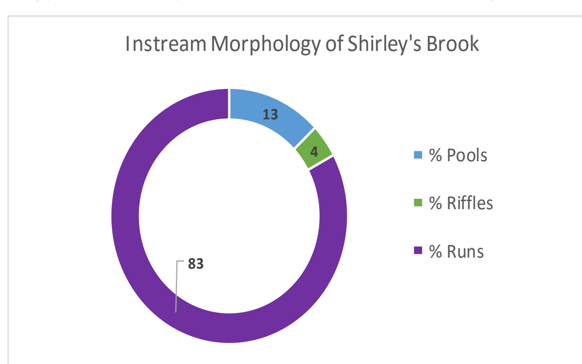


Figure 13: *In-stream morphology along Shirley`s Brook.*

It is beneficial for the health of the ecosystem if there is a variety of these in-stream features, to allow oxygen to flow through the creek, to provide habitat, and to have a well-connected watercourse. As seen in Figure 13, Shirley's Brook was found to consist of 83% runs, 4% riffles and 13% pools. Stewardship efforts could be focused at creating more in-stream pool/riffle sequences to enhance fish habitat.

In-stream Substrate

In-stream substrate describes the composition of the bed of the watercourse. A diversity of substrates is important for fish and benthic invertebrates because some species have specific habitat requirements and will only reproduce on certain types of substrate. A healthy stream will generally have a large variety of substrate types which will support a greater diversity of organisms.

Figure 14 summarizes the different types of substrate which make up the bed of Shirley's Brook.

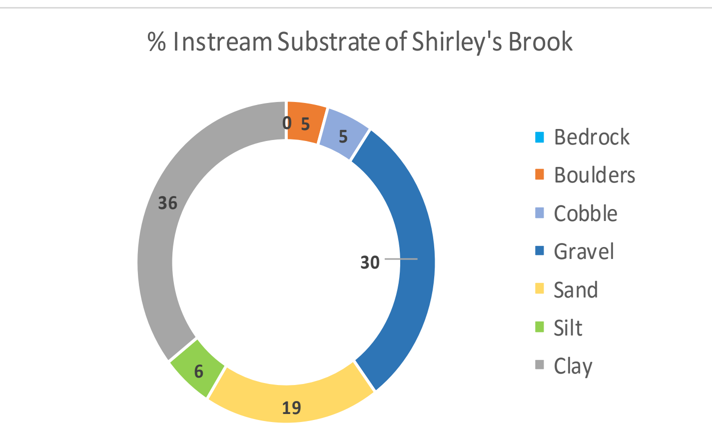


***Figure 14:** Percentages of in-stream substrate types in Shirley's Brook.*

Shirley's Brook is composed of high percentages of clay, gravel and sand, with smaller percentages of silt, cobble and boulder. Cobble, which makes up 5% of the in-stream substrate, provides spawning habitat for fish and invertebrates. It also provides habitat for benthic invertebrates (organisms that live on the bottom of a water body or in the sediment) that are a key food source for many fish and wildlife species. Boulders, which make up 5% of Shirley's Brook's in-stream substrate, will create cover and back eddies for larger fish to hide and to rest out of the current.

Clay and gravel are dominant substrate types which reflect the subwatershed's surficial geology and indicate that shoreline erosion is contributing these materials to downstream habitats.

Cobble and Boulder Habitat

As discussed, cobble and boulders both provide important fish habitat. Figure 15 shows the sections of Shirley's Brook where cobble and boulders were found to either be present or not present on the stream bed and shows that the creek has a healthy distribution of cobble and boulder substrate.

