Black Rapids Creek 2022 Catchment Report

Catchment Features	
Area	16.32 square kilometres 0.39% of the Rideau Valley watershed
Land Use	59.6% agriculture 10.5% forest 5.6% meadow 2.6 % rural 21.4% urban 0.3% wetlands
Surficial Geology	61.8% clay 3.2% diamicton 0.3% organic deposits 7.2% Paleozoic bedrock 27.4% sand
Thermal Regime	Coolwater to Cool-warmwater
Invasive Species	Fifteen invasive species were identified in 2022: bull thistle, common buckthorn, European frog-bit, flowering rush, garlic mustard, glossy buckthorn, Himalayan balsam, Japanese knotweed, non-native honeysuckle, Manitoba maple, non-native *Phragmites*, purple loosestrife, rusty crayfish, wild parsnip and yellow iris
Fish Community	Twenty six fish species have been observed from 2008 to 2022; game fish species include: black crappie, largemouth bass, pumpkinseed, rock bass, smallmouth bass, walleye, white sucker and yellow perch

Wetland Cover
0.3% of the watershed are unevaluated wetlands

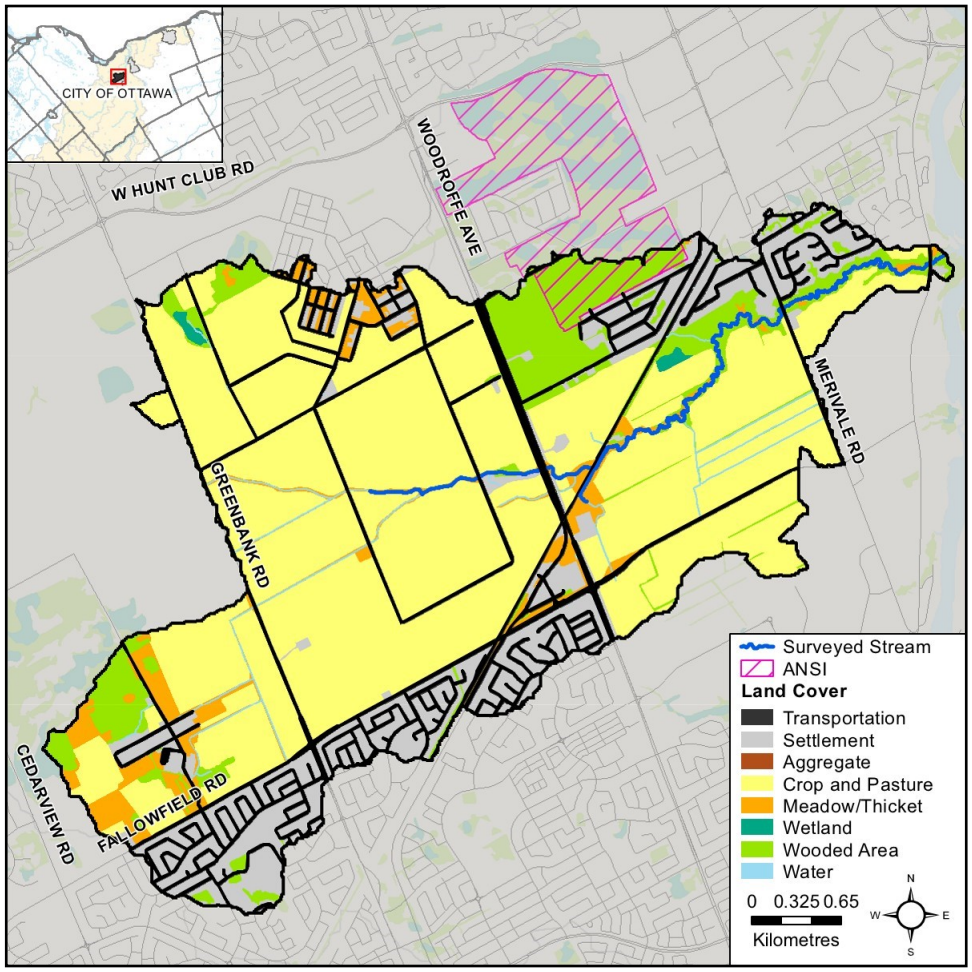


Figure 1 Land cover in the Black Rapids Creek catchment

Vegetation Cover		
Type	**Hectares**	**Percent of Cover**
Wooded Areas:	**171.80**	**97.3%**
Hedgerow	11.85	6.7%
Plantation	47.81	27.1%
Treed	105.11	59.6%
Wetlands*	**4.71**	**2.7%**
Total Cover	**176.51**	**100%**

*Includes treed swamps

Woodlot Analysis		
Size Category	**Number of Woodlots**	**Percent of Woodlots**
<1 Hectare	29	59.2%
1 to <10 Ha	17	34.7%
10 to <30 Ha	2	4.1%
>30 Ha	1	2.0%
Total Cover	**49**	**100%**

The Rideau Valley Conservation Authority in partnership with the City of Ottawa, National Capital Commission, Ottawa Flyfishers Society, Canadian Forces Ottawa Fish and Game Club, Ottawa Stewardship Council, Rideau Roundtable, South Nation Conservation and Mississippi Valley Conservation Authority form the City Stream Watch 2022 collaborative.

Black Rapids Creek 2022 Catchment Report

Introduction

Black Rapids Creek is a tributary of the Rideau River that is approximately six kilometers long, not including the tributaries that flow into the main stem of the creek. The creek flows in an easterly direction, beginning in the headwaters near Greenbank Road, crossing Woodroffe Avenue, Merivale Road and Prince of Wales Drive before flowing into the Rideau River south of the Black Rapids Lock Station. Black Rapids Creek is an important ecological link to other areas such as the Rideau River for fish and wildlife (Del, Degan and Masse, 2007). From Prince of Wales Drive until close to Woodroffe Avenue the creek has natural meanders and wide forested riparian buffers. At Woodroffe Avenue land use adjacent to the creek changes to active agriculture and riparian buffers are reduced. The majority of Black Rapids Creek is owned and managed by the National Capital Commission (NCC) and is part of the NCC Greenbelt lands.

The NCC and the Rideau Valley Conservation Authority (RVCA) partnered on a detailed study characterizing the instream and riparian conditions for Black Rapids Creek in 2014. A final report was prepared and titled the Black Rapids Creek existing conditions and opportunities for enhancement study 2014. The restoration of a headwater wetland adjacent to Woodroffe Road was identified as a result of the survey work. The headwater wetland was restored in 2016 and has been monitored since that time in 2017, 2019 and 2021 (RVCA, 2023). The wetland objectives were to increase flood storage, improve water quality, and enhance fish and wildlife habitat by creating a shallow emergent wetland feature that is connected to the headwaters of Black Rapids Creek. The restored wetland has proven to be successfully achieving its goals and objectives.

In 2022, 64 sections (6.4 km) of the main stem of Black Rapids Creek and its tributaries were surveyed as part of the City Stream Watch monitoring activities. The following is a summary of observations made by staff and volunteers along those surveys.

Beaver dam activity observed along Black Rapids Creek.

Black Rapids Creek Overbank Zone

Riparian Buffer Width Evaluation

The riparian buffer is the adjacent land area surrounding a stream or river. Naturally vegetated buffers are important to protect the health of streams and watersheds. Natural shorelines provide buffering capacity for contaminants and nutrients that would otherwise run off freely into aquatic systems. Well established shoreline plant communities will hold soil particles in place, preventing erosion, and will also provide the stream with shading and cover. Environment and Climate Change Canada recommends a guideline of 30 meters of natural vegetation on both sides of the stream for at least 75 percent of the stream length (Environment Canada, 2013).

Figure 2 demonstrates buffer conditions along the left and right banks of the surveyed sections of Black Rapids Creek. Buffers greater than 30 meters were present along 69 percent of the left bank and 53 percent of the right bank. A 15 to 30 meter buffer was present along five percent of the left bank and 14 of the right bank. A 5 to 15 meter buffer was present along 19 percent of the left bank and 25 percent of the right bank. A five meter buffer or less was present along six percent of the left bank and eight percent of the right bank. The buffer width evaluation on the sections surveyed of Black Rapids creek are below recommended guidelines.

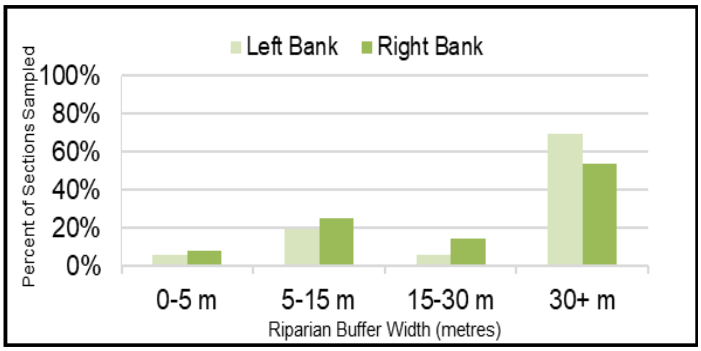


Figure 2 Vegetated buffer width along Black Rapids Creek.

Riparian Buffer Alterations

Alterations within the riparian buffer were assessed within three distinct shoreline zones (0-5 m, 5-15 m, 15-30 m), and evaluated based on the dominant vegetative community and/or land cover type. The evaluation of anthropogenic alterations to the natural riparian cover are shown in Figure 3.

Black Rapids Creek surveyed riparian zones were primarily natural, with 59 percent of the right bank and 64 percent of the left bank having dominant natural riparian vegetative communities. Alterations to the riparian buffer accounted for 33 percent of the right bank and 28 percent of the left bank. Highly altered conditions were observed on eight percent of both the right and left banks. These alterations were associated with infrastructure including the railway, roadways, and agricultural land uses.

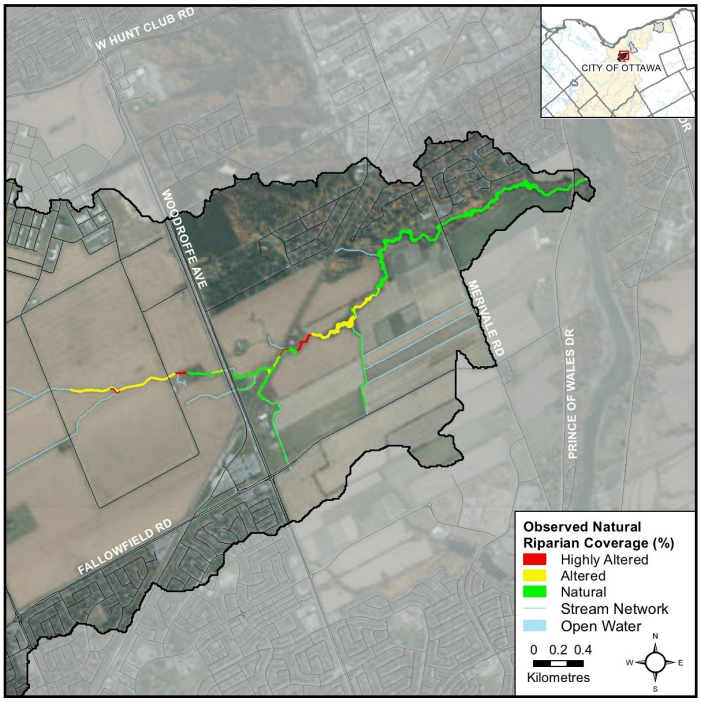


Figure 3 Riparian buffer alterations on Black Rapids Creek.

Vegetated buffer greater than 30 meters in width along Black Rapids Creek upstream of Prince of Wales Drive.

Roadway infrastructure on Prince of Wales along Black Rapids Creek.

Adjacent Land Use

Surrounding land use is considered from the beginning to the end of the survey section (100 m) and up to 100 meters on each side of the creek. Land use outside of this area is not considered for the surveys but is nonetheless part of the subwatershed and will influence the creek. Figure 4 shows the percent of surveyed sections that contain each type of land use.

