Carp C Tributary 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, stream garbage pick-ups 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 8.4 kms. Separate reports are available for each stream on our website.

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

Figure 1 shows the location of the Carp C subwatershed within MVCA's City Stream Watch program area.

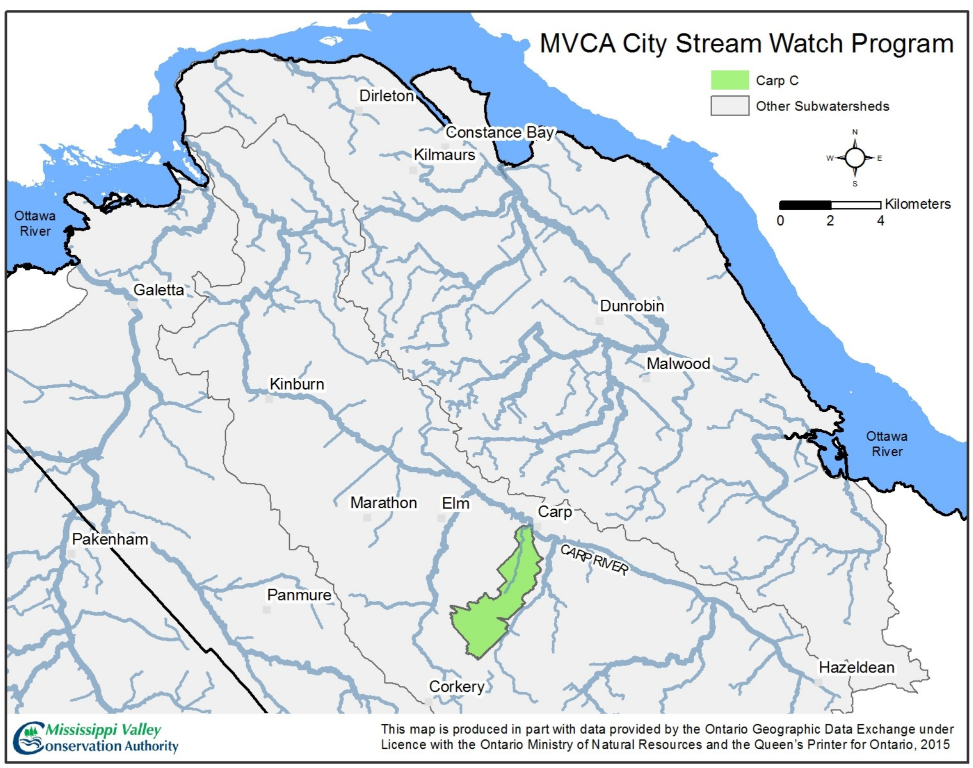


Figure 1: *MVCA's City Stream Watch area highlighting the location of the Carp C subwatershed.*

Carp C Tributary

Located in the west end of the City of Ottawa, Carp C is an unnamed tributary of the Carp River. MVCA has designated the creek "Carp C" for the purpose of our monitoring programs. It has a length of 6.4 kilometers (km) and drains an area of 7.1 square kilometers (km^2).

Carp C's headwaters originate north of March Road east of the 417 Highway and it flows through agricultural properties until it reaches the Carp River downstream of the village of Carp.

Table 1 presents a summary of some key features of the Carp C subwatershed.

Table 1: Subwatershed Features	
Area	7.1 square kilometers
Land Use	41.5% agriculture
	21% wetlands
	18.1% wooded area
	7% rural land-use
	4.8% roads
	0.1% water
	0% aggregate sites
	0% urban land-use
Surficial Geology	46.9% clay
	36.9% sand
	11.4% bedrock
	4.5% gravel
	0.2% organic deposits
	0.1% diamicton
Watercourse Length and Type	*Total Length:* 6.4 kilometers
	Watercourse Type:
	100% natural
	0% channelized
	Flow Type:
	Intermittent

