Barrhaven Creek 2015 Summary Report

Watershed Features	
Area	7.20 square kilometres 0.17% of the Rideau Valley watershed
Land Use	12% agriculture 68% urban 5% forest 14% rural 1% waterbody
Surficial Geology	67% clay 1% Paleozoic bedrock 31% diamicton 1% gravel
Watercourse Type	*Watercourse Type:* 88% natural 12% channelized *Flow Type:* 100% permanent
Invasive Species	There were seven invasive species observed in 2015: Common buckthorn, European frogbit, flowering rush, glossy buckthorn, Manitoba maple, Norway maple, purple loosestrife
Fish Community	26 fish species have been captured in Barrhaven Creek historically including eight game fish species

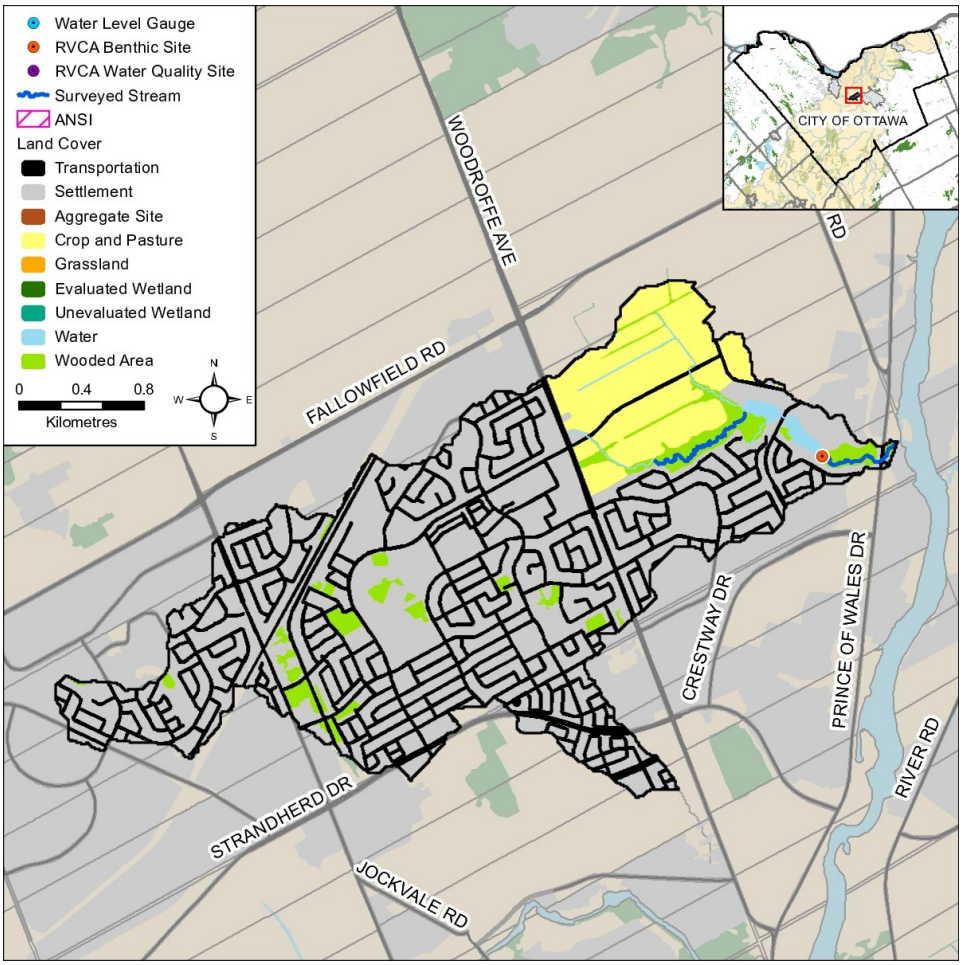

Figure 1 Land cover in the Barrhaven Creek catchment

Woodlot Cover		
Size Category	**Number of Woodlots**	**% of Woodlot Cover**
10-30 ha	1	3
>30 ha	0	0

Wetland Cover
0% of the catchment is wetland

Upper reach of Barrhaven Creek

The Rideau Valley Conservation Authority, in partnership with seven other agencies in Ottawa (City of Ottawa, Heron Park Community Association, Ottawa Flyfishers Society, Ottawa Stewardship Council, Rideau Roundtable, National Defence HQ - Fish and Game Club, and the National Capital Commission) form the 2015 City Stream Watch collaborative.

Introduction

The headwaters of Barrhaven Creek begin at Woodroffe Avenue and flow east through a large two– celled stormwater management pond, before crossing Prince of Wales Drive and entering the Rideau River. Historically, the headwaters of Barrhaven Creek used to begin near Greenbank Road but they have since been lost to development. Most of the vegetation in the catchment was cleared years ago for agricultural purposes, aside from the banks of the creek itself. The shoreline of the creek is mainly wooded, consisting of a mix of deciduous tree species.

In 2015, 15 sections (1.5 km) of Barrhaven Creek 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 15 sections.

Barrhaven Creek Overbank Zone

Riparian Buffer Width Evaluation

The riparian or shoreline zone is that special area where the land meets the water. Well-vegetated shorelines are critically important in protecting water quality and creating healthy aquatic habitats, lakes and rivers. Natural shorelines intercept sediments and contaminants that could impact water quality conditions and harm fish habitat in streams. Well established buffers protect the banks against erosion, improve habitat for fish by shading and cooling the water and provide protection for birds and other wildlife that feed and rear young near water. A recommended target (from Environment Canada's Guideline: How Much Habitat is Enough?) is to maintain a minimum 30 meter wide vegetated buffer along at least 75 percent of the length of both sides of rivers, creeks and streams. Overall, Barrhaven Creek does not meet the recommended target above. The creek has a buffer of greater than 30 meters along 38 percent of the right bank and seven percent of the left bank. The buffer on the right bank of Barrhaven Creek was wider than the buffer on the left bank due to residential development which has been focused along the south side of the creek. Figure 2 demonstrates the buffer conditions of the left and right banks separately.

Adjacent Land Use

The RVCA's City Stream Watch Program identifies seven different land uses beside Barrhaven Creek (Figure 3). Surrounding land use is considered from the beginning to end of each 100m survey section and up to 100m 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. Natural areas made up 64 percent of the surveyed stream, characterized predominantly by forest with a small amount of scrubland. Twenty six percent of the land use along the surveyed sections of the stream was made up of residential and infrastructure which includes road crossings. Seven percent of the land use was abandoned agriculture and the remaining three percent of the land use surveyed was recreational and industrial/commercial.

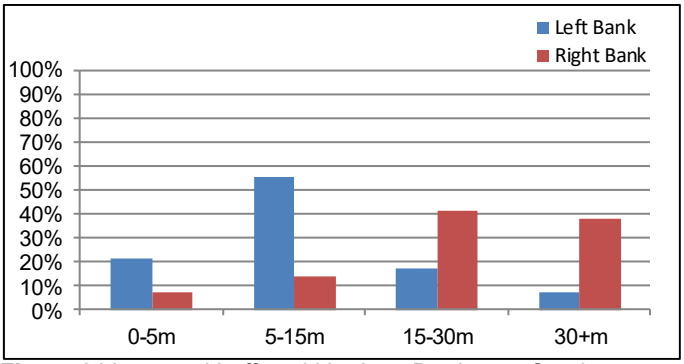

Figure 2 Vegetated buffer width along Barrhaven Creek

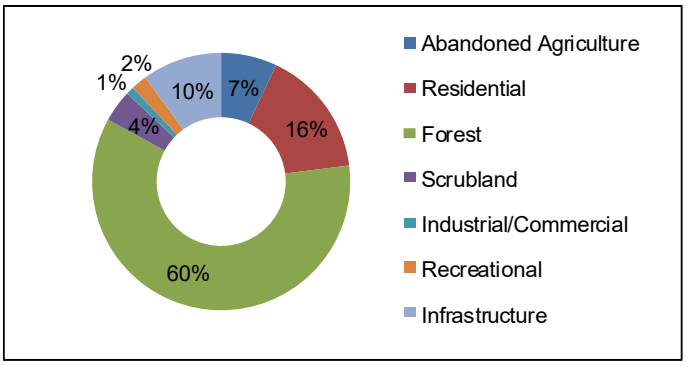

Figure 3 Land use along Barrhaven Creek

Barrhaven Creek Shoreline Zone

Erosion

Erosion is a normal, important stream process and may not affect actual bank stability; however, excessive erosion and deposition of sediment within a stream can have a detrimental effect on important fish and wildlife habitat. Poor bank stability can greatly contribute to the amount of sediment carried in a waterbody as well as loss of bank vegetation due to bank failure, resulting in trees falling into the stream and the potential to impact instream migration. Figure 4 shows low to moderate levels of bank erosion were observed along most sections of Barrhaven Creek.

Undercut Stream Banks

Undercut banks are a normal and natural part of stream function and can provide excellent refuge areas for fish. Figure 5 shows that the bank undercutting on Barrhaven Creek varied considerably. Much of the creek had low levels of bank undercutting, but this was interspersed with sections of moderate to high levels of undercutting especially downstream of the stormwater management pond.