Forest and scrubland were present in 70 percent and 73 percent of the sections surveyed, being the most common land use observed. Wetlands were present in 27 percent of the surveyed areas, and meadow was present in 58 percent of sections.

Aside from the natural areas, the most common land use in the catchment was active agriculture with 91 percent and pasture at two percent of the surveyed sections. Infrastructure was observed in 23 percent of the sections containing roads, railway, bridges and culverts. Residential land use was observed in 17 percent of surveyed sections and 22 percent was recreational along Black Rapids Creek.

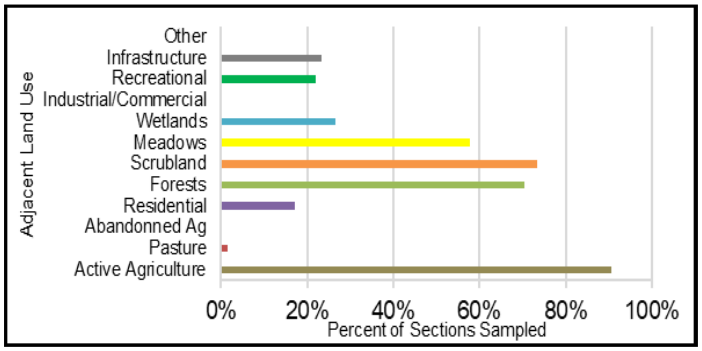


Figure 4 Adjacent land use 100 meters from each shoreline and percentage of presence along Black Rapids Creek.

Section along Black Rapids Creek with scrubland, meadow and forested buffer zones.

Black Rapids Creek Shoreline Zone

Anthropogenic Alterations

Stream alterations were classified based on specific functional criteria associated with potential human influences on the riparian buffer, shoreline state, flow conditions and channel structure.

Figure 5 shows the level of anthropogenic alterations for the 64 sections surveyed in the Black Rapids Creek catchment, with 33 sections remaining without any human alteration. Of the areas surveyed, 21 sections fell in the classification of natural. Natural sections had a riparian buffer greater than 15 meters in width and naturally vegetated shorelines.

Nine sections were classified as altered. They contained straightened sections and riparian buffers of five to 15 meters in width. Shoreline alterations included concrete bridges and culverts.

One of the surveyed sections was highly altered. The riparian buffers were less than five meters in width, the section was channelized. This section was located adjacent to road and railway infrastructure.

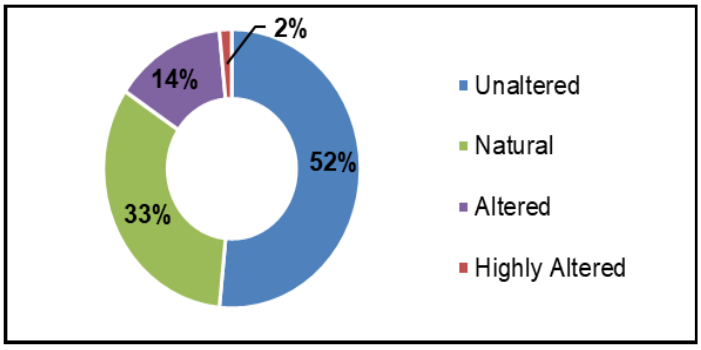


Figure 5 Anthropogenic alterations along Black Rapids Creek.

Channelized section of Black Rapids Creek in the headwaters near Woodroffe Road with increased turbidity.

Erosion

Stream erosion is the process by which water erodes and transports sediments, resulting in dynamic flows and diverse habitat conditions. Excessive erosion can result in drastic environmental changes, as habitat conditions, water quality and aquatic life are all negatively affected. Bank stability was assessed as the extent of each section with "unstable" shoreline conditions. These conditions are defined by the presence of significant exposed soils/roots, minimal bank vegetation, undercutting, slumping or scour and potential failed erosion measures (rip rap, gabion baskets, etc.).

Figure 6 shows the location and levels of erosion that were observed across the surveyed portions. Bank instability was observed in 31 percent of the left bank and right bank of the sections surveyed.

Undercut Stream Banks

A stream bank undercut is a bank that rises vertically or overhangs the stream or creek. Stream bank undercuts can provide excellent cover/shelter habitat for aquatic organisms including fish and benthic invertebrates. However, excessive or deep undercuts can be an indication of unstable shoreline conditions and may result in bank failure or collapse. Bank undercuts were assessed as the extent of each surveyed section with overhanging bank cover present.

Figure 7 shows where undercut banks were present and to what extent each section contained them in Black Rapids Creek. Along the left bank, 42 percent of sections had undercut banks; while the right bank had 41 percent of sections with undercut banks.

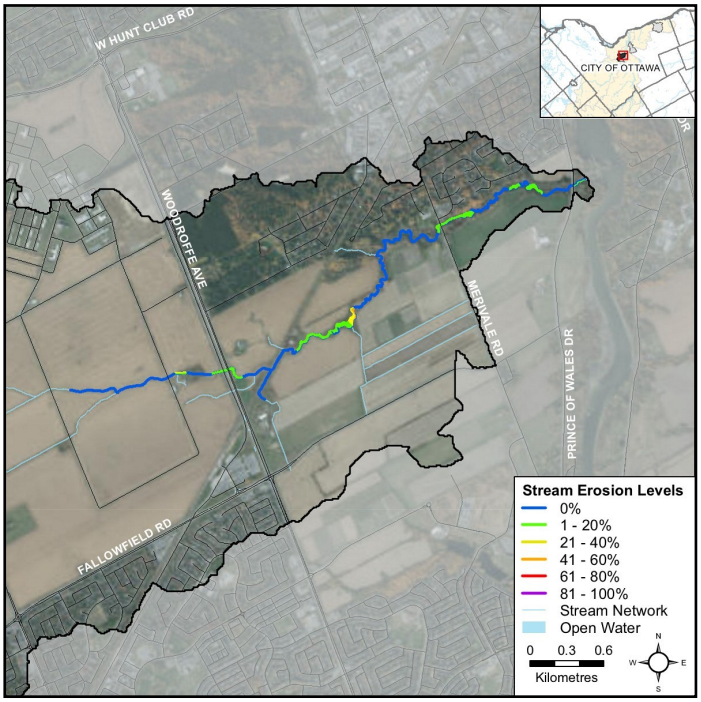


Figure 6 Erosion levels along Black Rapids Creek.

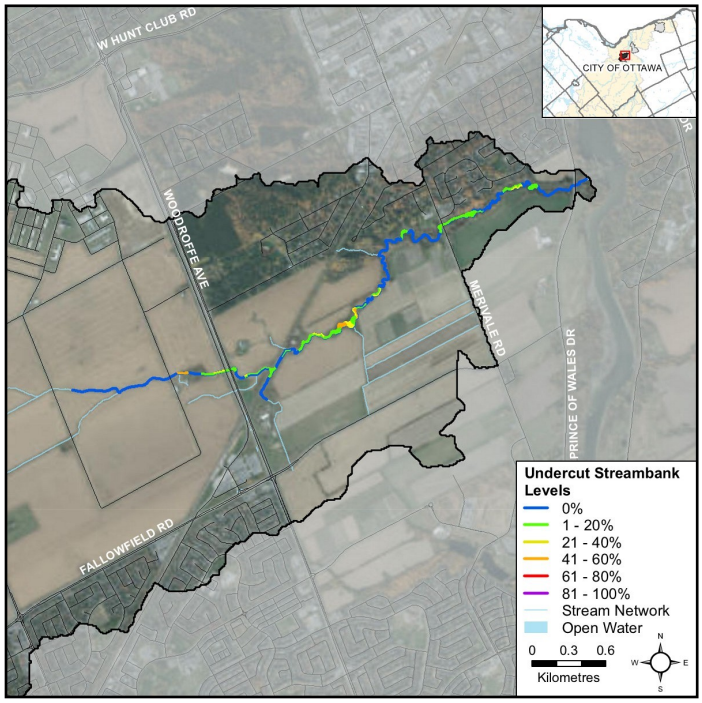


Figure 7 Undercut stream banks along Black Rapids Creek.

Minor bank erosion along Black Rapids Creek.

Undercut banks west of Prince of Wales Drive along Black Rapids Creek.

Stream Shading

Grasses, shrubs and trees all contribute towards shading a stream. Shade is important in moderating stream temperature, contributing to food supply and helping with nutrient reduction within a stream. Stream cover is assessed as the total coverage area in each section that is shaded by overhanging trees/grasses and tree canopy, at greater than one meter above the water surface.

Figure 8 shows the percentage of sections surveyed with various levels of stream shading. The majority of sections, 22 of them, had a shade cover of 21 to 40 percent. The highest shading levels observed along the system of 81 to 100% was in two sections. Twelve sections had high shading of 61 to 80 percent. Seventeen sections had 1 to 20 percent shade cover conditions and one section had no shading.

Figure 9 shows the distribution of these shading levels as a percentage of sections surveyed along Black Rapids Creek.

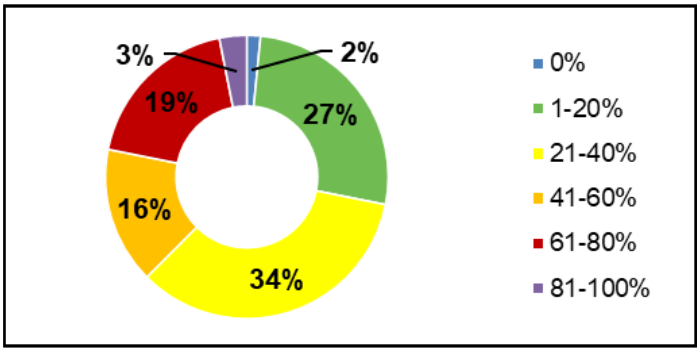


Figure 8 Stream shading levels along Black Rapids Creek.

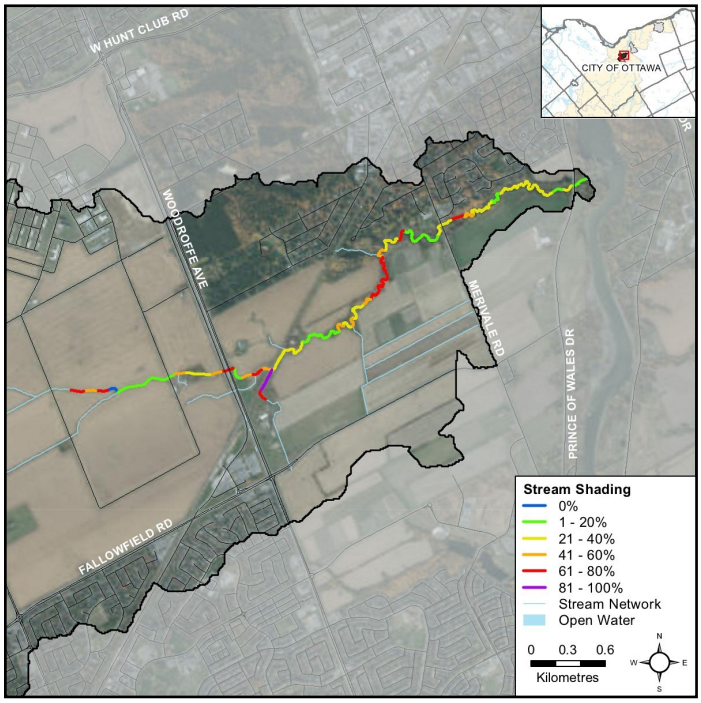


Figure 9 Stream shading along Black Rapids Creek.

A mix of trees and plants comprised the majority of shading. Overhanging plants, mainly grasses, robust and broad leaved emergent plants provided shade in 97 percent of the left bank and 98 percent of the right bank.

Overhanging Trees and Branches

Trees and branches that are less than one meter from the surface of the water are defined as overhanging. Overhanging branches and trees provide a food source, nutrients and shade which helps to moderate instream water temperatures.

Figure 10 shows the presence and percentage within each section of overhanging trees and branches that were observed along Black Rapids Creek. A total of 78 percent of the sections had overhanging trees and branches on the left bank and 67 percent for the right bank.

