Sawmill Creek

2022 Catchment Report

Catchment Features	
Area	20.73 square kilometres 0.49% of the Rideau Valley watershed
Land Use	11.3% forest 12.8% meadow 5.8% rural 54.8% urban 0.5% waterbody 14.8% wetlands
Surficial Geology	29.0% clay 9.4% diamicton 11.8% gravel 5.6% organic deposits 3.8% Paleozoic bedrock 40.3% sand
Thermal Regime	**Cool-coldwater** to **Cool-warmwater**
Invasive Species	Sixteen invasive species were identified in 2022: common buckthorn, curly-leaved pondweed, dog strangling vine, European frog-bit, garlic mustard, glossy buckthorn, Himalayan balsam, Japanese knotweed, Manitoba maple, non-native honeysuckle, non-native *Phragmites*, Norway maple, purple loosestrife, rusty crayfish, wild parsnip and yellow iris
Fish Community	Twenty-five fish species have been observed from 2008 to 2022; game fish species include: bluegill, muskellunge, pumpkinseed, rock bass, smallmouth bass, walleye and white sucker

Wetland Cover
14.8% of the watershed are wetlands
4.2% are unevaluated wetlands
10.6% are evaluated wetlands

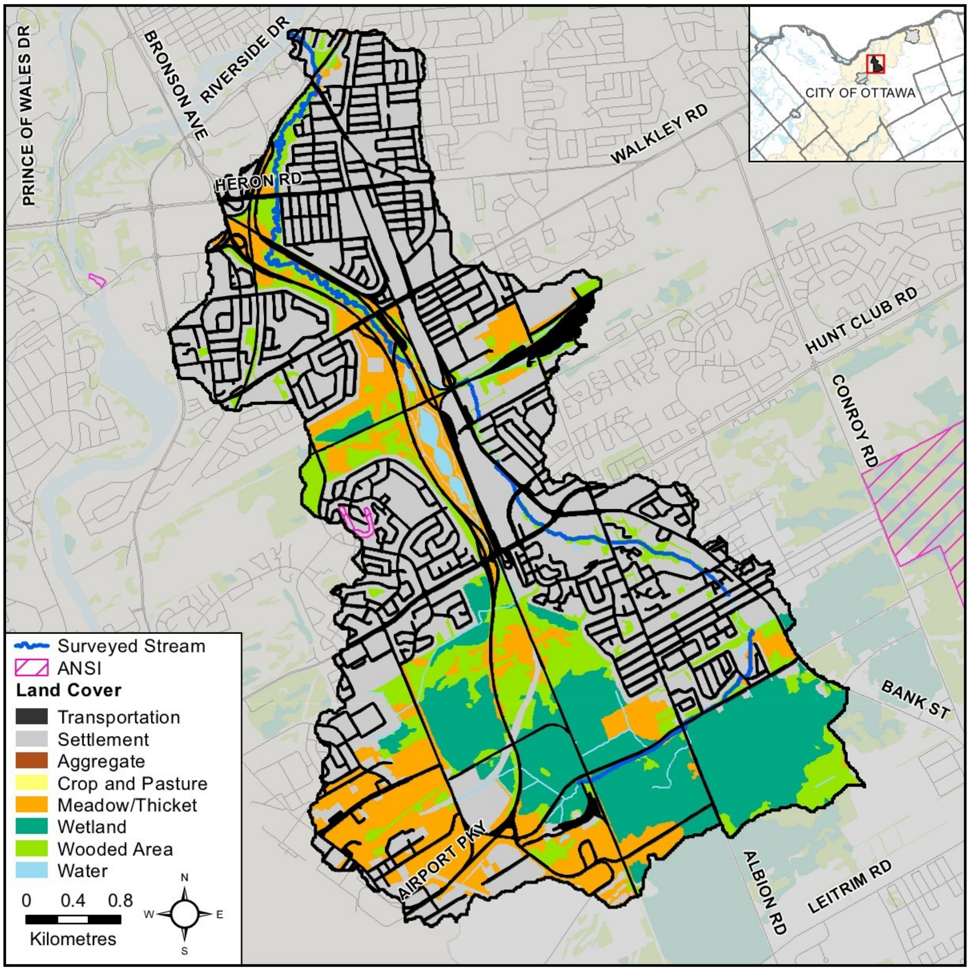

Figure 1 Land cover in the Sawmill Creek catchment

Vegetation Cover

Type	Hectares	Percent of Cover
Wooded Areas:	**233.35**	**43.3%**
Hedgerow	19.63	3.6%
Plantation	2.82	0.5%
Treed	210.89	39.1%
Wetlands*	**306.12**	**56.7%**
Total Cover	**539.47**	**100%**

*Includes treed swamps

Woodlot Analysis

Size Category	Number of Woodlots	Percent of Woodlots
<1 Hectare	67	61.5%
1 to <10 Ha	36	33.0%
10 to <30 Ha	6	5.5%
>30 Ha	0	0%
Total Cover	**109**	**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.

Introduction

Sawmill Creek is a tributary of the Rideau River that is approximately eleven kilometers long, not including the tributaries that flow into the creek, and drains 21 square kilometers of land. The creek flows in a north-western direction, beginning in the headwaters in the Lester Road Wetland Complex, flowing northward along Bank Street and the Airport Parkway before it crosses Heron Road and Riverside Drive. It ultimately flows into the Rideau River north-east of the Bank Street bridge. Sawmill Creek is an important ecological link from the headwater wetland known as the Lester Road Provincially Significant Wetland to the Rideau River for fish and wildlife (OMNRF, 2023); catchment parts in the National Capital Commission (NCC) Pine Grove Sector Greenbelt lands and the Airport Parkway Natural Link (NCC, 2013); and having provincially significant woodlands (OMNRF, 2023). Commencing at Lester Road to Hunt Club Road, the creek flows though residential areas with moderate forested riparian buffers. The following two kilometer stretch is highly modified, until the creek crosses Bank Street near Johnston Road, the riparian buffers of Sawmill creek are narrow; with intense adjacent urban land use and impervious surfaces. Much of the subwatershed is urbanized, and the vegetation in the subwatershed has been impacted but there remain some more extensive forested areas around Blossom Park, McCarthy Woods and north of Walkley Road along the creek (CH2MHILL, 2003).

The Sawmill Creek catchment has areas that are encouraged to be protected to maintain their natural function. The Airport Parkway natural link is encouraged to maintain its natural function by the City of Ottawa, NCC and the Rideau Valley Conservation Authority implementing recommendations of the 2002 Sawmill Creek Watershed Study (NCC, 2013). The Lester Road Wetlands are also required to be protected due to their provincial significance. Overall Sawmill creek has many areas that are protected, as well as some areas that are under pressure from its proximity to urban development. Due to the highly urbanized status of Sawmill Creek, the City Stream watch program implements annual stream garbage cleanups along the system to minimize the amount of pollution in the stream which is important for the fish and wildlife that rely on the system as a habitat.

In 2022, 96 sections (9.6 km) of the main stem of Sawmill 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.

Section of Sawmill Creek in the Lester Road Wetland Complex.

Sawmill 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 Sawmill Creek. Buffers greater than 30 meters were present along 37 percent of the left bank and right bank. A 15 to 30 meter buffer was present along 27 percent of the left bank and 19 of the right bank. A 5 to 15 meter buffer was present along 16 percent of the left bank and 20 percent of the right bank. A five meter buffer or less was present along 20 percent of the left bank and 25 percent of the right bank. The buffer width evaluation on the sections surveyed of Sawmill creek are below recommended guidelines.

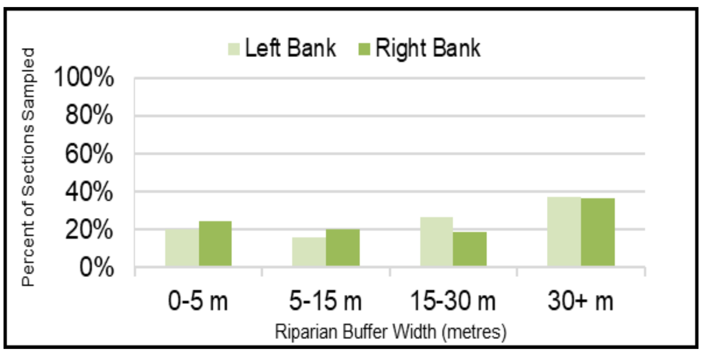

Figure 2 Vegetated buffer width along Sawmill Creek.

Vegetated buffer greater than 30 meters in width along Sawmill Creek upstream of Bank Street.

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.

Sawmill Creek surveyed riparian zones natural for 51 percent of the right bank and 63 percent of the left bank, having dominant natural riparian vegetative communities. Alterations to the riparian buffer accounted for 22 percent of the right bank and 17 percent of the left bank; highly altered conditions were observed on 27 percent of the right bank and 21 percent of the left bank. These alterations were associated with infrastructure including roadways, residential and commercial land uses.

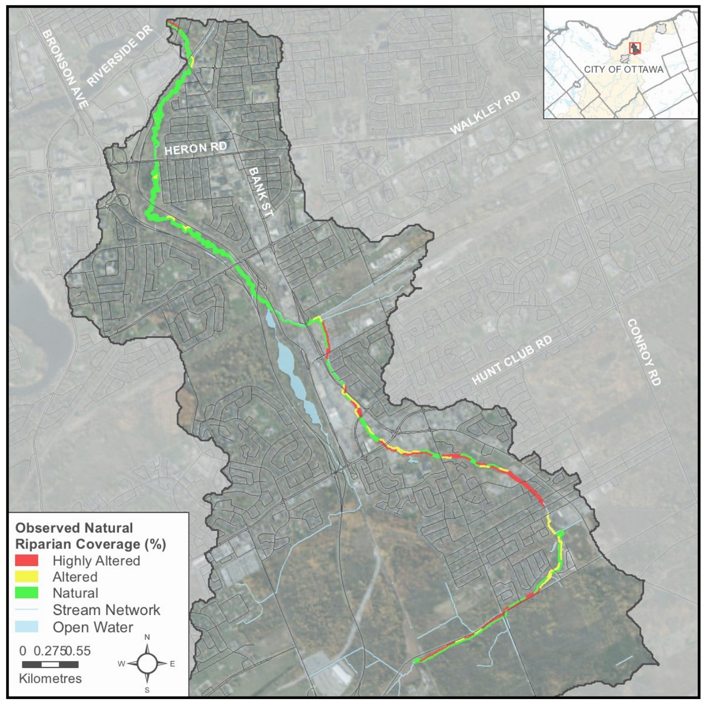

Figure 3 Riparian buffer alterations on Sawmill Creek.