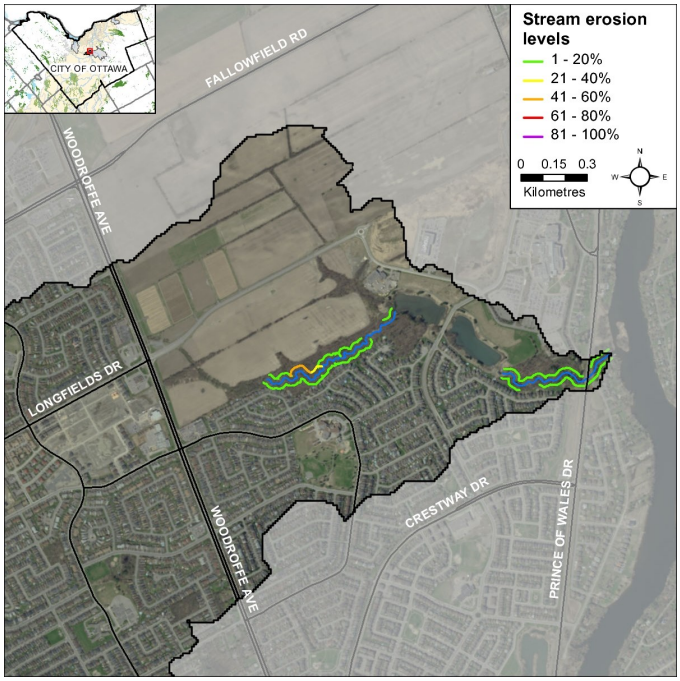

Figure 4 Erosion along Barrhaven Creek

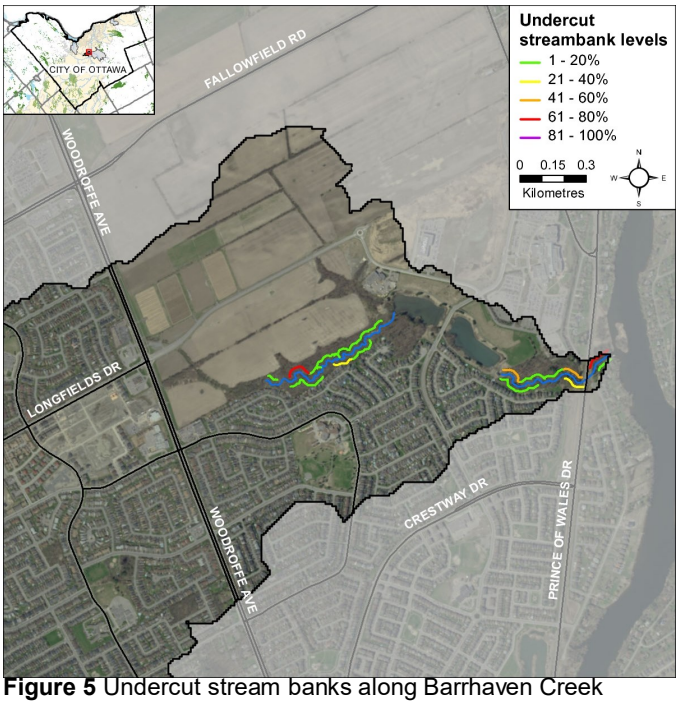

Figure 5 Undercut stream banks along Barrhaven Creek

Stream bank erosion along the right bank of Barrhaven Creek

Bank undercutting along Barrhaven 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. Figure 6 shows stream shading along Barrhaven Creek. Barrhaven Creek benefits from the forested buffer that was maintained when the area was historically cleared for development and agriculture. As a result, very high levels of shading were seen along most of the creek.

Instream Woody Debris

The forested buffer along Barrhaven Creek also contributes to the amount of woody debris, in the form of branches and trees, found in the stream. Figure 7 shows that overall Barrhaven Creek had moderate levels of instream woody debris downstream of the stormwater management pond and high levels of instream woody debris upstream of the pond. Instream woody debris is important for fish and benthic habitat, by providing refuge and feeding areas.

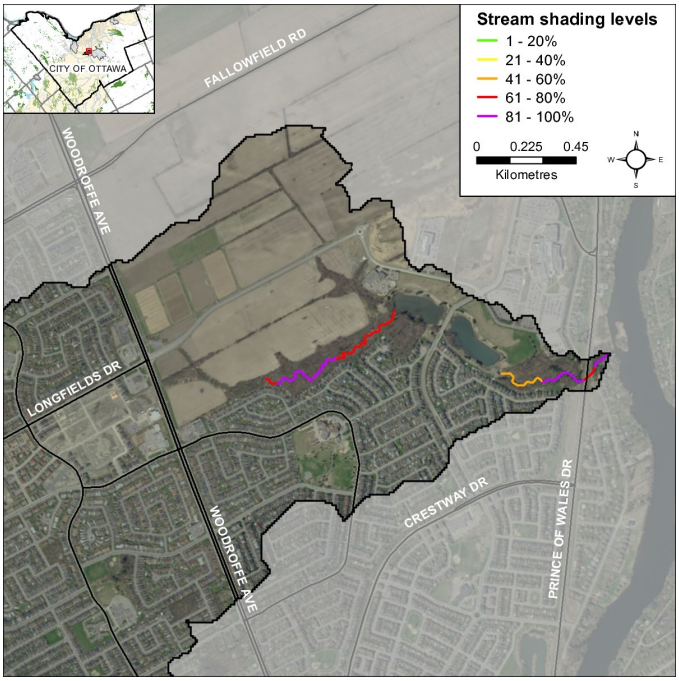

Figure 6 Stream shading along Barrhaven Creek

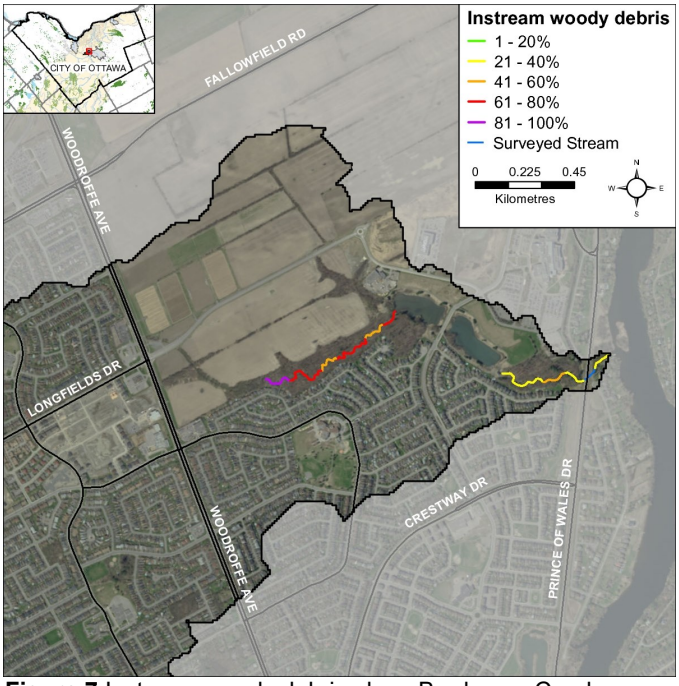

Figure 7 Instream woody debris along Barrhaven Creek

Stream shade along Barrhaven Creek

Instream woody debris along Barrhaven Creek

Overhanging Trees and Branches

Trees and branches that are less than one metre from the surface of the water are defined as overhanging. At this proximity to the water branches and trees provide a food source, nutrients and shade which helps to moderate instream water temperatures. Figure 8 shows that the forested buffer along Barrhaven Creek has a high canopy since most of the creek sections had low to moderate levels of overhanging branches and trees within one metre of the surface of the water.

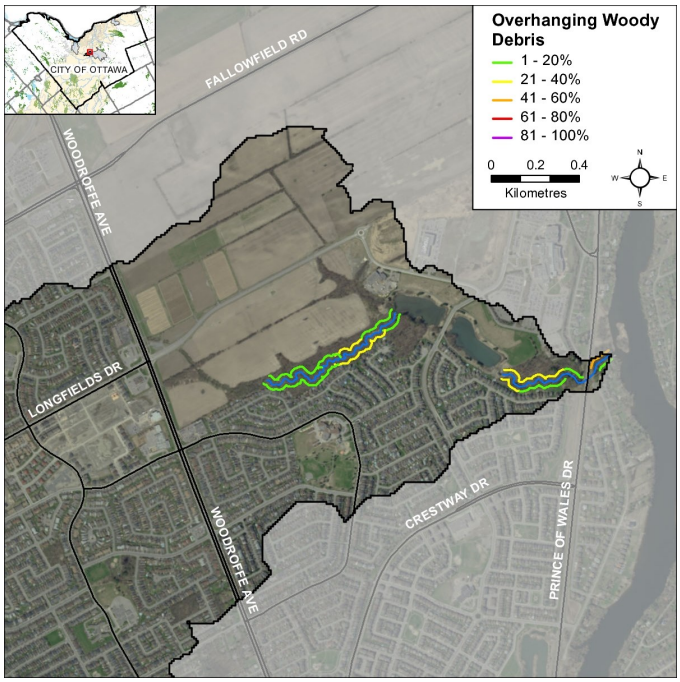

Figure 8 Overhanging trees and branches

Overhanging trees and branches on Barrhaven Creek

Anthropogenic Alterations

Figure 9 shows that 60 percent of the sections on Barrhaven Creek remain "natural". Sections considered "altered" account for 33 percent of the stream, while only seven percent of the sections sampled were considered “highly altered”. None of the sections of Barrhaven Creek were considered “unaltered”, meaning that all of the sections had some form of human influence or the riparian buffer was less than 30 metres. The highly altered sections of Barrhaven creek refer to areas where the creek approaches and runs through a culvert or there is a road crossing with associated instream/shoreline modifications especially at the Prince of Wales Drive crossing.

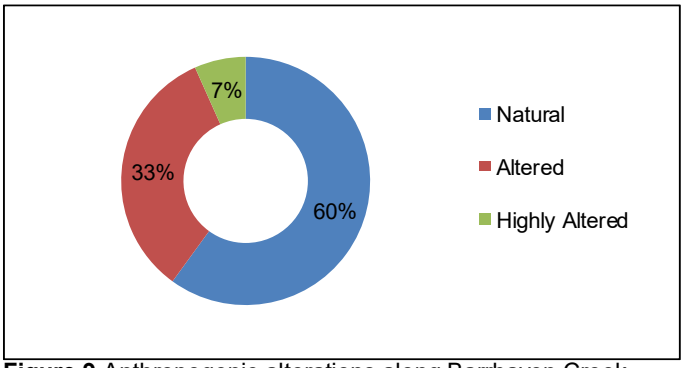

Figure 9 Anthropogenic alterations along Barrhaven Creek

A highly altered section of Barrhaven Creek at Prince of Wales Drive

Barrhaven Creek Instream Aquatic Habitat

Habitat Complexity

Streams are naturally meandering systems that move over time with varying degrees of habitat complexity. Examples of habitat complexity include habitat types such as pools and riffles as well as substrate variability and woody debris structure. A high percentage of habitat complexity (heterogeneity) typically increases the biodiversity of aquatic organisms within a system. Habitat complexity is strongly influenced by the variability of substrate types found in a creek. Forty seven percent of Barrhaven Creek was considered homogeneous. Homogeneous areas were typically dominated by clay substrate upstream of the stormwater pond. Fifty three percent of the system was considered heterogeneous, these areas were characterized by more diverse substrate types downstream of the stormwater pond.