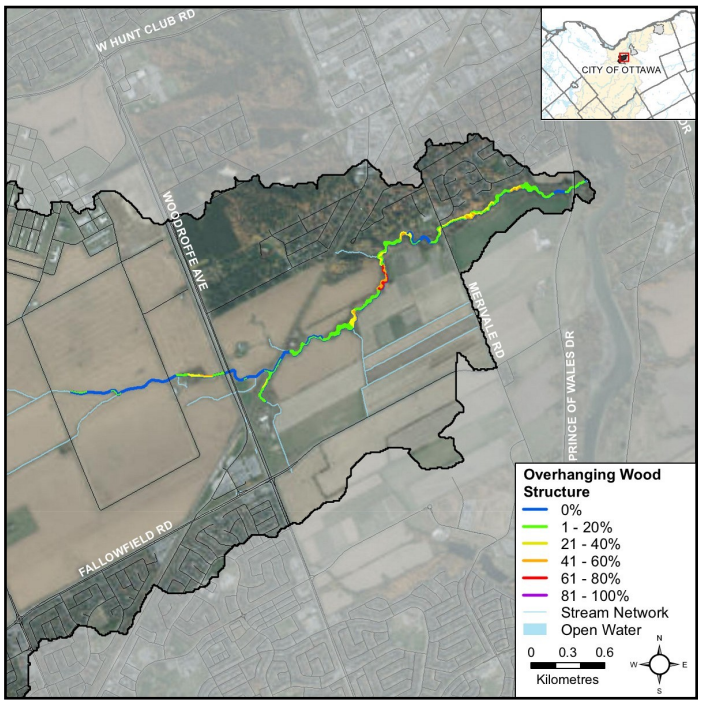


Figure 10 Overhanging trees and branches along Black Rapids Creek.

Overhanging trees and shrubs provided shade and cooling stream temperatures along Black Rapids Creek.

Black Rapids Creek Instream Habitat

Habitat Complexity

Habitat complexity is a measure of the diversity of habitat types and features within a stream. Streams with high habitat complexity support a greater variety of species niches, and therefore contribute to greater diversity. Factors such as substrate, morphologic conditions (pools, riffles) and cover material (vegetation, wood structure, etc.) all provide crucial habitat to aquatic life. Habitat complexity is assessed based on the presence of boulder, cobble and gravel substrates, as well as the presence of instream wood structure. A higher score shows greater complexity where a variety of species can be supported. Figure 11 shows habitat complexity of the sections surveyed: eight percent had no complexity; 44 percent had a score of one; 34 percent scored two; and 14 percent scored three. No sections surveyed scored four for the highest habitat complexity.

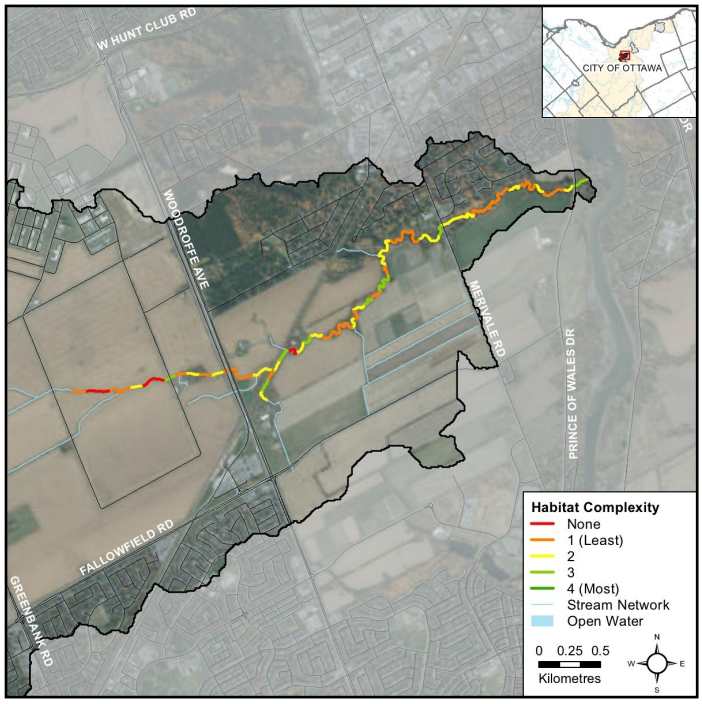


Figure 11 Instream habitat complexity along Black Rapids Creek.

Section of Black Rapids Creek with complex habitat features including boulders, cobble and instream wood structure.

Instream Substrate

Diverse substrate is important for fish and benthic invertebrate habitat because some species have specific substrate requirements and for example will only reproduce on certain types of substrate. The absence of diverse substrate types may limit the diversity of species within a stream.

Substrate complexity along Black Rapids Creek was observed to be fairly homogenous in 69 percent of sections surveyed, and heterogenous in the remaining 31 percent. Figure 12 shows the substrate types observed. It is a system dominated by silt, with 97 percent of sections containing this type of substrate. Most sections surveyed, 92 percent, also contained clay. Other substrate types included sand, gravel, cobble, boulders and bedrock.

Figure 13 shows the dominant substrate types along the creek. From the assessed areas the dominant substrate type was silt in 45 percent of sections, followed by clay in 42 percent of sections surveyed. Cobble, gravel, bedrock and sand were all dominant in less than six percent of sections surveyed each.

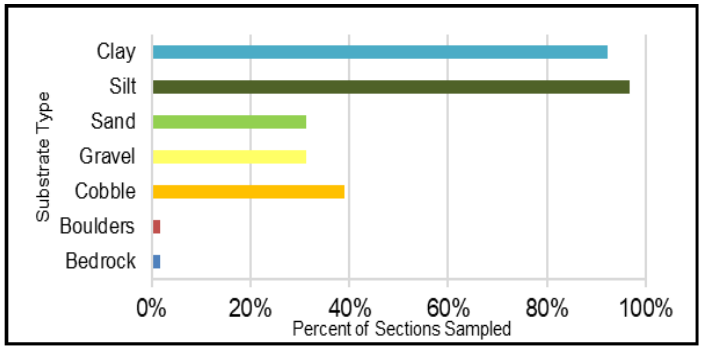


Figure 12 Instream substrate along Black Rapids Creek.

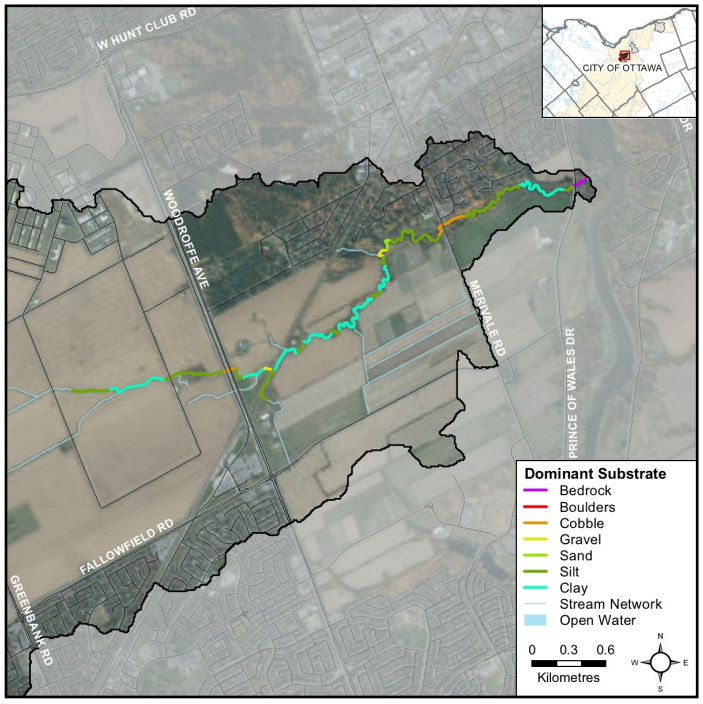


Figure 13 Dominant instream substrates along Black Rapids Creek.

Instream Morphology

Pools and riffles are important habitat features for aquatic life. Riffles are fast flowing areas characterized by agitation and overturn of the water surface. Riffles thereby play a crucial role in contributing to dissolved oxygen conditions and directly support spawning for some fish species. They are also areas that support increased benthic invertebrate populations which are an important food source for many aquatic species. Pools are characterized by minimal flows, with relatively deep water and winter and summer refuge habitat for aquatic species. Runs are moderately shallow, with unagitated surfaces of water and areas where the thalweg (deepest part of the channel) is in the center of the channel.

Figure 14 shows that the surveyed portions of Black Rapids Creek have moderate diversity of morphological conditions, suitable for a variety of aquatic species and life stages; 83 percent of sections contained pools, 58 percent of sections contained riffles and 97 percent contained runs.

Figure 15 shows the locations of sections surveyed which contained riffle habitat.

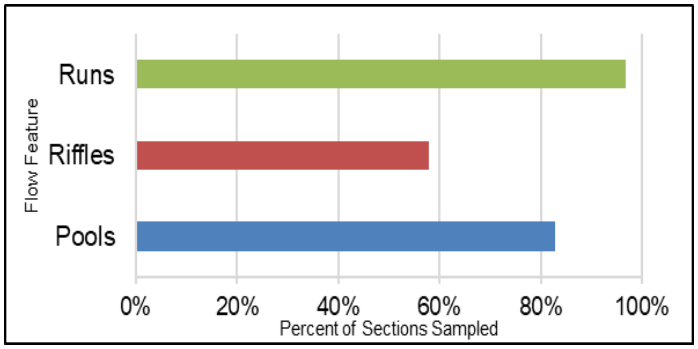


Figure 14 Instream morphology along Black Rapids Creek.

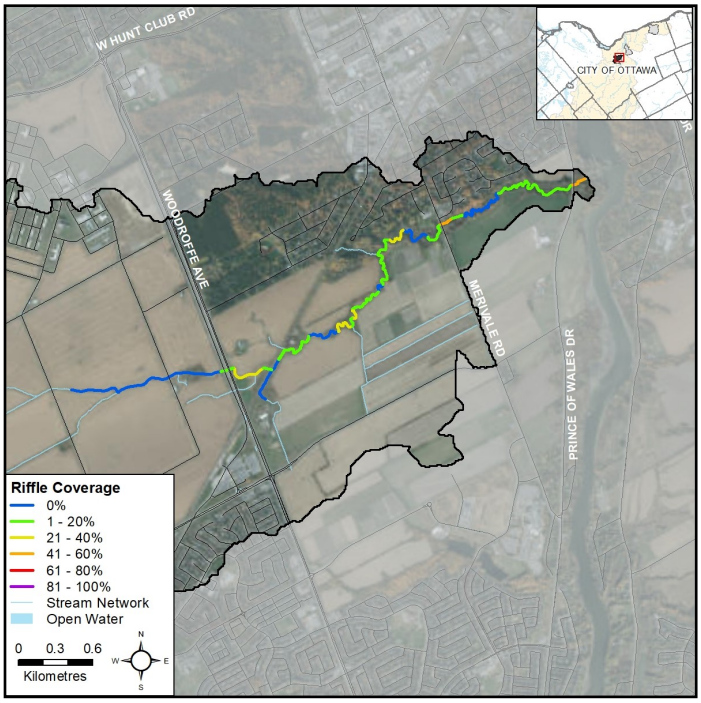


Figure 15 Riffle habitat locations along Black Rapids Creek.

Instream Wood Structure

Figure 16 shows that a large portion of Black Rapids Creek had moderate levels of instream wood structure in the form of branches and trees. Instream wood structure is important for fish and wildlife habitat, by providing refuge and feeding areas. Excessive amounts can result in temporary seasonal migration barriers. The May 2022 wind storm resulted in a number of trees being downed into Black Rapids Creek (RVCA, 2022).

Instream wood structures found along Black Rapids Creek are important for fish and wildlife habitat.