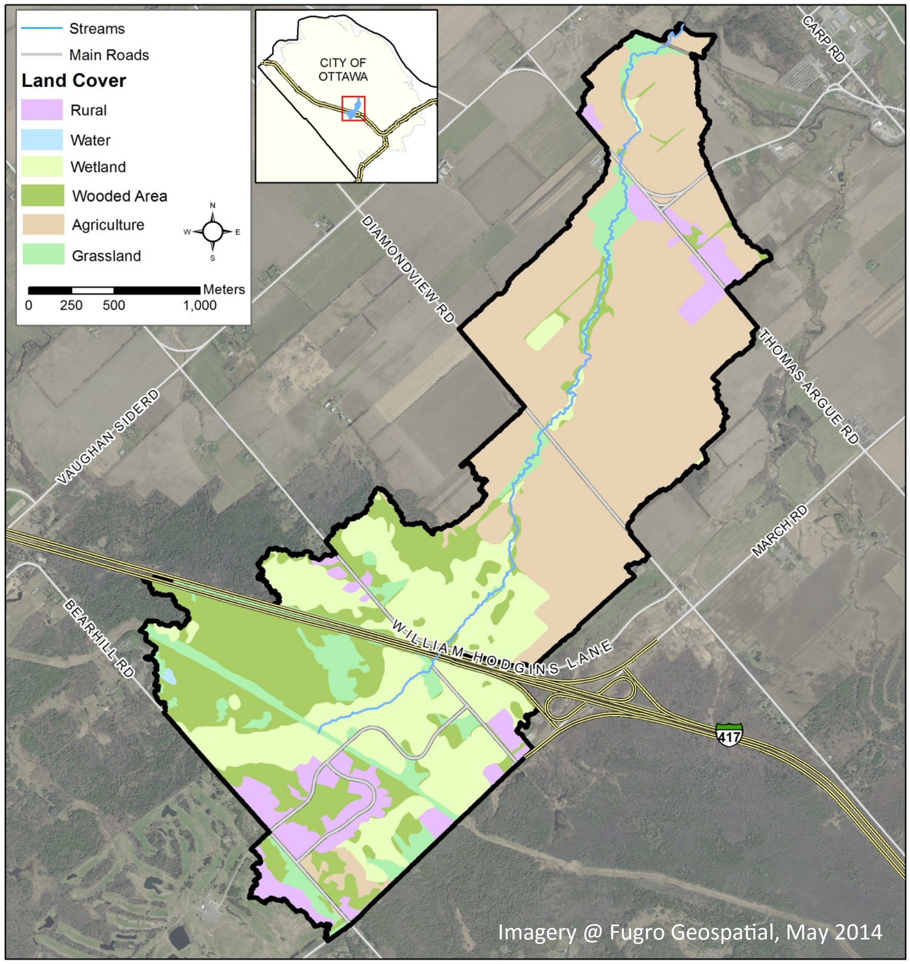


Figure 2: *Land Use in the Carp C subwatershed.*

The Carp C Subwatershed

As seen in Figure 2, the Carp C subwatershed is fairly small with the headwaters consisting of wetland and woodland habitat, then it travels through agricultural lands in a green corridor of wetland, woodland and grassland.

The majority of the watershed is agricultural land. The creek provides a natural corridor and habitat within this land use for a range of aquatic and terrestrial species.

Rural residential land uses make up only 7% of the watershed area and are predominantly in the headwaters adjacent to the Greensmere Golf and Country Club, as well as in the downstream area near the Village of Carp.

Fish species found in Carp C: Brassy Minnow, Brook Stickleback, Common Mudminnow (pictured above), Creek Chub, Dace sp., Northern Pearl Dace, White Sucker, Blacknose Dace, Fathead Minnow.

Monitoring in Carp C

In 2016, permission was granted to survey 41 sections of Carp C, shown in Figure 3, which cover approximately 4.1 km of the creek. Only 4 of the possible 41 sections were successfully surveyed due to severe drought conditions. Survey dates were limited so effort was focused closer to the road crossings and aerial imagery is being used to help understand sections that were not walked.

The sections surveyed primarily informed us about the conditions in a pool created by a beaver dam. This is a critical refuge habitat for aquatic species and a source of drinking water for terrestrial species considering other reaches of the tributary were completely dry at the time of sampling.

The temperature probes (page 11) show interesting data indicating that when water is flowing it is cool water. This steady water temperature is likely supported by groundwater seeps and stream shading. It is hoped that this can be further assessed to expand our understanding of the tributary when it comes up again in the City Stream Watch rotation.

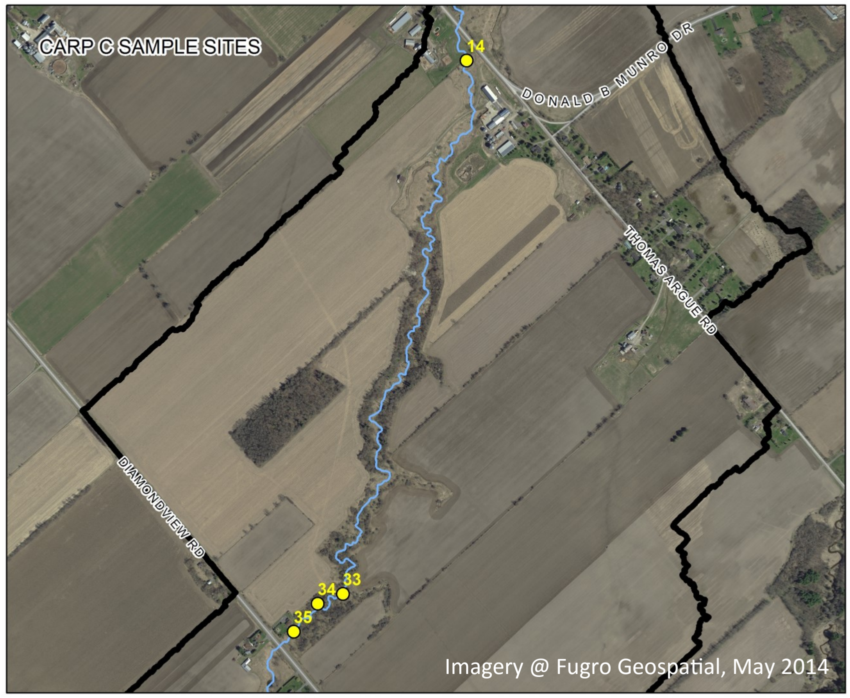


Figure 3: *Locations of the monitoring sites along Carp C.*

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 100m 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.