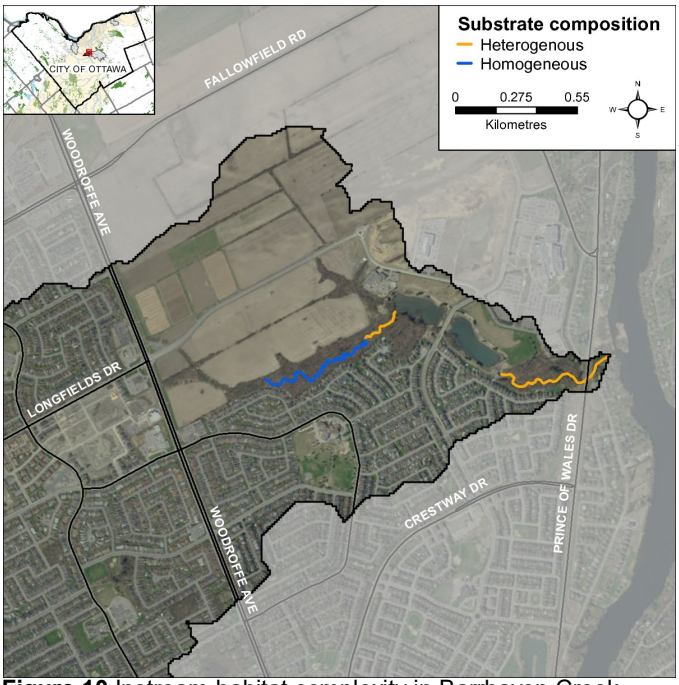

Figure 10 Instream habitat complexity in Barrhaven Creek

Habitat complexity on Barrhaven Creek

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. Figure 11 shows that 53 percent of the instream substrate observed on Barrahven Creek was clay. Ten percent of the substrate was recorded as cobble, seven percent was boulders, and 10 percent was recorded as gravel. The remaining 20 percent was made up of 16 percent silt and four percent sand. Figure 12 shows the distribution of the dominant substrate types along the system. Clay substrates dominated near the mouth of the creek and upstream of the stormwater management pond, whereas cobble and gravel substrates dominated the creek sections in between Prince of Wales Drive and the stormwater management pond.

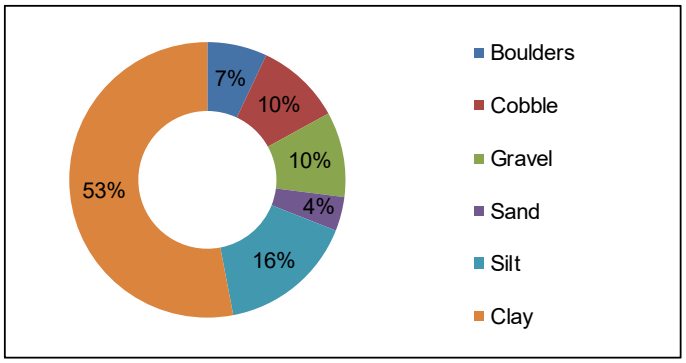

Figure 11 Instream substrate along Barrhaven Creek

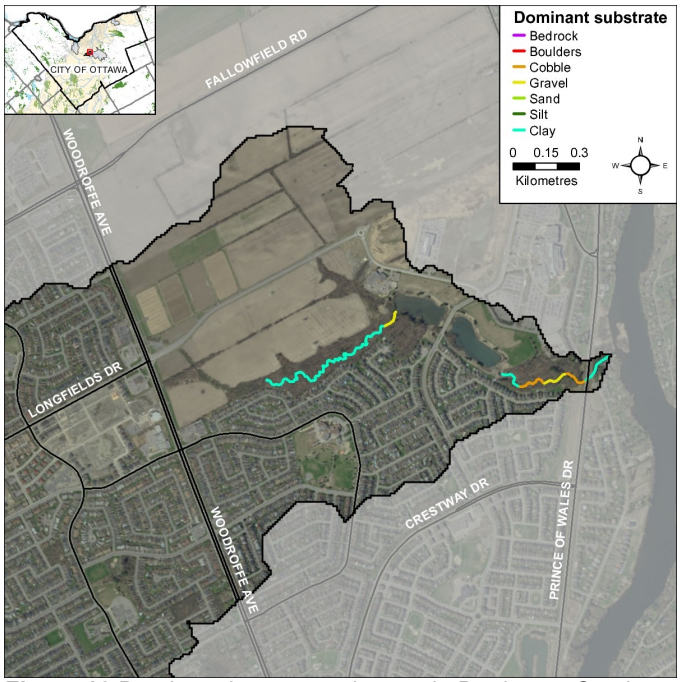

Figure 12 Dominant instream substrate in Barrhaven Creek

Cobble and Boulder Habitat

Boulders create instream cover and back eddies for large fish to hide and/or rest out of the current. Cobble provides important over-wintering and/or spawning habitat for small or juvenile fish. Cobble can also provide habitat conditions for benthic invertebrates that are a key food source for many fish and wildlife species. Figure 13 shows the distribution of cobble and boulder habitat along Barrhaven Creek. Areas of cobble and boulder habitat are concentrated downstream of the stormwater management pond, extending for one section upstream of the pond. There was also boulder habitat observed in a section upstream of the pond near the end of the creek.

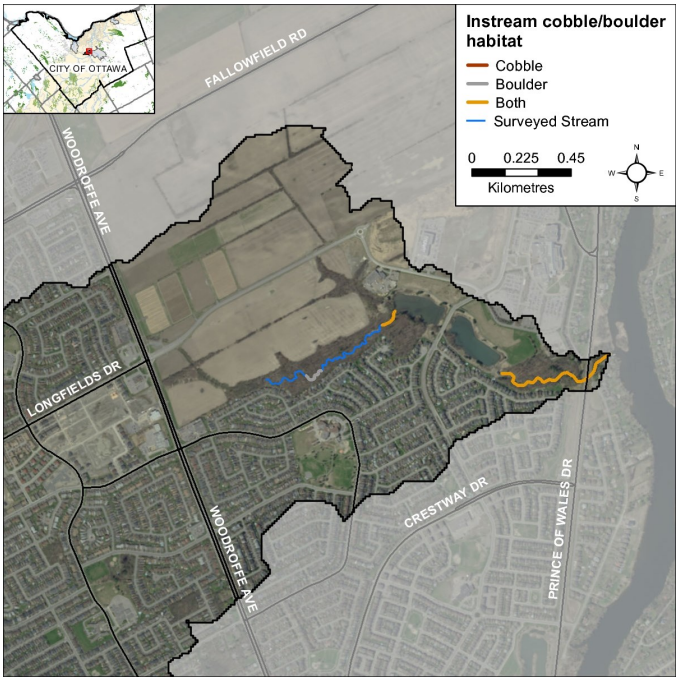

Figure 13 Cobble and boulder habitat in Barrhaven Creek

Cobble and boulder habitat observed along Barrhaven Creek

Instream Morphology

Pools and riffles are important habitat features for fish. Riffles are areas of agitated water and they contribute higher dissolved oxygen to the stream and act as spawning substrate for some species of fish, such as sauger and walleye. Pools provide shelter for fish and can be refuge areas in the summer if water levels drop and water temperature in the creek increases. Pools also provide important over-wintering areas for fish. Runs are usually 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 Barrhaven Creek has high variability in instream morphology; 48 percent consists of pools, 39 percent consists of runs and 13 percent consists of riffles. Figure 15 shows where areas of riffle habitat was observed in Barrhaven Creek. The riffle habitat was all concentrated downstream of the stormwater management pond.

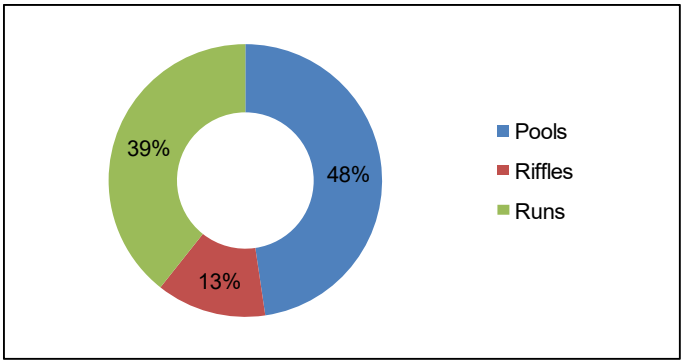

Figure 14 Instream morphology along Barrhaven Creek

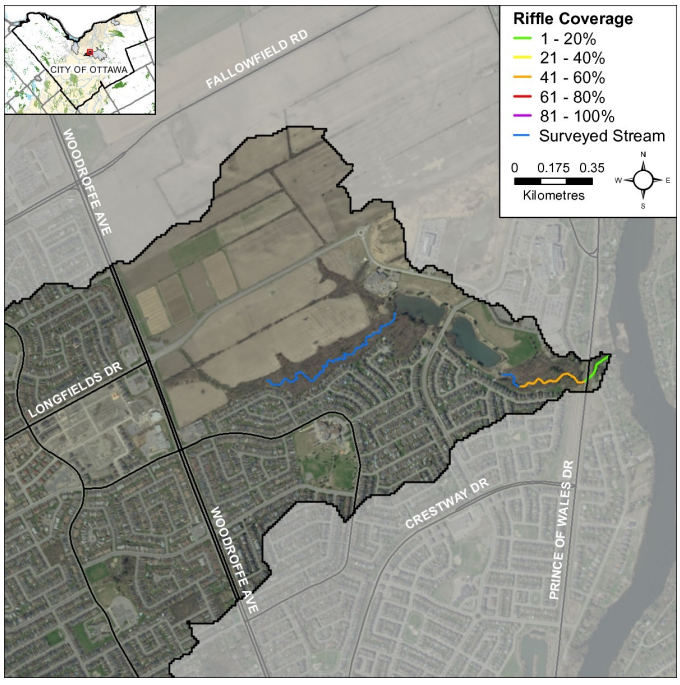

Figure 15 Riffle coverage in Barrhaven Creek

Vegetation Type

Instream vegetation provides a variety of functions and is a critical component of the aquatic ecosystem. For example, emergent plants along the shoreline can provide important rearing habitat for waterfowl. Submerged plants provide habitat for fish to find shelter from predator fish while they feed. Floating plants such as water lilies shade the water keeping temperatures cool while reducing algae growth. Figure 16 depicts the low diversity of plant community structure in Barrhaven Creek. Areas with no vegetation were most common at 56 percent. Algae was recorded at 35 percent and the remaining nine percent was a mix of narrow-leaved emergents, broad-leaved emergents, free-floating plants and submerged plants. The distribution of dominant types of instream vegetation is reflected in Figure 17. Low levels of vegetation in Barrhaven Creek are due to stormwater influence in the creek which result in extreme water level fluctuations impacting the ability of vegetation to establish in clay substrates.