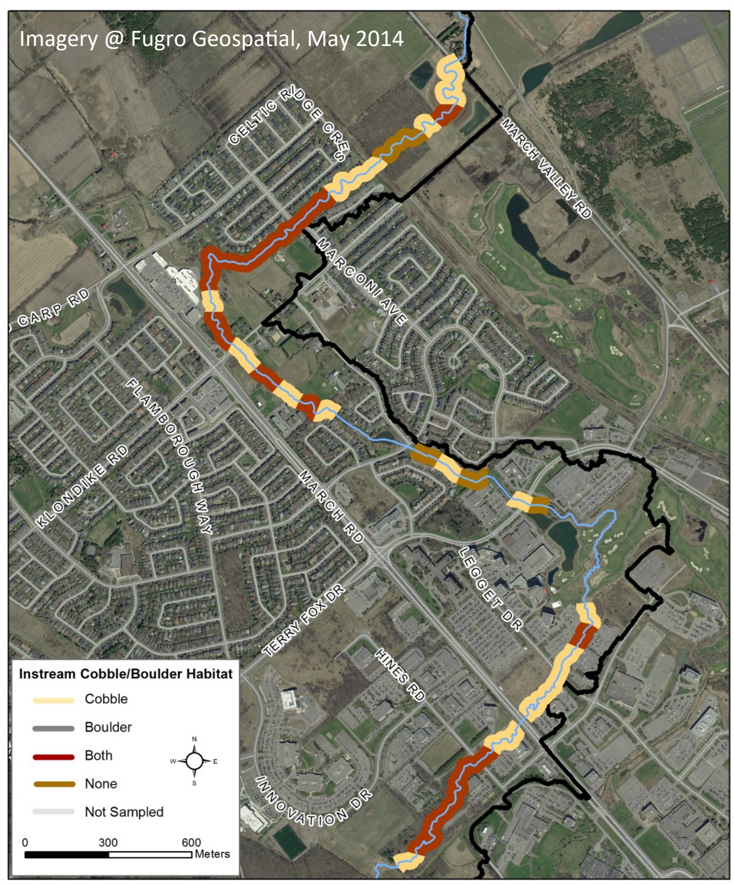


***Figure 15:** Cobble and boulder habitat along Shirley's Brook.*

Type and Abundance of In-Stream Vegetation

A well-balanced amount and suitable variety of in-stream vegetation is important for a healthy stream ecosystem. Aquatic plants provide habitat for fish and wildlife, contribute oxygen to the stream, and help to remove contaminants from the water. However, too much in-stream vegetation can be detrimental and can signify an unhealthy stream. Certain types of vegetation, such as algae, can also be indicative of poor stream health, as it is often seen in streams with high nitrogen and phosphorous inputs (from runoff or wastewater).

Types of In-stream Vegetation

There are many factors that can influence the presence of aquatic plants, some of which include the substrate type, increases in air and water temperature, and the time of year the assessment was completed. As seen in Figure 16, the in-stream vegetation that was observed in each surveyed section was divided by type into eight categories; narrow-leaved emergent, broad-leaved emergent, robust emergent, free floating plants, floating plants, submerged plants, algae and no plants.

Shirley's Brook had very high proportions of submerged plants (35%), algae (26%) and areas of no vegetation (26%).

Amount of In-stream Vegetation

In-stream vegetation helps to remove contaminants from the water, contribute oxygen to the stream, provide habitat for fish and wildlife, and reduce current velocities, however too much vegetation can be detrimental. For this assessment, the amount of in-stream vegetation is measured according to five categories, ranging from "extensive", where the stream is choked with vegetation, to "rare", where there are very few plants.

Figure 17 shows the amount of in-stream vegetation in Shirley's Brook. The creek was found to have a good diversity of vegetation abundance with each category being represented. Overall however, the creek had more sections with low vegetation amounts, with 9% low, 41% rare, and 16% no vegetation.

Low, rare, and no in-stream vegetation levels in Shirley's Brook are likely due to substrate type. For example areas that are overloaded with silt or contain more cobble do not facilitate easy plant growth. It may also be the result of water depths or currents creating conditions that limit plant growth.

