McEwan Creek 2016 Summary Report

Watershed Features

Area	24.9 square kilometres 0.59% of the Rideau Valley watershed
Land Use	7% agriculture 64% urban 13% forest 8% meadow 6% wetland
Surficial Geology	62% clay 3% diamicton 3% gravel 1% Paleozoic bedrock 32% sand
Watercourse Type	Thermal Conditions (2016) **Warm** to **Coolwater**
Invasive Species	Eight invasive species were identified in 2016, including: *common buckthorn, flowering rush, garlic mustard, Himalayan balsam, Manitoba maple, Norway maple, wild parsnip* and *purple loosestrife*
Fish Community	16 species of fish have been captured in the McEwan Creek catchment

Wetland Cover

6% of the catchment is wetland

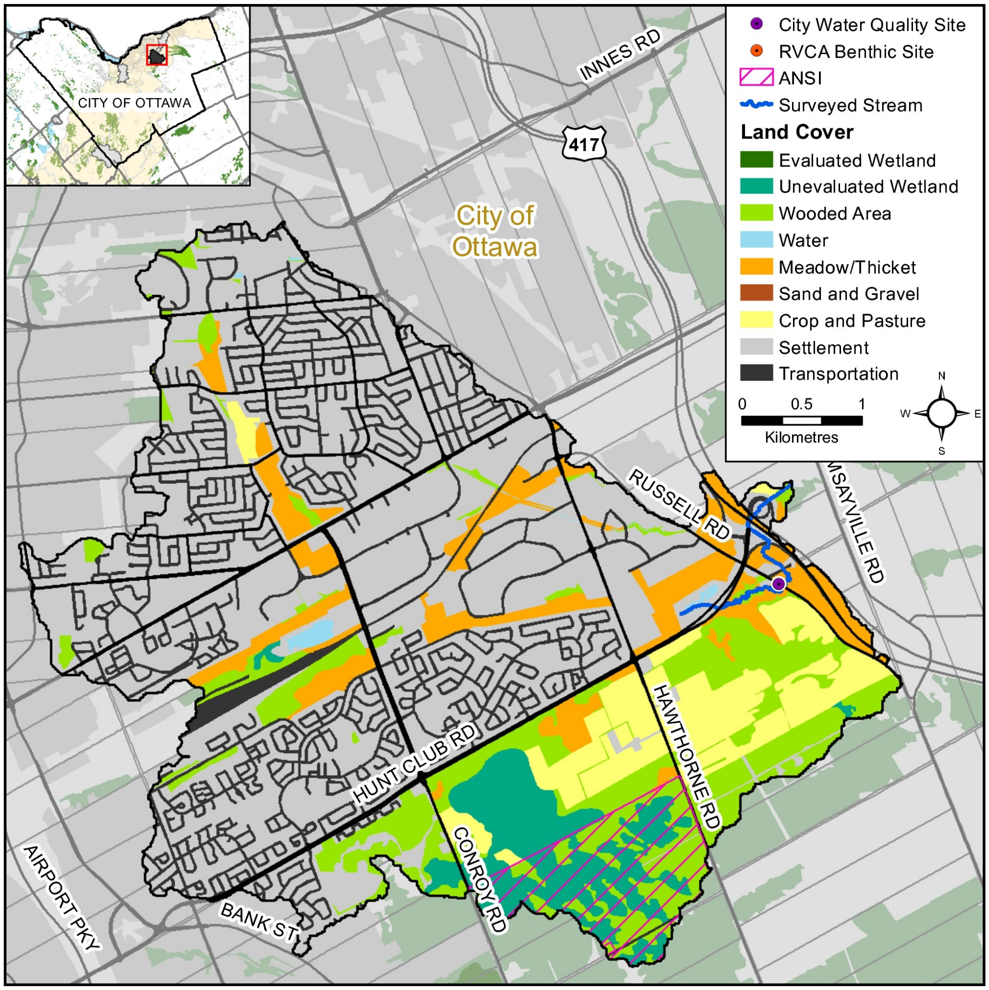
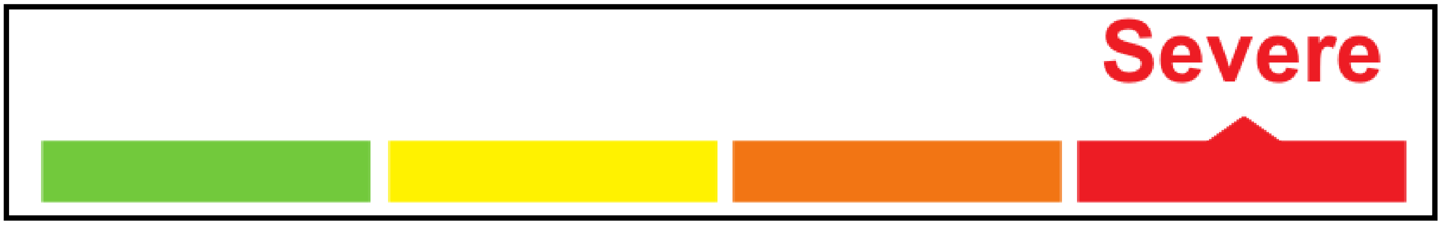


Figure 1 Land cover in the McEwan Creek catchment

McEwan Creek downstream of the HWY 417 crossing

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 2016 City Stream Watch collaborative.

Drought Conditions - Rideau Valley Watershed



Low Water Conditions

During the summer of 2016, the Rideau Valley watershed experienced periods of *severe* drought. Precipitation levels were measured at less than 40% of the long-term average, as the water supply was unable to meet local demand. The lack of rainfall affected the success and function of farm crops, municipal and private wells, lawns and gardens, navigation and ultimately the health of our lakes, rivers and streams.

Low water conditions were readily observed throughout the watershed, as many of the streams were highly fragmented or completely dry. Aquatic species such as amphibians, fish and macroinvertebrates were affected, as suitable habitat may have been limited.

City Stream Watch

Low water levels and flows were common across our city streams, and are reflected in our overall evaluation. Given the atypical conditions, all assessments were subject to the effects of low water, and may not reflect the overall health of the systems. The City Stream Watch program will continue to monitor conditions over the long term to better understand the effects of climate and precipitation patterns.

Introduction

McEwan Creek is located in the Gloucester-Southgate region, with its headwaters east of Albion Road, close to the Canadian National Railway line. The stream conveys flows through the Eastern Community trunk sewer, and re-emerges between Hawthorne and Russell Road. The stream flows east, crossing Russell Road and Highway 417, where it outlets into Ramsay Creek and subsequently Greens Creek. McEwan Creek is highly developed with influences from industrial/commercial land use, residential areas, agricultural lands and municipal infrastructure. Land use changes in the watershed have resulted in drastic and unstable flow conditions as well as poor water quality. McEwan Creek was historically re-directed to join the Mather Award Ditch, which transports storm water from the residential area north of Walkley Road and the industrial/ commercial lands south of Walkley Road. Recent developments include the addition of a large storm water pond along the Hunt Club Road extension.

Natural areas within the catchment include the Jim Durrell Woods, Conroy Woods, Hawthorne Marsh, Lorry Greenberg Bush and Swansea Woods, Stevenage Woods, and the Pine Grove Forest. The Conroy Swamp and the Hawthorne Marsh have been evaluated as having environmental significance as they support regionally significant plant species. The creek has also been the subject of an NCC/City phased restoration project since the late 1990s which has resulted in improvements to the stream banks and vegetation cover. Vegetation surveys conducted by Brunton Consulting Services have identified extensive spread of invasive *glossy buckthorn* throughout the catchment area.

Despite its highly altered state, McEwan Creek does provide habitat for a variety of aquatic and terrestrial species. Fish sampling conducted in 2010 by the City Stream Watch identified the presence of 7 distinct species, with records of up to 16 species within the catchment.

McEwan Creek Overbank Zone

Riparian Buffer Width Evaluation

The riparian zone is the interface between the water and the land surrounding a stream or river. Well-vegetated shorelines are of critical importance in protecting water quality and promoting for healthy aquatic habitats. Natural shorelines intercept sediments and contaminants that could impact water quality conditions and harm fish habitat. Furthermore, 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. The recommended target (from Environment Canada's Guideline: How Much Habitat is Enough?) for the protection of aquatic habitat is to maintain a minimum 30 meter wide vegetated buffer along at least 75% of the stream length (Figure 2). McEwan Creek was observed as having adequate buffer conditions over only 51% of the left bank and 45% of the right bank. These conditions do not meet the recommended standard as efforts should be undertaken to improve upon the riparian area in McEwan Creek.