Instream Vegetation Abundance

Instream vegetation is an important factor for a healthy stream ecosystem. Vegetation helps to remove contaminants from the water, contributes oxygen to the stream, and provides habitat for fish and wildlife. Too much vegetation can also be detrimental. Figure 18 demonstrates that overall Barrhaven Creek had very low levels of instream vegetation. Areas with no vegetation accounted for 48 percent, rare levels accounted for 33 percent, low levels accounted for seven percent and the remaining 12 percent were normal levels. The low levels of vegetation are the result of stormwater influence resulting in extreme water level fluctuations in the creek as well as the dominance of clay substrates. Most types of vegetation, other than algae, have trouble establishing in these conditions.

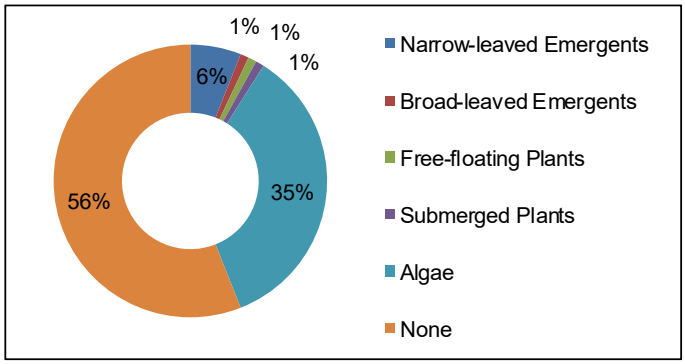

Figure 16 Vegetation types along Barrhaven Creek

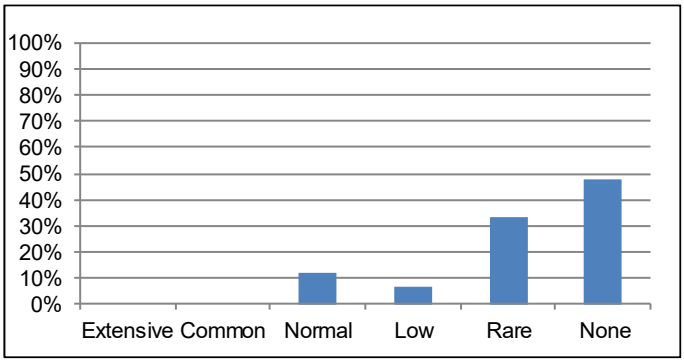

Figure 18 Instream vegetation abundance in Barrhaven Creek

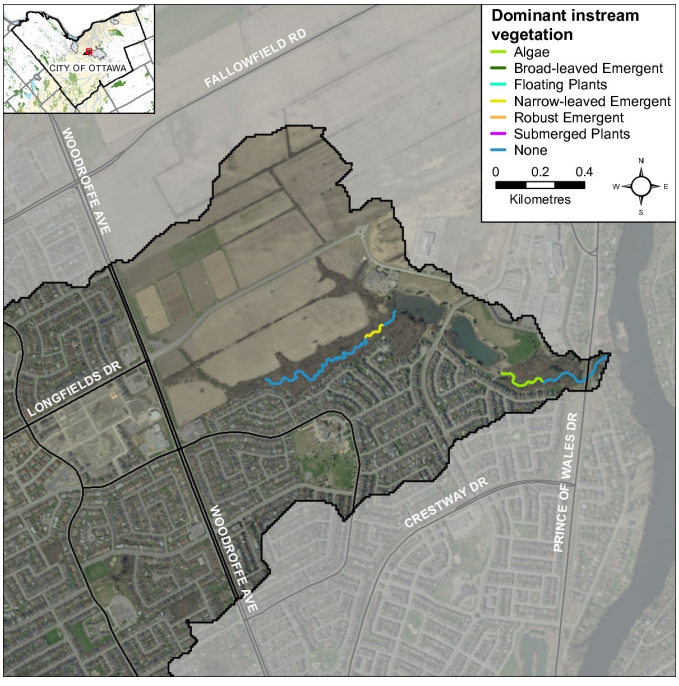

Figure 17 Dominant instream vegetation types

Narrow-leaved emergent vegetation and floating plants observed on Barrhaven Creek

Barrhaven Creek Stream Health

Invasive Species

Invasive species can have major implications on streams and species diversity. Invasive species are one of the largest threats to ecosystems throughout Ontario and can outcompete native species, having negative effects on local wildlife, fish and plant populations. Invasive species were observed along 73 percent of the sections surveyed along Barrhaven Creek (Figure 19). Figure 20 shows the variety of invasive species observed along Barrhaven Creek. The invasive species which were observed most often were purple loosestrife (*Lythrum salicaria)*, Manitoba maple (*Acer negundo*), and common buckthorn (*Rhamnus cathartica*). In many of the sections, more than one invasive species was present.

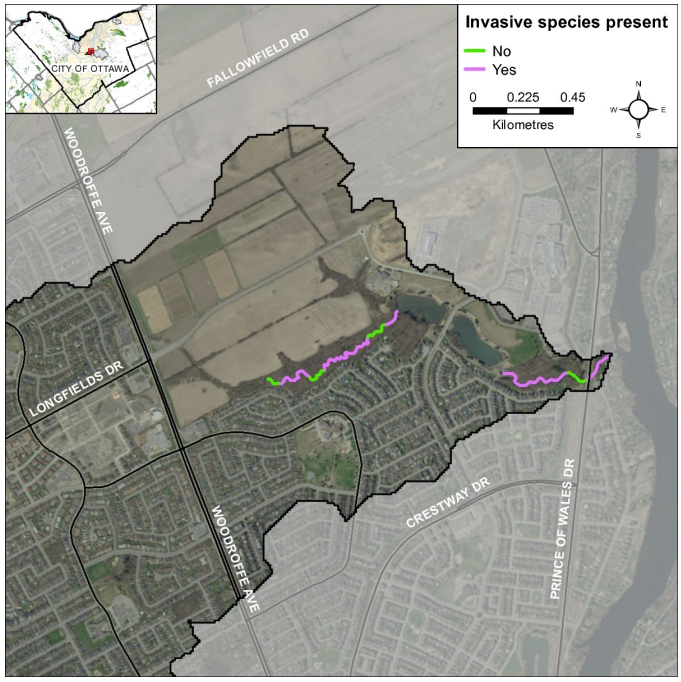

Figure 19 Presence of invasive species along Barrhaven Creek

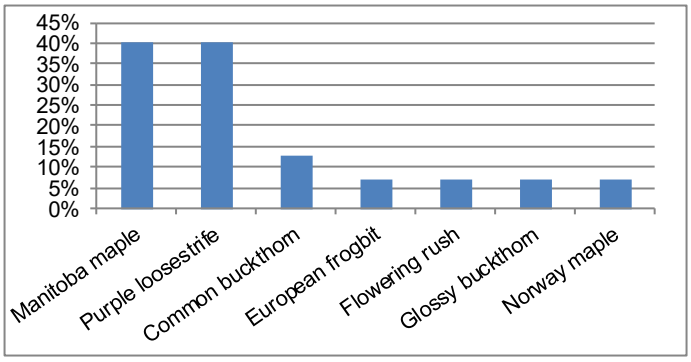

Figure 20 Invasive species observed along Barrhaven Creek

Pollution

Figure 21 demonstrates the incidence of pollution/ garbage in Barrhaven Creek. Twenty percent of the sections surveyed on Barrhaven Creek did not have any observable garbage. Sixty-seven percent had floating garbage and 53 percent had garbage on the stream bottom. Most of the sections where garbage was observed had both floating garbage and garbage on the stream bottom and were found downstream of the stormwater management pond.

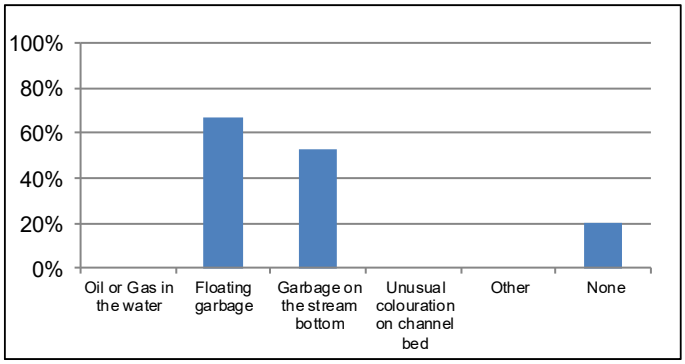

Figure 21 Pollution observed along Barrhaven Creek

Abandoned car parts observed along Barrhaven Creek

Wildlife

The diversity of fish and wildlife populations can be an indicator of water quality and overall stream health.

Wildlife	Observed
Birds	mallard, Canada goose, red-winged black bird, common starling, American robin, crow
Mammals	chipmunk, squirrel
Reptiles Amphibians	snapping turtle, bull frog, tadpoles, green frog
Aquatic Insects	freshwater mussel, water strider
Other	mosquito, spider

Table 1 Wildlife observed along Barrhaven Creek

Barrhaven Creek Water Chemistry

Water Chemistry Measurement

During the stream characterization survey, a YSI probe is used to collect water chemistry information. Dissolved oxygen, conductivity and pH are measured at the start and end of each 100m section.

Volunteers measuring water chemistry using a YSI

Dissolved Oxygen

Dissolved oxygen is a measure of the amount of oxygen dissolved in water. The Canadian Environmental Quality Guidelines of the Canadian Council of Ministers of the Environment (CCME) suggest that for the protection of aquatic life the lowest acceptable dissolved oxygen concentration should be 6 mg/L for warmwater biota (red line in Figure 22) and 9.5 mg/L for coldwater biota (blue line in Figure 22) (CCME, 1999). Figure 22 shows that the reaches of Barrhaven Creek downstream of the stormwater pond meet the standard for warmwater biota. In contrast, the upper reaches of the creek had lower average dissolved oxygen compared to other stretches and don't meet the standard of 6 mg/L for warmwater biota.