Roadway infrastructure on the transitway along Sawmill 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 63 percent and 60 percent of the sections surveyed, being the most common land use observed. Wetlands were present in 17 percent of the surveyed areas, and meadow was present in 31 percent of sections.

Aside from the natural areas, the most common land use in the catchment was infrastructure, containing roads, railway, bridges and culverts, with 43 percent and residential at 27 percent of the surveyed sections. Industrial and commercial land use was observed in 16 percent of the sections. Seven percent was attributed to recreational uses, such as walking trails and parks. The other two percent of land use was attributed to other land uses, a cemetery.

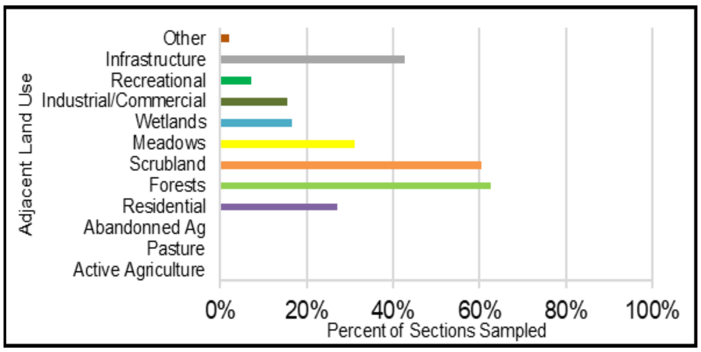

Figure 4 Adjacent land use 100 meters from each shoreline and percentage of presence along Sawmill Creek.

Section along Sawmill Creek with mix land uses including natural forest, scrubland, meadow and urban infrastructure.

Sawmill 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 96 sections surveyed in the Sawmill Creek catchment, with 28 sections remaining without any human alteration. Of the areas surveyed, 44 sections fell in the classification of natural. Natural sections had a riparian buffer greater than 15 meters in width and naturally vegetated shorelines.

21 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 and stormwater outlets were present in the sections.

Three of the surveyed sections were highly altered. The riparian buffers were less than five meters in width. Two sections were contained long culvert sections under Riverside Drive, and one section was fully channelized into a culvert under Walkley Road.

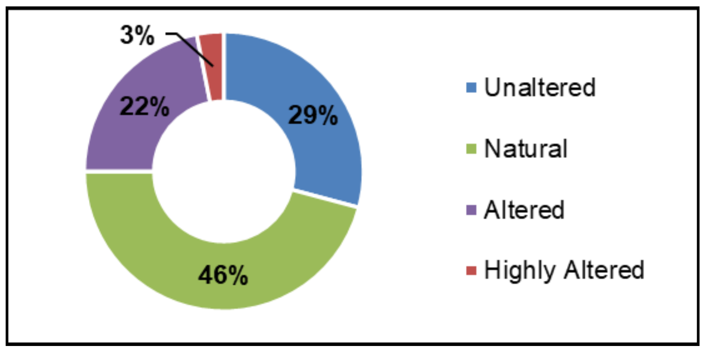

Figure 5 Anthropogenic alterations along Sawmill Creek.

Channelized section of Sawmill Creek under Walkley Road.

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 of erosion that was observed across the surveyed portions. Bank instability was observed in 54 percent of the left bank and 57 percent of the 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 Sawmill Creek. Along the left bank, 57 percent of sections had undercut banks; while the right bank had 60 percent of sections with undercut banks.

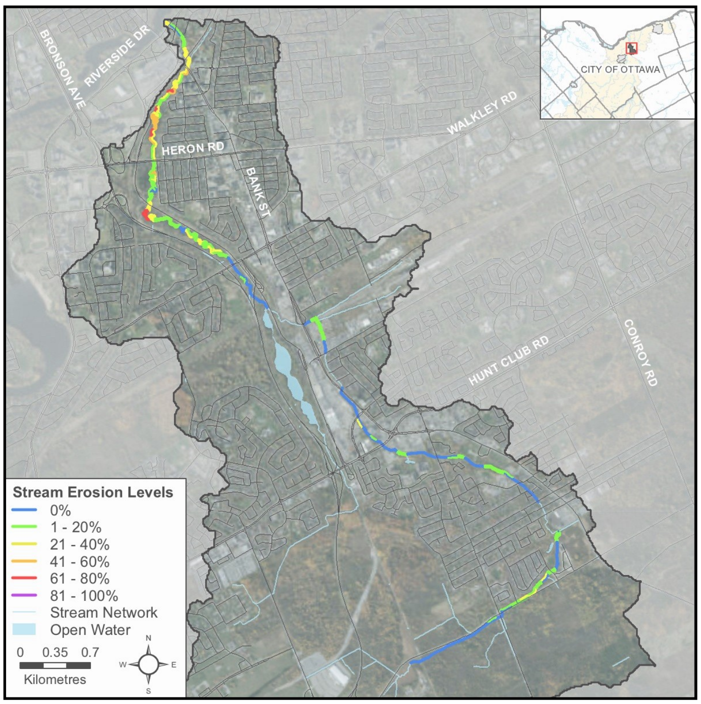

Figure 6 Erosion levels along Sawmill Creek.

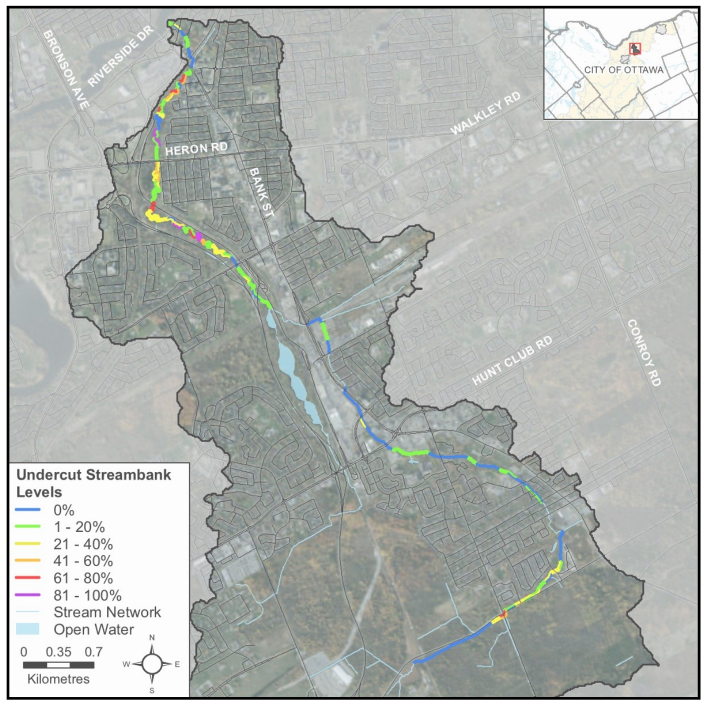

Figure 7 Undercut stream banks along Sawmill Creek.

Bank erosion exposing tree roots, creating instability for trees along the left bank of Sawmill Creek.

Undercut right banks downstream of Heron Road along Sawmill 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, 36 of them, had a shade cover of 61 to 80 percent. The highest shading levels observed of 81 to 100 percent was present in 21 sections. Nineteen sections had shading levels between 41 to 60 percent and ten sections had levels between 21 to 40 percent. Eight sections had one to 20 percent shading and two sections had no shading at all.

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

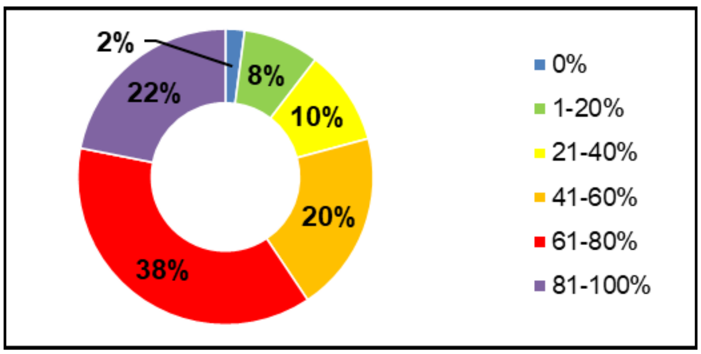

Figure 8 Stream shading levels along Sawmill Creek.

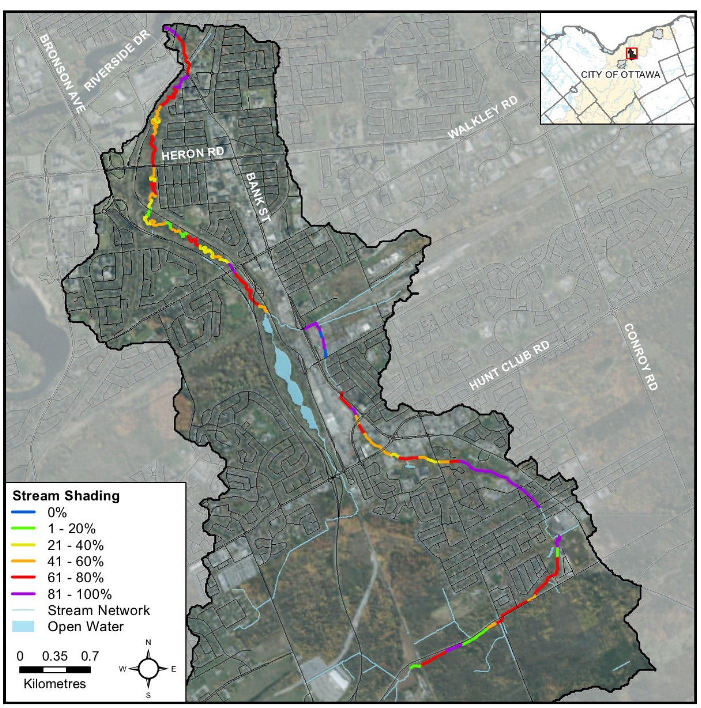

Figure 9 Stream shading along Sawmill Creek.

A mix of trees and plants comprised the majority of shading. Overhanging plants, mainly grasses, robust and broad leaved emergent plants, were seen in 73 percent of the left and right banks.

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 Sawmill Creek. A total of 93 percent of the left bank and 84 percent of the right bank of the sections had overhanging trees and branches.