Table 2 shows some basic assessment measurements for Carp C. The surveyed sections had an average stream width of 4.5 m and an average depth of 0.43 m. When the field survey took place, the average water temperature was 23.4 °C.

Table 2: Carp C Assessment Facts

	Minimum	Maximum	Average
Air Temperature (°C)	26.0	27.1	26.6
Water Temperature (° C)	20.1	23.6	23.4
Wetted Width (m)	1.9	11.8	4.5
Stream Depth (m)	0.00	0.71	0.43

General Land Use Adjacent to Carp C

General land use along each surveyed section of Carp C 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 Carp C.

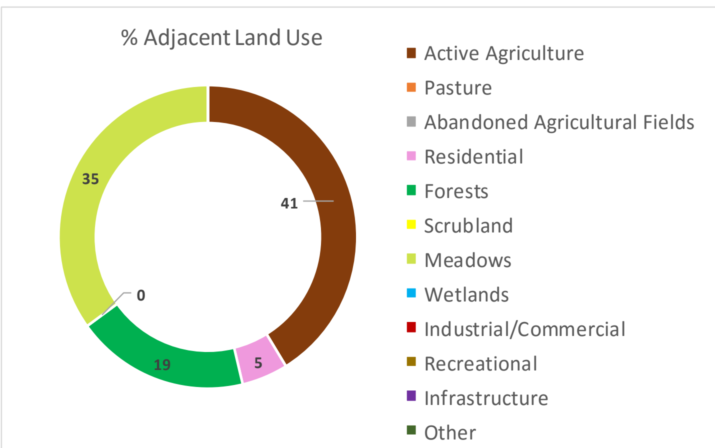


Figure 4: *Land use alongside Carp C.*

At 41%, active agriculture represents the most prominent category of land use followed by meadow at 35%, and forest at 19%.

As described on page 2, the land use in the overall subwatershed area is dominated by agriculture, wetlands in the headwaters and woodlands along the creek corridor.

This is reflected well in the percentages seen in Figure 4. In particular, it shows a high percentage of active agriculture, forest and meadow in the lands adjacent to the tributary.

Human Alterations to Carp C

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, 25% of Carp C was found to be completely unaltered, 50% was natural (with minor alterations), and 25% was highly altered (with considerable human impact).

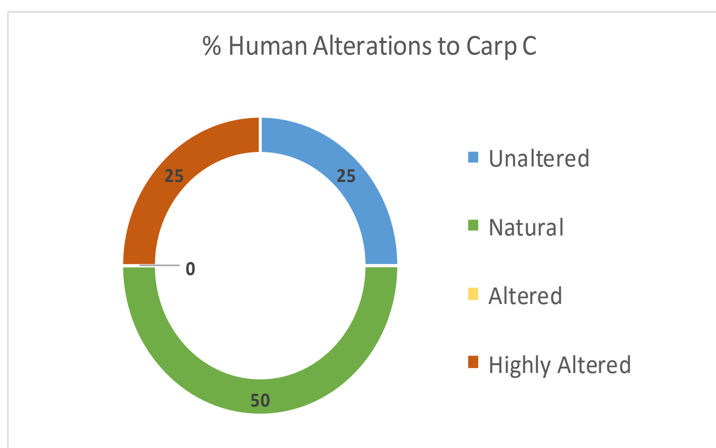


Figure 5: *Extent of human alterations to Carp C.*

Even though the majority of the tributary was not visited directly it can be seen in aerial photography that most of the creek flows within a natural corridor. Human alterations to the channel have occurred due to road crossings or are due to historic agricultural activities.

Riparian Buffer along Carp C

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).

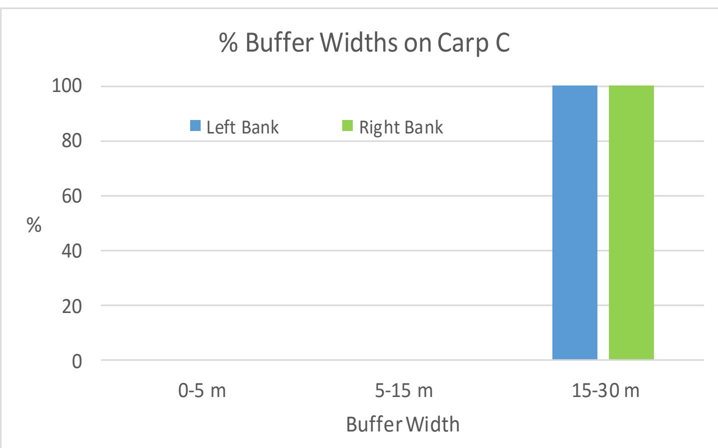


Figure 6: Riparian buffer widths along Carp C.

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 30 m of either side of the watercourse. As summarized in Figure 6, it was found that the sections of Carp C that were surveyed on foot have a relatively good riparian buffer.

Results show that 100% of the surveyed section's left and right banks have a buffer width in the 15-30 m range. As seen in Figure 7, aerial imagery was used to provide an estimate for the areas not walked, distinguished by the black outlines. The green portions on the map show where the buffer of tall grasses extends beyond 30 m.