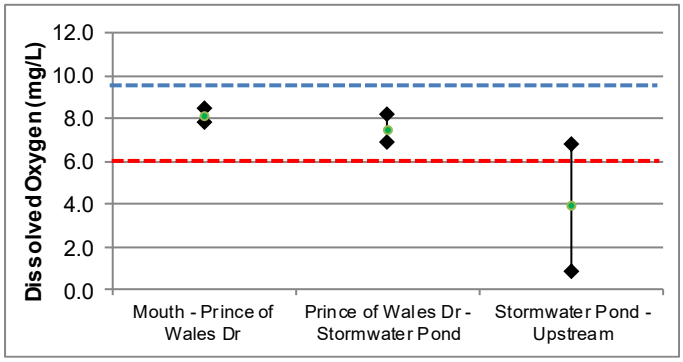

Figure 22 Dissolved oxygen ranges in Barrhaven Creek

Conductivity

Conductivity in streams is primarily influenced by the geology of the surrounding environment, but can vary drastically as a function of surface water runoff. Currently there are no CCME guideline standards for stream conductivity, however readings which are outside the normal range observed within the system are often an indication of unmitigated discharge and/or stormwater input. Figure 23 shows the average specific conductivity readings in different reaches of the creek. The overall average specific conductivity observed within Barrhaven Creek was 919 µs/cm. The lowest average conductivity reading on Barrhaven Creek was 790 µs/cm which was recorded in the stretch of the creek upstream of the stormwater pond where only one stormwater outlet was recorded. The highest conductivity was seen in the reach of the creek directly downstream of the stormwater pond where the average specific conductivity was 1131 µs/cm. Downstream of Prince of Wales Drive the conductivity was an average of 837 µs/cm.

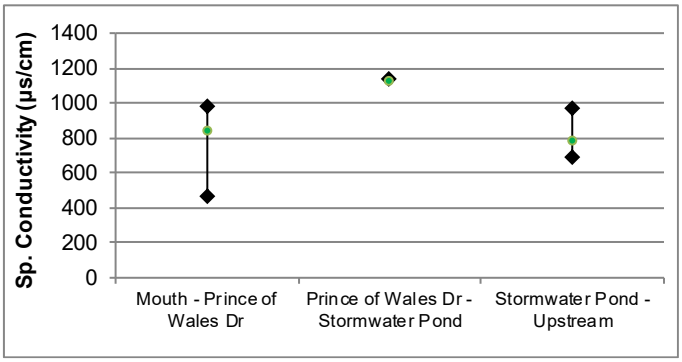

Figure 23 Specific conductivity ranges in Barrhaven Creek

pH

Based on the PWQO for pH, a range of 6.5 to 8.5 should be maintained for the protection of aquatic life. Average pH values for Barrhaven Creek ranged between 7.5 and 7.6, thereby meeting the provincial standard.

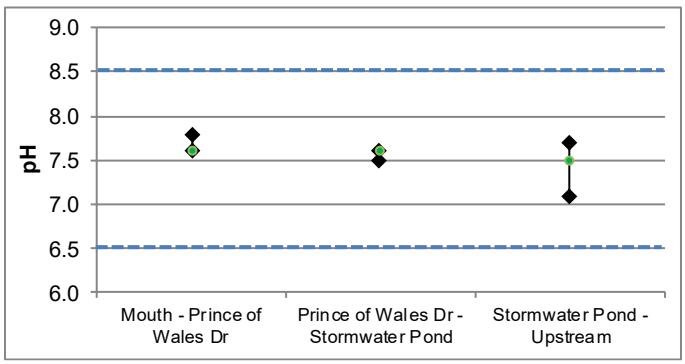

Figure 24 pH ranges in Barrhaven Creek

Barrhaven Creek Thermal Classification

Thermal Classification

Many factors can influence fluctuations in stream temperature, including springs, tributaries, precipitation runoff, discharge pipes and stream shading from riparian vegetation. Two temperature loggers were deployed in late April to monitor water temperature in Barrhaven Creek. Water temperature is used along with the maximum air temperature (using a revised Stoneman and Jones method) to classify sampling reaches into one of five categories that correspond to the thermal preferences of local fish communities (Figure 27). Figure 25 shows the locations where temperature loggers were installed on Barrhaven Creek.

Analysis of the data collected indicates that the thermal classification of Barrhaven Creek ranges between cool and cool-warm water (Figure 27). The cool water reach was recorded upstream of the stormwater pond.

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 are noted when observed. Figure 26 shows areas where one or more groundwater indicators were observed during stream surveys on Barrhaven Creek. All of the groundwater indicators observed were in the upper reaches of Barrhaven Creek upstream of the stormwater pond. This corresponds to the section of creek where cool water temperatures were recorded.

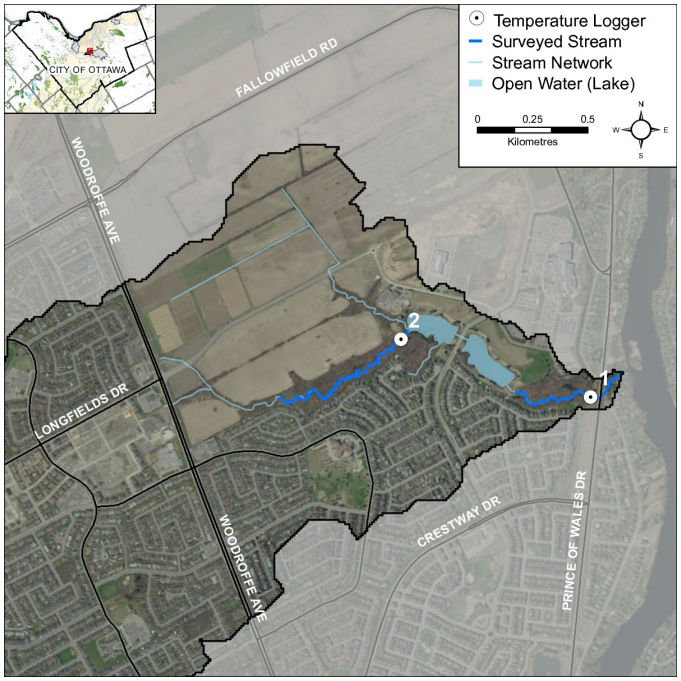

Figure 25 Temperature loggers along Barrhaven Creek

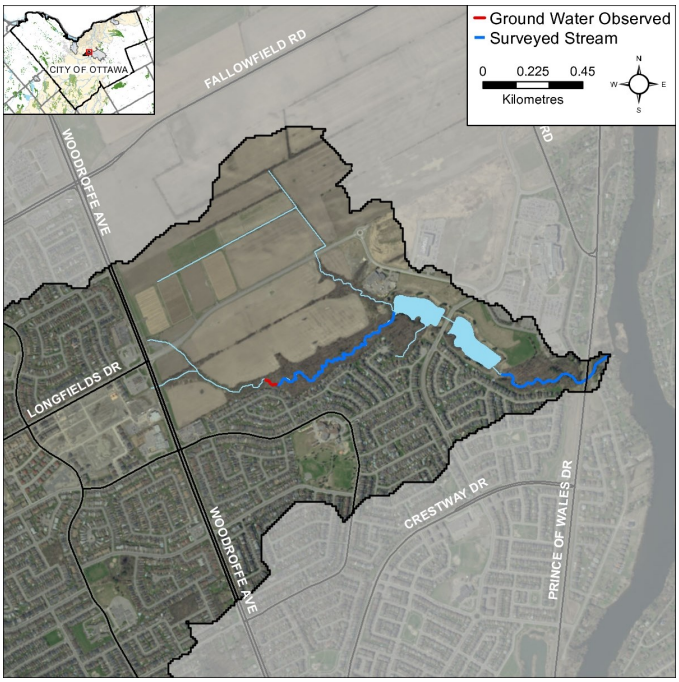

Figure 26 Groundwater indicators observed

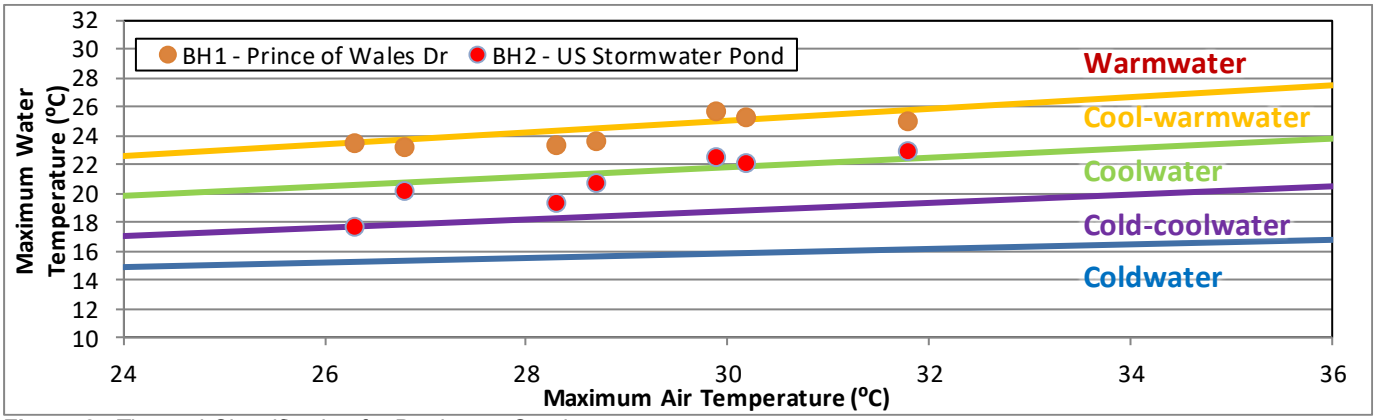

Figure 27 Thermal Classification for Barrhaven Creek

Barrhaven Creek Fish Community

Fish Community

Fish sampling sites located along Barrhaven Creek are shown in Figure 28. The provincial fish codes shown in Figure 28 are listed (in Table 2) beside the common name of those fish species identified in Barrhaven Creek. The thermal classification of Barrhaven Creek ranges between cool and cool-warm water, with twenty six fish species having been observed historically including eight game fish species. Only one fish species, brook stickleback, has been observed upstream of the stormwater pond.

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. Figure 29 shows that along Barrhaven Creek, one grade barrier and four debris dams were observed. The grade barrier is part of the culvert crossing at Prince of Wales Drive. Most of the debris dams were located upstream of the stormwater pond.