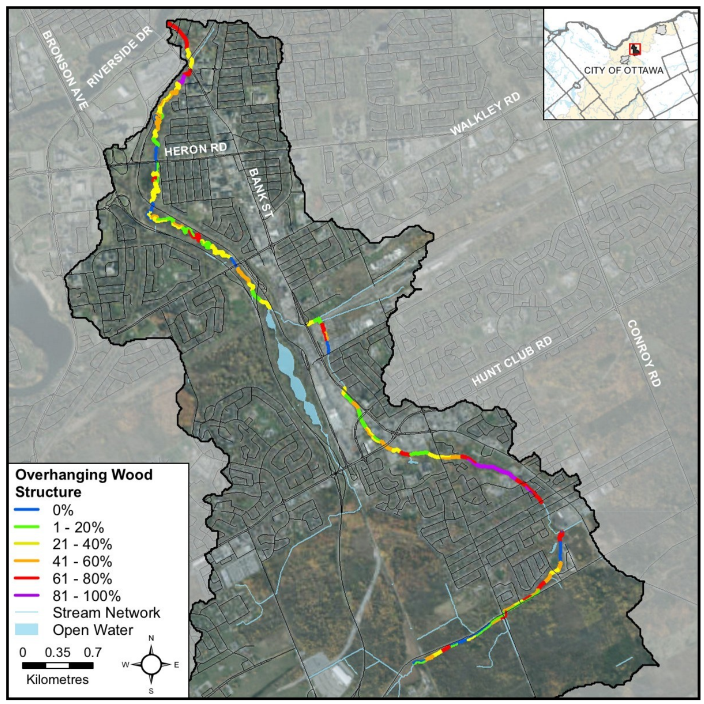

Figure 10 Overhanging trees and branches along Sawmill Creek.

Overhanging trees and shrubs provide shade and cool stream temperatures along Sawmill Creek.

Sawmill 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: one percent had no complexity; 21 percent had a score of one; 36 percent scored two; 36 percent scored three; and 5 percent scored four for habitat complexity.

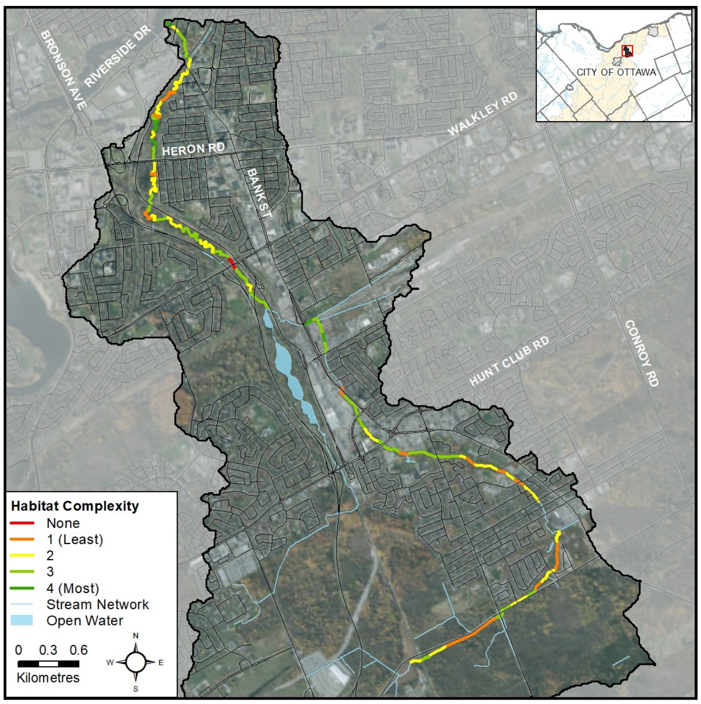

Figure 11 Instream habitat complexity along Sawmill Creek.

Section of Sawmill Creek with complex habitat features including boulders, cobble, gravel 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 Sawmill Creek was observed to be fairly homogenous in 55 percent of sections surveyed, and heterogenous in the remaining 45 percent. Figure 12 shows the substrate types observed. It is a system dominated by clay, with 81 percent of sections containing this type of substrate. Over half the sections surveyed also contained silt, sand, gravel and cobble. Other substrate types included boulders and bedrock.

Figure 13 shows the dominant substrate types along the creek. From the assessed areas the dominant substrate type was clay at 50 percent, followed by silt at 30 percent of sections surveyed, and cobble was third dominant at 11 percent of sections surveyed.

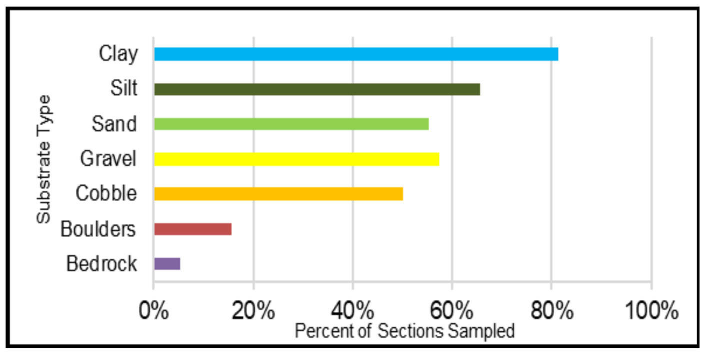

Figure 12 Instream substrate along Sawmill Creek.

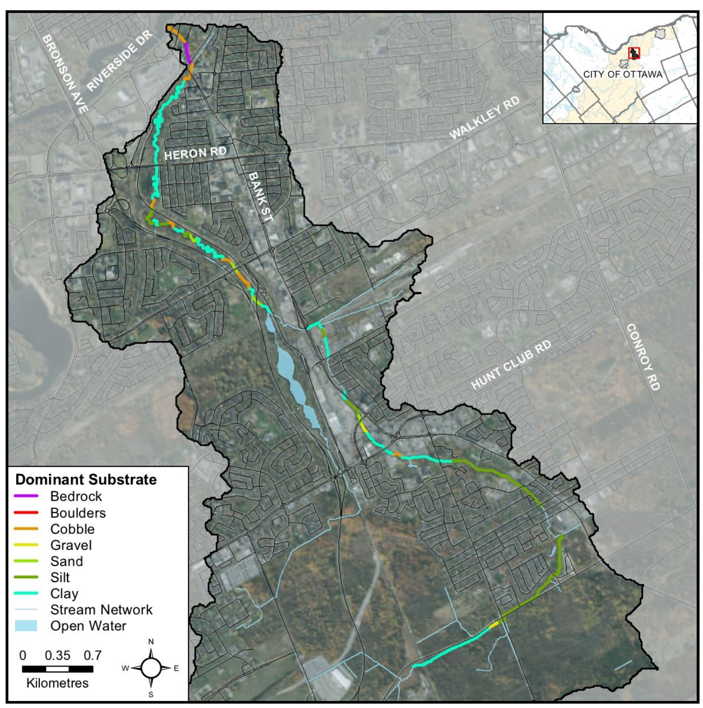

Figure 13 Dominant instream substrates along Sawmill Creek.

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 Sawmill Creek have a high diversity of morphological conditions, suitable for a variety of aquatic species and life stages; 82 percent of sections contained pools, 66 percent of sections contained riffles and 99 percent contained runs.

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

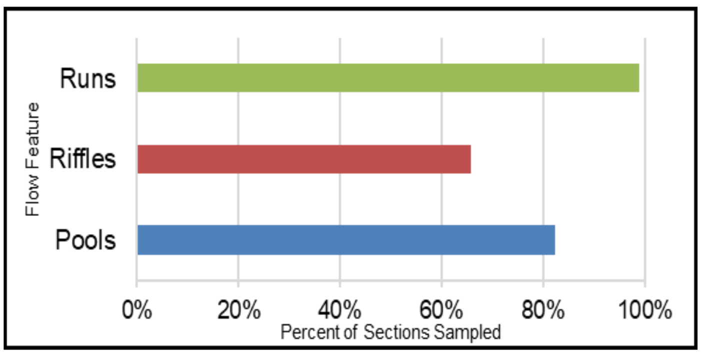

Figure 14 Instream morphology along Sawmill Creek.

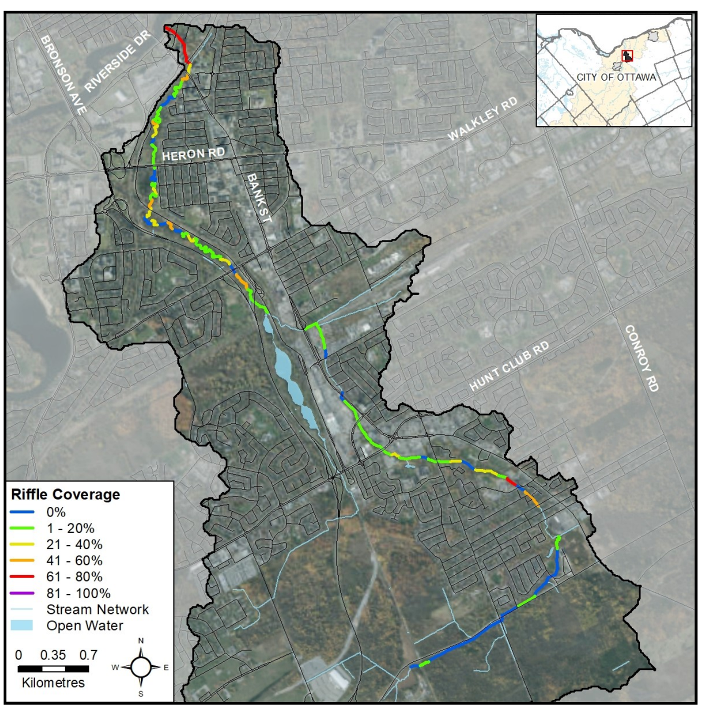

Figure 15 Riffle habitat locations along Sawmill Creek.

Instream Wood Structure

Figure 16 shows that a large portion of Sawmill 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 Sawmill Creek (RVCA, 2022).

Instream wood structures found along Sawmill Creek are important for fish and wildlife habitat (above), some can become seasonal migration barriers (below).