Overall the majority of the tributary downstream of Diamondview Rd (3.4 kms) has a good buffer zone of undisturbed grasses, shrubs or trees. Some areas have a reduced buffer due to the road network or the shape of the active agricultural fields.

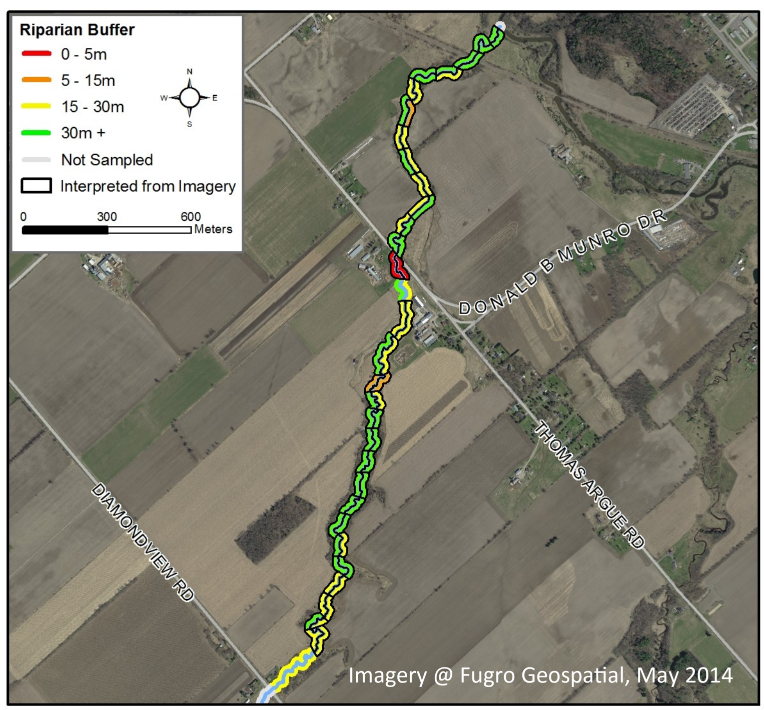


Figure 7: *Vegetated buffer width along Carp C.*

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, Carp C has a low amount 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 open wetland, or areas dominated by tall grasses, and in some areas it reflects clearing of the vegetation too close to the creek.

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, one of the surveyed stream sections was classified as having 61-80% overhanging trees and branches while the three other reaches where found to have less than 40% overhanging branches.

Aerial photography indicates that a good portion of the stream has trees or shrubs along the banks. In particular the headwaters upstream of Diamondview Road flow through a forest. Throughout the corridor to the Carp River there are pockets of open wetland fringed with trees as well as areas well shaded by trees and shrubs.

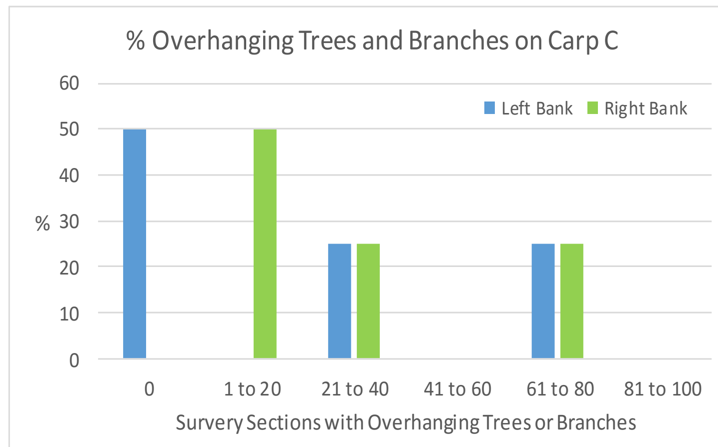


Figure 9: *Percentage of each surveyed section of Carp C with overhanging trees and branches.*

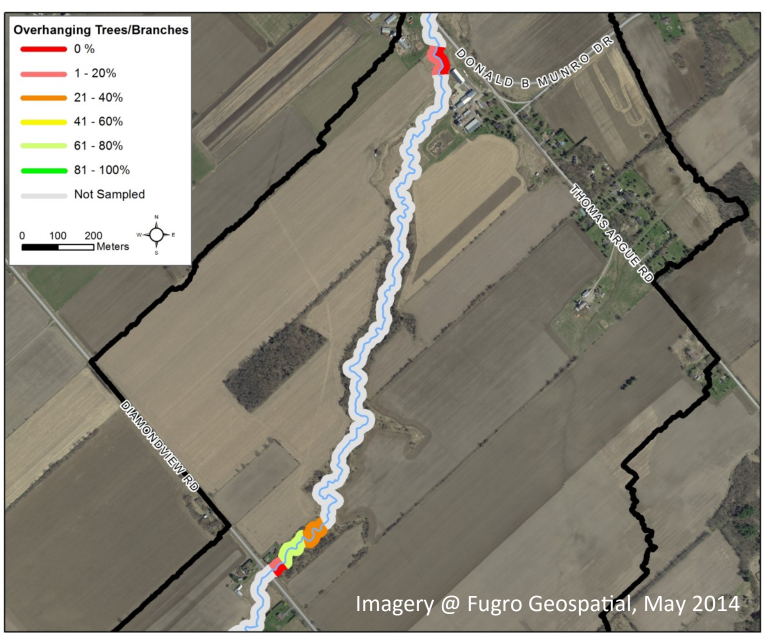


Figure 8: *Overhanging trees and branches along Carp C.*

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 Carp C. It shows that the shading is extremely variable. This is due to the diversity of riparian vegetation along the creek, with large sections of open meadow interspersed with areas of dense scrubland or forest. There are also pockets of open and forested wetland habitat.