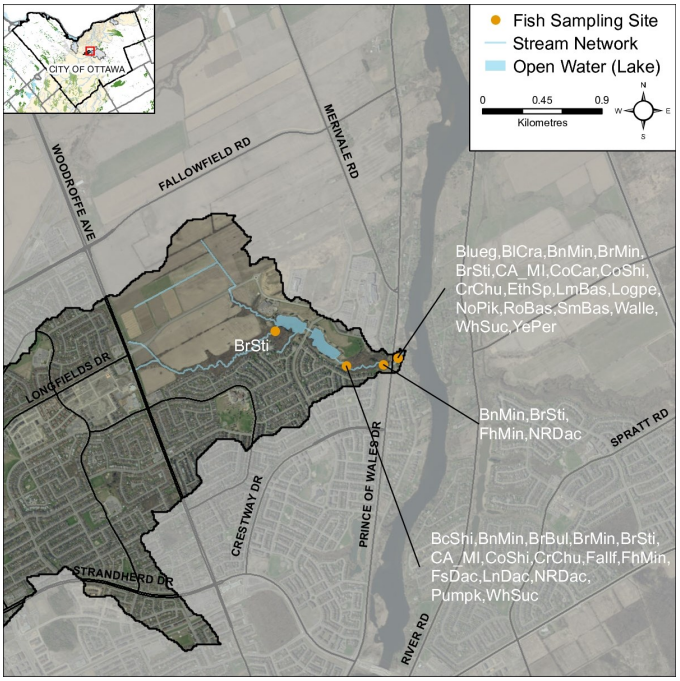

Figure 28 Barrhaven Creek fish community

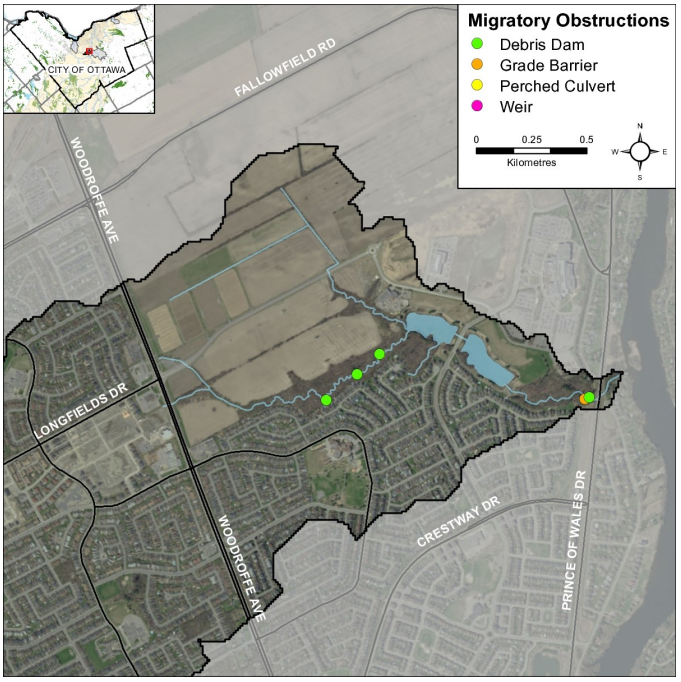

Figure 29 Barrhaven Creek migratory obstructions

Species observed in Barrhaven Creek (with fish code)			
black crappie.....	BlCra	fathead minnow.....	FhMin
blackchin shiner.....	BcShi	finescale dace.....	FsDac
bluegill.....	Blueg	largemouth bass.....	LmBas
bluntnose minnow..	BnMin	logperch.....	Logpe
brassy minnow.....	BrMin	longnose dace.....	LnDac
brook stickleback...	BrSti	northern pike.....	NoPik
brown bullhead.....	BrBul	northern redbelly dace	NRDac
carps and minnows	CA_MI	pumpkinseed.....	Pumpk
common carp.....	CoCar	rock bass.....	RoBas
common shiner.....	CoShi	smallmouth bass.....	SmBas
creek chub.....	CrChu	walleye.....	Walle
Etheostoma sp.....	EthSp	white sucker.....	WhSuc
fallfish.....	Fallf	yellow perch.....	YePer

Table 2 Fish species observed in Barrhaven Creek

Grade barrier observed within the culvert at Prince of Wales Dr.

Headwater Drainage Feature Assessment

Headwaters Sampling

The City Stream Watch program assessed Headwater Drainage Features for Barrhaven Creek, Bilberry Creek, Mosquito Creek and Stillwater Creek in 2015. This protocol measures zero, first and second order headwater drainage features (HDF). It is a rapid assessment method characterizing the amount of water, sediment transport, and storage capacity within headwater drainage features (HDF). RVCA is working with other Conservation Authorities and the Ministry of Natural Resources and Forestry to implement the protocol with the goal of providing standard datasets to support science development and monitoring of headwater drainage features. An HDF is a depression in the land that conveys surface flow. Additionally, this module provides a means of characterizing the connectivity, form and unique features associated with each HDF (OSAP Protocol, 2013). The Barrhaven Creek catchment area is heavily impacted by development pressures. Most of the headwater features which were historically connected to Barrhaven Creek have been filled in for development that has taken place in the catchment area starting in the early 1990's. In 2015, the program sampled two headwater features in the Barrhaven Creek catchment in the spring and summer seasons. Figure 30 demonstrates the 2015 Barrhaven Creek sample locations.

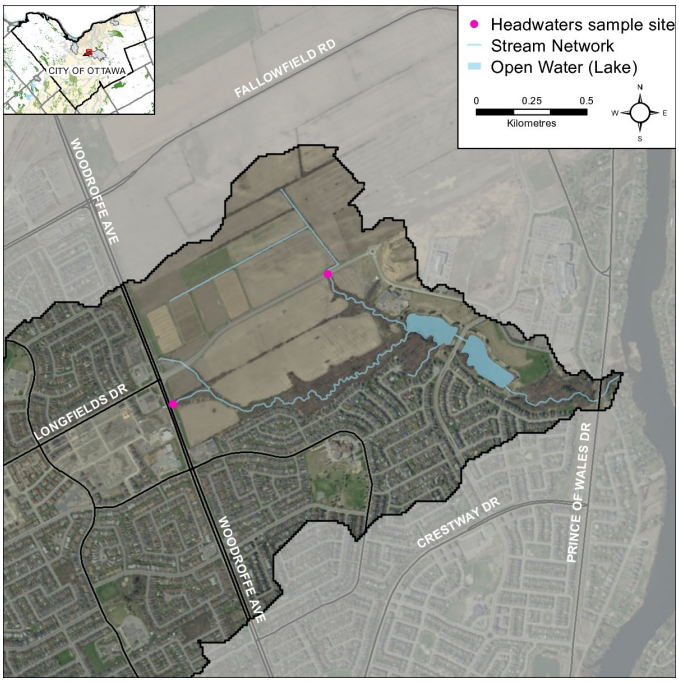

Figure 30 Barrhaven Creek HDF sampling sites

Feature Type

The headwater sampling protocol assesses the feature type in order to understand the function of each feature. The evaluation includes the following classifications: defined natural channel, channelized or constrained, multi-thread, no defined feature, tiled, wetland, swale, roadside ditch and pond outlet. By assessing the values associated with the headwater drainage features in the catchment area we can understand the ecosystem services that they provide to the watershed in the form of hydrology, sediment transport, and aquatic and terrestrial functions. The two headwater features that were assessed in the Barrhaven Creek catchment are channelized features which have been impacted by surrounding agricultural and residential development. Figure 31 shows the feature type of the primary feature at the sampling locations.

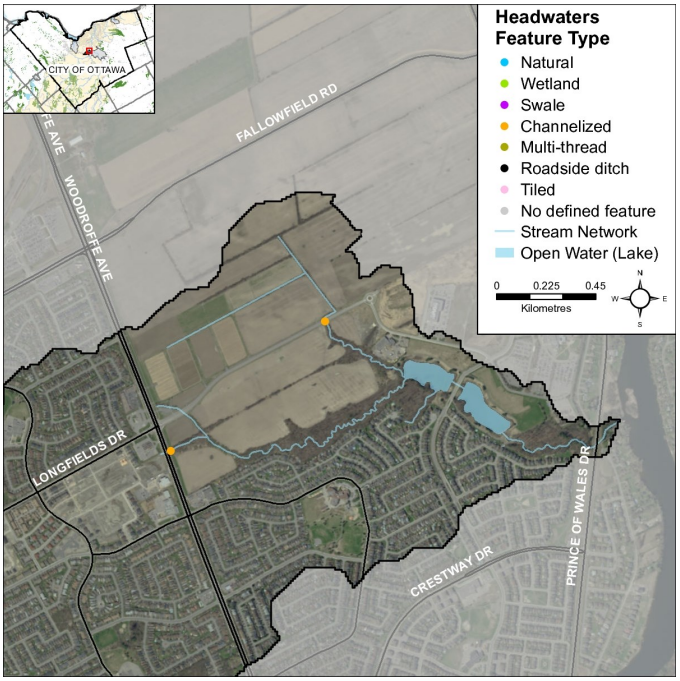

Figure 31 Barrhaven Creek HDF feature types

Channelized HDF feature along Woodroffe Avenue

Headwater Feature Flow

The observed flow condition within headwater drainage features can be highly variable depending on timing relative to the spring freshet, recent rainfall, soil moisture, etc. Flow conditions are assessed in the spring and in the summer to determine if features are perennial and flow year round, if they are intermittent and dry up during the summer months or if they are ephemeral systems that do not flow regularly and generally respond to specific rainstorm events or snowmelt. Flow conditions in headwater systems can change from year to year depending on local precipitation patterns. Figure 32 shows the observed flow conditions at the sampling locations in the Barrhaven Creek catchment. Both sampling sites were intermittent and had no observable flow during summer sampling.