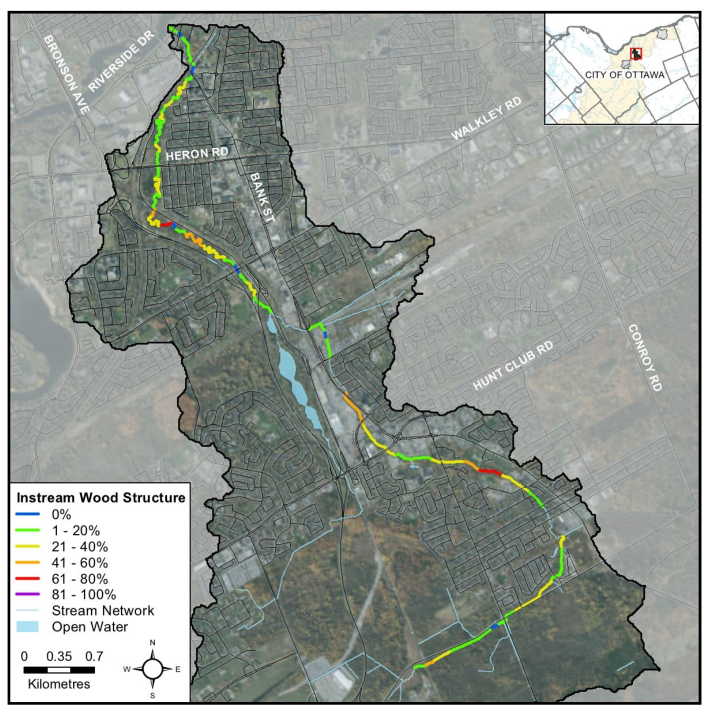

Figure 16 Instream wood structures along Sawmill Creek.

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 Sawmill Creek. There were 84 sections which had areas of the stream where no vegetation was present. Vegetation types in the 96 sections surveyed included: submerged vegetation present in 47 sections; narrow-leaved emergent vegetation in 36 sections; algae in 27 sections; robust emergent and broad leaved emergent plants in 11 sections each; free-floating in three sections; and floating plants in two sections.

Figure 18 shows that Sawmill Creek was dominated by no instream vegetation along the system.

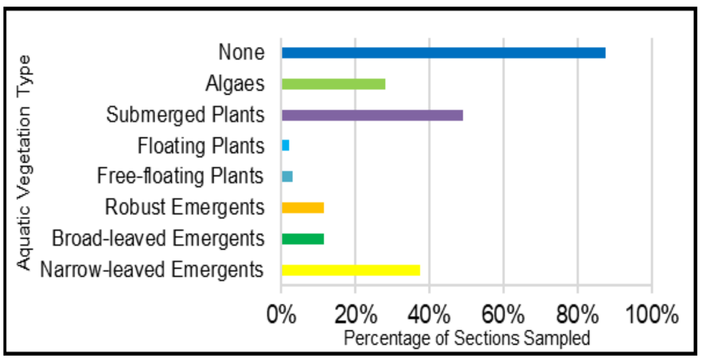

Figure 17 Aquatic vegetation presence along Sawmill Creek.

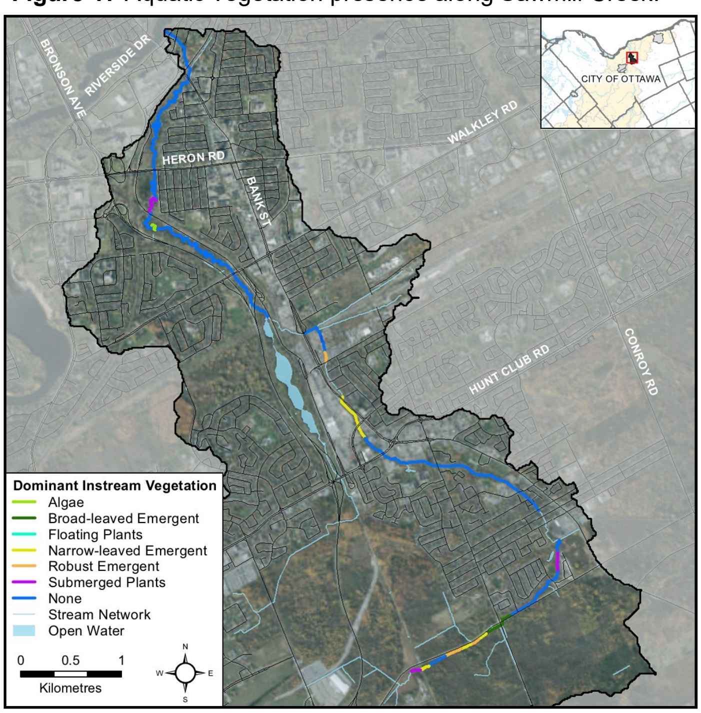

Figure 18 Dominant instream vegetation in Sawmill Creek.

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 is categorized based on the extent of its presence in a section, from none or sparse, to parts being choked. As seen in Figure 19, 86 percent of sections along Sawmill Creek had areas of no vegetation and 39 percent had rare abundance. Low levels of vegetation abundance were observed in 31 percent of sections and normal levels in 14 percent. Common levels were observed in eight percent of sections and extensive levels were recorded in two percent of sections.

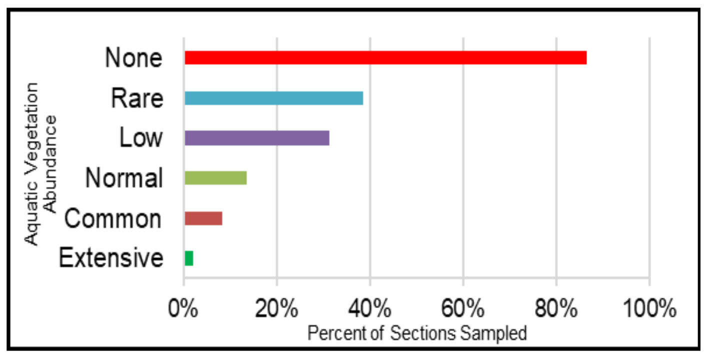

Figure 19 Instream vegetation abundance along Sawmill Creek.

Section of Sawmill Creek in the Lester Road Wetland Complex were submerged vegetation was dominant and a variety of other vegetation types were observed, including cattails and rushes.

Sawmill 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 species observed per section surveyed.

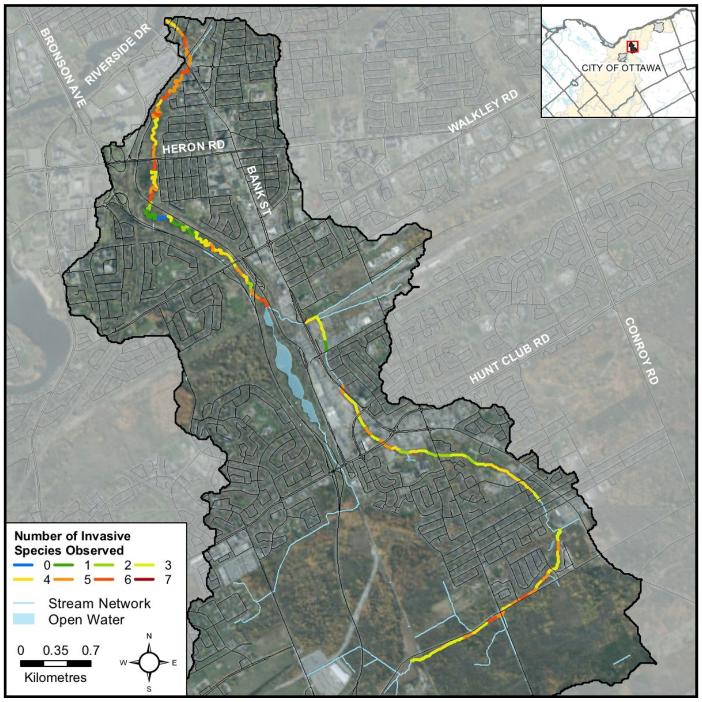

Figure 20 Invasive species diversity along Sawmill Creek.

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

- common buckthorn (*Rhamnus cathartica*)
- curly-leaved pondweed (*Potamogeton crispus*)
- dog-strangling vine (*Cynanchum rossicum & C. nigrum*)
- European frog-bit (*Hydrocharis morsus-ranae*)
- 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*)
- Norway maple (*Acer plantoides*)
- poison/wild parsnip (*Pastinaca sativa*)
- purple loosestrife (*Lythrum salicaria*)
- rusty crayfish (*Orconectes rusticus*)
- yellow iris (Iris pseudacorus)

Dog strangling vine (*Cynqnchum nigrum*) observed along surveyed portions of Sawmill Creek for the first time 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 Sawmill Creek. The levels of garbage found in the main portion of the stream were high, with 83 percent of sections surveyed containing garbage such as household items, plastics, Styrofoam, furniture, sports equipment, construction waste and tires. Floating garbage was found within 62 of the surveyed sections. Garbage on the stream bottom was found in 47 sections surveyed. One section was observed to have oil or gas trails.

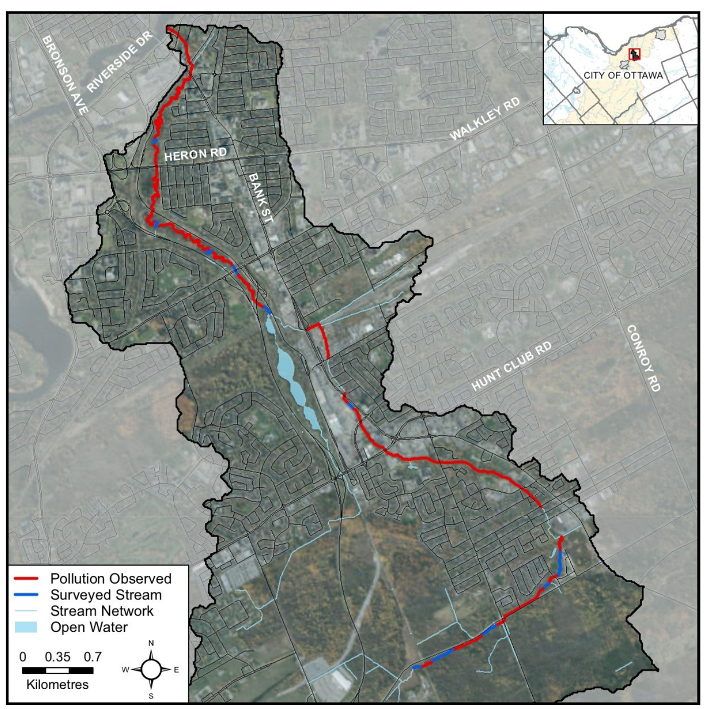

Figure 21 Pollution observed along Sawmill Creek.

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 Sawmill Creek catchment (Table 1).

Table 1 Wildlife observations along Sawmill Creek in 2022.