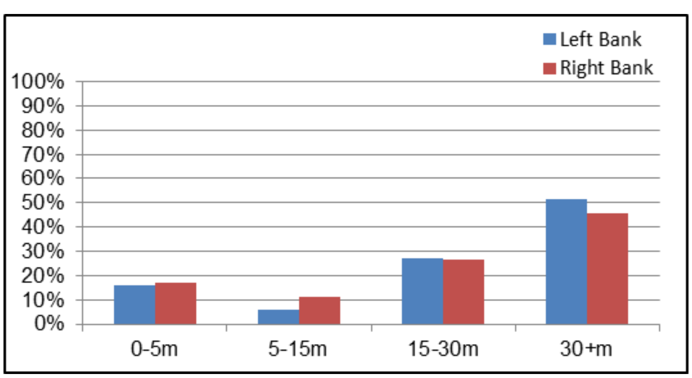


Figure 2 Vegetated buffer width along McEwan Creek

Adjacent Land Use

Land use surrounding the creek is categorized into 11 classes, and assessed within 100m of each shoreline. These classes include: active and abandoned agriculture, pasture land, residential areas, forests, scrubland, meadows, wetlands, industrial /commercial zones, recreational areas, and infrastructure. Land use outside of this 100m buffer is not considered, but may still have influence within the catchment.

Meadow cover was common across the surveyed area and identified in 68% of all sites (Figure 3). Infrastructure was prevalent within the catchment and identified in 60% of sections, in addition to residential land use in 24% of sites. Scrubland habitat was also common and observed in 52% of the surveyed stream, with forest cover limited to 24% of sites. Instances of abandoned agriculture were also identified, and account for 16% of the surveyed stream.

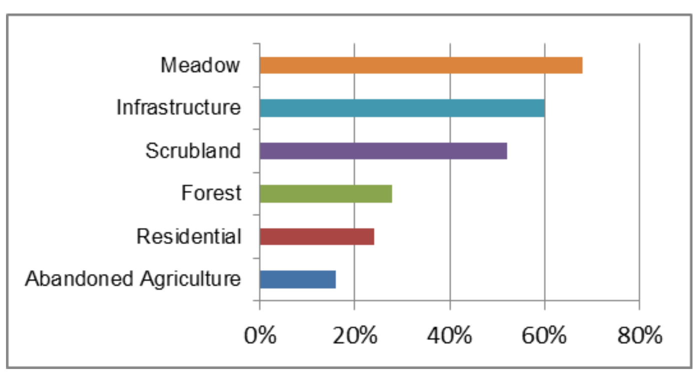


Figure 3 Land use along McEwan Creek

McEwan Creek Shoreline Zone

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 overall extent of each section with “unstable” shoreline conditions. These conditions are defined by the presence of significant exposed soils/roots, minimal bank vegetation, severe undercutting, slumping or scour, and failed erosion control measures.

Shoreline erosion was generally minor across McEwan Creek, however several regions were identified with significant instability (Figure 4). Severe shoreline erosion was identified upstream of the HWY 417 crossing, as extreme bank destabilization and scouring were evident. Further erosion was observed in proximity to both Russell and Hunt Club Road. Periodic high flow events and stream channelization were common within McEwan Creek and are likely associated with the conditions observed.

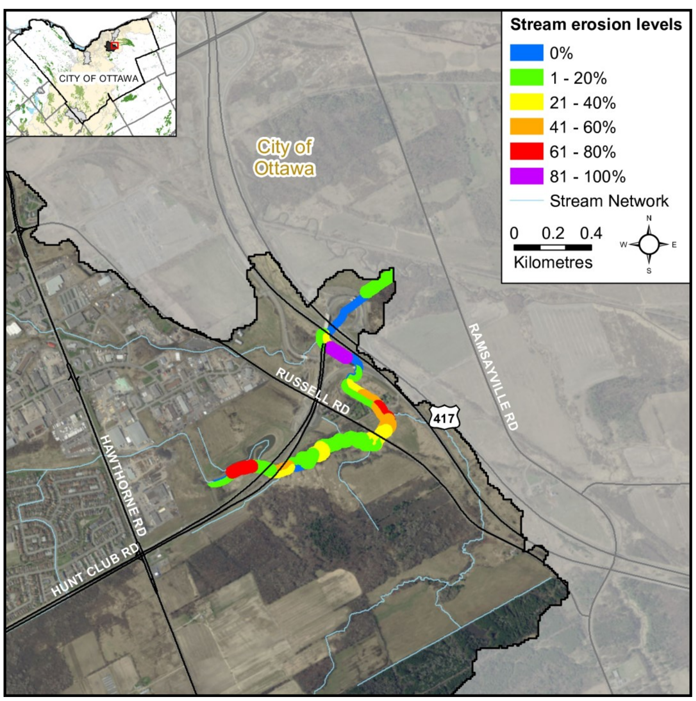


Figure 4 Erosion along McEwan Creek

Undercut banks along McEwan creek

Undercut Stream Banks

Stream bank undercuts can provide excellent cover habitat for aquatic life, however excessive levels can be an indication of unstable shoreline conditions. Bank undercut was assessed as the overall extent of each surveyed section with overhanging bank cover present.

Bank undercut was identified in 32% (right bank) to 48% (left bank) of all surveyed sites, with an average coverage extent of 29% in those sections (Figure 5). Undercut conditions were particularly apparent upstream of the Hunt Club storm water pond.

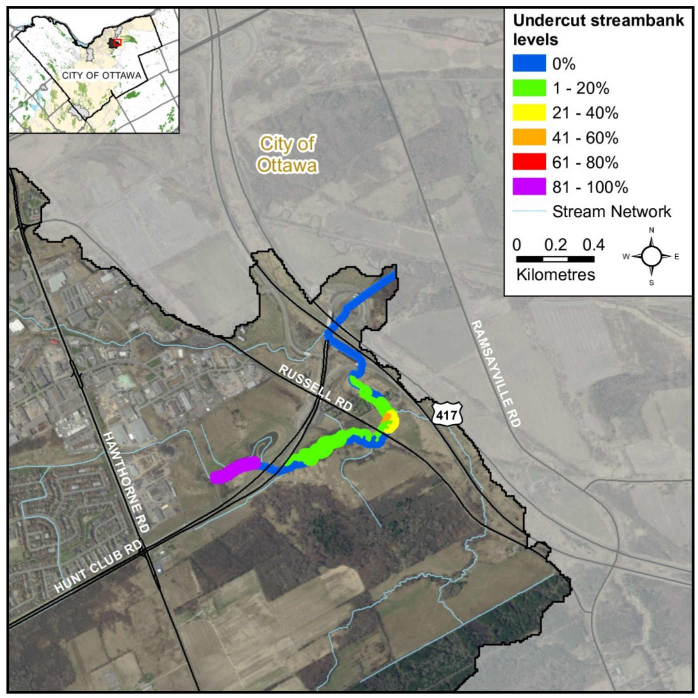


Figure 5 Undercut stream banks along McEwan Creek

Erosion control measures (ie. gabion baskets) along McEwan 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 1m above the water surface.

McEwan Creek was characterized by relatively low shoreline cover, with shading at or below 30% within the 75th percentile (Figure 6). The most frequent cover level was assessed at 20%, and accounts for approximately 24% of the surveyed stream. Stream shading was found to be most prevalent between Russell and Hunt Club Road (Figure 7).

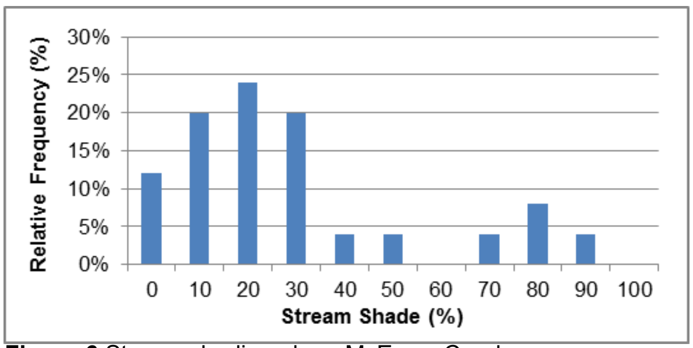


Figure 6 Stream shading along McEwan Creek

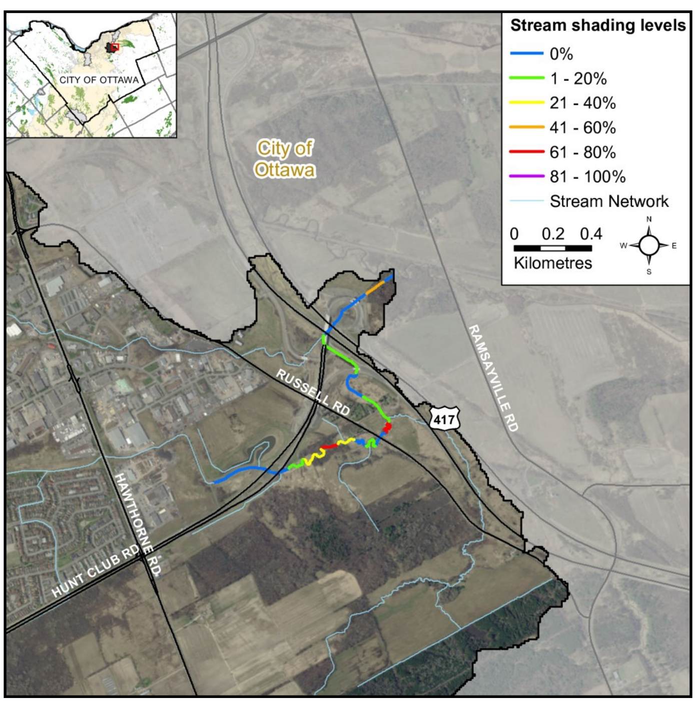


Figure 7 Stream shading along McEwan Creek

Riparian Buffer Alterations

Alterations within the riparian buffer were assessed within three distinct shoreline zones (0-5m, 5-15m, 15-30m), and evaluated based on the dominant vegetative community and/or land cover type (Figure 8).