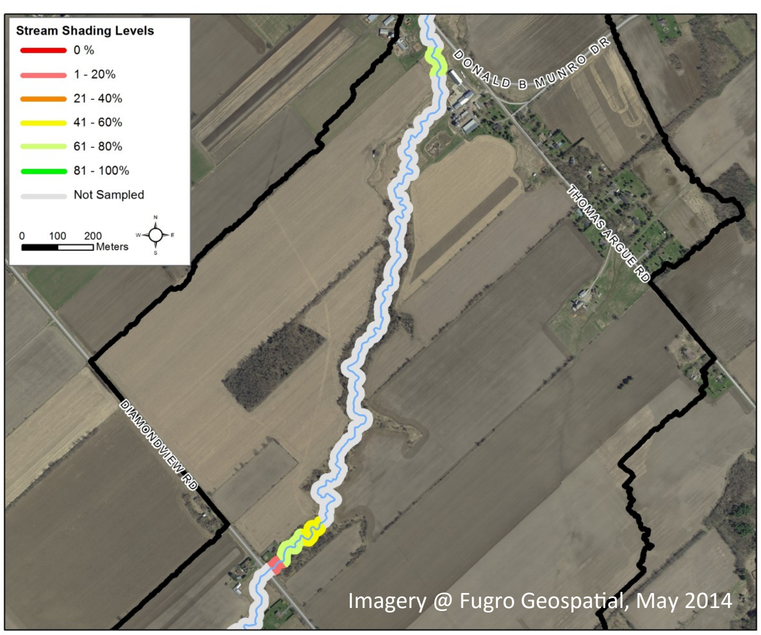


Figure 10: *Stream Shading along Carp C.*

Figure 11 shows the data quantified as the percent of creek sections classified according to the various levels of shading. For example, 25% of the 4 stream sections that were surveyed were classified as having 1 to 20% shading along the entire section. With 25% at 41-60% shading and 50% with 61-80% shading, 3/4 of the length surveyed was well shaded.

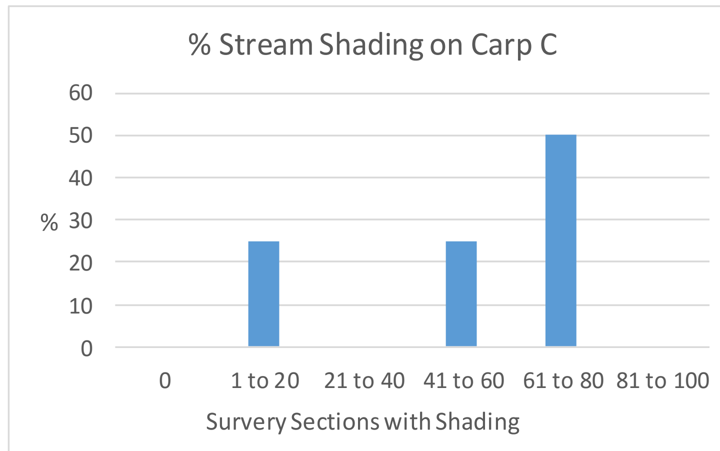


Figure 11: *Shading along Carp C.*

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 resulting in instability, erosion and sedimentation.

Figure 12 shows the percentage of undercut stream banks along each surveyed section of Carp C. Overall, the sections of Carp C that were surveyed were found to have very little undercutting. The one pocket of undercutting, just south of Donald B. Munro Drive, occurred in an area of tight meanders and shallow rooting grasses. If it is relatively stable, it should be left to provide refuge and shelter habitat. If the area appears unstable and the landowners are willing, there is potential for a shoreline planting project to help improve stability.

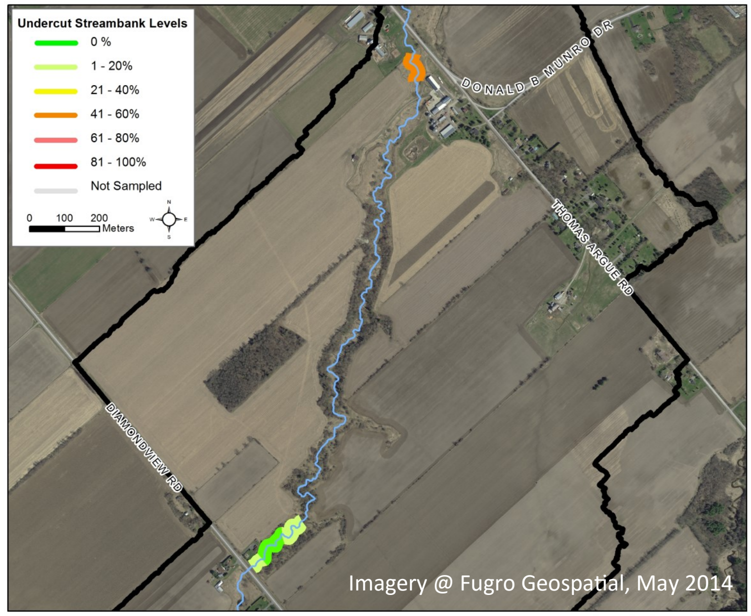


Figure 12: *Undercut stream banks along Carp C.*

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 Carp C can be seen in Figure 13.