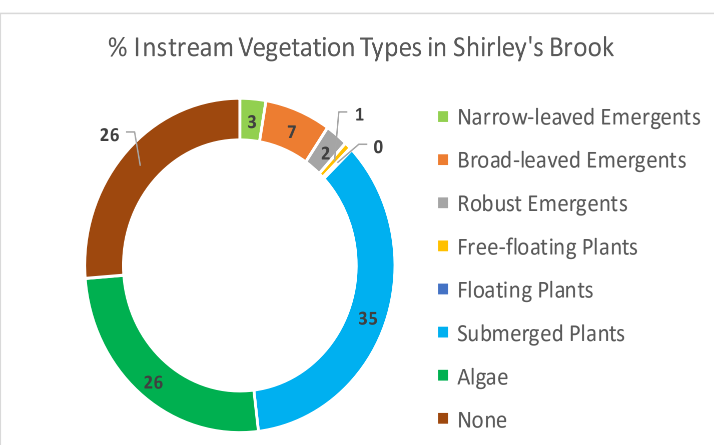


Figure 16: *Types of in-stream vegetation in Shirley's Brook.*

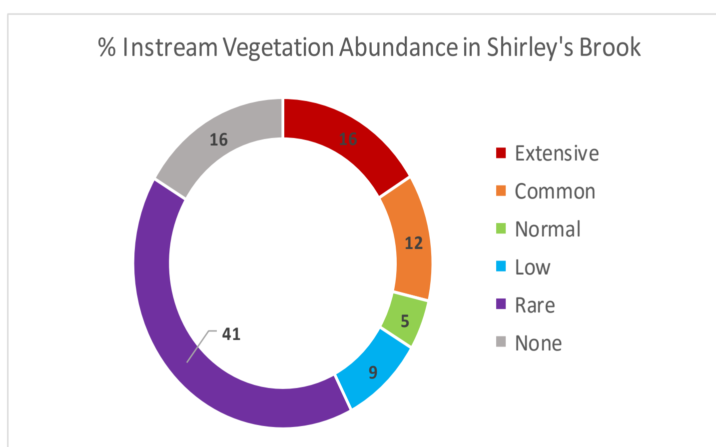


Figure 17: *Abundances of in-stream vegetation in Shirley's Brook.*

Thermal Classification

Temperature is an important parameter in streams as it influences many aspects of physical, chemical and biological health. Figure 18 shows where the temperature datalogger was deployed in Shirley`s Brook from late May to mid September 2016 to give a representative sample of how water temperature fluctuates.

Many factors can influence fluctuations in stream temperature, including springs, tributaries, precipitation runoff, discharge pipes and stream shading from riparian vegetation. Water temperature is used along with the maximum air temperature (using the revised Stoneman and Jones method by Cindy Chu *et al*) to classify a watercourse as either warm, cool-warm, cool, cold-cool, or cold water. Figure 19 shows the thermal classifications of Shirley’s Brook.

Analysis of the data collected indicates that Shirley’s Brook should be classified as a cool-warm stream with the downstream site being slightly warmer than the upstream location.