The riparian buffer zone along McEwan Creek was found to be predominantly natural, with 80% of the left bank and 76% of the right bank evaluated as having natural vegetative communities (Figure 8). Alterations to the shoreline accounted for 20% of the left bank and 24% of the right bank, with highly altered conditions assessed at 8%, inclusively. Common sources of alteration included erosion control measures, road crossings and storm water infrastructure.

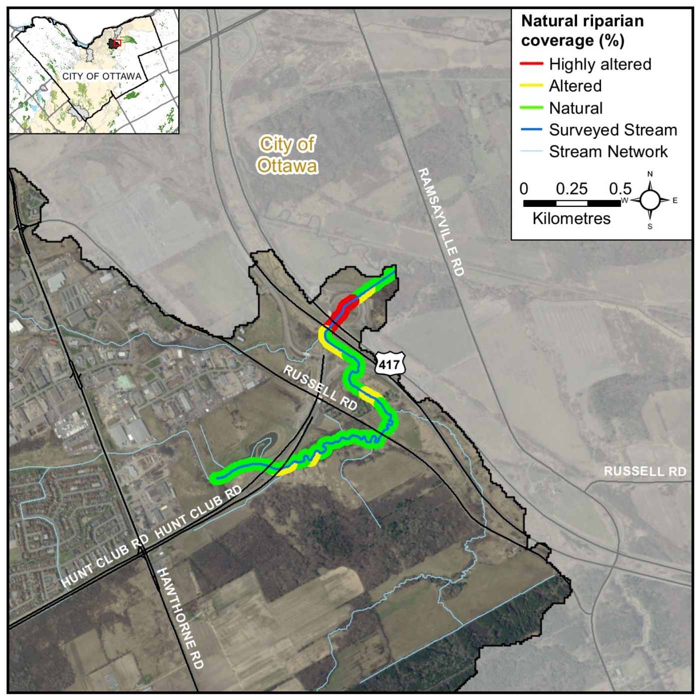


Figure 8 Riparian buffer alterations within McEwan Creek

Heavily modified stream section along McEwan Creek

Overhanging Trees and Branches

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

Overhanging trees and branches were identified in approximately 66% of all surveyed sites, with an average coverage extent of 20% in those sections (Figure 9). Direct overhanging canopy was minimal across the stream, with minor instances of improved cover identified upstream of Hunt Club Rd and downstream of Russell Rd.

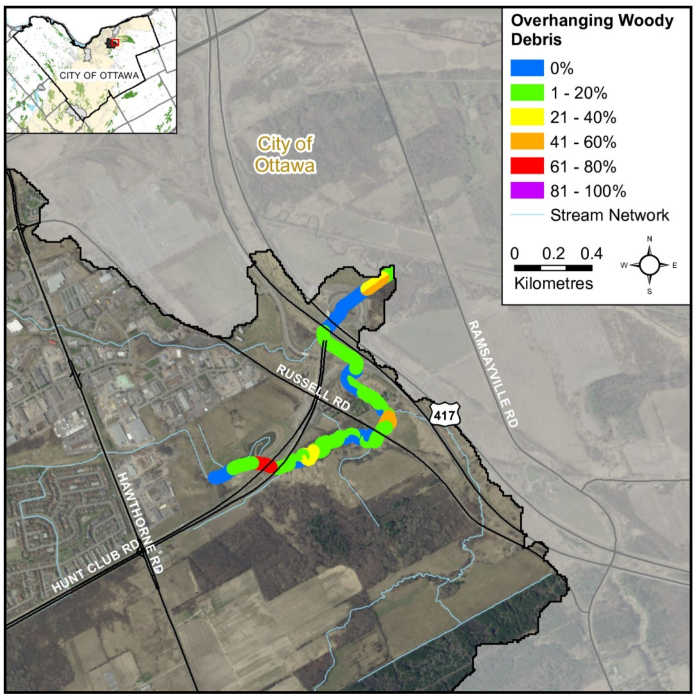


Figure 9 Overhanging trees and branches

Overhanging trees and branches on McEwan Creek

Anthropogenic Alterations

Stream alterations are classified based on specific functional criteria associated with the flow conditions, the riparian buffer, and potential human influences. McEwan Creek is considered to be in a natural state for 16% of the surveyed stream (Figure 10). Altered classes (ie. Altered & Highly Altered) account for the majority of observations at 84% of the stream length, with extensive alterations identified in 44% of sites. Common alterations include erosion control features, channelization, shoreline hardening, municipal infrastructure and storm-water outlets.

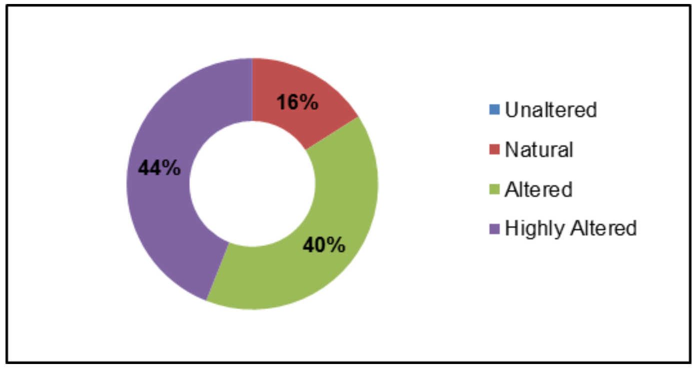


Figure 10 Anthropogenic alterations along McEwan Creek

A natural stream section along McEwan Creek

A highly altered stream section along McEwan Creek

McEwan Creek Instream Aquatic Habitat

Habitat Complexity

Habitat complexity is a measure of the overall 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, flow 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 woody material.

Fish habitat conditions on McEwan Creek varied considerably from highly diverse to severely impacted. Low habitat complexity was common throughout the system, with 52% of sites assessed as having 2 or fewer habitat factors (Figure 11). Diverse habitat conditions were identified in 48% of the surveyed stream (ie. 3 or more habitat factors), with optimal conditions at 12%, inclusively.

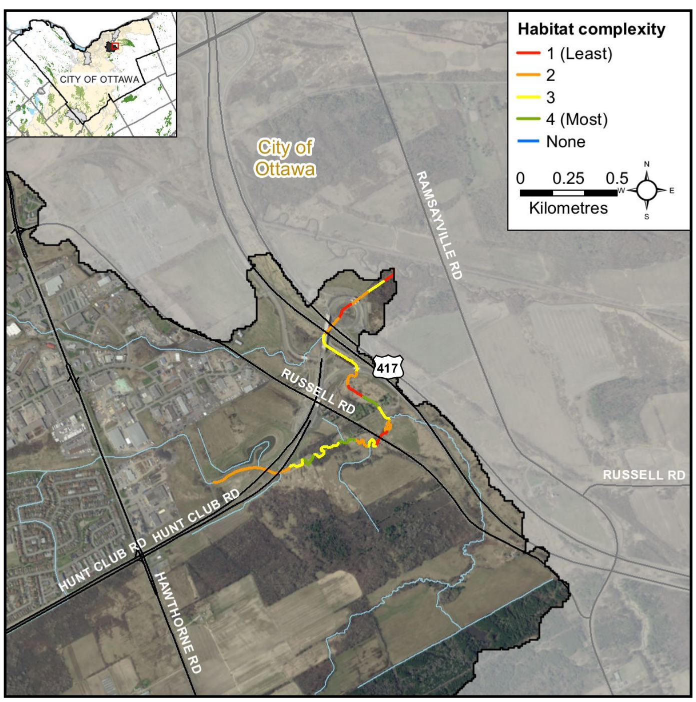


Figure 11 Instream habitat complexity in McEwan Creek

Diverse habitat cover in McEwan Creek

Instream Substrate

Diverse substrate is important for fish and benthic invertebrates as many species rely on specific substrate types to complete their life cycles. The absence of diverse substrate types may limit the overall diversity of species within a stream.

Cobble was identified in 88% of all surveyed sites, and was often associated with the destabilization of erosion control measures (Figure 12). Sands, silt and gravel were prevalent across the system with 68% silt, 64% sand and 72% gravel presence overall. Boulders were identified in 32% of sites, with minor instances of bedrock observed (4%). Clay substrate was found to be dominant throughout much of the surveyed extent and identified in 84% of sites (Figure 13).