Birds	American crow, American goldfinch, American redstart, American robin, belted kingfisher, black-capped chickadee, blue jay, blue-headed vireo, Canada goose, chipping sparrow, common grackle, downy woodpecker, eastern kingbird, eastern phoebe, great blue heron, grey catbird, hairy woodpecker, house sparrow, killdeer, mallard, northern cardinal, nuthatches, orioles, red-eyed vireo, red-winged blackbird, ring-billed gull, thrushes, wood duck, yellow warbler
Reptiles & Amphibians	Eastern gartersnake, green frog and other frogs
Mammals	American beaver, chipmunk, Eastern gray squirrel (black morph), muskrat, rabbits, raccoon tracks, voles
Aquatic Insects & Benthic Invertebrates	amphipods, caddisfly larvae, chironomid larvae, cranefly larvae, crayfish, isopods, leeches, mayfly larvae, pea clams, riffle beetles, snails, water striders, worms
Other	bumblebees, butterflies, damselflies, dragonflies, mosquitoes, moths, spiders, snails

An American beaver (*Castor canadensis*) observed swimming along Sawmill Creek.

Forktail damselfly, *Ischnura sp.*, observed along the bank of Sawmill Creek.

Eastern gartersnake (*Tamnophis sirtalis sirtalis*) observed along the bank of Sawmill Creek.

Sawmill 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.

Volunteer collecting water chemistry measurements with a multiparameter probe.

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 Sawmill Creek. The two dashed lines depict the Canadian water quality guidelines. Most of the surveyed portions were found to have oxygen levels within or above the Canadian water quality guidelines. These levels are sufficient to support warm-water aquatic life. Lower levels of dissolved oxygen seen near D'Aoust Avenue may relate to wetland habitats which can have these conditions. Average concentration levels across the system were 7.9 mg/L.

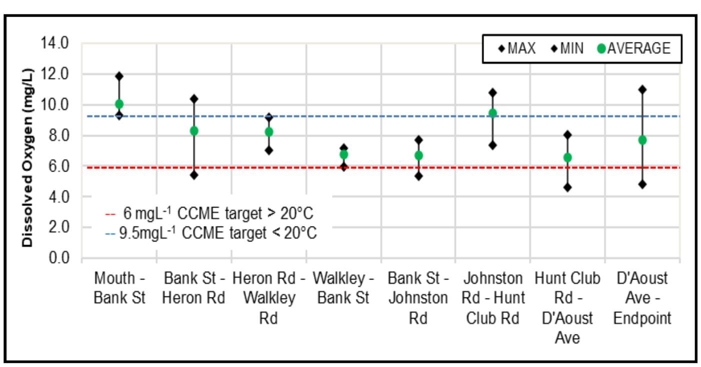

Figure 22 Dissolved oxygen ranges along surveyed sections of Sawmill Creek.

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 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 Sawmill Creek. The average level is depicted by the dashed line (1251.3 µS/cm). Conductivity levels are lower in areas approaching headwater reaches. Higher levels were observed in the sections closer to road infrastructure and high urban land uses with impervious surfaces (Bank Street to Hunt Club Road).

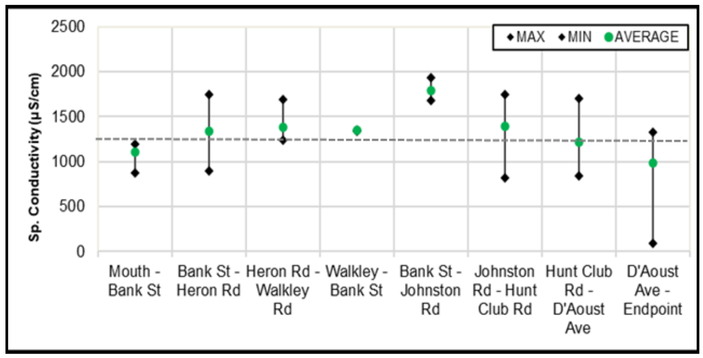

Figure 23 Specific Conductivity ranges along surveyed sections of Sawmill Creek.

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 Sawmill Creek had pH levels that meet the PWQO, depicted by the dashed lines. The average level across the system was pH 7.79.

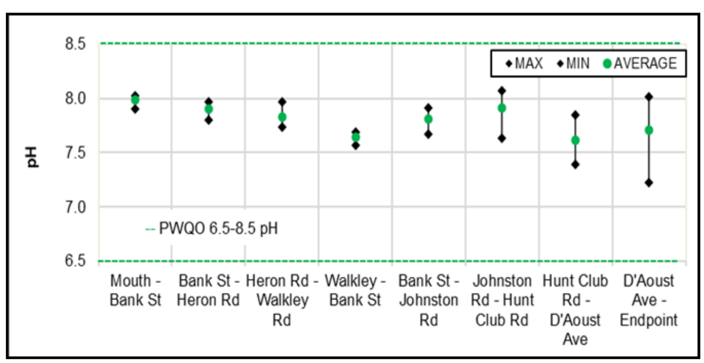

Figure 24 pH ranges along surveyed sections of Sawmill Creek.

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.

Section on Sawmill Creek west of Albion Road with **impaired** oxygen conditions (Dissolved oxygen levels of 4.78 mg/L and 52.3 % saturation).

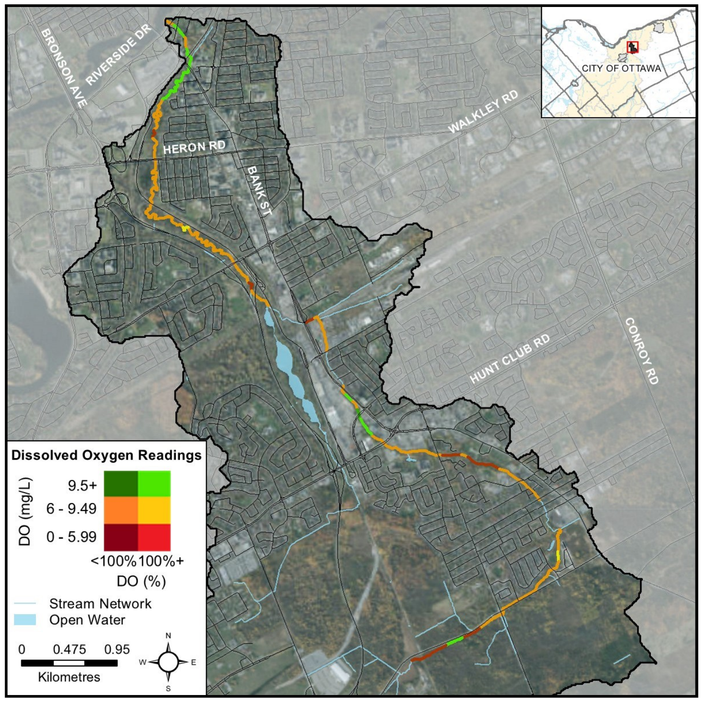

Figure 25 Bivariate assessment of dissolved oxygen concentration (mg/L) and saturation (%) along Sawmill Creek.

Figure 25 shows the oxygen conditions across the areas that were surveyed in 2022. Dissolved oxygen conditions in Sawmill Creek were for the majority of sections, sufficient to sustain warm-water biota in areas from downstream of Heron Road to the sections near the intersection of Lester Road and Albion Road. Sections shown in dark red, along Lester Road, and between Albion Road and D'Aoust Avenue, had significant levels of impairment both in concentration and percent saturation. The areas near Lester Road had wetland features that have naturally lower oxygen levels. The other oxygen impaired sections flow through highly urbanized areas. There were some pockets that contained slightly higher concentrations and saturation conditions near the mouth and smaller areas throughout. Fish species were observed, even though the average conditions are low in oxygen, in refuge areas throughout the system. An increase in instream vegetation and riffle habitat would increase levels of oxygen across the system.

Section on Sawmill Creek near the confluence with the Rideau River with optimal oxygen conditions for cold-water biota (Dissolved oxygen levels of 9.76 mg/L and 104.1 % 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 Sawmill Creek (1251.3 µS/cm) significantly exceeded guidelines (500 µS/cm) used for the Canadian Environmental Performance Index (Environment Canada 2011).

Figure 26 shows relative specific conductivity levels in Sawmill Creek. Normal levels were maintained for most of the surveyed portions. Moderately elevated conditions were observed near Bank Street, Heron Road and Hunt Club Road. These locations are consistent with areas that have untreated stormwater from historical development. Highly elevated conditions were noted near Johnston Road and in the Lester Road Wetland Complex.

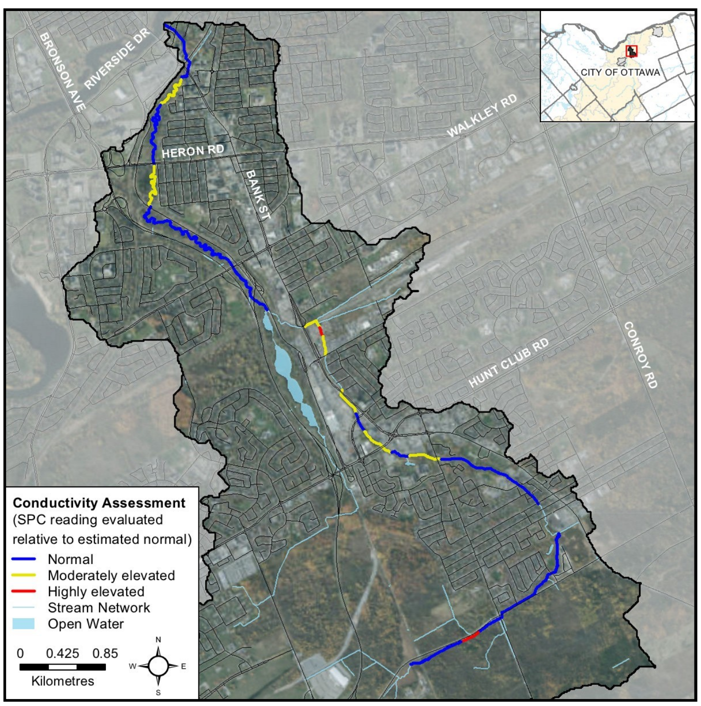

Figure 26 Relative specific conductivity levels along Sawmill Creek.

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.