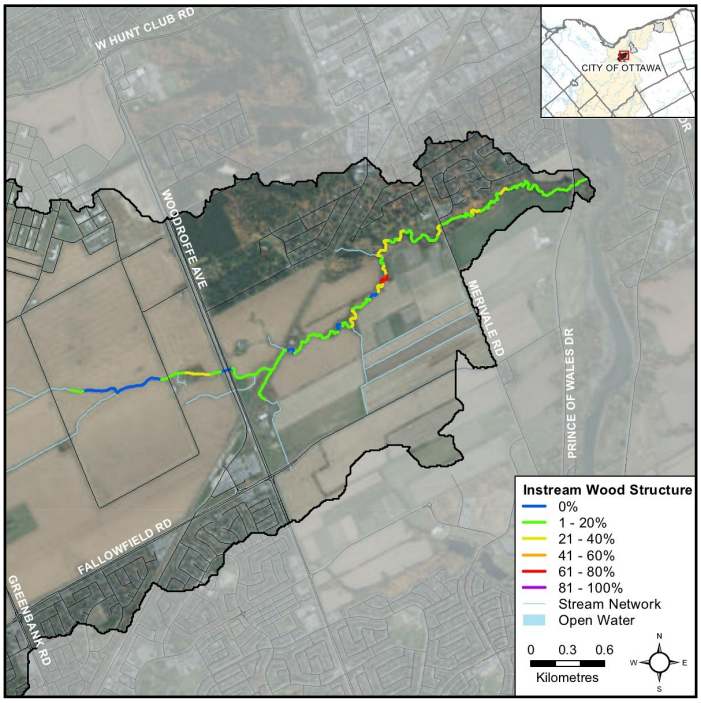


Figure 16 Instream wood structures along Black Rapids Creek.

Instream Aquatic Vegetation Type

Instream vegetation is a key component of aquatic ecosystems. It promotes stream health by:

- Providing riparian and instream habitat;
- Maintaining water quality by erosion control, nutrient cycling, and pollutant absorption;
- Stabilizing flows and reducing shoreline erosion;
- Contributing dissolved oxygen via photosynthesis;
- Moderating temperatures through shading.

Figure 17 shows the aquatic vegetation community structure along Black Rapids Creek. Vegetation types in the 64 sections surveyed included: narrow-leaved emergent vegetation in 53 sections; submerged vegetation present in 37 sections; algae in 33 sections; broad-leaved emergent plants in 30 sections; free-floating in 18 sections; robust emergent plants in 14 sections; and floating plants in nine sections. There were 35 sections which had areas of the stream where no vegetation was present. Figure 18 shows the diversity of the dominant instream aquatic vegetation type.

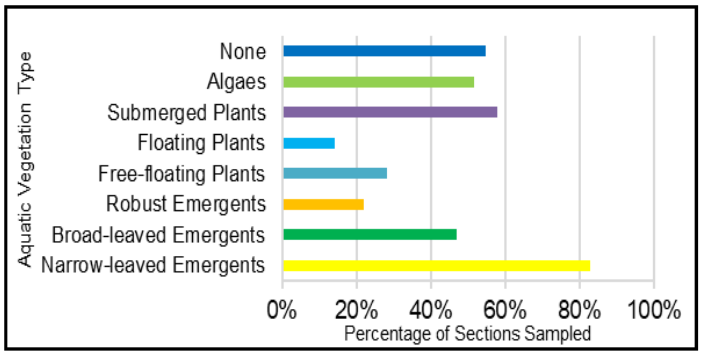


Figure 17 Aquatic vegetation presence along Black Rapids Creek.

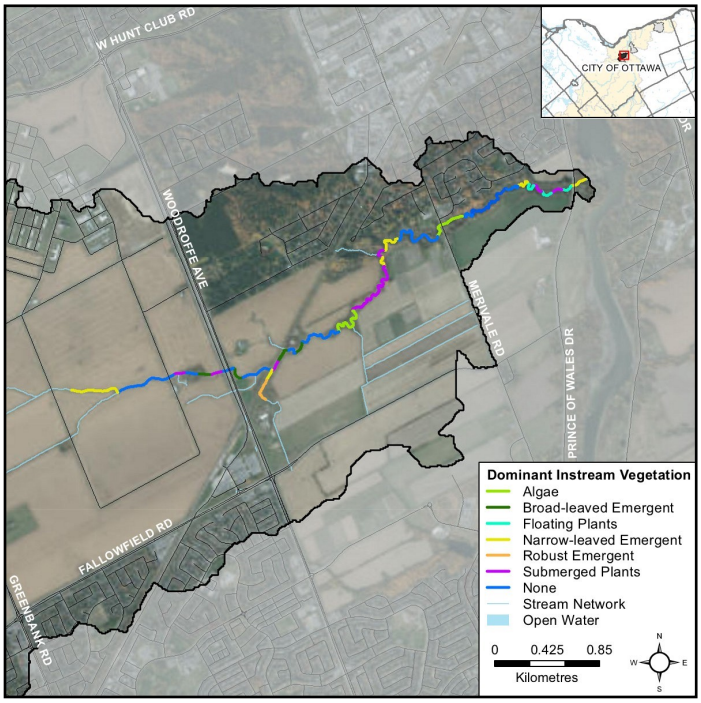


Figure 18 Dominant instream vegetation in Black Rapids Creek.

Instream Vegetation Abundance

The abundance of instream vegetation is also crucial for aquatic ecosystem health. Lack of vegetation and rare or low abundances can impair the ability of plants to contribute adequately to dissolved oxygen, provide habitat, and remove nutrients and contaminants. Extensive amounts of vegetation can also have negative impacts by lowering dissolved oxygen levels during decomposition. It can act as a physical barrier for humans and wildlife, and it can lead to a reduction in plant diversity. Invasive species in particular tend to have extensive growth.

Abundance of vegetation is classified by the amount of vegetation present along each section. The level of vegetation are categorized based on the extent of its presence in a section, from none or sparse, to parts being choked. As seen in Figure 19, 55 percent of sections along Black Rapids Creek had no vegetation, 47 percent had normal vegetation abundance, and 45 percent had low levels of vegetation. Common and extensive abundance was observed in 34 and 16 percent of sections respectively. Rare abundance was observed in 19 percent of sections. Sections without instream vegetation included areas where the substrate was dominated by clay substrates, which can limit aquatic vegetation establishment.

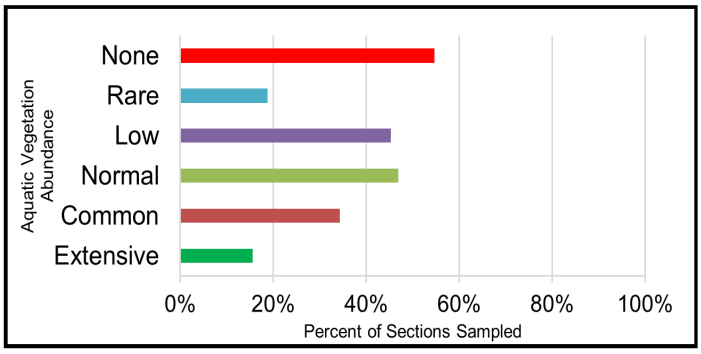


Figure 19 Instream vegetation abundance along Black Rapids Creek.

Broad leaved emergent vegetation observed along Black Rapids Creek.

Black Rapids Creek Stream Health

Invasive Species

Invasive species are harmful to the environment, the economy and our society. They have high reproduction, quick establishment of dense colonies, tolerate a variety of environmental conditions and lack natural predators. They can have major implications on stream health and reduce species diversity (OMNR 2012). They can be difficult to eradicate, however it is important to continue to research, monitor and manage them. Figure 20 shows the diversity of invasive species observed per section surveyed.

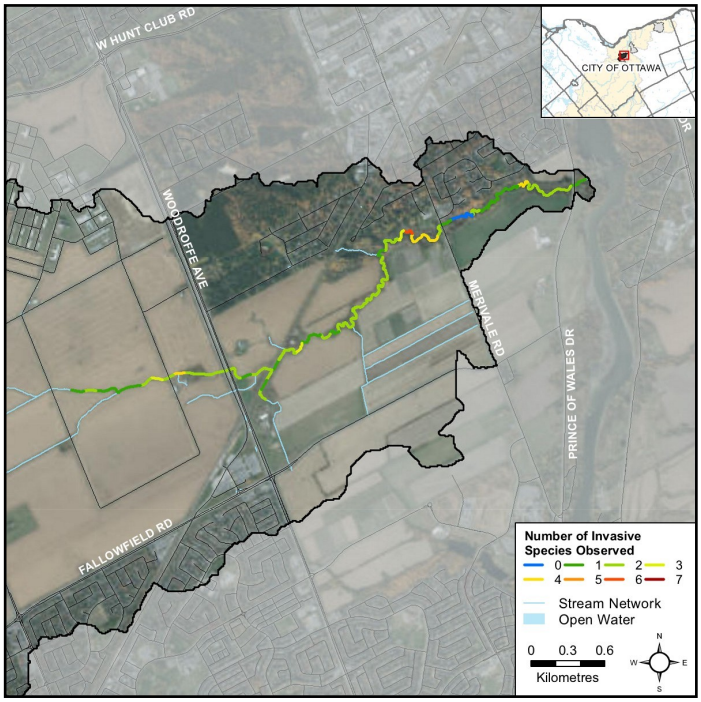


Figure 20 Invasive species diversity along Black Rapids Creek.

The following invasive species were observed in the surveyed portions of Black Rapids Creek in 2022:

- bull thistle (*Cirsium vulgare*)
- common buckthorn (*Rhamnus cathartica*)
- European frog-bit (*Hydrocharis morsus-ranae*)
- flowering rush (*Butomus umbrellatus*)
- garlic mustard (*Allaria petiolata*)
- glossy buckthorn (*Rhamnus frangula*)
- Himalayan balsam (*Impatiens glandulifera*)
- Japanese knotweed (*Reynoutria japonica*)
- Manitoba maple (*Acer negundo*)
- non-native honeysuckle (*Lonicera spp.)*
- non-native *Phragmites* (*Phragmites australis*)
- poison/wild parsnip (*Pastinaca sativa*)
- purple loosestrife (*Lythrum salicaria*)
- rusty crayfish (*Orconectes rusticus*)
- yellow iris (*Iris pseudacorus*)

Purple loosestrife observed along surveyed portions of Black Rapids Creek in 2022.

To report and find information about invasive species visit:

http://www.invadingspecies.com

Managed by the Ontario Federation of Anglers and Hunters.

Pollution

Figure 21 shows where pollution was observed along Black Rapids Creek. The levels of garbage found in the main portion of the stream were low, with 69 percent of sections surveyed containing no garbage. Garbage on the stream bottom was found in 20 percent of sections surveyed and floating garbage was found within 16 percent of sections. An oil barrel was found in one of the sections and old farming equipment was also seen.

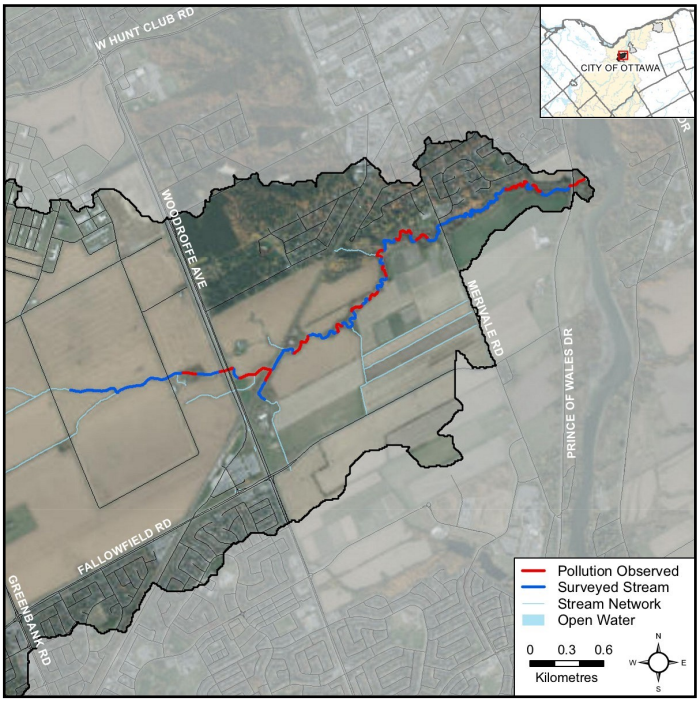


Figure 21 Pollution observed along Black Rapids Creek.