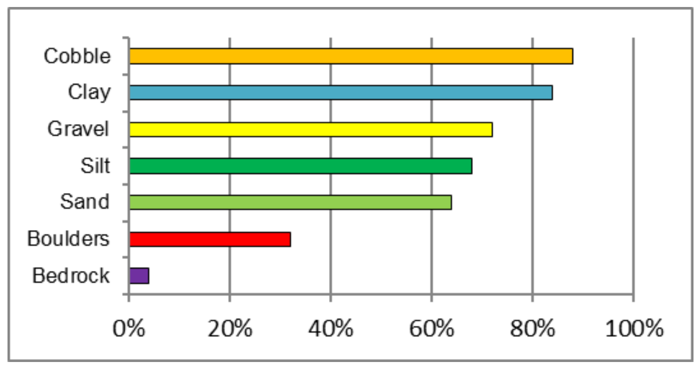


Figure 12 Instream substrate along McEwan Creek

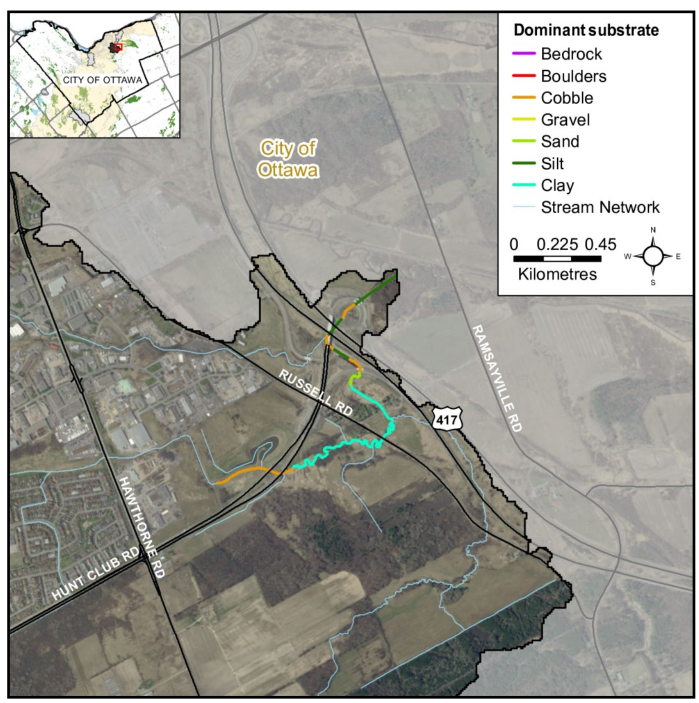


Figure 13 Dominant instream substrate in McEwan Creek

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. Pools are characterized by minimal flows, with relatively deep water and provide thermal, habitat and flow refuge for aquatic species. Runs are moderately shallow, with unagitated surface flow and areas where the thalweg (deepest part of the channel) is in the center of the channel.

Despite the presence of extensive channel constraints (ie. shoreline hardening/channelization), McEwan Creek was found to have a high diversity of flow/habitat types and may be associated with ongoing NCC/City of Ottawa restoration efforts. Riffle habitat was identified in 76% of the surveyed stream, with corresponding pool habitat in 84% of all sites (Figure 14 & 15). Run conditions were most common and observed across all survey sites (100%).

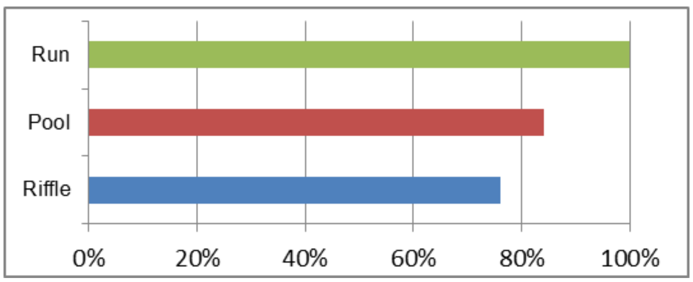


Figure 14 Instream morphology along McEwan Creek

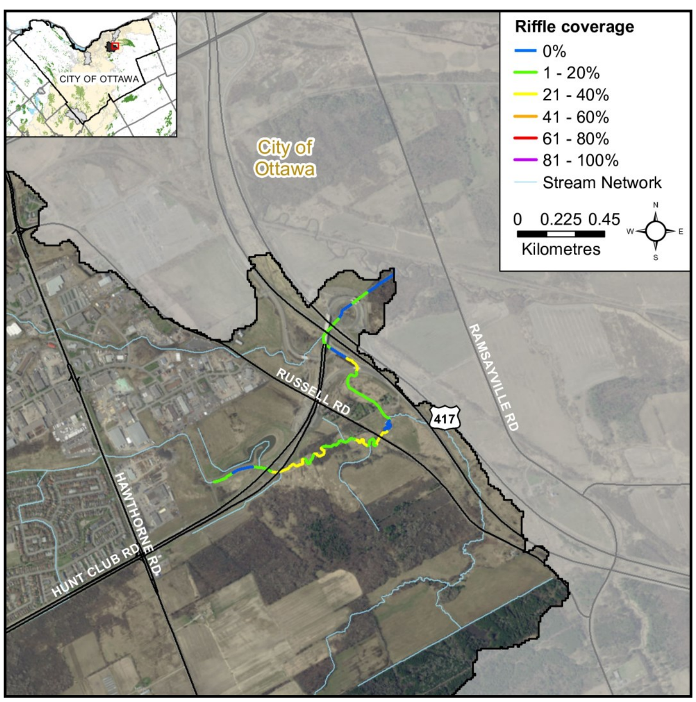


Figure 15 Riffle coverage in McEwan Creek

Vegetation Type

Instream vegetative communities are a crucial component of aquatic ecosystems, providing both direct and indirect support to aquatic life. Aquatic plants promote for stream health by:

- Providing direct riparian/instream habitat
- Stabilizing flows/reducing shoreline erosion
- Contributing to dissolved oxygen through photosynthesis
- Maintaining temperature conditions through shading

Algaes were categorized as the most common instream vegetation observed, with 84% presence overall (Figure 16 & 17). Submergent plant types were identified in 60% of all surveyed sites, with most observations corresponding to native species. Robust emergent plants were identified in 28% of sites, and include observations of invasive *flowering rush*. Narrow-leaved emergent such as grasses and sedges were identified in 32% of sites, with minor instances of broad-leaved emergents observed (12%).

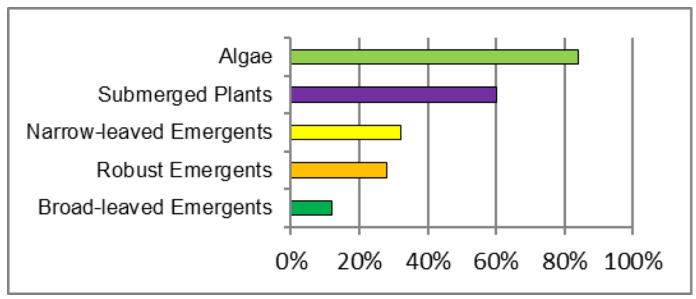


Figure 16 Aquatic vegetation presence along McEwan Creek

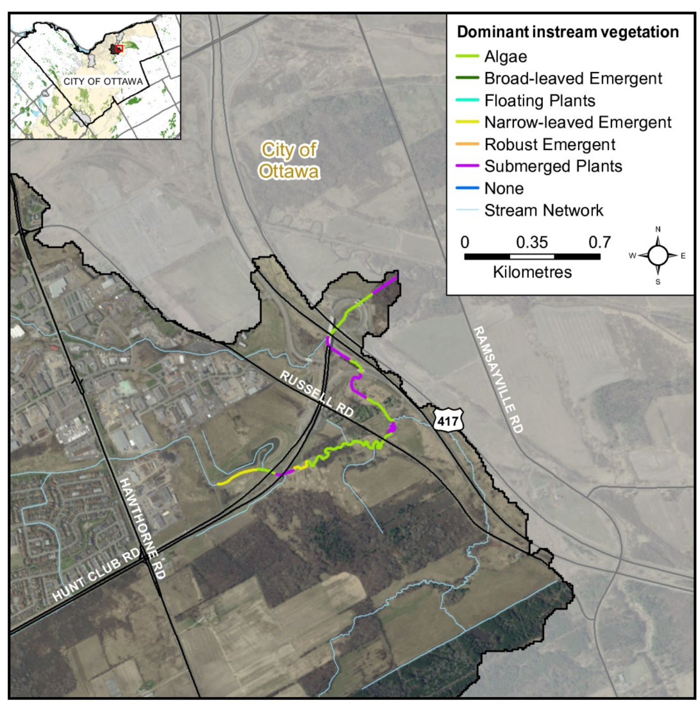


Figure 17 Dominant instream vegetation in McEwan Creek

Instream Vegetation Abundance

Instream vegetation is an important factor which contributes to the health of the stream. Vegetation helps to remove contaminants from the water, contributes oxygen to the stream, and provides habitat for fish and wildlife. Vegetation presence is crucial to stream function, however extensive or rare levels can be detrimental.