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 12, Carp C was found to consist of 95% runs, 0% riffles and 5% pools. Stewardship efforts could be focused at creating more in-stream pool/riffle sequences to enhance fish habitat.

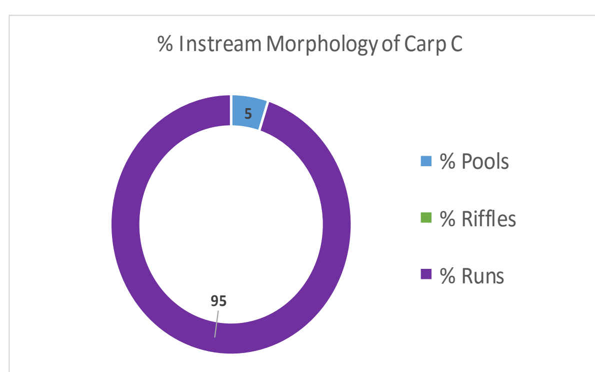


Figure 13: *In-stream morphology along Carp C.*

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 Carp C.

In the sections surveyed, Carp C's substrate is mostly made up of silt, clay and a little sand. No areas with bedrock, boulder, cobble or gravel were discovered. This is likely due to the local geology consisting of 47% clay and 37% sand.

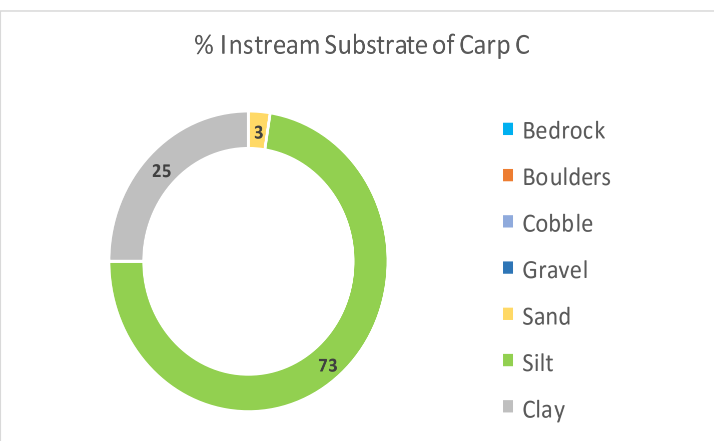


Figure 14: *Percentages of in-stream substrate types in Carp C.*

Cobble and Boulder Habitat

As discussed, cobble and boulders both provide important fish habitat. Figure 15 shows that sections of Carp C surveyed did not have cobble or boulders present along the stream bed.

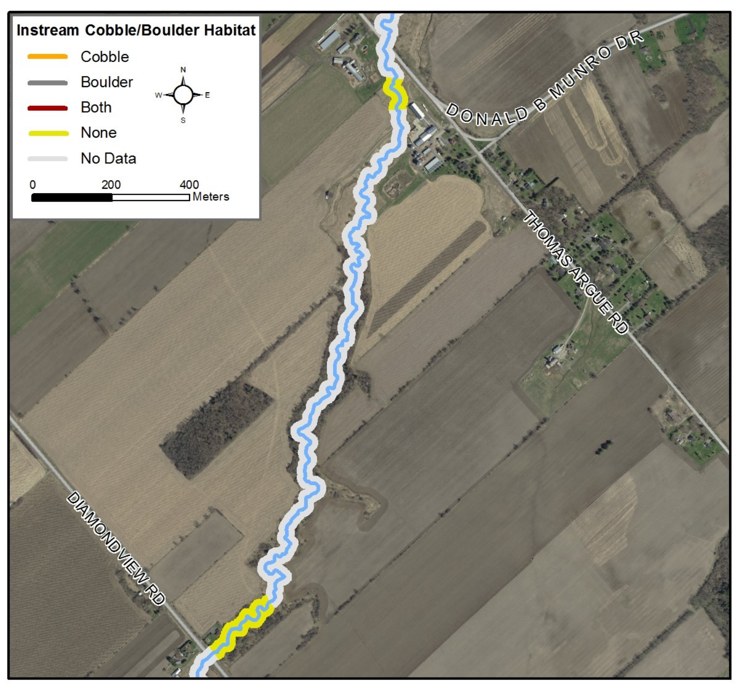


Figure 15: *Cobble and boulder habitat along Carp C.*

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).

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 16 shows the amounts of in-stream vegetation in Carp C. The creek was found to have very low to rare in-stream vegetation abundance.

Low in-stream vegetation levels in Carp C are likely due to substrate type. For example areas that are overloaded with silt or packed clay do not facilitate easy plant growth. It may also be the result of water depths, currents, or shade creating conditions that limit plant growth.