Wildlife

The diversity of fish and wildlife populations can be an indicator of water quality and stream health. Wildlife observations were noted during monitoring and survey activities; they do not represent an extensive evaluation of species presence in the Black Rapids Creek catchment (Table 1). It is noteworthy to mention species at risk observed included the monarch butterfly and the snapping turtle.

Monarch butterfly (*Danaus plexippus*) caterpillar observed on a milkweed plant along Black Rapids Creek.

Monarch butterfly (*Danaus plexippus*) observed along Black Rapids Creek.

Table 1 Wildlife observations along Black Rapids Creek in 2022.

Birds	American goldfinch, American redstart, American robin, belted kingfisher, black-capped chickadee, blue jay, Canada goose, common grackle, downy woodpecker, eastern kingbird, eastern phoebe, great blue heron, grey catbird, house finch, killdeer, least sandpiper, mallard, northern cardinal, northern flicker, pileated woodpecker, song sparrow, red-tailed hawk, red-winged blackbird, ruby throated hummingbird, tree swallow, turkey vulture, yellow warbler
Reptiles & Amphibians	American bullfrog, American toad, gray treefrog, green frog, northern leopard frog, snapping turtle
Mammals	American beaver, coyote tracks, deer tracks, muskrat tracks, raccoon tracks
Aquatic Insects & Benthic Invertebrates	crayfish, dragonfly larvae, damselfly larvae, isopods, giant floater, giant water bug, leeches, monarch butterfly, mussels, snails, whirligig beetle, water striders
Other	beetles, black flies, bumblebees, butterflies, damselflies, deer flies, dragonflies, mosquitoes, moths, spiders, snails

Recently hatched snapping turtle (*Chelydra serpentina*) observed along Black Rapids Creek.

Black Rapids Creek Water Chemistry

Water Chemistry Assessment

Water chemistry collection is done at the start and end of each 100 meter section with a multiparameter YSI probe. Monitored parameters include: air and water temperature, pH, conductivity, dissolved oxygen concentration and saturation. Water chemistry measurements can provide insight into how healthy a stream is in supporting aquatic organisms. The healthier the system is from a water quality perspective typically translates into increased species richness.

Dissolved Oxygen

Dissolved oxygen is essential for a healthy aquatic ecosystem, as fish and other aquatic organisms need oxygen to survive. The level of oxygen required is dependent on the particular species and life stage. The lowest acceptable concentration for the early and other life stages according to the Canadian water quality guidelines for the protection of aquatic life are: 6.0 milligrams per liter in warm-water biota and 9.5 milligrams per liter for cold-water biota (CCME 1999).

Figure 22 shows the concentration levels found in the surveyed portions of Black Rapids Creek. The two dashed lines depict the recommended levels of dissolved oxygen by the Canadian water quality guidelines. Most of the surveyed portions were found to have oxygen levels above the Canadian water quality guidelines for warm water species. Dissolved oxygen levels that were sufficient to support cool water aquatic life were found in the middle reaches of the system from Merivale Road to Woodroffe Avenue. However, there were sections found between Merivale Road and where Black rapids flows into the Rideau River that fell below the recommended guidelines of 6mg/l for warm water species. The tributary also had low levels of dissolved oxygen, and it flows from a wetland system. Lower levels of dissolved oxygen can be found in wetland habitats as a result of high biological oxygen demand.

Average concentration levels across the system were 9.0 mg/L.

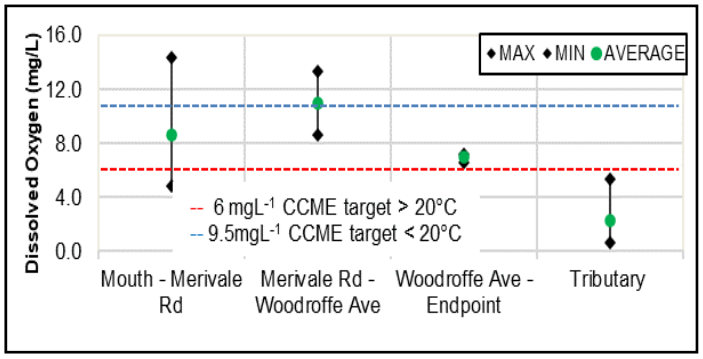


Figure 22 Dissolved oxygen ranges along surveyed sections of Black Rapids Creek.

Conductivity

Conductivity is a measure of water's capacity to conduct electrical flow. This capacity is dictated by the presence of conductive ions that originate from inorganic materials and dissolved salts. Water conductivity in natural environments is typically dictated by the geology of the area, however anthropogenic inputs can also have a profound effect. Currently there is no existing guideline for stream conductivity levels, however conductivity measurements outside of normal range across a system are good indicators of anthropogenic inputs including unmitigated discharges and storm water input.

Figure 23 shows specific conductivity levels in Black Rapids Creek. The average level across the system is depicted by the dashed line (732 µS/cm). Conductivity levels are higher in areas approaching the headwater reaches. Lower levels were observed in the sections closer to the confluence with the Rideau River.

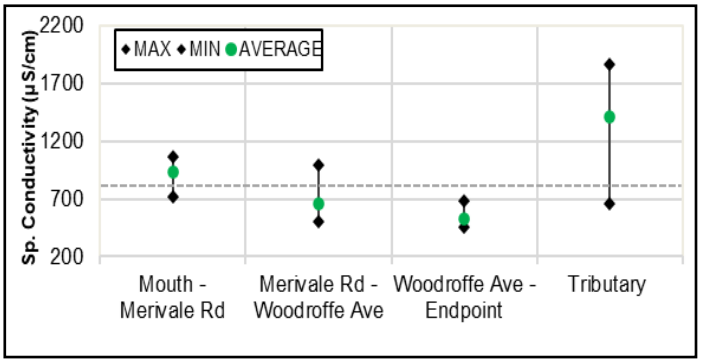


Figure 23 Specific Conductivity ranges along surveyed sections of Black Rapids Creek.

pH

pH is a measure of alkalinity or acidity. This parameter is influenced by the geology of the system but it can also be influenced by anthropogenic inputs. For pH the provincial water quality objective (PWQO) recommends a range of 6.5 to 8.5 to protect aquatic life (MOEE 1994).

Figure 24 shows Black Rapids Creek had pH levels that meet the PWQO, depicted by the dashed lines. The average level across the system was pH 7.42.

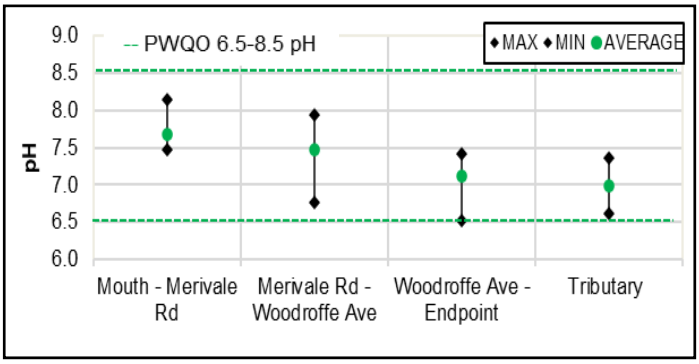


Figure 24 pH ranges along surveyed sections of Black Rapids Creek.

Oxygen Saturation (%)

Oxygen saturation is measured as the ratio of dissolved oxygen relative to the maximum amount of oxygen that will dissolve based on the temperature and atmospheric pressure. Well oxygenated water will stabilize at or above 100 percent saturation, however the presence of decaying matter/pollutants can drastically reduce these levels. Oxygen input through photosynthesis has the potential to increase saturation above 100 percent to a maximum of 500 percent, depending on the productivity level of the environment. In order to represent the relationship between concentration and saturation, the measured values have been summarized into 6 classes:

1) <100% Saturation / <6.0 mg/L Concentration

Oxygen concentration and saturation are not sufficient to support aquatic life and may represent impairment.

2) >100% Saturation / <6.0 mg/L Concentration

Oxygen concentration is not sufficient to support aquatic life, however saturation levels indicate that the water has stabilized at its estimated maximum. This is indicative of higher water temperatures and stagnant flows.

3) <100% Saturation / 6.0—9.5 mg/L Concentration

Oxygen concentration is sufficient to support warm-water biota, however depletion factors are likely present and are limiting maximum saturation.

4) >100% Saturation / 6.0—9.5 mg/L Concentration

Oxygen concentration and saturation levels are optimal for warm-water biota.

5) <100% Saturation / >9.5 mg/L Concentration

Oxygen concentration is sufficient to support cold-water biota, however depletion factors are likely present and are limiting maximum saturation.

6) >100% Saturation / >9.5 mg/L Concentration

Oxygen concentration and saturation levels are optimal for warm and cold-water biota.

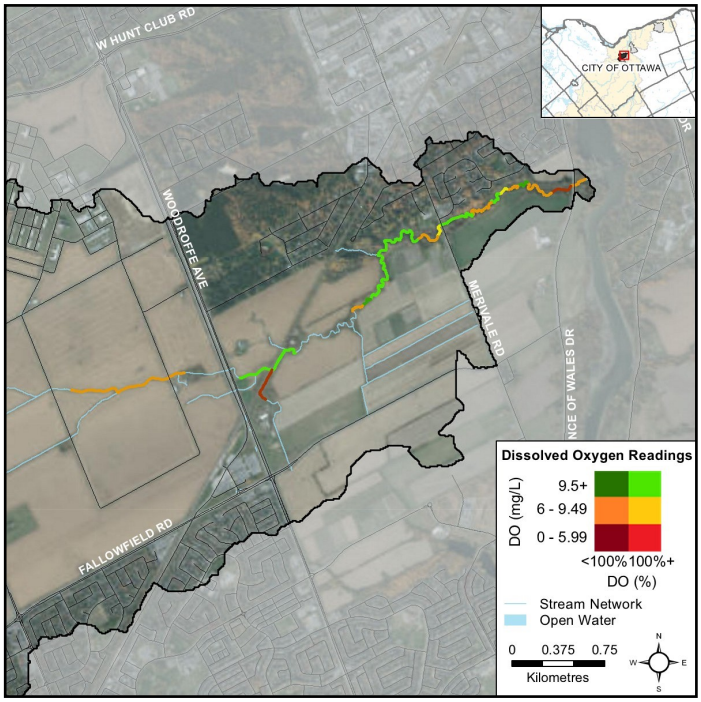


Figure 25 Bivariate assessment of dissolved oxygen concentration (mg/L) and saturation (%) along Black Rapids Creek.

Figure 25 shows the oxygen conditions across the areas that were surveyed in 2022. Dissolved oxygen conditions in Black Rapids Creek were sufficient to sustain a combination of warm-water and cold-water biota in areas upstream of Prince of Wales to Woodroffe Avenue. Areas with lower oxygen levels in this stretch are located near beaver dams, which can result in these conditions. Sections shown in dark red Figure 25, had significant levels of impairment both in concentration and percent saturation. Upstream of Prince of Wales Drive there were areas that had low levels of riffle habitat which provide increased oxygen levels in streams. These areas also had the presence of algae, which if abundant, can deplete oxygen in the stream and this can lead to lower oxygen levels. The headwater features upstream of Woodroffe Avenue also had low levels of oxygen in the system this is likely due to adjacent land uses and minimal habitat complexity in the channel.

Section on Black Rapids Creek west of Prince of Wales Drive with **impaired** oxygen conditions (Dissolved oxygen levels of 4.86 mg/L and 55.8% saturation).