Instream vegetation abundance was found to be impaired, with "normal to common" levels identified within only 25% of the instream surface area (Figure 18). Low to absent (ie. low, rare, none) levels accounted for the majority of observations at approximately 75%. The poor conditions observed on McEwan Creek are likely influenced by sedimentation, channel modification and unstable flows throughout the system.

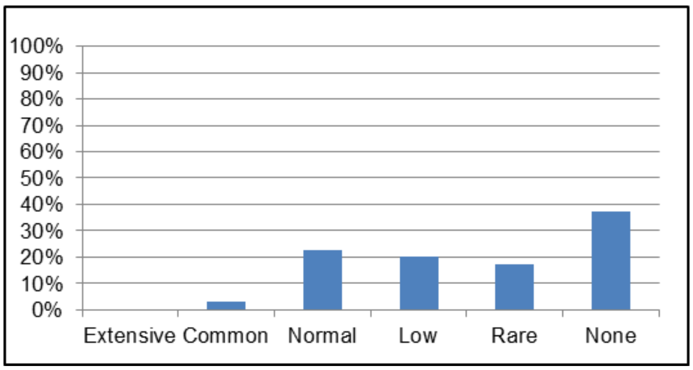


Figure 18 Instream vegetation abundance in McEwan Creek

Instream wetland vegetation on McEwan Creek

Section of McEwan Creek without defined aquatic vegetation

McEwan 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 100% of the surveyed stream, with a total of 8 species identified.

Invasive species abundance (ie. the number of observed invasives per section) was assessed to determine the potential range/vector of many of these species. Approximately 60% of McEwan Creek had 4 or fewer invasive species identified within each section. (Figure 19). Higher density (5– 7 species) and/or isolated invasive communities were identified consistently in all regions upstream of the HWY 417 crossing. *Himalayan balsam* was found extensively across most of McEwan Creek, with observations over 96% of surveyed streams. Removal efforts in 2016 were focused on headwater locations, as these appear to be a primary source of invasive species emergence.

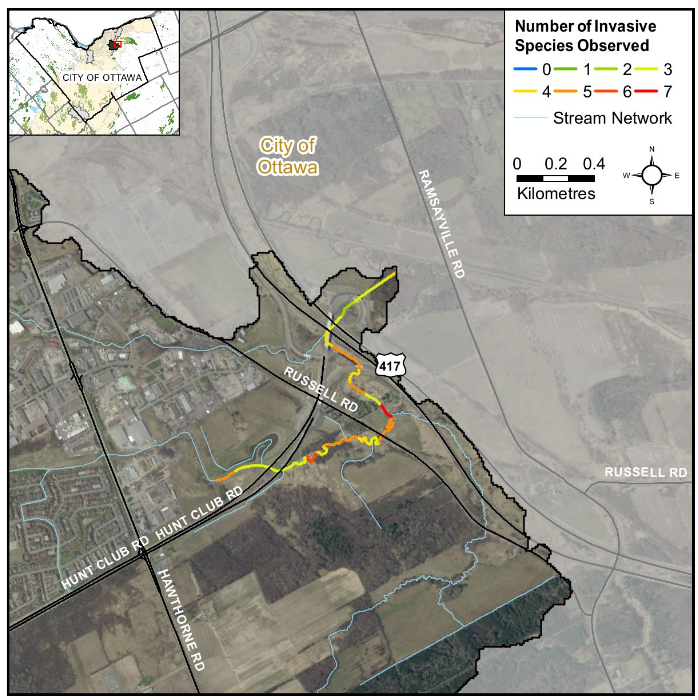


Figure 19 Invasive species abundance in McEwan Creek

Invasive *Himalayan balsam* along the bank of McEwan Creek

Pollution

Pollution was identified in 88% of all surveyed sections in McEwan Creek (Figure 20). Common waste identified included scrap metals and domestic products. Garbage was identified along the stream bottom in 64% of sites, with floating garbage identified in 32% of all surveyed locations. Minor instances of industrial/commercial waste dumping was also identified (ie. Other-4%).

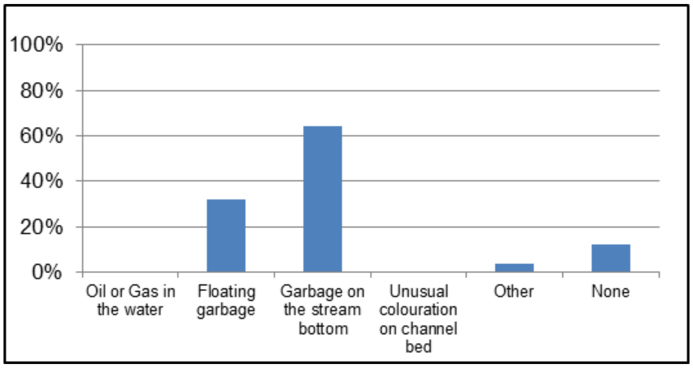


Figure 20 Pollution observed within McEwan Creek

Pollution observed along McEwan Creek

Volunteers and staff collecting garbage and removing invasive plants along McEwan Creek

Wildlife

The diversity of fish and wildlife populations can be an indicator of water quality and overall stream health (Table 1). Wildlife observations are noted during standard monitoring and survey activities, and do not represent an extensive evaluation of species presence/absence. No species of note or special consideration were observed.

Table 1 Wildlife observed along McEwan Creek in 2016

Birds	American goldfinch, great blue heron, killdeer, mallard, red-winged blackbird, spotted sand piper, swallow spp
Reptiles & Amphibians	leopard frog, tree frog
Mammals	mink, muskrat, raccoon, weasel
Aquatic Insects and Benthic Invertebrates	caddisfly, leech, sow bug, water boatman, water strider, whirligig beetle
Other	aphid, bumblebee, bee, butterfly, damselfly, dragonfly, moth, mosquito

Male *ebony jewelwing damselfly* in McEwan Creek

Mink along the shoreline of McEwan Creek

McEwan Creek Water Chemistry

Water Chemistry Assessment

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

Collecting water chemistry measurements with a YSI probe on McEwan Creek

Dissolved Oxygen

Dissolved oxygen is a measure of the amount of oxygen dissolved in water. Guidelines supported under 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 21) and 9.5 mg/L for coldwater biota (blue line in Figure 21) (CCME, 1999).

Warmwater conditions were largely maintained throughout the system, with minor instances of coldwater criteria in proximity to Russell Rd and downstream of Hunt Club Rd. Oxygen depletion was evident across most of the surveyed stream, as 56% of sites were below full saturation levels. These conditions are indicative of potential impairment despite the suitable concentrations above the cold and warmwater thresholds (Figure 21).

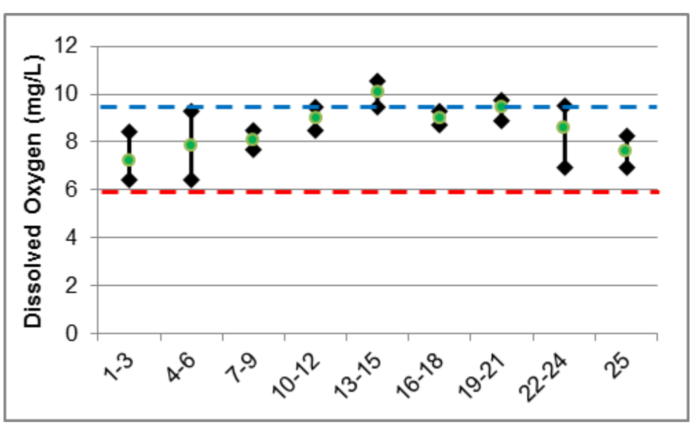


Figure 21 Dissolved oxygen ranges in McEwan Creek

Conductivity

Conductivity in streams is primarily influenced by the geology of the surrounding environment, but can vary drastically as a result of surface water runoff. Currently there are no CCME guidelines for stream conductivity, however readings which are outside the normal range observed within the system are often an indication of unmitigated discharge and/or storm-water input. The average specific conductivity observed within McEwan Creek was 1358 µs/cm (blue line in Figure 22).

Peak conductivity levels were identified between the mouth of McEwan Creek and the HWY 417 on-ramp (1736 µs/cm). Sections upstream of this location were subject to a significant storm event, and reflect a high degree of variation in the SPC. Water input from the Hunt Club storm water pond was observed as having reduced SPC relative to the average conditions on McEwan Creek.

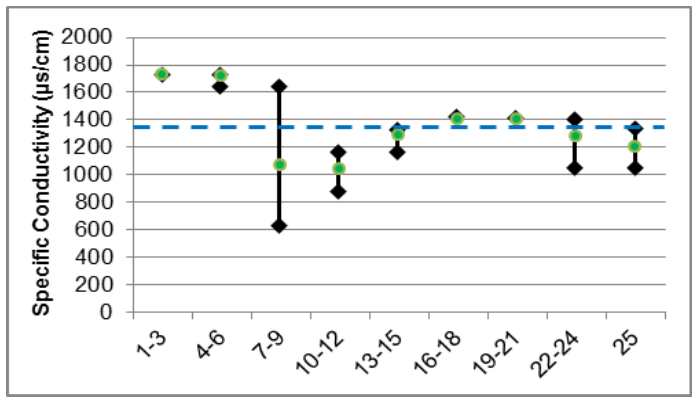


Figure 22 Conductivity ranges in McEwan Creek

pH

Based on the Provincial water quality objectives for pH, a range of 6.5 to 8.5 should be maintained for the protection of aquatic life.