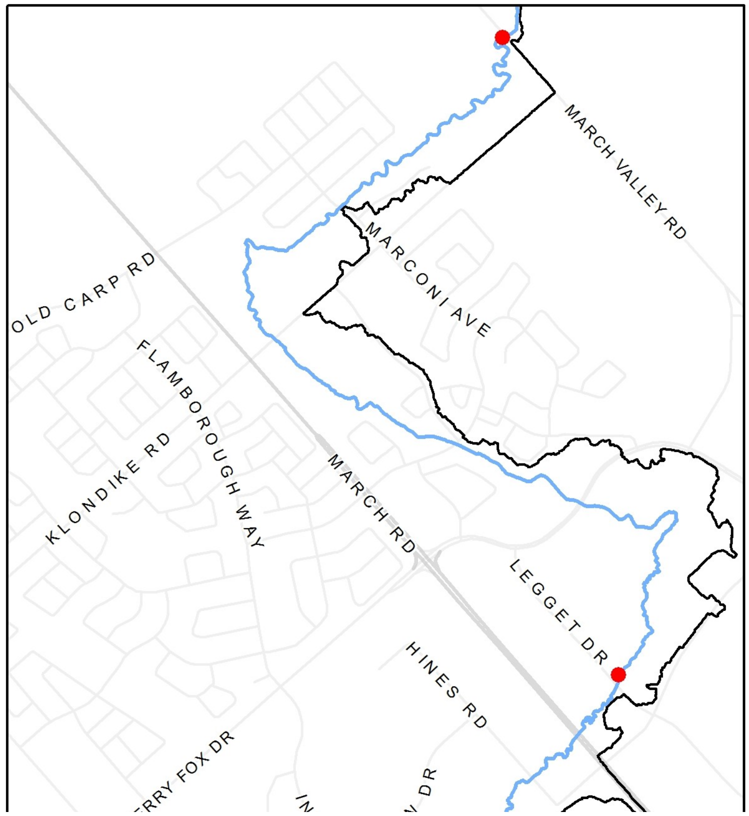


Figure 18: *Location of temperature loggers in Shirley’s Brook.*

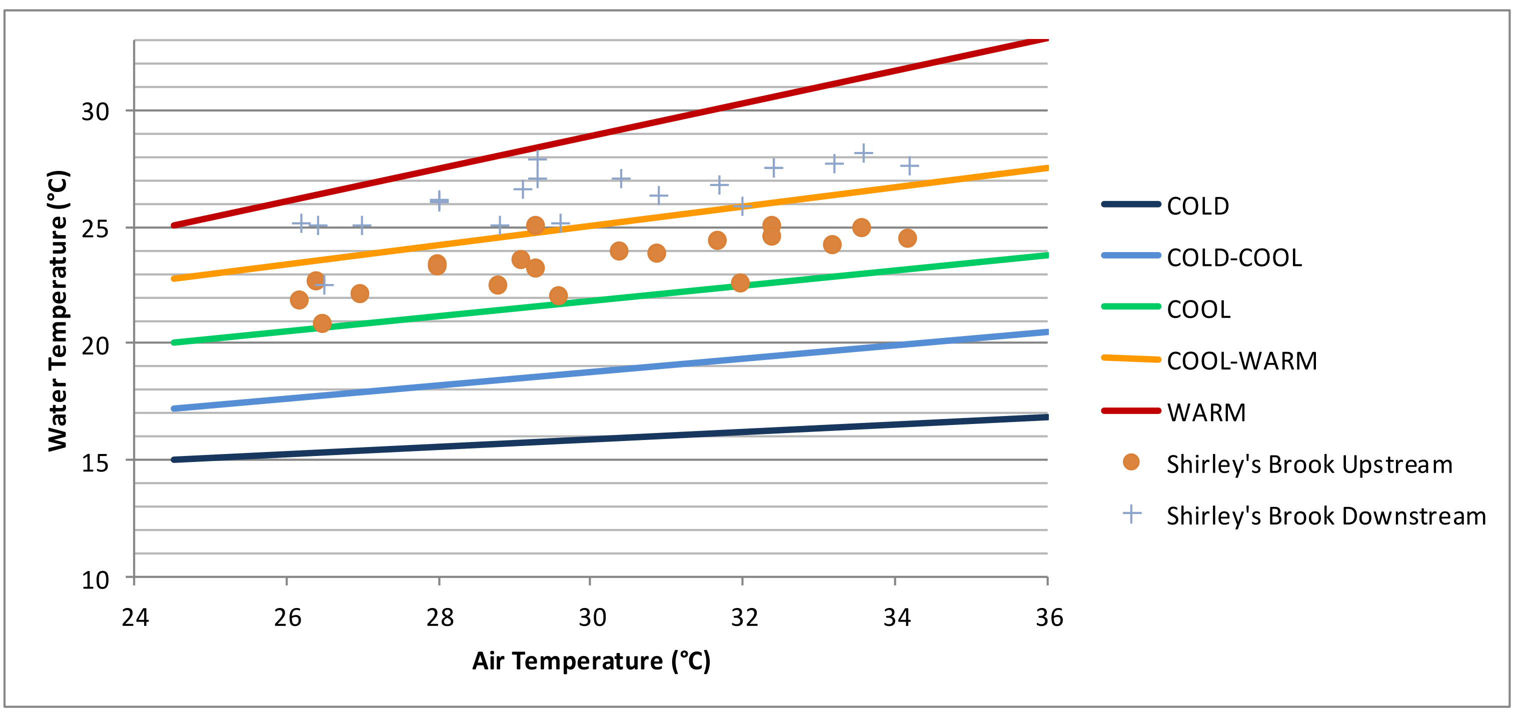


Figure 19: *Thermal classification of Shirley's Brook.*

Each point on the graph represents a water temperature that was taken under the following conditions:

- Sampling dates between July 1 and August 31.
- Sampling date has a maximum air temperature ≥ 24.5 °C and was preceded by two consecutive days with a maximum air temperature ≥ 24.5 °C during which time no precipitation occurred.
- Water temperature is taken at 4:00 pm

Wildlife Observed

There was a variety of wildlife observed during the assessment of Shirley's Brook. Many raccoon tracks were seen. Green frogs, dragonflies, damselflies, minnows, a Japanese Scarab Beetle, and various aquatic insects were also observed. A highlight was an up close sighting of a great blue heron near an office parking lot.

Water Chemistry and Quality

A YSI probe was used to collect water quality data including pH, dissolved oxygen, and conductivity, at each site assessed. The maximum, minimum and average readings for each of those parameters are presented in Table 3.

Dissolved oxygen measures the amount of available oxygen within the water that is accessible to wildlife. According to the Canadian Water Quality Guidelines for the Protection of Aquatic Life, the guideline value for the concentration of dissolved oxygen in freshwater for early life stages is 6.0 milligrams/liter (mg/L) for warm water ecosystems and 9.5 mg/L for cold water ecosystems. The average amount of dissolved oxygen in Shirley's Brook measured 8.28 mg/L, making it healthy for warm water fish, and slightly below the requirements for cold water fish.

Table 3: Shirley's Brook Water Quality Data

	Minimum	Maximum	Average
pH	7.27	8.09	7.69
Dissolved Oxygen (mg/L)	1.01	14.02	8.28
Conductivity (µS/cm)	878	1878	1424

Conductivity is defined as the ability of water to pass an electrical current, and is an indirect measure of the saltiness of the water caused by dissolved ions. Fish cannot tolerate large increases in saltiness in the water. Factors that can change the conductivity of freshwater include climate change and human activity. Warmer climate conditions increase the evaporation of water, leaving existing water with higher concentrations of dissolved ions (higher conductivity). Use of road salt in and around the stream can also elevate ion levels, along with industrial and human wastewater. Because of all these factors, conductivity of a stream can fluctuate greatly with readings between 0 and 10,000 microSiemens/centimeter (µS/cm). The United States Environmental Protection Agency notes that streams supporting good mixed fisheries generally fall between 150 and 500 µS/cm. The average conductivity of Shirley's Brook is 1424 µS/cm, putting it well above the ideal range. This can have an effect on the wildlife present. At this level of study it is hard to determine the cause of the high values . However it does help provide a benchmark value and a notice about potential stressors to the in-stream habitat.

The measurement of pH tells us the relative acidity or alkalinity of the creek. The scale ranges from 1 (most acidic) to 14 (most basic) and has 7 as the middle and most neutral point. The average pH of Shirley's Brook is 7.69, a nearly neutral condition, which is good for many species of fish to thrive.

Potential Riparian Restoration Opportunities

Naturally vegetated shorelines help reduce erosion, filter pollutants from entering the watercourse, assist in flood control and provide food and habitat for a diversity of wildlife.

Figure 20 depicts the locations identified by MVCA staff and volunteers, as areas for potential restoration activities.

The next steps will be to approach the landowners and work with them on a voluntary basis to enhance their shorelines through a number of potential activities, such as increasing the unmowed areas along the shore or agreeing to plant and maintain native shoreline species of trees or shrubs.

Other activities that would benefit Shirley's Brook include the removal of invasive species such as Yellow Iris and Dog-Strangling Vine, and garbage clean-ups near road crossings as well as behind commercial buildings.