Section on Black Rapids Creek west of Merivale Road with **optimal** oxygen conditions for cold-water biota (Dissolved oxygen levels of 13.23 mg/L and 138.1% saturation).

Specific Conductivity Assessment

Specific conductivity (SPC) is a standardized measure of electrical conductance, collected at or corrected to a water temperature of 25°C. SPC is directly related to the concentration of ions in water, and is influenced by the area geology and anthropogenic input as it contributes to the presence of dissolved salts, alkalis, chlorides, sulfides and carbonate compounds. The higher the concentration of these compounds, the higher the conductivity. Common sources of elevated conductivity include stormwater, agricultural inputs and commercial or industrial effluents.

In order to summarize the conditions observed, levels were evaluated as either normal, moderately elevated or highly elevated. These categories are defined by the amount of variation (standard deviation) at each section compared to the system's average.

Average levels of specific conductivity measured in the surveyed portions of Black Rapids Creek (732.0 µS/cm) exceeded guidelines (<500 µS/cm) used for the Canadian Environmental Performance Index (Environment Canada 2011).

Figure 26 shows relative specific conductivity levels in Black Rapids Creek. Normal levels were maintained for most of the surveyed portions. Moderately elevated conditions were observed approaching Merivale Road and the most upstream portions surveyed. Sections downstream of Merivale Road have storm water influences from adjacent development. The area upstream has agricultural land use influences. Highly elevated sections were observed in the headwaters on the south side of the railway infrastructure and is influenced by upstream stormwater runoff and agricultural land use.

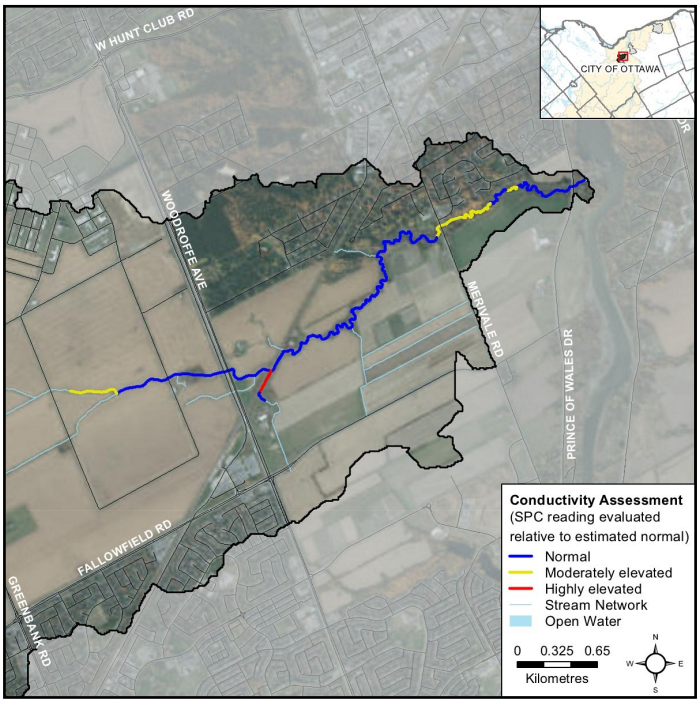


Figure 26 Relative specific conductivity levels along Black Rapids Creek.

Groundwater

Groundwater discharge areas can influence stream temperature, contribute nutrients, and provide important stream habitat for fish and other biota. During stream surveys, indicators of groundwater discharge were noted when observed (Figure 27). Indicators included: springs/ seeps, watercress, iron staining, significant temperature changes and rainbow mineral film.

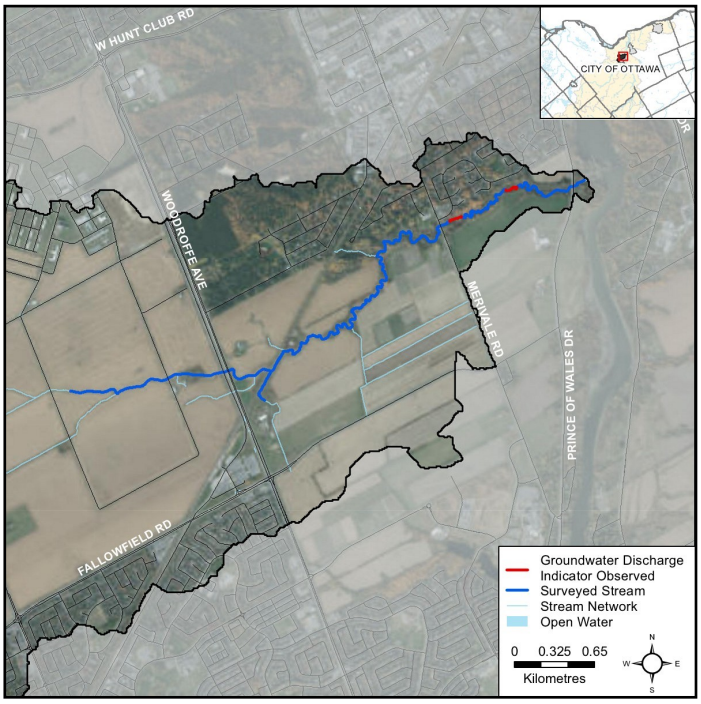


Figure 27 Groundwater indicators observed in the Black Rapids Creek catchment.

Section of the Black Rapids Creek where groundwater observations of seeps were made.

Black Rapids Creek Thermal Classification

Thermal Classification

Instream water temperatures are influenced by various factors including season, time of day, precipitation, storm water run off, springs, tributaries, drains, discharge pipes, stream shading from riparian vegetation and artificial shade created by infrastructure. To monitor water temperatures in Black Rapids Creek, four temperature loggers were placed in early July and retrieved at the end of September.

Figure 28 shows where thermal sampling sites were located. Analysis of data from the loggers (using the Stoneman and Jones, 1996, method adapted by Chu et al., 2009), indicate that Black Rapids Creek is classified as a **cool-warm water** to **coolwater** system. Figures 29 and 30 show a comparison of thermal conditions between 2014 and 2022.

Fish species observed in the monitored areas have thermal preferences from cold to warm as indicated by Cocker at al. (2001).

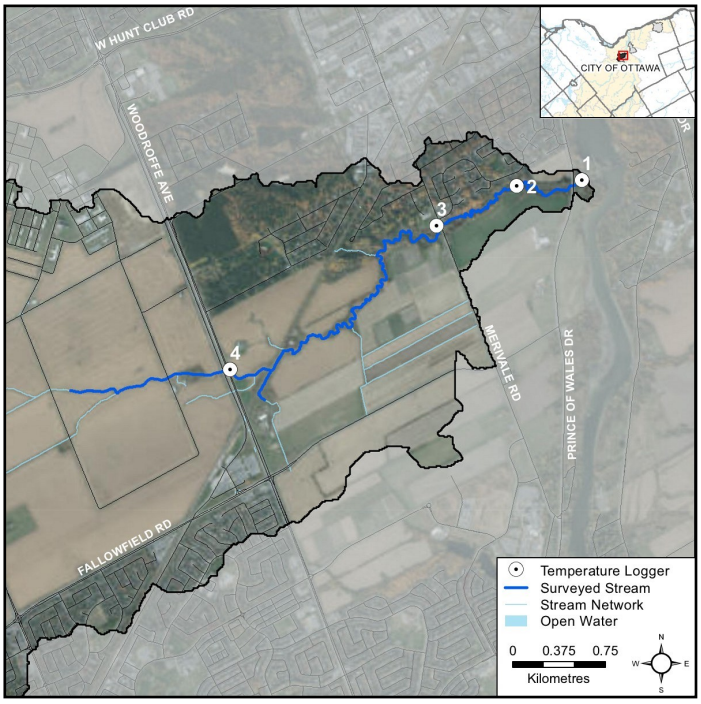


Figure 28 Temperature logger locations on Black Rapids Creek.

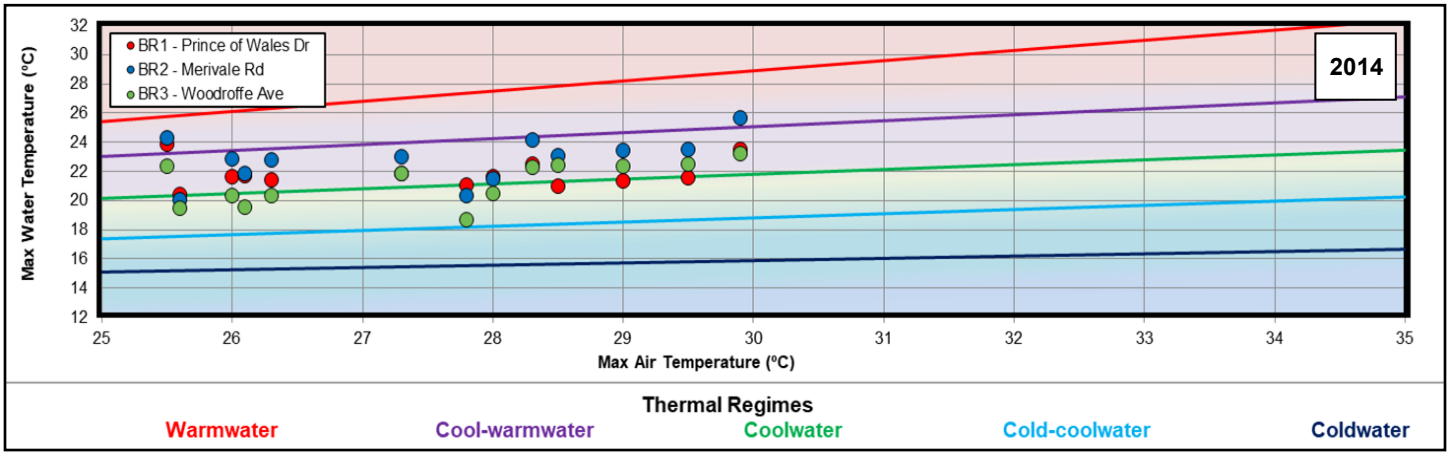


Figure 29 Thermal Classification for Black Rapids Creek with the five thermal regimes adapted from Stoneman and Jones (1996) by Chu et al. (2009): **cool-warmwater** category for Black Rapids Creek in **2014.**

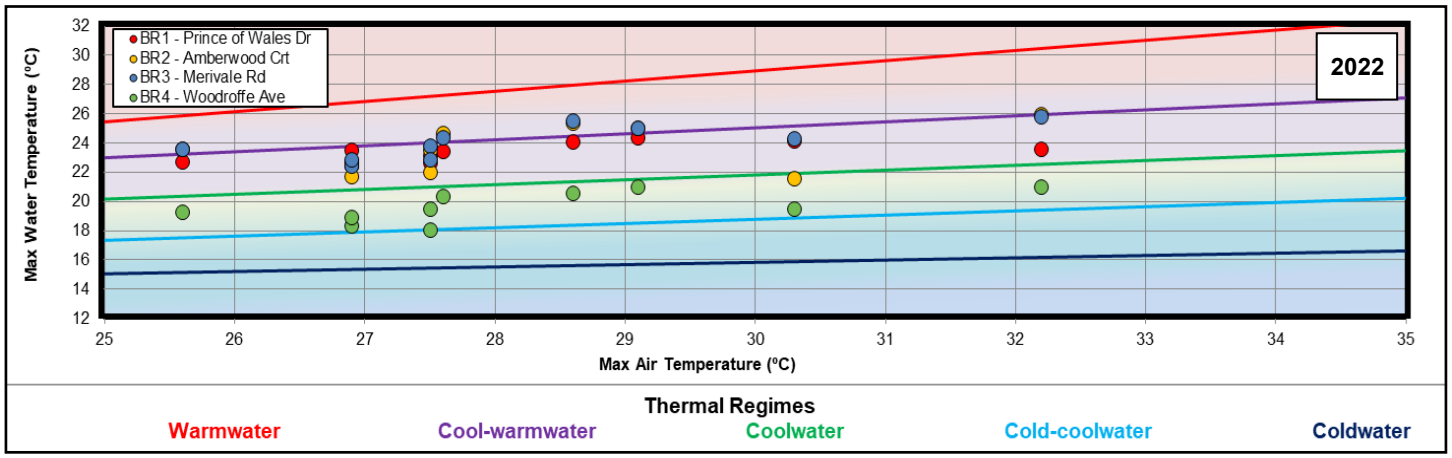


Figure 30 Thermal Classification for Black Rapids Creek with the five thermal regimes adapted from Stoneman and Jones (1996) by Chu et al. (2009): conditions range from **coolwater** (BR4) to the **cool-warmwater** (BR1-BR3) category for Black Rapids Creek in **2022.**

Black Rapids Creek Fish Community

Fish Community Summary

Five fish sampling sites were evaluated between August and September 2022. Four site locations were sampled with the use of a backpack electrofishing unit, and one site was sampled with a bag seine net. The restored wetland site, located by a southern branch, was sampled with a bag seine net in 2017 and 2018.