Average pH throughout McEwan Creek was approximately 7.85, with no exceedances above/below the Provincial standard (Figure 23). Sections upstream of the HWY 417 on-ramp were subject to significant storm activity, and reflect a 53% increase in acidity during this event.

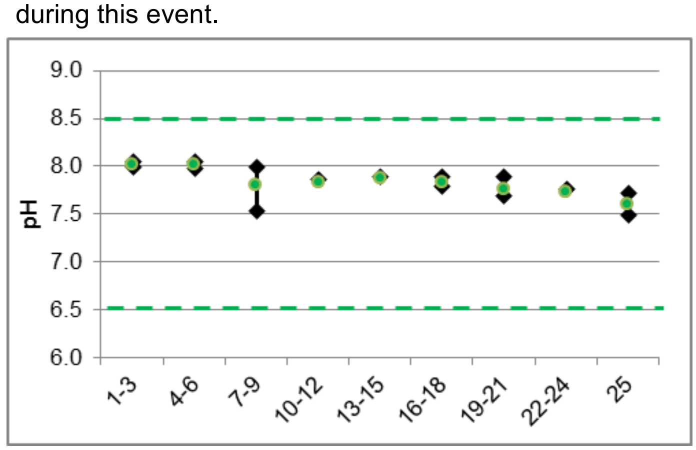


Figure 23 pH ranges in McEwan Creek

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% 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% to a maximum of 500%, 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 warmwater 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 warmwater biota.

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

- Oxygen concentration is sufficient to support coldwater 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 coldwater biota.

Site on McEwan Creek with poor oxygen conditions (Upstream of Hunt Club Rd)

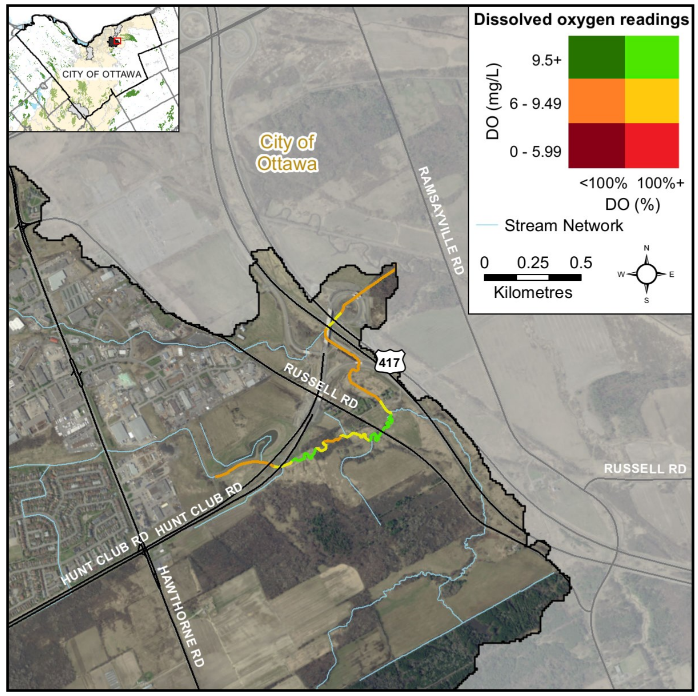


Figure 24 A bivariate assessment of dissolved oxygen concentration (mg/L) and saturation (%) on McEwan Creek

Dissolved oxygen conditions on McEwan Creek are generally sufficient for warmwater species, however oxygen depletion was evident throughout most of the system. (Figure 24). Potential impairment was identified from the mouth to Blake Rd as well as upstream of Hunt Club Rd. Oxygen concentration within these reaches was suitable for warmwater biota, however the corresponding saturation levels were indicative of oxygen depletion. Optimal conditions were observed in proximity to Russell Rd and downstream of Hunt Club Rd.

Site on McEwan Creek with optimal oxygen conditions (Upstream of Russell Rd)

Specific Conductivity Assessment

Specific conductivity (SPC) is a standardized measure of electrical conductance, collected at or corrected to a water temperature of 25ºC. SPC is directly related to the concentration of ions in water, and is commonly influenced by 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 storm water, agricultural inputs and commercial/industrial effluents.

In order to summarize the conditions observed, SPC levels were evaluated as either normal, moderately elevated or highly elevated. These categories correspond directly to the degree of variation (ie. standard deviation) at each site relative to the average across the system (Figure 25).

Due to the effects of a significant storm event, SPC levels were highly variable upstream of the HWY 417 on -ramp. These variable conditions reflect the relative differences between standard summer flows and the observed storm event, rather than direct pollutant sources.

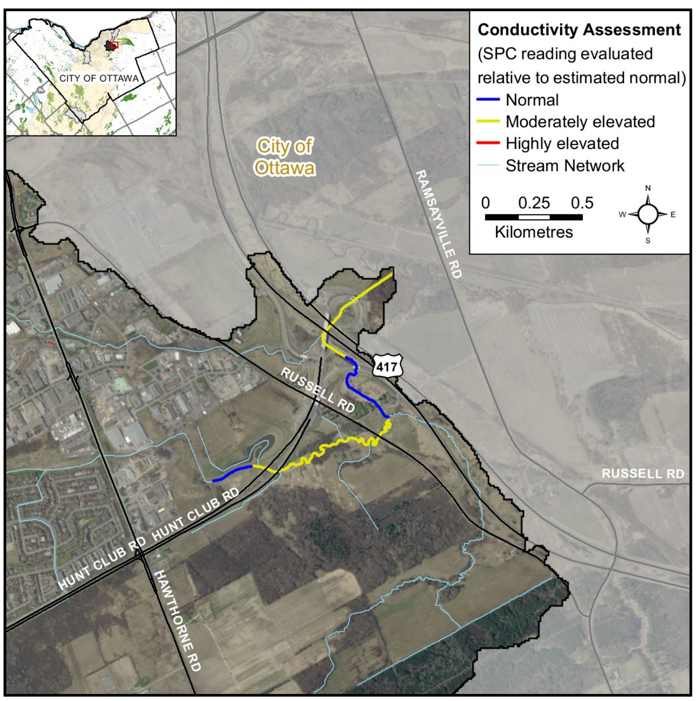


Figure 25 Relative specific conductivity levels on McEwan Creek

Areas of Concern

Based on an overall evaluation of the sampled water chemistry attributes, several areas of McEwan Creek show potential impairment. These regions generally correspond with outflow and/or proximity to developed areas. The following sites are associated with poor oxygen conditions, elevated conductivity and variable pH levels (Figure 26).

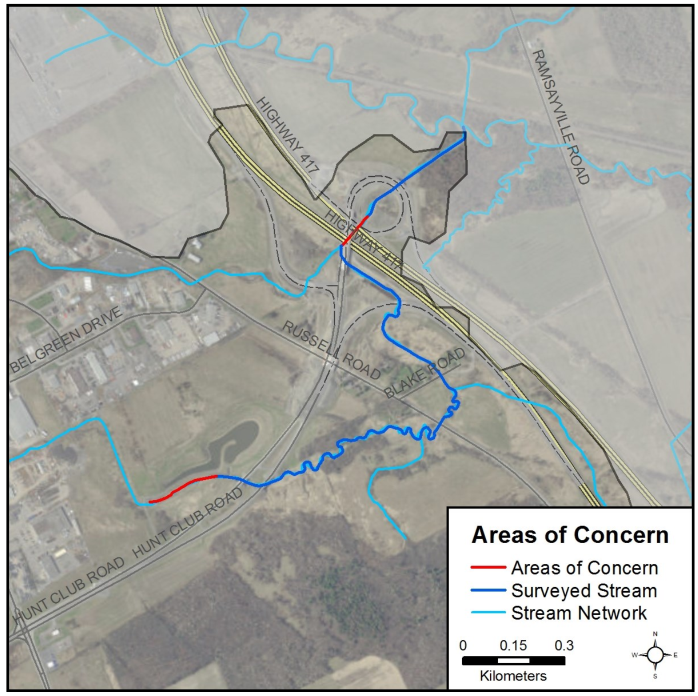


Figure 26 McEwan Creek areas of concern based on water chemistry evaluation

Storm water outflow with elevated conductivity and reduced oxygen conditions

McEwan 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. Three loggers were deployed in late April to monitor water temperature in McEwan Creek (Figure 27). 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 29). Temperatures within McEwan creek ranged from warm to cool water conditions. Temperatures at the Hunt Club Rd site stabilized within the coolwater range, while all other sites maintained warm to cool-warm temperatures.