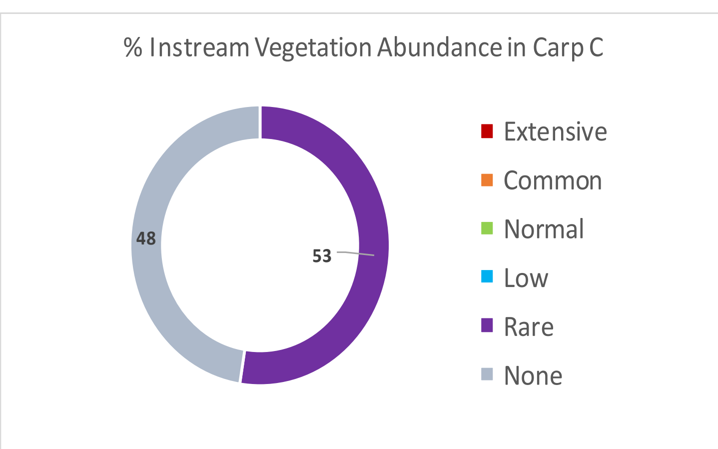


Figure 16: *Abundances of in-stream vegetation in Carp C.*

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 17, 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.

The limited amount of aquatic vegetation that was found in Carp C consisted of narrow leaved emergent plants (pictured below). This is likely a combination of the stream lacking suitable substrate and sunshine conditions for establishment of a wider diversity of plants.

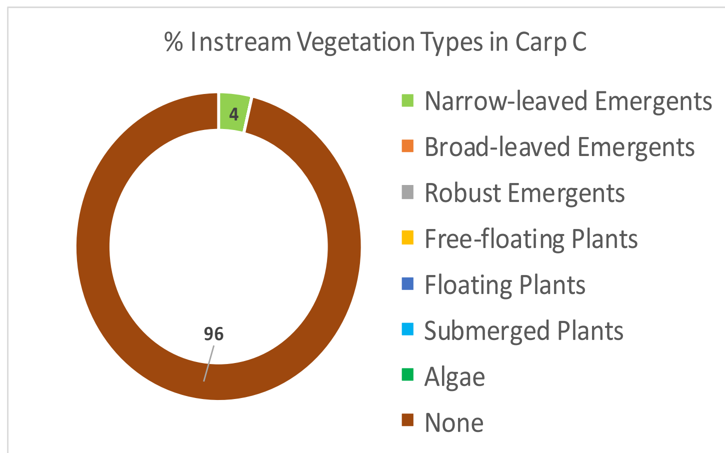


Figure 17: *Types of In-stream vegetation in Carp C.*

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 Carp C from late May to mid September 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 Carp C.

Analysis of the data collected indicates that Carp C should be classified as a cool stream with the upstream site more variable in the cool-warm range and the downstream site more consistently within the cold-cool temperatures.