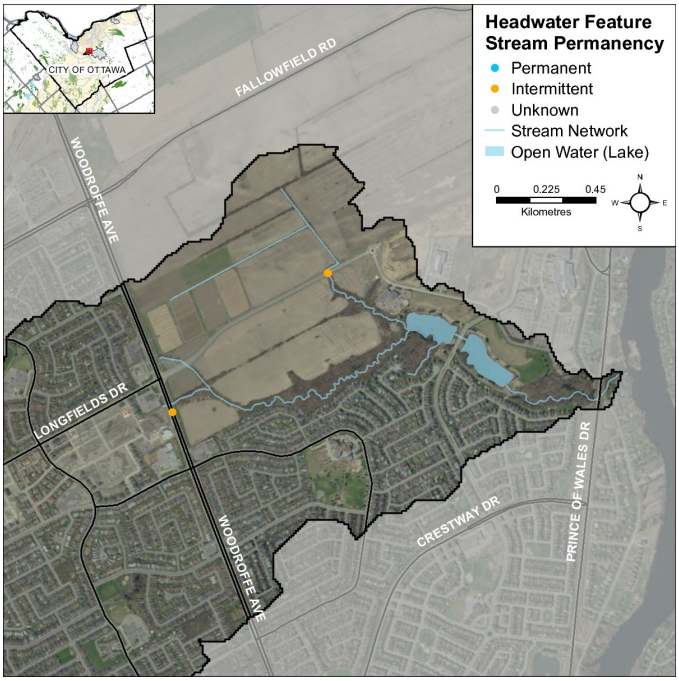

Figure 32 Barrhaven Creek HDF flow conditions

Spring conditions at the Longfields Drive HDF sampling site

Summer conditions at the Longfields Drive HDF sampling site

Headwater Feature Sediment Deposition

Assessing the amount of recent sediment deposited in a channel provides an index of the degree to which the feature could be transporting sediment to downstream reaches (OSAP, 2013). Evidence of excessive sediment deposition might indicate the requirement to follow up with more detailed targeted assessments upstream of the site location to identify potential best management practices to be implemented. The sites sampled in the Barrhaven Creek catchment had moderate levels of sediment deposition. Figure 33 depicts the degree of sediment deposition observed at the sampled headwater sites in the Barrhaven Creek catchment.

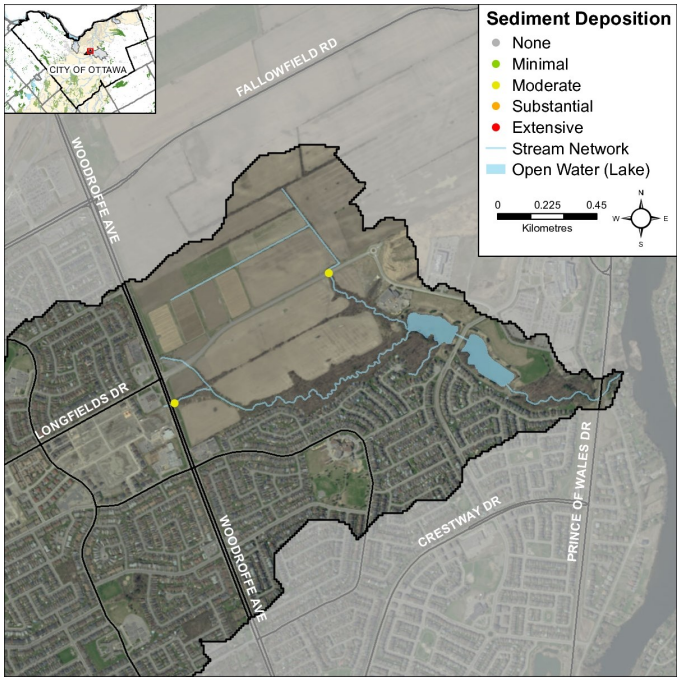

Figure 33 Barrhaven Creek HDF sediment deposition

Headwater Feature Vegetation

Headwater feature vegetation evaluates the type of vegetation that is found within the drainage feature. The type of vegetation within the channel influences the aquatic and terrestrial ecosystem values that the feature provides. For some types of headwater features the vegetation within the feature plays a very important role in flow and sediment movement and provides wildlife habitat. The following classifications are evaluated: no vegetation, lawn, wetland, meadow, scrubland and forest. Figure 34 depicts the dominant vegetation type observed at both sampled headwater sites in the Barrhaven Creek catchment was scrubland.

Headwater Feature Riparian Vegetation

Headwater riparian vegetation evaluates the type of vegetation that is found along the headwater drainage feature. The type of vegetation within the riparian corridor influences the aquatic and terrestrial ecosystem values that the feature provides to the watershed. Although impacted by development in close proximity, the riparian vegetation at the sample locations in Barrhaven Creek were dominated by natural vegetation in the form of scrubland. Figure 35 depicts the type of riparian vegetation observed at the sampled headwater sites in the Barrhaven Creek catchment.

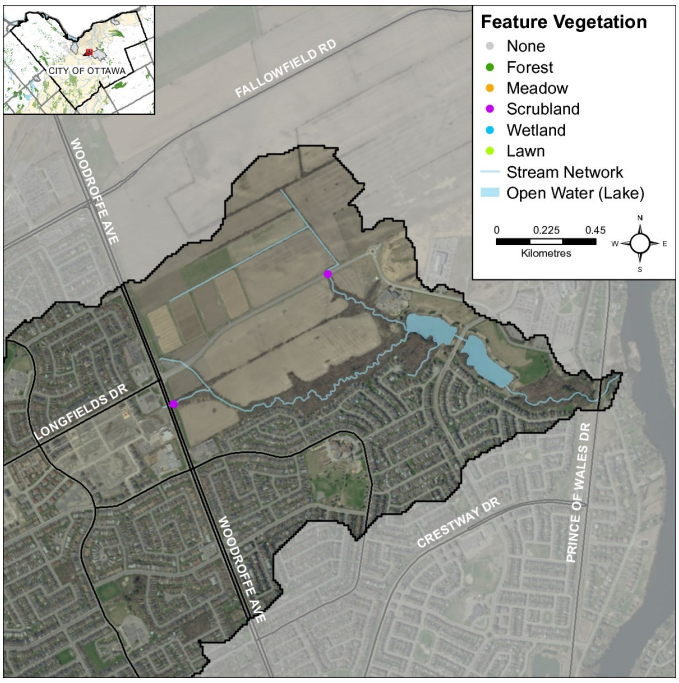

Figure 34 Barrhaven Creek HDF feature vegetation

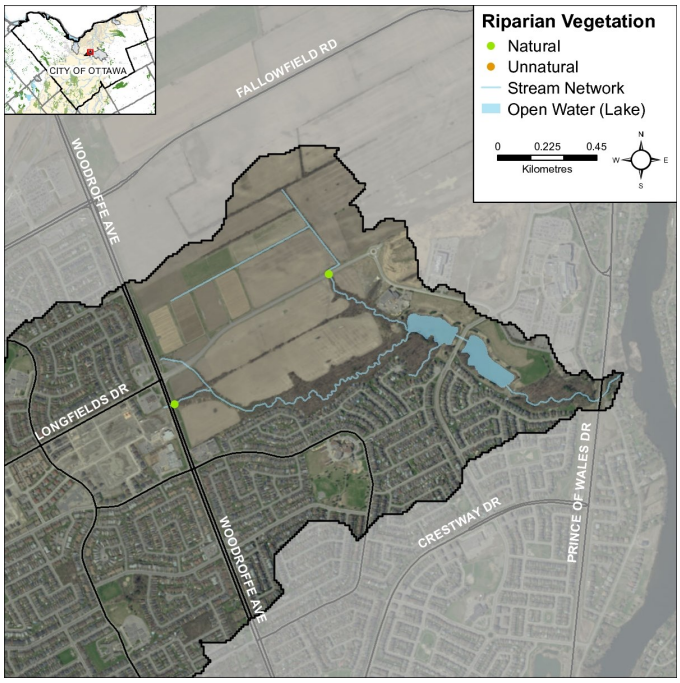

Figure 35 Barrhaven Creek HDF riparian vegetation

Scrubland feature vegetation along Woodroffe Avenue

Natural riparian vegetation at the Longfields Drive site

Feature Channel Modifications

Channel modifications were assessed at each headwater drainage feature sampling location. Modifications include channelization, dredging, hardening and realignments. Both sampling locations in the Barrhaven Creek catchment were classified as having channel modifications. The sampling site along Longfields Drive was classified as having channel hardening in the form of rip rap. At the time of sampling, the site along Woodroffe Avenue was heavily impacted by recent development and was classified as having mixed modifications in the form channel hardening, straightening, and barriers in close proximity. Figure 36 shows the channel modifications observed at the sampling locations for Barrhaven Creek.

Headwater Feature Upstream Roughness

Feature roughness will provide a measure of the amount of materials within the bankfull channel that could slow down the velocity of water flowing within the headwater feature (OSAP, 2013). Materials on the channel bottom that provide roughness include vegetation, woody debris and boulders/cobble substrates. Roughness can provide benefits in mitigating downstream erosion on the headwater drainage feature and the receiving watercourse by reducing velocities. Roughness also provides important habitat conditions to aquatic organisms. In the Barrhaven Creek catchment, one sample location had extreme feature roughness and the other had moderate roughness. Figure 37 shows the feature roughness conditions at the sampling locations in the Barrhaven Creek catchment.