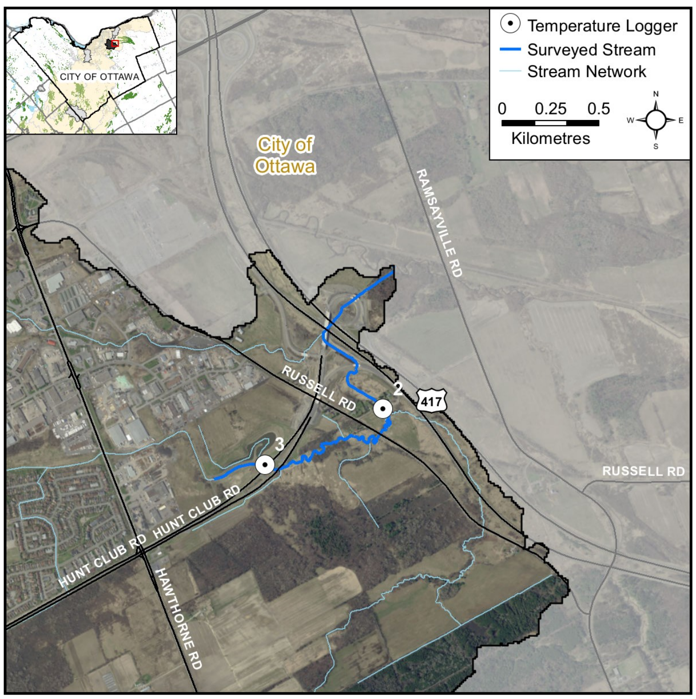


Figure 27 Temperature loggers along McEwan Creek

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 assessed and identified.

Indicators of potential groundwater input were limited within McEwan Creek and isolated to a single 200m reach (Figure 28). Groundwater presence was evaluated based on the presence of watercress.

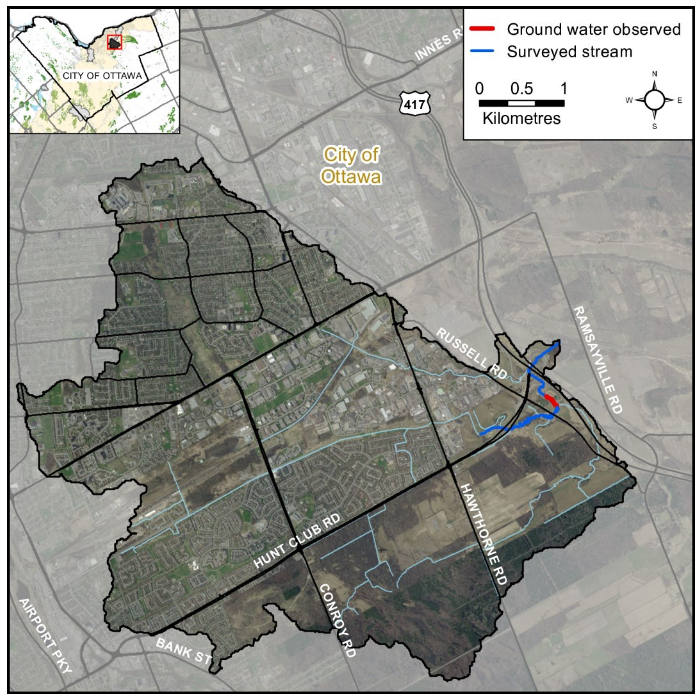


Figure 28 Groundwater indicators observed in McEwan Creek

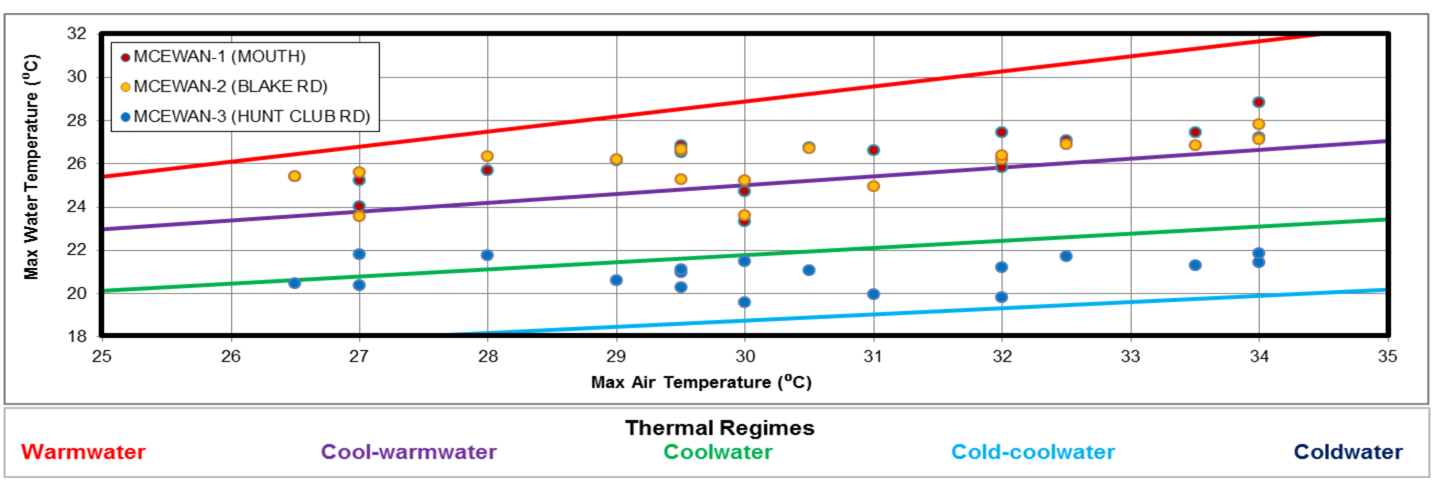


Figure 29 Thermal Classification for McEwan Creek

McEwan Creek Fish Community

Fish Community

Historic fish sampling records indicate the presence of 16 distinct species within McEwan Creek (Table 2). RVCA fish sampling efforts have identified all 16 of the listed species. No species of note or special consideration were observed.

Fish sampling records include data from 28 separate sampling events and 7 sites (Figure 30).

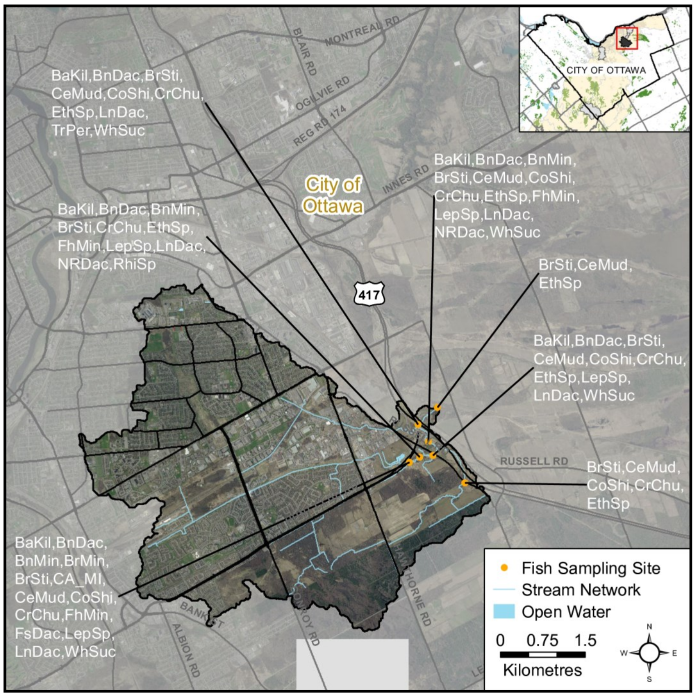
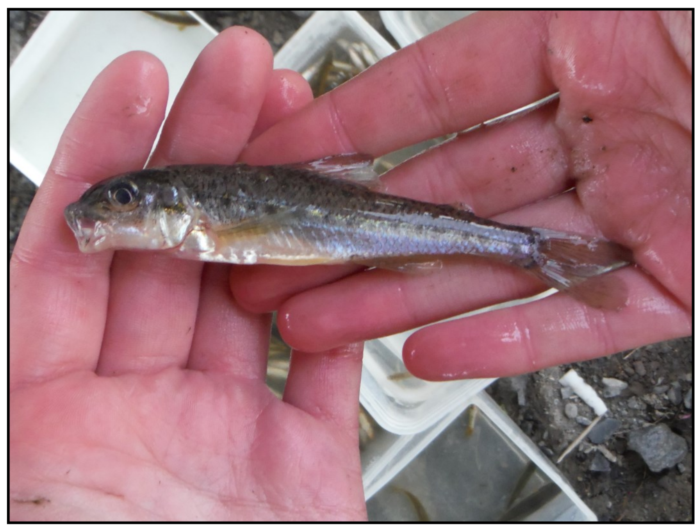