Ten species were captured in 2022; they are listed in Table 2 along with their thermal classification preferences (Coker et al., 2001) and MNR species codes. Black Rapids Creek had a mixed fish community ranging from cold to warm water species.

The sampling locations where these species were observed, as well as RVCA historical sites, in white, are depicted in Figure 31. The codes used in the figure are the MNR species codes provided in Table 2. For comparisons across sampling years and a complete list of RVCA historical fish records from Black Rapids Creek refer to page 18 of this report.

Table 2 Fish species observed in Black Rapids Creek in 2022.

Species	Thermal Class	MNR Species Code
Bluntnose minnow *Pimephales notatus*	**Warm**	BnMin
Brook stickleback *Culaea inconstans*	**Cool**	BrSti
Carps and minnows unidentified species	**Cool to Warm**	CA_MI
Central mudminnow *Umbra limi*	**Cool**	CeMud
Creek chub *Semotilus atromaculatus*	**Cool**	CrChu
Fathead minnow Pimephales promelas	**Warm**	FhMin
Longnose dace *Rhinichthys cataractae*	**Cool**	LnDac
Mottled sculpin *Cottus bairdii*	**Cold**	MoScu
Rock bass *Ambloplites rupestris*	**Cool**	RoBas
Smallmouth bass *Micropterus dolomieu*	**Warm**	SmBas
White sucker *Catostomus commersonii*	**Cool**	WhSuc
Total Species		**10**

Smallmouth bass, *Micropterus dolomieu*, observed in Black Rapids Creek.

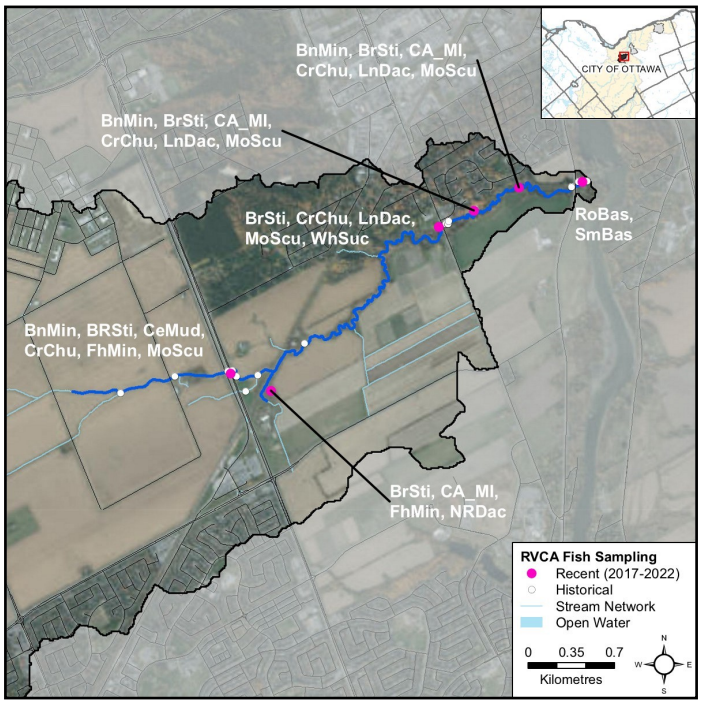
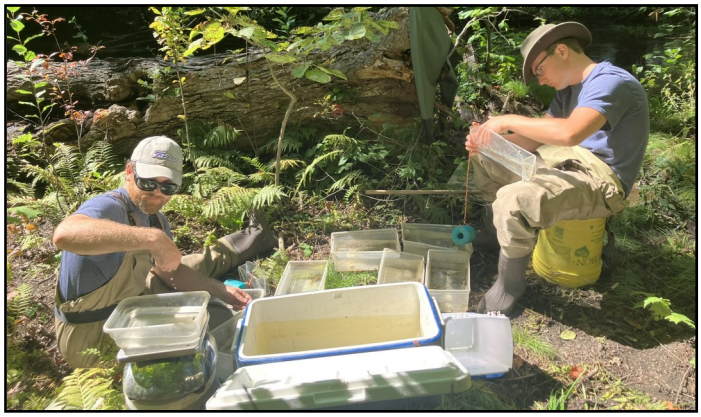


Figure 31 Black Rapids Creek fish sampling locations (historical in white, 2022 in pink) and fish species observations from 2022.



Fish community sample sorting (above) and mottled sculpin, *Cottus biardi*, (below) observed in Black Rapids Creek.

Migratory Obstructions

It is important to know locations of migratory obstructions because these can prevent fish from accessing important spawning and rearing habitat. Migratory obstructions can be natural or manmade, and they can be permanent or seasonal.

There were several migratory obstructions observed along the surveyed portions of Black Rapids Creek. The location of the migratory obstructions observed in 2022 are shown in Figure 32. They were all debris dams which become seasonal obstructions during low flow conditions.

Debris dams, such as the one above, seen along Black Rapids Creek create seasonal migratory obstructions for many fish species.

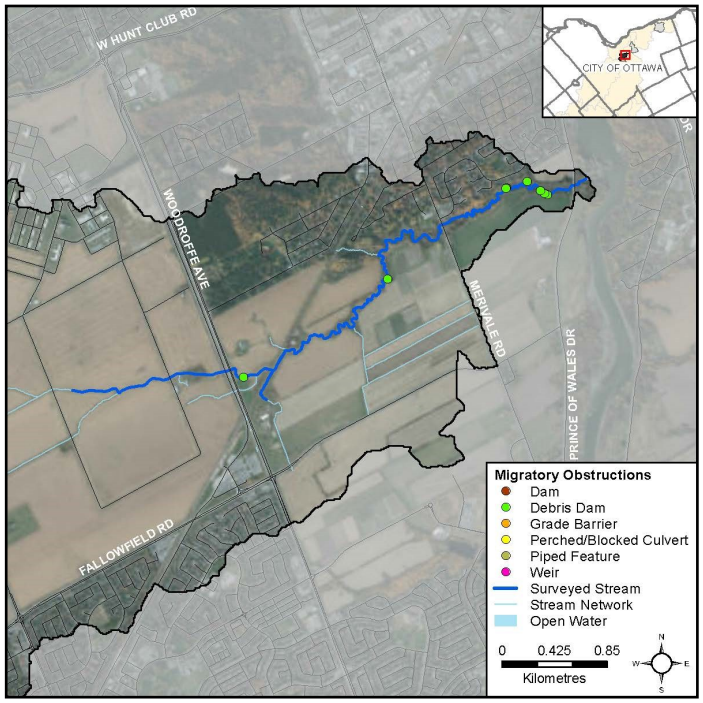


Figure 32 Locations of migratory obstructions along Black Rapids Creek.

Beaver Dams

Beaver dams create natural changes in the environment. Some of the benefits include providing habitat for fish and wildlife, flood control, baseflow during low water conditions and sediment retention. Additional benefits come from bacterial decomposition of wood material used in the dams which removes excess nutrient and toxins. Beaver dams can in certain circumstances result in seasonal barriers to fish migration. They can also potentially put important infrastructure at risk upstream of the dam location. If this is an issue, there are dam flow device options that can be considered and potentially implemented that balance the risks to infrastructure while supporting the ecosystem created by the dam.

In 2022 a total of seven beaver dams were identified on the surveyed portions of Black Rapids Creek and are shown in Figure 33. One beaver lodge was also noted.

An active beaver dam and a lodge along Black Rapids Creek upstream of Merivale Road.

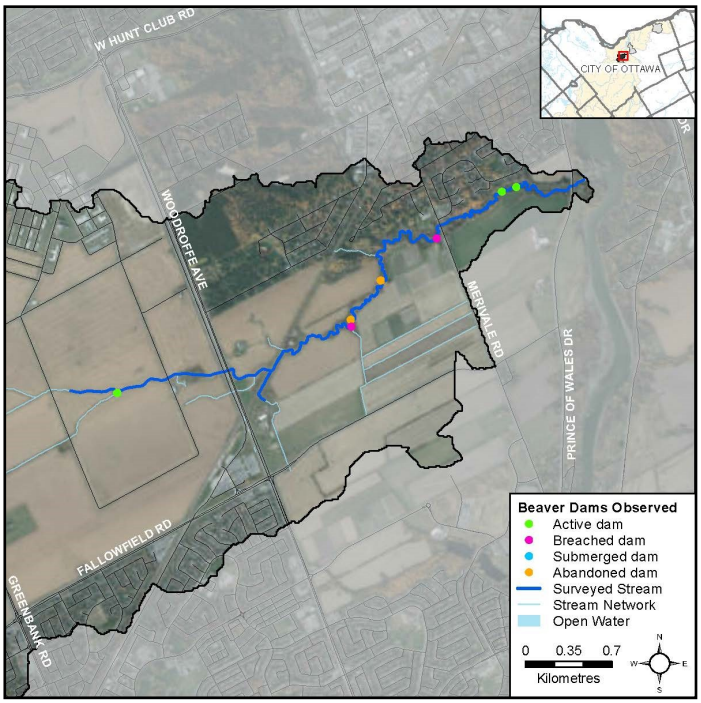


Figure 33 Locations of beaver dams along Black Rapids Creek.

Stream Comparison Between 2003, 2008, 2014 and 2022

The following tables provide a comparison of observations on Black Rapids Creek between the 2003, 2008, 2014 and 2022 survey years (RVCA, 2003; RVCA, 2008; RVCA, 2014). Monitoring protocols since 2008 have been modified and enhanced, so only certain data from previous years can be compared to later years. In order to accurately represent current and historical information, the data was only compared for those sections which were surveyed in all years presented. This information is a comparative evaluation and doesn't represent the entirety of our assessment.

Water Chemistry

Water chemistry parameters are collected throughout all the sections surveyed in the stream. This criteria reflects the conditions and changes in the environment. Variation in these conditions can be attributed to environmental and ecological changes. Some can be in part due to natural variability within the system from various weather, seasonal, and annual conditions. Table 3 shows a comparison of these water chemistry parameters between 2014 and 2022, as well as certain indicators from 2008.

Average pH decreased by 0.47 units from 2014 to 2022 and specific conductivity increased slightly by 0.7 µS/cm. These small changes may reflect seasonal and annual variability. Average dissolved oxygen levels were found to be lower by 1.6 milligrams per liter from 2014 to 2022. These changes can also be attributed to different sampling windows across monitoring years; seasonal conditions and warmer temperatures which are less conducive to the stream's ability to hold more oxygen.

Average summer water temperatures range from warmer water in 2022 (18.3°C) to cooler values in 2014 (16.8°C) and 2008 (17.2°C), with 1.5 degrees centigrade of variation. In 2022 warmer temperatures than the previous reporting year are probably due to the different sampling time windows. Observations from 2008 were made from June to September, whereas observations in 2014 were made mostly in June and in 2022 in the month of August.