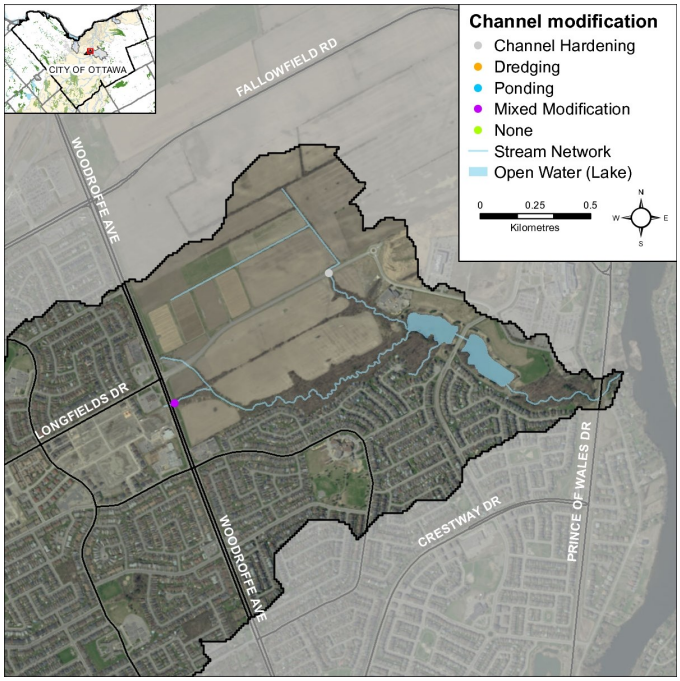

Figure 36 Barrhaven Creek HDF channel modifications

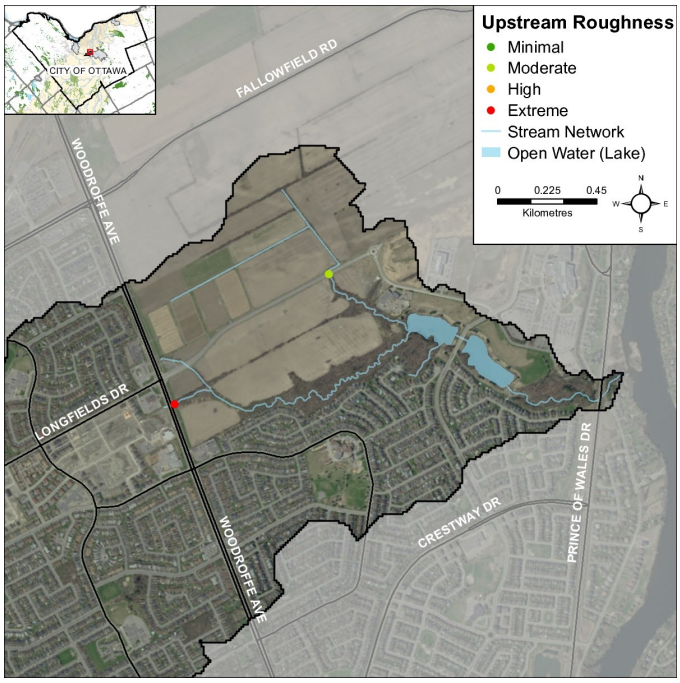

Figure 37 Barrhaven Creek HDF feature roughness

HDF sampling site with mixed modifications

Scrubland vegetation contributing to feature roughness along Woodroffe Avenue

Stream Comparison Between 2009 and 2015

The following tables provide a comparison of observations on Barrhaven Creek between the 2009 and 2015 survey years. In order to accurately represent current and historical information, the site data was only compared for those locations which were surveyed in both reporting periods. In some instances, this resulted in changes to our overall summary information. This information is therefore only a comparative evaluation and does not represent the entirety of our assessment.

Anthropogenic Changes

Table 3 shows that between 2009 and 2015 anthropogenic alterations along Barrhaven Creek have increased. In 2009, 13 percent of the sections had no anthropogenic alterations, in 2015 that number has decreased to zero. Conversely, in 2009 there were no highly altered sections whereas in 2015 seven percent of the sections were highly altered. This change may be caused by changes in the stream survey protocol and the classification of channelization. In 2010, anthropogenic alterations were further defined in the protocol, which has caused some land uses to shift categories since that time.

Anthropogenic Alterations	2009 (%)	2015 (%)
No anthropogenic alterations	13	0
"Natural" conditions with minor human alterations	67	60
"Altered" with considerable human impact but significant natural portions	20	33
"Highly altered" by humans with few natural portions	0	7

Table 3 Comparison of anthropogenic alterations along Barrhaven Creek between 2009 and 2015

A section of Barrhaven Creek highly altered by rip rap along the shoreline

Bank Stability Changes

According to observations, bank stability on Barrhaven Creek has improved overall since 2009. In 2009, 71 percent of the left and right banks were considered stable. In 2015, 92 percent of the left bank and 85 percent of the right bank were stable.

Bank Stability	2009 (%) Left Bank	2009 (%) Right Bank	2015 (%) Left Bank	2015 (%) Right Bank
Stable	71	71	92	85
Unstable	29	29	8	15

Table 4 Comparison of bank stability along Barrhaven Creek between 2009 and 2015

Changes in Instream Vegetation

Figure 38 shows that there has been a decrease in instream vegetation in Barrhaven Creek since 2009. The amount of common and extensive levels of vegetation totaled 13 percent in 2009, and that number has decreased to zero in 2015. The amount of low and absent (none) levels of vegetation totaled 70 percent in 2009 and increased to 81 percent by 2015. The decrease in instream vegetation may be in part attributed to increased stormwater influence in the system but vegetation growth is also dependent on climatic variables as well as the stage of the growing season when observations took place.

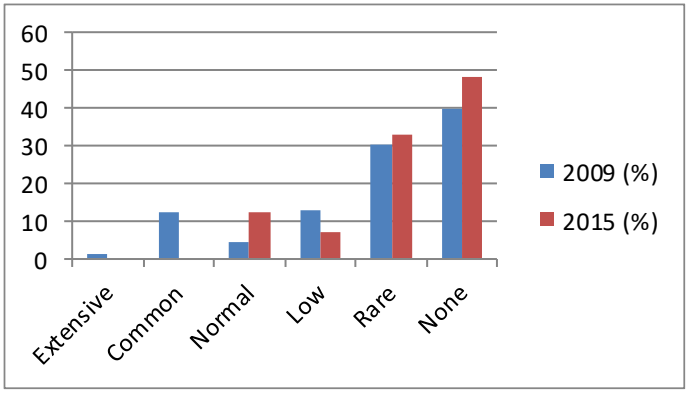

Figure 38 Comparison of instream vegetation levels between 2009 and 2015

Changes in Pollution and Garbage

Overall the amount of pollution and garbage in Barrhaven Creek has decreased since 2009. Table 5 shows that the number of sections surveyed that were free from garbage has increased from zero to 20 percent since 2009.

Pollution/Garbage	2009 (%)	2015 (%)
None	0	20
Floating garbage	73	67
Garbage on stream bottom	47	53
Oil or gas trails	7	0
Discoloration of channel bed	0	0

Table 5 Comparison of pollution/garbage levels in Barrhaven Creek between 2009 and 2015

Fish Community

Fish sampling was conducted on Barrhaven Creek by the City Stream Watch program in 2009 and 2015. In total, 24 species of fish have been captured through City Stream Watch fish sampling efforts.
In 2009, 21 species were captured in three fish sampling sessions using a combination of methods depending on the site (seine net, fyke net, windemere trap and electrofishing). In 2015 fish sampling effort was increased targeting 5 different sites with 13 sampling sessions using a fyke net and electrofishing. Only 12 species were caught in 2015.
Twelve species caught in 2009 were not found in 2015. This does not mean the species have disappeared from Barrhaven Creek but could be influenced by location, weather conditions, time of sampling and sampling method.

A volunteer trying on electrofishing equipment

Walleye captured at the mouth of Barrhaven Creek in 2015

Species	Code	2009	2015
black crappie.....	BlCra	X	
bluegill.....	Blueg	X	
bluntnose minnow.....	BnMin	X	
brassy minnow.....	BrMin	X	
brook stickleback.....	BrSti	X	X
carps and minnows...	CA_MI	X	
common carp.....	CoCar		X
common shiner.....	CoShi	X	X
creek chub.....	CrChu	X	X
Etheostoma sp.....	EthSp	X	
fallfish.....	FallF		X
fathead minnow.....	FhMin	X	X
finescale dace.....	FsDac	X	
largemouth bass.....	LmBas	X	
logperch.....	LogPe	X	
longnose dace.....	LnDac		X
northern pike.....	NoPik	X	
northern redbelly dace	NRDac	X	X
pumpkinseed.....	Pumpk	X	
rock bass.....	RoBas	X	X
smallmouth bass.....	SmBas	X	X
walleye.....	Walle	X	X
white sucker.....	WhSuc	X	X
yellow perch.....	YePer	X	
Total Species		**21**	**12**

Table 6 Comparison of fish species caught in 2009 and 2015

Monitoring and Restoration

Monitoring and Restoration Projects on Barrhaven Creek

Table 7 below highlights the monitoring and restoration work that has been done on Barrhaven Creek to date by the Rideau Valley Conservation Authority. Potential restoration opportunities are listed below.

Accomplishment	Year	Description
City Stream Watch Stream Characterization Monitoring	2009	20 stream surveys were completed on Barrhaven Creek
	2015	15 stream surveys were completed on Barrhaven Creek
City Stream Watch Fish Sampling	2009	Three sites were sampled on Barrhaven Creek
	2015	Five sites were sampled on Barrhaven Creek
City Stream Watch Termal Classification	2009	One temperature logger was deployed
	2015	Two temperature loggers were deployed
City Stream Watch Headwater Drainage Feature Sampling	2015	Two headwater drainage feature sites were sampled in the Barrhaven Creek catchment
City Stream Watch Stream Cleanup	2015	City Stream Watch volunteers removed debris of human origin from Barrhaven Creek near the stormwater pond

Table 7 Monitoring and Restoration on Barrhaven Creek

Potential Riparian Restoration Opportunities

Figure 39 depicts the locations where City Stream Watch staff and volunteers observed areas where the riparian zone could be restored or enhanced using one or more of the following techniques: riparian planting, erosion control, invasive species control and wildlife habitat creation.
Two opportunities were listed for Barrhaven Creek; erosion control near the mouth of the creek and wildlife habitat creation upstream of the stormwater pond.

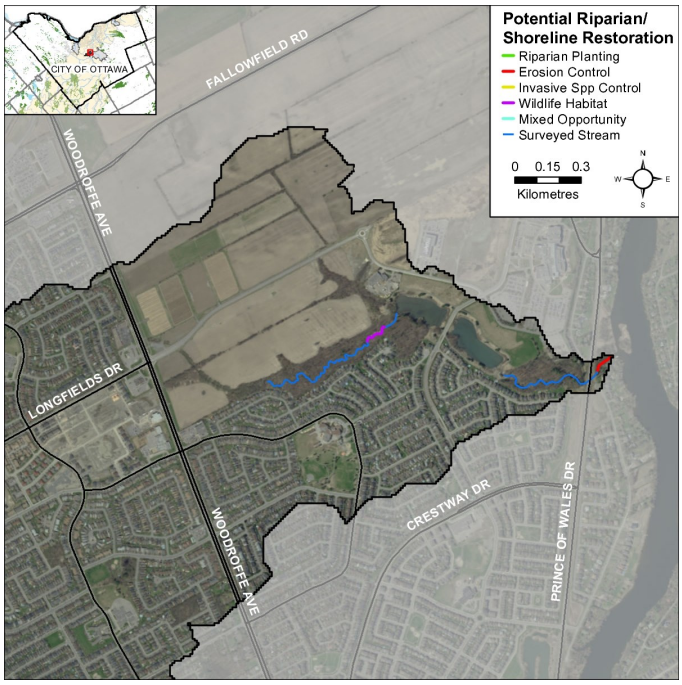

Figure 39 Potential riparian/shoreline restoration opportunities

Erosion control opportunity near the mouth of the creek

Volunteers at the 2015 Barrhaven Creek stream cleanup



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For more information on the overall 2015 City Stream Watch Program and the volunteer activities, please refer to the City Stream Watch 2015 Summary Report.