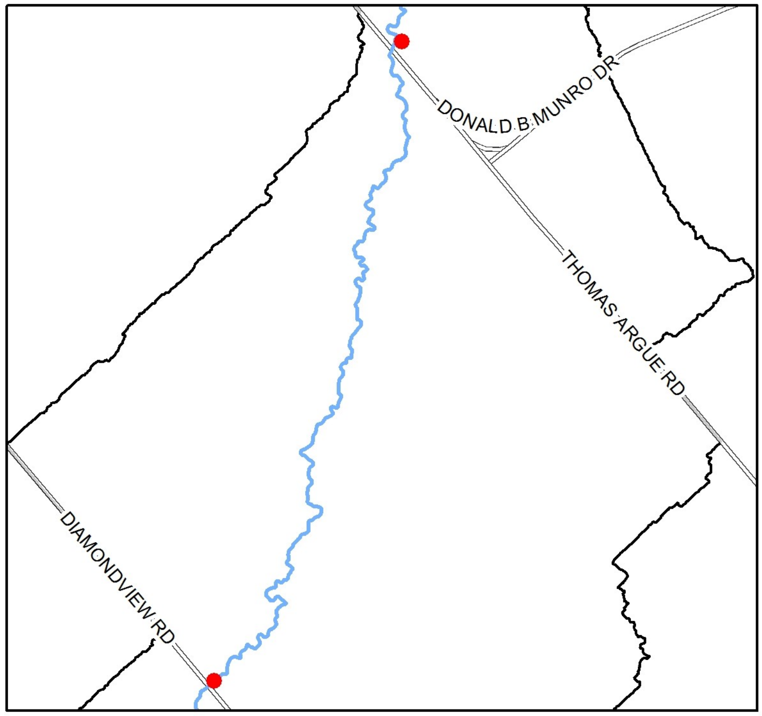


Figure 18: *Location of temperature logger Carp C.*

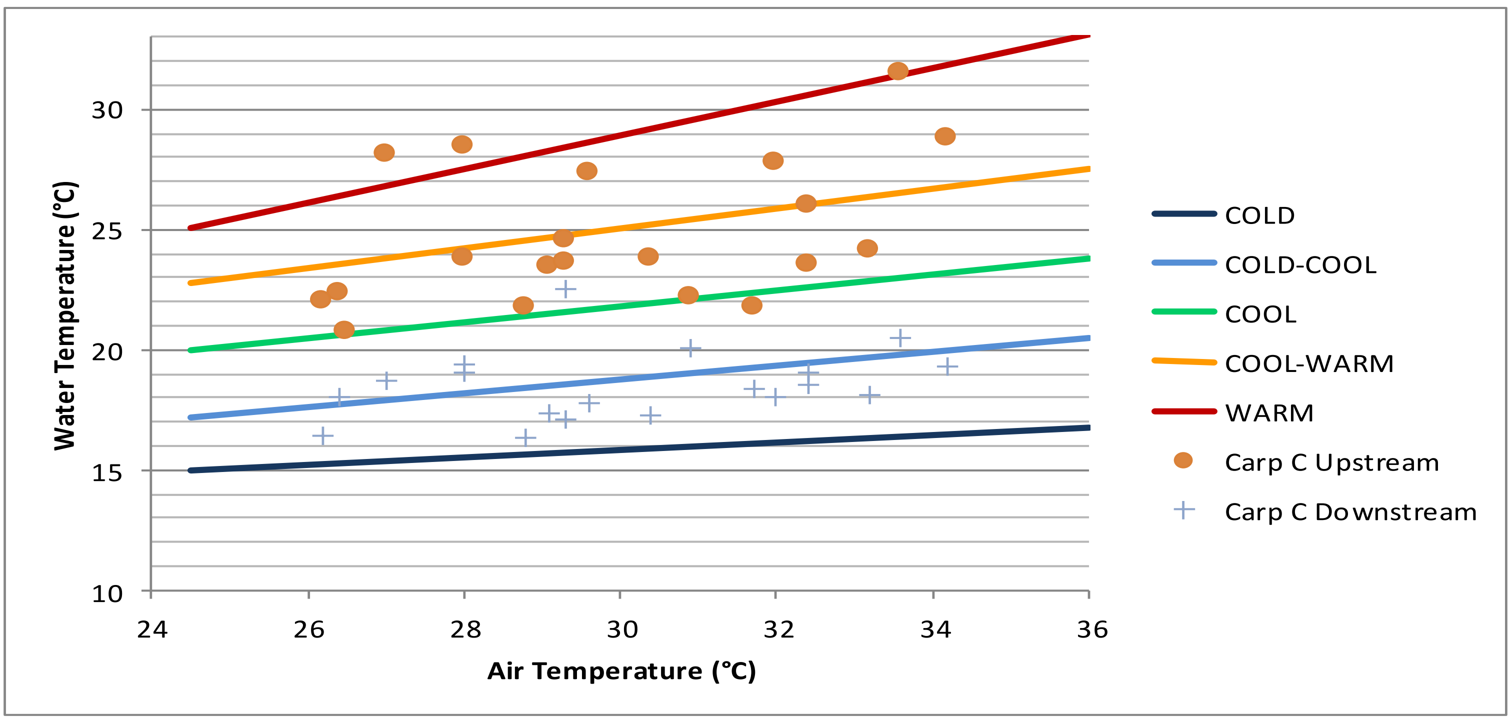


Figure 19: *Thermal classification of Carp C .*

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 were many species of wildlife observed during this assessment of Carp C. Beaver activity is a big influence on the creek providing the deepest wet area for our survey. Other animals observed include song birds, frogs, tadpoles, minnows, a great blue heron, a sandpiper, as well racoon and deer tracks were noted.

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 Carp C measured at 1.55mg/L, making it a stressful environment for warm water fish. This reading could be due to the drought conditions preventing adequate mixing and flow.

Table 3: Carp C Water Quality Data

	Minimum	Maximum	Average
pH	n/a	6.59	n/a
Dissolved Oxygen (mg/L)	0.31	2.47	1.55
Conductivity (µS/cm)	940	1186	963

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 Carp C is 963 µS/cm, putting it above the ideal range. This can have an effect on the wildlife present.

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 pH of Carp C is 6.59 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.

In 2014 MVCA organized a shoreline planting project along the western shore of the Carp River and along the northern bank of the outlet of Carp C (Figure 20).

In 2015 MVCA planted 325 trees and shrubs along Carp C on a portion of the Munro Farm.

These areas were mostly tall grasses with some trees and signs of shoreline erosion. They now also have a mix of native trees and shrubs enhancing the biodiversity, shoreline soil retention, and once the plantings become established they will contribute to stream shading.

The next steps will be to approach the landowners and work with them on a voluntary basis to further enhance their shorelines through a number of potential activities, such as agreeing to more plantings of native species.

Figure 20: *Volunteers helping with a shoreline planting project along the Carp River and Carp C tributary in 2014.*

Photos top to bottom: Invasive Purple Loosestrife, Invasive Yellow Iris, Native Blue-Flag Iris.

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.

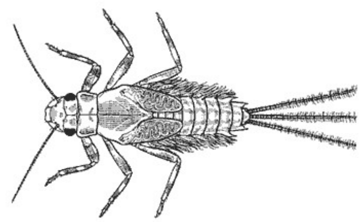
MVCA uses stream surveys to target specific areas that need restoration work. Stream garbage clean ups are carried out, blockages are removed, and shoreline planting, erosion control and habitat enhancements are organized.

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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