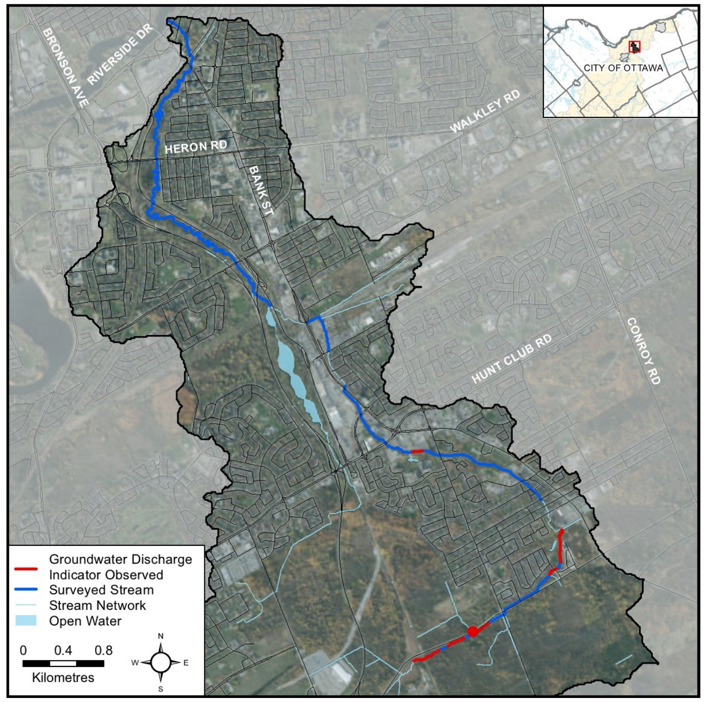

Figure 27 Groundwater indicators observed in the Sawmill Creek catchment.

The majority of sections of Sawmill Creek where groundwater was observed were in the headwaters near the Lester Road Wetland Complex which provides important baseflow to Sawmill Creek.

Sawmill 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 Sawmill Creek, three temperature loggers were placed in early June and retrieved at the end of September.

Figure 28 shows where thermal sampling sites were located. One instrument was lost and data is missing at a fourth location. Analysis of data from three loggers (using the Stoneman and Jones, 1996, method adapted by Chu et al., 2009), indicate Sawmill Creek is classified as **cold-coolwater** and **cool-warmwater**. Figures 29 and 30 show a comparison of thermal conditions from 2014 and 2022.

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

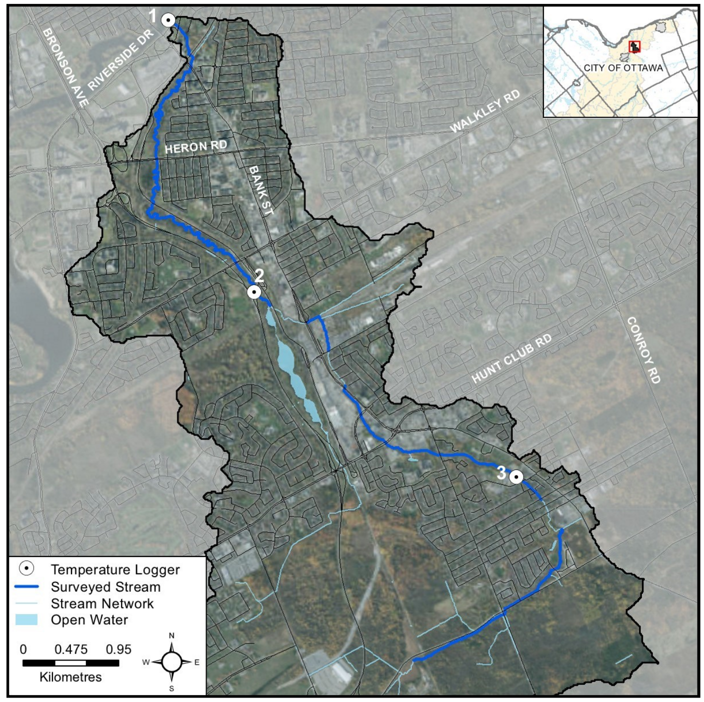

Figure 28 Temperature logger locations on Sawmill Creek.

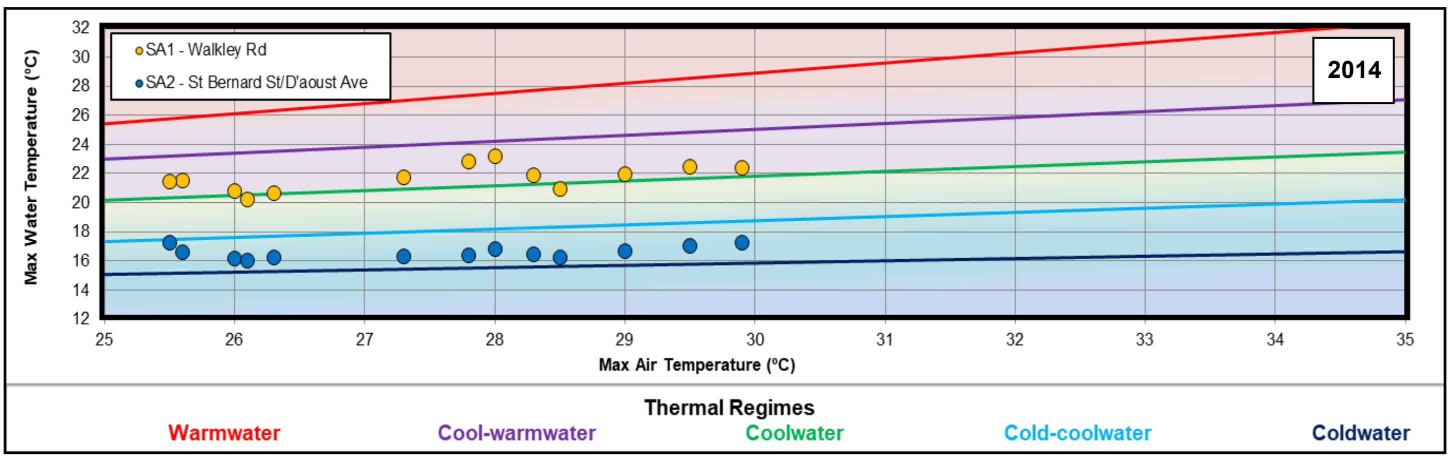

Figure 29 Thermal Classification for Sawmill Creek with the five thermal regimes adapted from Stoneman and Jones (1996) by Chu et al. (2009): **cool-warmwater** (SA1) and **cold-coolwater** (SA2) categories for two sites sampled on Sawmill Creek in **2014.**

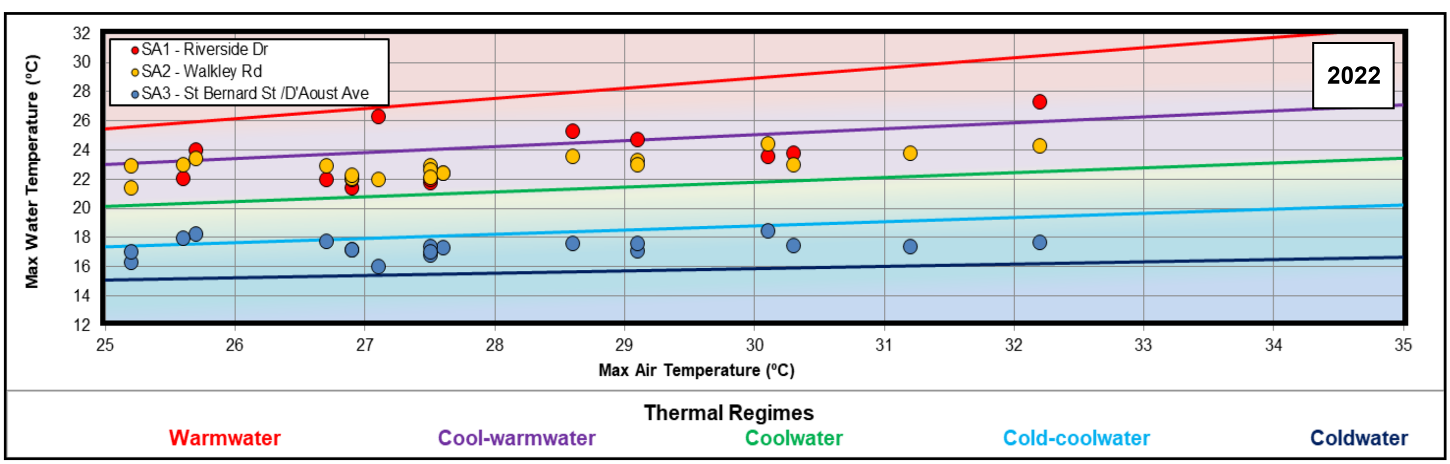

Figure 30 Thermal Classification for Sawmill Creek with the five thermal regimes adapted from Stoneman and Jones (1996) by Chu et al. (2009): **cool-warmwater** (SA1 and SA2) and **cold-coolwater** (SA3) categories for three sites sampled on Sawmill Creek in **2022.**

Sawmill Creek Fish Community

Fish Community Summary

Five fish sampling sites were evaluated between June and August 2022. All locations were sampled with the use of a backpack electrofishing unit.

Fifteen identified 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. Sawmill 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 Sawmill Creek refer to page 18 of this report.

Table 2 Fish species observed in Sawmill Creek in 2022.

Species	Thermal Class	MNR Species Code
Banded killifish *Fundulus diphanus*	**Cool**	BaKil
Blacknose dace *Rhinichthys atratulus*	**Cool**	BnDac
Brook stickleback *Culaea inconstans*	**Cool**	BrSti
Carps and minnows unidentified species	**Cool to Warm**	CA_MIN
Central mudminnow *Umbra limi*	**Cool**	CeMud
Common shiner *Luxilus cornutus*	**Cool**	CoShi
Creek chub *Semotilus atromaculatus*	**Cool**	CrChu
Darter species *Etheostoma Spp.*	**Cool to Cool-warm**	EthSp
Fathead minnow Pimephales promelas	**Warm**	FhMin
Logperch *Percina caprodes*	**Cool-warm**	LoPer
Longnose dace *Rinichtys cataractae*	**Cool**	LnDac
Mottled scuplin *Cottus bairdii*	**Cold**	MoScu
Rock bass *Ambloplites rupestris*	**Cool**	RoBas
Smallmouth bass *Micropterus dolomieu*	**Warm**	SmBas
Spotfin Shiner *Cyprinella siloptera*	**Warm**	SfShi
White sucker *Catastomus commersonii*	**Cool**	WhSuc
Total Species		**15**

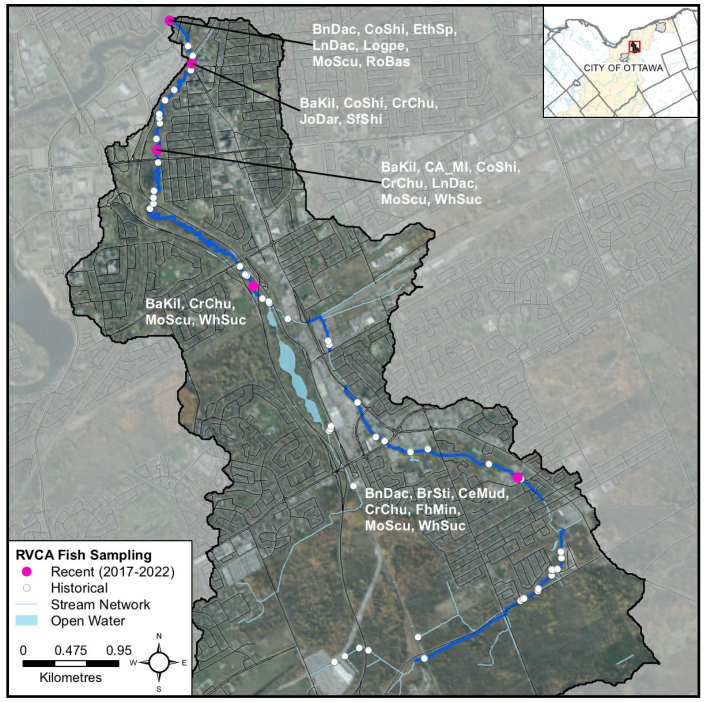

Figure 31 Sawmill Creek fish sampling locations (historical in white, 2022 in pink) and fish species observations from 2022.