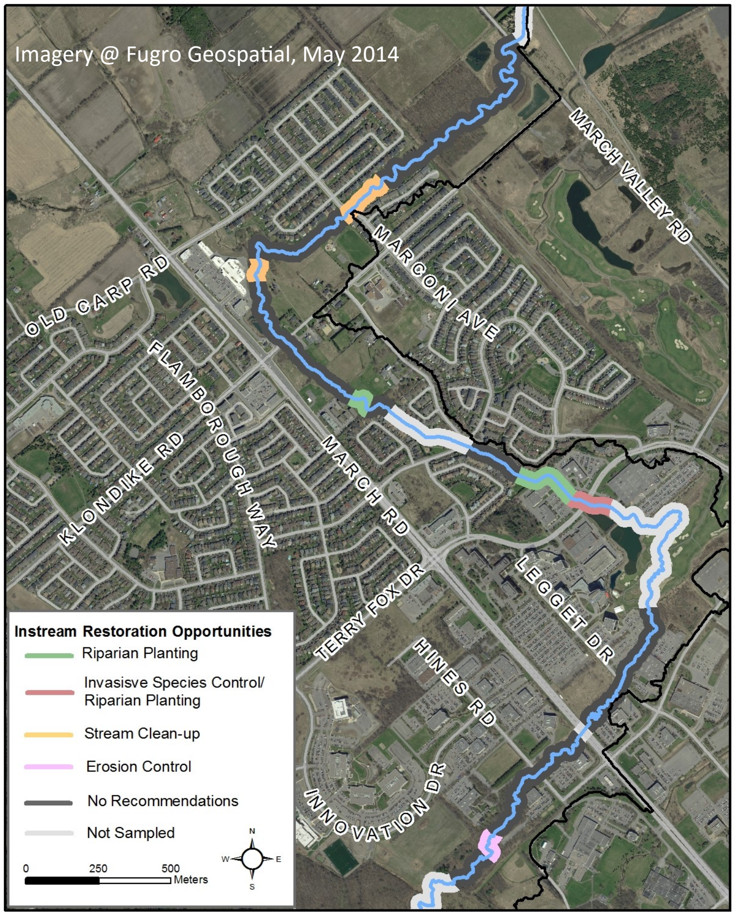
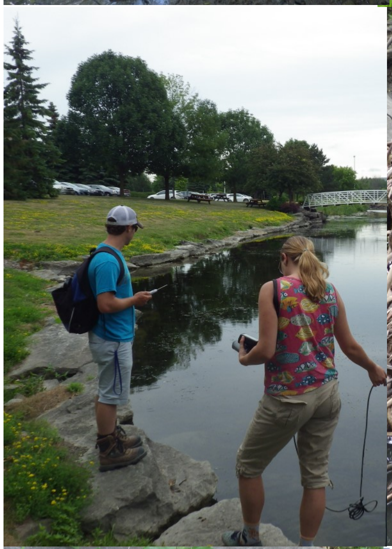


Figure 20: *Areas for potential restoration projects along Shirley`s Brook.*



How Does This Information Get Used?

The City Stream Watch Program is an excellent monitoring program that allows MVCA to assess the condition of subwatersheds over time. Stewardship activities in areas that need further work are completed and improve the health of the ecosystem.

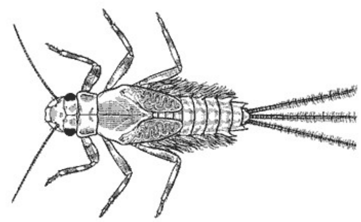
MVCA uses stream surveys to target specific areas that need restoration work. Stream garbage clean ups are carried out, blockages are removed, and shoreline planting, erosion control and habitat enhancements are organized.

MVCA is always looking for volunteers to help with monitoring and stewardship programs!

Call 613-253-0006 ext. 234, if you are interested!

Volunteer projects that are carried out as a result of the City Stream Watch Program are:

* Planting trees and shrubs along the shoreline
* Removing invasive plant species
* Stream garbage clean-ups
* Learning about and participating in monitoring the streams
* Learning about and participating in fish sampling/identification and wildlife identification
* Learning about and participating in benthic invertebrate sampling/identification
* Participating in natural photography



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