Aside from these general temperature observations, loggers provide a detailed recording of stream thermal conditions. Standardized stream temperature assessments account for climatic factors including air temperatures and precipitation. With the data collected from temperature loggers at Prince of Wales Drive, Merivale Road and Woodroffe Avenue in all three cycle years, standardized stream temperature factors were calculated and summarized in Table 3. This factor has remained the same, 0.80 for every degree of air temperature, from 2008 to 2022. In 2014 and 2022, Black Rapids Creek at Prince of Wales Drive and Merivale Road was classified as cool-warmwater. Woodroffe Avenue was classified as coolwater in 2022 and cool-warmwater in 2014 (methods from Chu et al., 2009).

Table 3 Water chemistry comparison (2008, 2014, and 2022).

Water Chemistry (2008, 2014 and 2022)				
Year	**Parameter**	**Unit**	**Average**	**STND Error**
2014	pH	-	7.89	± 0.13
2022	pH	-	7.42	± 0.04
2014	Sp. Conductivity	us/cm	731.3	± 50.4
2022	Sp. Conductivity	us/cm	732.0	± 32.2
2014	Dissolved Oxygen	mg/L	10.6	± 0.5
2022	Dissolved Oxygen	mg/L	9.0	± 0.6
2008	Water Temperature	ºC	17.2	± 0.4
2014	Water Temperature	ºC	16.8	± 0.4
2022	Water Temperature	ºC	18.3	± 0.3
2008	Standardized Stream Temperature[1]	ºC Water / 1ºC Air	0.80	± 0.56
2014	Standardized Stream Temperature[1]	ºC Water /	0.80	± 0.25
2022	Standardized Stream Temperature[1]	ºC Water /	0.80	± 0.15

[1] ***Standardized Stream Temperature:*** Temperature data is collected via logger and standardized based on the following conditions:

- Daily maximum air temperatures must exceed 24.5 ºC;
- No precipitation for 3 days preceding measurement;
- Measurements to be taken between 4:00PM - 6:00PM;
- Water temperature points collected from July 1st- September 10th;
- Logger must be deployed in flowing waters.

Invasive Species

The percentage of sections surveyed where invasive species were observed had an increase of 12 percent (Table 4). Most invasive species previously reported had an increase in the number of sections they were observed in. There are also several species that were not previously reported; notably non-native *Phragmites*.

Table 4 Invasive species presence (% of sections) observed in 2014 and 2022 (NPR are Not Previously Reported species).

Invasive Species	2014	2022	+/-
Bull thistle	NPR	16%	▲
Common & glossy buckthorn	51%	6%	▼
European frogbit	1%	2%	▲
Flowering rush	NPR	2%	▲
Garlic mustard	3%	3%	-
Himalayan balsam	7%	9%	▲
Honeysuckle (non-native)	3%	5%	▲
Japanese knotweed	3%	3%	-
Manitoba maple	40%	33%	▼
Phragmites (non-native)	NPR	6%	▲
Poison/wild parsnip	NPR	25%	▲
Purple loosestrife	79%	77%	▼
Rusty crayfish	NPR	2%	▲
Yellow iris	NPR	2%	▲
Total percent of sections invaded	**85%**	**97%**	▲

Pollution

Garbage accumulation on Black Rapids Creek was found to decrease from 2008 to 2014 and by 2022. In 2022 the polluted sections contained garbage such as, concrete pieces, Styrofoam, metal scraps, construction wood scraps, old farming equipment, an oil barrel, tires, plastics, packaging, beverage containers and cans. Table 5 shows pollution levels in three monitoring years.

Table 5 Pollution levels (presence in % of sections surveyed) comparison between 2008-2022.

Pollution/Garbage	2008	2014	2022	+/-
Floating garbage	18%	19%	16%	▼
Garbage on stream bottom	14%	22%	20%	▼
Oil or gas trail	4%	0%	2%	▲
Other	0%	0%	2%	▲
Total polluted sections	**36%**	**32%**	**31%**	▼

Instream Aquatic Vegetation

Table 6 shows decreases in instream aquatic vegetation from 2014-2022. Narrow-leaved emergent plants (e.g. sedges), free-floating plants (e.g. duckweed) and floating plants (e.g. water lilies) were present in comparable abundance in both survey years. Submerged plants (e.g. pondweed) and algae had lower observations in the number of sections surveyed. Drastic declines seen in broad leaved emergent plants (e.g. arrowhead) and robust emergent plants (e.g. cattails) may possibly be associated with beaver activity and different water depth conditions.

Table 6 Instream aquatic vegetation (presence in % of sections) comparison between 2014 and 2022.

Instream Vegetation	2014	2022	+/-
Narrow-leaved emergent plants	74%	83%	▼
Broad-leaved emergent plants	74%	47%	▼
Robust emergent plants	52%	22%	▼
Free-floating plants	26%	28%	▼
Floating plants	10%	14%	▲
Submerged plants	74%	58%	▼
Algae	78%	52%	▼
None	1%	55%	▲

Fish Community

Fish sampling was carried out by the City Stream Watch program in 2003, 2008, 2014 and 2022 to evaluate fish community composition in Black Rapids Creek; additional fish community assessments were done in the restored wetland as part of monitoring activities in 2017 and 2019 (see Table 7). In total 26 species have been observed in Black Rapids Creek. In 2003 nine species were observed at two sites; in 2008, 22 fish species were observed at nine sites; in 2014, 16 species were observed in seven sites; in 2017 and 2019 four species were observed in the restored wetland; and ten species were observed in five sites in 2022. Sample locations were revisits across the years, with some locations having additional sites. All species observed in 2022 had been captured in previous years, showing consistent community structure.

Table 7 Comparison of fish species caught between 2003-2022.

Species	2003	2008	2014	2017/ 2019	2022
Black crappie *Pomoxis nigromaculatus*		X			
Blackchin shiner *Notropis heterodon*		X			
Blacknose shiner *Notropis heterolepis*	X		X		
Bluntnose minnow *Pimephales notatus*	X				X
Brassy minnow *Hybognathus hankinsoni*			X		
Brook stickleback *Culaea inconstans*	X	X	X	X	X
Carps and minnows unidentified species		X	X	X	X
Central mudminnow *Umbra limi*		X	X	X	X
Common shiner *Luxilus cornutus*	X	X	X		
Creek chub *Semotilus atromaculatus*	X	X	X		X
Darter species *Etheostoma spp.*		X	X		
Fallfish *Semotilus corporalis*			X		
Fathead minnow Pimephales promelas		X	X	X	X
Finescale dace *Chrosomus neogaeus*		X	X		
Hornyhead chub *Nocomis bigattus*		X			
Largemouth bass *Micropterus salmoides*	X	X			
Logperch *Percina caprodes*		X	X		
Longnose dace *Rhinichthys cataractae*		X	X		X
Mottled sculpin *Semotilus atromaculatus*	X	X	X		X
Northern pearl dace *Margariscus nachtriebi*		X	X		
Northern redbelly dace *Chrosomus eos*	X	X	X	X	
Pumpkinseed *Lepomis gibbosus*		X			
Rock bass *Ambloplites rupestris*		X			X
Smallmouth bass *Micropterus dolomieu*		X			X
Walleye *Sander vitreus*		X			
White sucker *Catostomus commersonii*	X	X	X		X
Yellow perch *Perca flavescens*		X			
Total Species 26	**9**	**22**	**16**	**4**	**10**

Monitoring and Restoration

Table 8 highlights recent and past monitoring and restoration activities that have been completed on Black Rapids Creek and its catchment by the Rideau Valley Conservation Authority's City Stream Watch program. Monitoring activities and efforts change over the years.

Table 8 City Stream Watch activities on Black Rapids Creek.

Accomplishment	Year	Description
City Stream Watch Stream Monitoring	2003	5.7 km of stream was surveyed
	2008	5.6 km of stream was surveyed
	2014	7.3 km of stream was surveyed
	2022	6.4 km of stream was surveyed
City Stream Watch Fish Sampling	2003	Two fish community sites were sampled
	2008	Nine fish community site were sampled
	2014	Seven fish community sites were sampled
	2022	Five fish community sites were sampled
City Stream Watch Thermal Classification	2008	Three temperature probes were deployed from May to September
	2014	Three temperature probes were deployed from April to September
	2022	Four temperature probes were deployed from July to September
Headwater Drainage Feature Assessment	2014	Four headwater drainage feature sites were sampled in the Black Rapids Creek catchment
City Stream Watch Invasive Species Removals	2014	Himalayan balsam removed from 1500 m^2 of the Black Rapids Creek shoreline
	2016/ 2018	Common buckthorn removed from 75 m^2 of the restored Black Rapids wetland
Wetland Restoration/ Shoreline Naturalization	2014	Volunteers and staff planted 560 shrubs and trees along a tributary of Black Rapids Creek shoreline
	2016	Volunteers and staff planted 389 shrubs and trees in the restored Black Rapids wetland
	2018	Volunteers and staff planted 500 shrubs and trees along the Black Rapids Creek shoreline
	2019	Volunteers and staff planted 500 shrubs and trees along the Black Rapids Creek shoreline

Potential Riparian Restoration Opportunities

Riparian restoration opportunities include potential enhancement through riparian planting. Opportunities were identified along Black Rapids Creek surveyed areas (Figure 34).

Riparian Planting

Certain riparian areas of Black Rapids Creek can benefit from planting to increase plant diversity. Many sections had riparian buffers of low plant diversity. Additional planting would increase shading, enhance wildlife habitat, prevent soil erosion and mitigate negative impacts from runoff and anthropogenic input.

Area of Black Rapids Creek in the headwaters that would benefit from riparian planting.

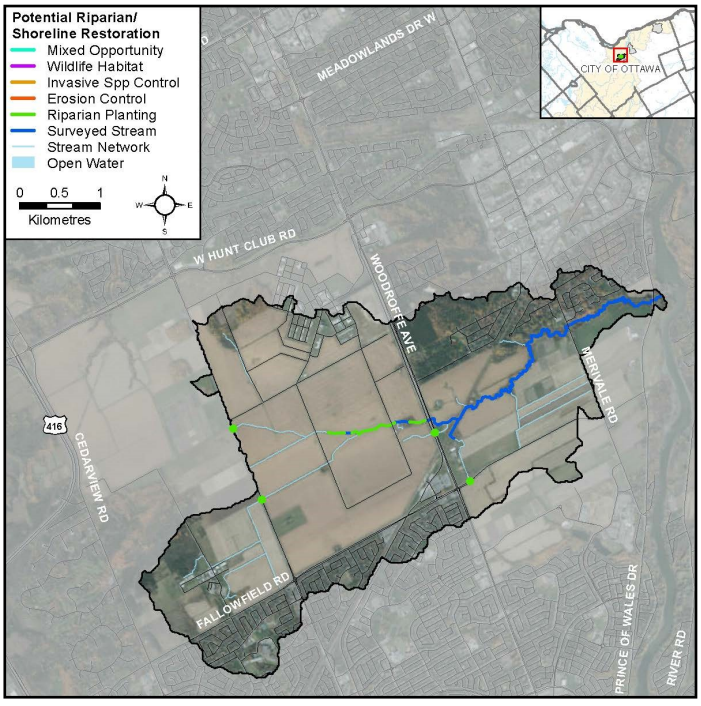


Figure 34 Potential riparian/shoreline restoration opportunities along Black Rapids Creek and its headwater reaches.



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1. Canadian Council of Ministers of the Environment (CCME), 1999. Canadian water quality guidelines for the protection of aquatic life: Dissolved oxygen (freshwater). In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg, MN.
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For more information on the 2022 City Stream Watch Program and the volunteer activities, please refer to the City Stream Watch 2022 Summary Report:

https://www.rvca.ca/rvca-publications/city-stream-watch-reports

RVCA City Stream Watch would like to thank all the **volunteers** who assisted in the collection of information; as well as the many **landowners** who gave us property access to portions of the stream; and to our **City Stream Watch Collaborative members**: City of Ottawa, National Capital Commission, Ottawa Flyfishers Society, Canadian Forces Ottawa Fish and Game Club, Ottawa Stewardship Council, Rideau Roundtable, South Nation Conservation, Mississippi Valley Conservation Authority and Rideau Valley Conservation Authority.