Mottled sculpins (*Cottus biardi*) are indicators of cold water and were found in most locations.

An example of two game species observed in Sawmill Creek: rock bass, *Ambloplites rupestris,* (above) and a juvenile smallmouth bass, *Micropterus dolomieu,* (below).

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 seven migratory obstructions observed along the surveyed portions of Sawmill Creek. The locations of the obstructions and their types are shown in Figure 32. Several debris dams were observed, and these are seasonal migratory obstructions, when water levels are low. One perched culvert was observed at Banks Street; and two weirs were noted near Walkley Road and Daze Street, these are permanent migratory obstructions.

Weirs can result in fish passage obstructions, however in the case of the weir at Daze Road on Sawmill Creek it was installed to create a flow bypass and direct flow in to the constructed wetlands along the Airport Parkway; this has mitigated downstream flooding on Sawmill creek.

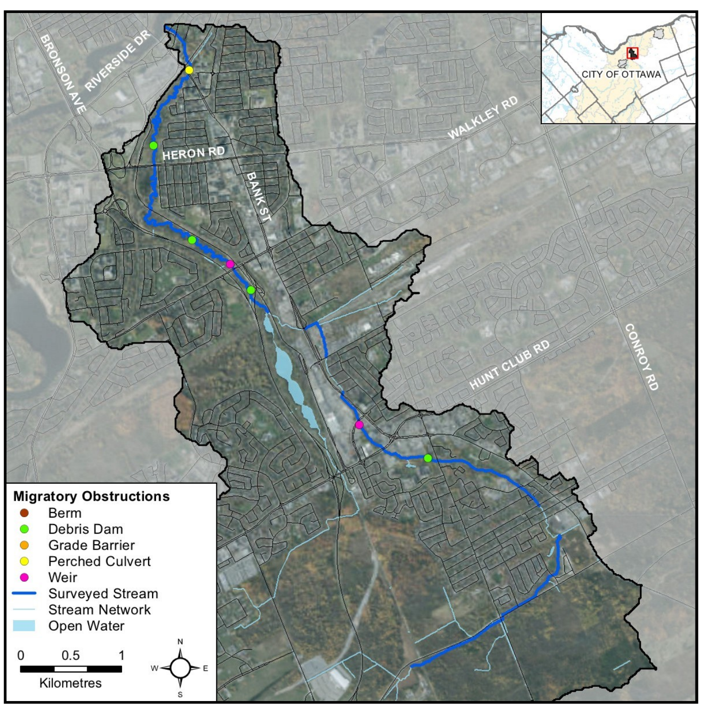

Figure 32 Locations of migratory obstructions along Sawmill Creek.

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 11 beaver dams were identified on the surveyed portions of Sawmill Creek and are shown in Figure 33. During the stream surveys a beaver was observed swimming in the creek. Additionally, a beaver lodge were noted as well.

An active beaver dam along Sawmill Creek downstream of Walkley Road.

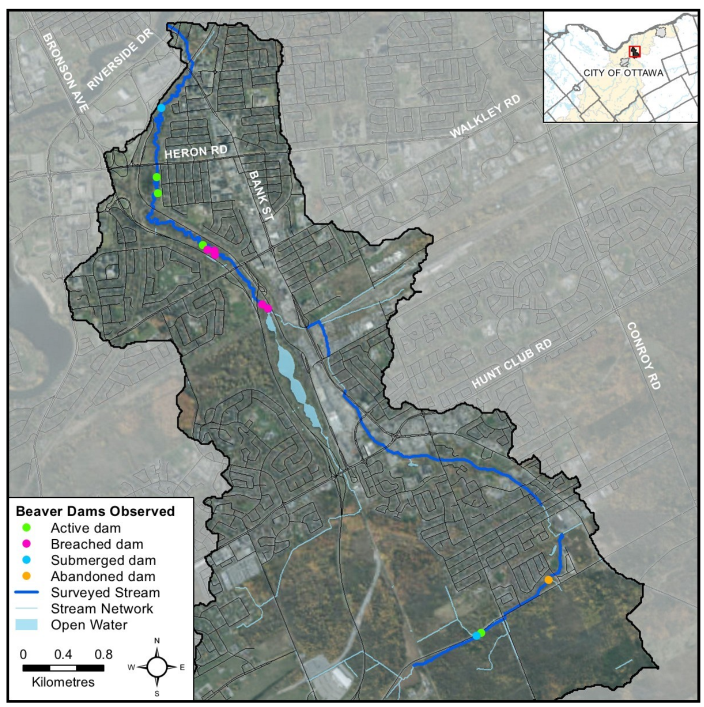

Figure 33 Locations of beaver dams along Sawmill Creek.

Stream Comparison Between 2003, 2008, 2014 and 2022

The following tables provide a comparison of observations on Sawmill 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 that year 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 remained the same from 2014 to 2022; and average specific conductivity decreased from 2014 by 14 µS/cm. Average dissolved oxygen levels were found to be lower by 0.9 milligrams per liter from 2014 to 2022. These changes could be attributed to seasonal conditions and cooler temperatures which are more conducive for the stream's ability to hold more oxygen.

Average summer water temperatures range from cooler water in 2008 (17.6°C) to warmer values in 2014 (17.9° C) and 2022 (18.6°C), with one degree centigrade of increase across the years.

Some temperature variations can be attributed to different seasonal variation across years. Observations from in all three years were made from June to 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 Riverside Drive, Walkley Road and D'Aoust Avenue, in 2008 and 2022, as well as data from loggers at both Walkley Road and D'Aoust Avenue in 2014; standardized stream temperature factors were calculated and summarized in Table 3. This factor has some variability, of 0.07 for every degree of air temperature from 2014 to 2022. The value for 2014 is variable due to the lack of a third logger at the location of Riverside Drive. The site at Riverside Drive is heavily influenced by the Rideau River thermal regime. In 2014 and 2022 Sawmill Creek was classified as cold-coolwater to warm-coolwater (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	-	7.79	± 0.26
2022	pH	-	7.79	± 0.02
2014	Sp. Conductivity	us/cm	1265.0	± 30.4
2022	Sp. Conductivity	us/cm	1251.3	± 31.3
2014	Dissolved Oxygen	mg/L	8.8	± 0.2
2022	Dissolved Oxygen	mg/L	7.9	± 0.2
2008	Water Temperature	ºC	17.6	± 0.5
2014	Water Temperature	ºC	17.9	± 0.3
2022	Water Temperature	ºC	18.6	± 0.2
2008	Standardized Stream Temperature[1]	ºC Water / 1ºC Air	0.77	± 0.32
2014	Standardized Stream Temperature[1]	ºC Water / 1ºC Air	0.70	± 0.12
2022	Standardized Stream Temperature[1]	ºC Water / 1ºC Air	0.77	± 0.11

[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). Many invasive species previously reported had an increase in the number of sections they were observed in, demonstrating their invasive growth. Species that were not observed in 2022 are likely still present but not observed again. There is a new species that has been noted, European frogbit.

Table 4 Invasive species presence (% of sections) observed in 2014 and 2022 along Sawmill Creek; not reported (NR).

Invasive Species	2014	2022	+/-
Chinese mystery snail	1%	NR	▼
Common & glossy buckthorn	55%	80%	▲
Curly-leaved pondweed	28%	17%	▼
Dog strangling vine	16%	35%	▲
European frogbit	NR	3%	▲
Flowering rush	8%	NR	▼
Garlic mustard	4%	5%	▲
Goldfish	1%	NR	▼
Himalayan balsam	11%	47%	▲
Honeysuckle (non-native)	3%	4%	▲
Japanese knotweed	3%	5%	▲
Manitoba maple	32%	75%	▲
Poison/wild parsnip	16%	17%	▲
Purple loosestrife	35%	18%	▼
Rusty crayfish	3%	1%	▼
Yellow iris	2%	2%	-
Total percent of sections invaded	**87%**	**99%**	▲

Pollution

Garbage accumulation on Sawmill Creek was found to decrease from 2008 to 2014 and to 2022. It is worth noting that in 2022 this still represents eight kilometers of stream polluted with garbage. In 2022 the polluted sections contained garbage, such as plastics, packaging, cardboard, beverage containers and tires. Pollution is so prevalent, the City Stream Watch program does multiple garbage clean ups in Sawmill Creek each year. Table 5 shows pollution levels in all three monitoring years.

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

Pollution/Garbage	2008	2014	2022	+/-
Floating garbage	75%	59%	65%	▲
Garbage on stream bottom	92%	69%	49%	▼
Oil or gas trails	4%	0%	1%	▲
Unusual colouration	2%	6%	0%	▼
Total polluted sections	**98%**	**86%**	**83%**	▼

Instream Aquatic Vegetation

Table 6 shows increases in the more abundant instream aquatic vegetation from 2014-2022. Narrow-leaved emergent plants (e.g. sedges), robust emergent plants (e.g. cattails) and free floating plants (e.g. duckweed) had increases in their presence across sections. Broad leaved emergent plants (e.g. arrowhead) and floating plants (e.g. water lilies) were present in comparable abundance in both years. Submerged plants (e.g. pondweed) and algae were observed in lower quantities.

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

Instream Vegetation	2014	2022	+/-
Narrow-leaved emergent plants	23%	38%	▲
Broad-leaved emergent plants	8%	11%	▲
Robust emergent plants	10%	11%	▲
Free-floating plants	2%	3%	▲
Floating plants	3%	2%	▼
Submerged plants	62%	49%	▼
Algae	65%	28%	▼
None	45%	88%	▲

Fish Community

Fish sampling was carried out by the City Stream Watch program in 2008, 2014 and 2022 to evaluate fish community composition in Sawmill Creek (see Table 7). In total 25 species have been observed in Sawmill Creek. In 2008, 14 fish species were captured at five sites; in 2014, 19 species were observed in six sites; and 15 species were observed in five sites in 2022. Four sample locations in 2022 were revisited from 2014, a new site was added in 2022 at D'Aoust Avenue.

The majority of species observed in 2022 had been captured in previous years, with the spotfin shiner, *Notropis hudsonius* (on right), as a new observation.

Table 7 Comparison of fish species caught between 2008-2022.

Species	2008	2014	2022
Banded killifish *Fundulus diphanus*		X	X
Blacknose dace *Rhinichthys atratulus*	X	X	X
Bluntnose minnow *Pimephales notatus*	X		
Brassy minnow *Hyboganthus hankinsoni*		X	
Brook stickleback *Culaea inconstans*	X	X	X
Carps and minnows unidentified species	X	X	X
Central mudminnow *Umbra limi*	X		X
Common shiner *Luxilus cornutus*		X	X
Creek chub *Semotilus atromaculatus*	X	X	X
Darter species *Etheostoma Spp.*	X	X	X
Fathead minnow Pimephales promelas		X	X
Golden shiner *Notemigonus crysoleucas*		X	
Logperch *Percina caprodes*	X	X	X
Longnose dace *Rinichtys cataractae*	X	X	X
Mottled sculpin *Cottus bairdii*	X	X	X
Muskellunge *Esox masquinongy*	X		
Northern pearl dace *Margariscus nachtriebi*		X	
Northern redbelly dace *Chrosomus eos*		X	
Pumpkinseed *Lepomis gibbosus*		X	
Pumpkinseed x bluegill hybrid *Lepomis gibbosus x michrochirus*	X		
Rock bass *Ambloplites rupestris*	X	X	X
Smallmouth bass *Micropterus dolomieu*	X		X
Spotfin Shiner *Cyprinella siloptera*			X
Spottail shiner *Notropis hudsonius*		X	
Walleye *Sander vitreus*		X	
White sucker *Catostomus commersonii*	X	X	X
Total Species 25	**14**	**19**	**15**

Monitoring and Restoration

Monitoring on Sawmill Creek

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

Table 8 City Stream Watch activities on Sawmill Creek.

Accomplishment	Year	Description
City Stream Watch Stream Monitoring	2003	5.4 km of stream was surveyed
	2008	9.8 km of stream was surveyed
	2014	11.0 km of stream was surveyed
	2022	9.6 km of stream was surveyed
City Stream Watch Fish Sampling	2008	Five fish community sites were sampled
	2014	Six 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 October
	2014	Two temperature probes were deployed from May to September
	2022	Three temperature probe was deployed from July to September
Headwater Drainage Feature Assessment	2014	Four headwater drainage feature sites were sampled in the catchment
	2019	Two headwater drainage feature sites were sampled in the catchment
City Stream Watch Garbage Cleanups	2004-2007	There were 10 cleanups by volunteers, a total of 18.65 km of shoreline was cleared of garbage
	2008-2011	There were 7 cleanups by volunteers, a total of 10.9 km of shoreline was cleared of garbage
	2012-2015	There were 12 cleanups by volunteers, a total of 7.5 km of shoreline was cleared of garbage
	2016-2019	There were 10 cleanups by volunteers, a total of 5.06 km of shoreline was cleared of garbage
	2022	Volunteers participated in 5 stream cleanups, 2.14 km of Sawmill Creek's shoreline was cleared of over 335 kg of garbage that accumulated during the pandemic City Stream Watch hiatus
City Stream Watch Invasive Species Removals	2015-2019	Japanese knotweed was removed and managed from the shoreline of Sawmill Creek near Hunt Club Road, over the years a 2700 m^2 area was cleared and reduced to 286 m^2
	2022	After the pandemic City Stream Watch hiatus the Japanese knotweed patch grew in size, a 2000 m^2 area was cleared by volunteers
	2019	Volunteers cleared 662 m of shoreline, near Brookfield pathway, from Himalayan balsam and dog strangling vine
	2022	Volunteers cleared a 41m^2 area of shoreline, near Gloria Avenue, from Himalayan balsam
City Stream Watch Shoreline Naturalization	2005, 2006 and 2008	Volunteers planted 1,160 trees and shrubs to restore the shoreline slopes along Heron Park
	2012	Volunteers planted 445 trees and shrubs in the shoreline near Johnston Road

Potential Riparian Restoration Opportunities

Riparian restoration opportunities include potential enhancement through riparian planting, erosion control and invasive species management. Opportunities were identified along Sawmill Creek surveyed areas (Figure 34).

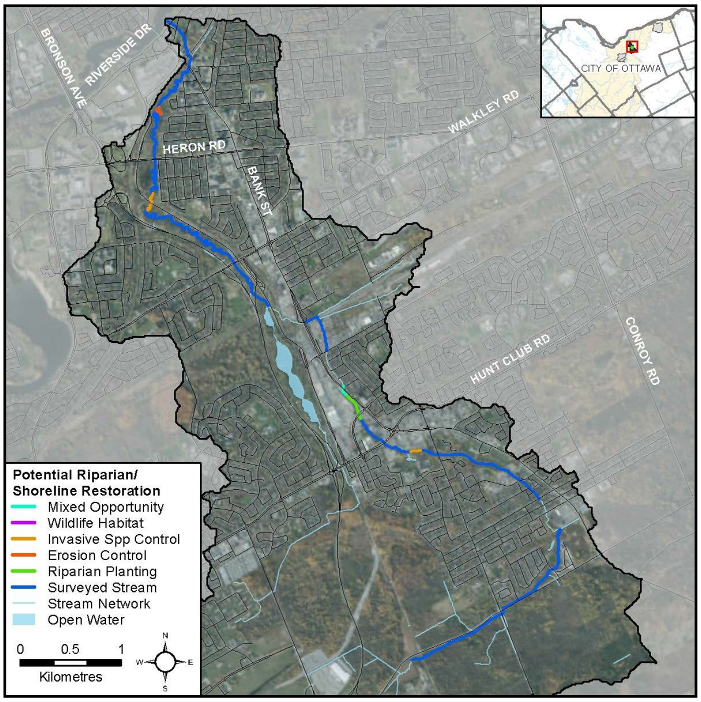

Figure 34 Potential riparian/shoreline restoration opportunities along Sawmill Creek.

Riparian Planting and Erosion Control

Various riparian areas of Sawmill 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.

The area highlighted by Daze Street (Figure 34), would benefit greatly from shoreline and riparian area restoration. This location has stressors that are influencing the system as a result of adjacent commercial and road infrastructure land uses. Shoreline erosion mitigation measures should be implemented at a location adjacent to Heron Park as identified in Figure 34.

Invasive Species Management

Various riparian areas of Sawmill Creek can benefit from invasive species removals. Unfortunately Sawmill Creek is heavily impacted by invasive species along the majority of the system, therefore it is important to be strategic about planning invasive species management projects. This includes targeting new invaders to the system and smaller patch locations with good access for staff and volunteers.

One area in particular south of Hunt Club Road (Figure 34) has been under management and control for Japanese knotweed by the City Stream Watch program since 2015. This resilient invader is difficult to eliminate, however volunteer efforts have put a stop to the spread and have contained this patch to one small area.

Another area near the Brookfield and Sawmill Creek pathways (Figure 34) will need more Himalayan balsam management in the future to prevent further spreading.

Potential Instream Restoration Opportunities

Instream restoration opportunities include potential enhancement through channel modification, fish habitat enhancement and stream garbage cleanups. Opportunities were identified along Sawmill Creek surveyed areas (Figure 35).

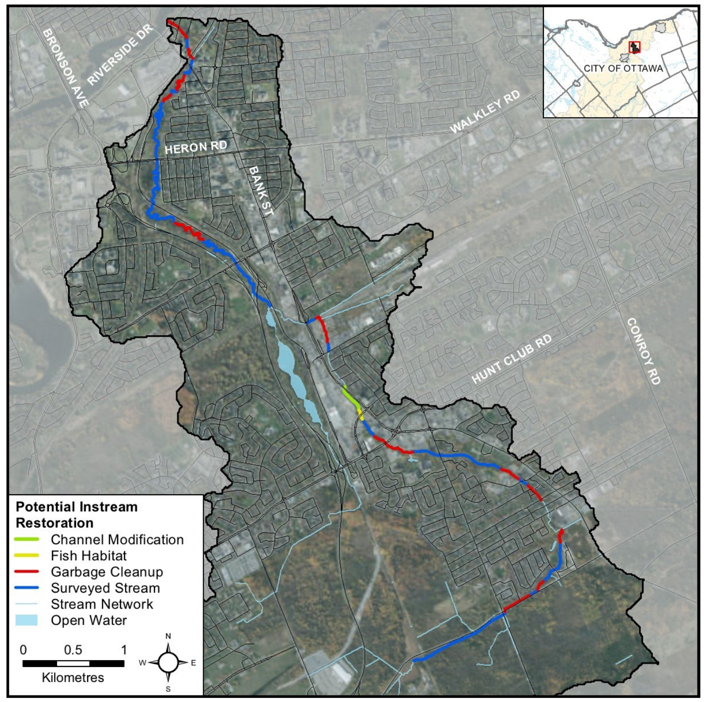

Figure 35 Potential instream restoration opportunities along Sawmill Creek.

Channel modification and fish habitat enhancement

Modifications of the channel portions to reflect a more natural state would greatly benefit the overall health of the system. Additionally adding instream structures and increasing the heterogeneity of the stream would improve habitat for fish populations. Channelized areas near Daze Street (Figure 35) would benefit from channel modification to improve the state of the stream in this area.

Stream Garbage Cleanups

Sawmill creek in particular has a chronic issue with the presence of garbage along the stream itself and its shorelines. This is due mainly in part to its location within highly urbanized areas. As a result of this, Sawmill Creek will require ongoing stream cleanup efforts to mitigate pollution from entering the watercourse.

Snow Disposal

Another contributing source of garbage in Sawmill Creek involves improper snow disposal along the creek at several locations. It is important that adjacent landowners remove snow properly and avoid disposing it into Sawmill Creek and its riparian area as this negatively impacts instream aquatic habitat conditions and water quality.



References

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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

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