Figure 30 McEwan Creek fish sampling locations

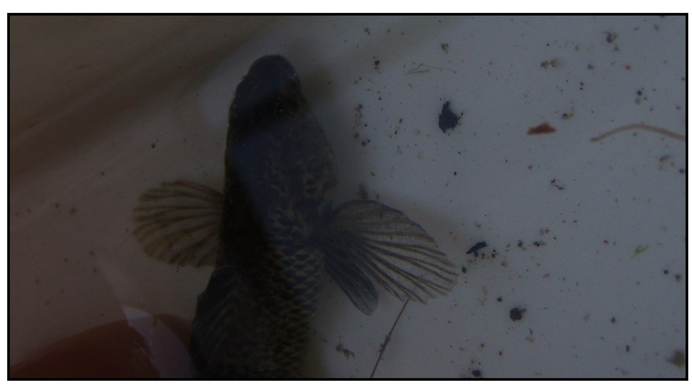
Windemere trap set along the shore of McEwan Creek

Table 2 Fish species observed in McEwan Creek

Species	Code
Banded killifish	BaKil
Blacknose dace	BnDac
Bluntnose minnow	BnMin
Brassy minnow	BrMin
Brook stickleback	BrSti
Cyprinid Spp	CA_MI
Central mudminnow	CeMud
Common shiner	CoShi
Creek chub	CrChu
Etheostoma Sp.	EthSp
Fathead minnow	FhMin
Finescale dace	FsDac
Lepomis Sp.	LepSp
Longnose dace	LnDac
Northern redbelly dace	NRDac
Trout-perch	TrPer
White sucker	WhSuc



Trout-perch captured on McEwan Creek



Etheostoma Sp. captured on McEwan Creek

Migratory Obstructions

Migratory obstructions represent limitations to fish dispersal within a system and may restrict access to important spawning and rearing habitat. Barriers can be natural or man-made features, with either seasonal or permanent influence.

Migratory obstructions were identified at three locations within the McEwan Creek catchment (Figure 31). A minor seasonal barrier was observed downstream of the Hunt Club Rd crossing, in addition to multiple debris dams along the Mather Award drain.

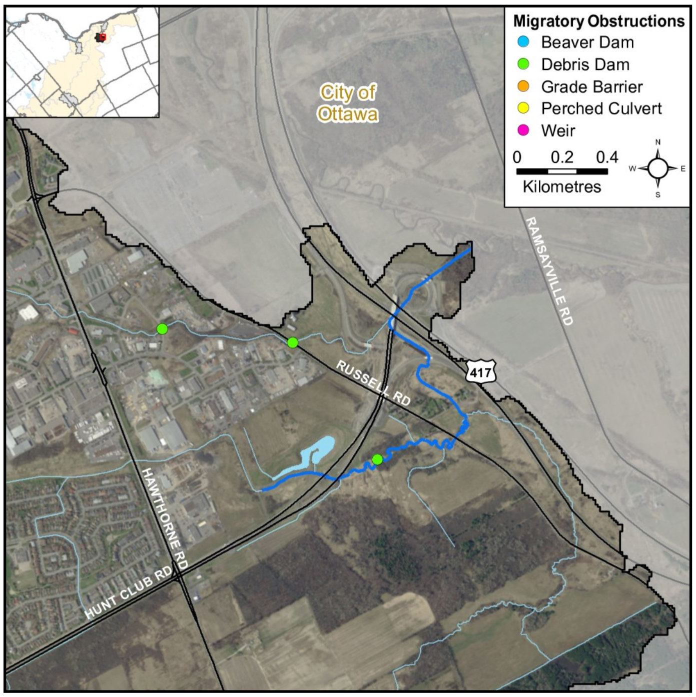


Figure 31 McEwan Creek migratory obstructions

Debris dam observed in McEwan Creek

Beaver Dams

Beaver dams are considered potential barriers to fish migration. No active dams were identified on McEwan Creek in 2016.

Point bar along a meander of McEwan Creek

Confluence of McEwan Creek and the Mather Award drain

Upstream extent of McEwan Creek

Headwater Drainage Feature Assessment

Headwaters Sampling

Headwater drainage features (HDF) represent the origin from which water enters a watershed. These features convey surface flows directly from groundwater discharge, rain and melt water to the greater catchment area. HDF's have not traditionally been a component of most monitoring efforts, as their form and function on the landscape are not well established. These features may provide direct and seasonal fish habitat, as well as thermal refuge as a result of groundwater influence (OSAP Protocol, 2013). Furthermore, HDF's may be important sources, conveyors and storers of sediment, nutrients and flow, and may have an important role for terrestrial and wetland species. The RVCA is currently working with other Conservation Authorities and the Ministry of Natural Resources and Forestry to implement a sampling protocol with the goal of providing standard datasets to support scientific development and monitoring of these features. This protocol provides a direct means of characterizing the sediment and flow capacity, connectivity, form and unique features associated with each HDF (OSAP Protocol, 2013). Features are evaluated through a rapid assessment protocol and sampled at road crossings.

In 2016 the CSW program assessed 7 sites in the McEwan Creek catchment area (Figure 32).

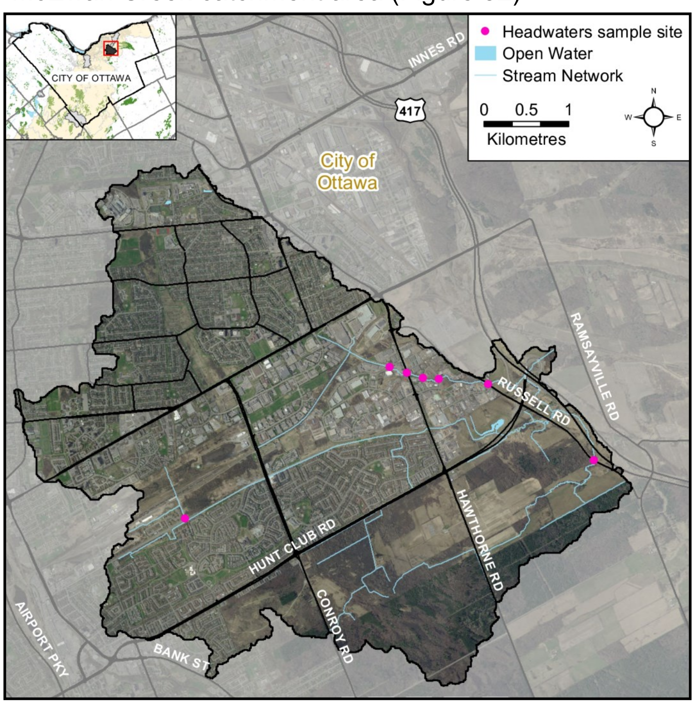


Figure 32 McEwan Creek HDF sampling sites

Feature Type

The headwater sampling protocol assesses the feature type in order to understand the function of each feature. The evaluation includes the following feature classifications: defined natural channel, channelized or constrained, multi-thread, no defined feature, tiled, wetland, swale, roadside ditch and pond outlet. By assessing the form of the HDF, we can better understand the function it provides within the catchment as it relates to the hydrology, sediment transport capacity and habitat conditions.

The McEwan Creek catchment is almost entirely modified, with 6 of the 7 headwater locations classified as channelized or constrained. One site along Russell Rd was determined to be a natural flow channel (Figure 33).

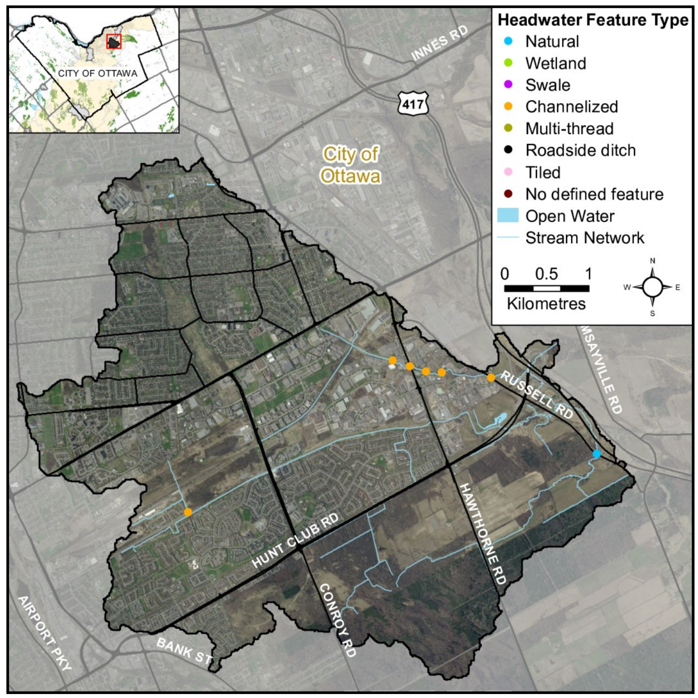


Figure 33 McEwan Creek HDF feature types

Channelized drainage feature along the Mather Award drain (Ages Dr)

Headwater Feature Flow

Flow conditions within an HDF can be highly variable as a result of seasonal factors, moisture conditions, rainfall events and snow-melt. 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 with irregular flow patterns that generally respond to specific rainstorm events or snowmelt. Flow conditions in headwater systems can change from year to year depending on local precipitation patterns.

Flow conditions in the McEwan Creek catchment were largely perennial despite low water conditions across the watershed (Figure 34). Flow within these features is likely associated with storm water input rather than baseflow contribution.

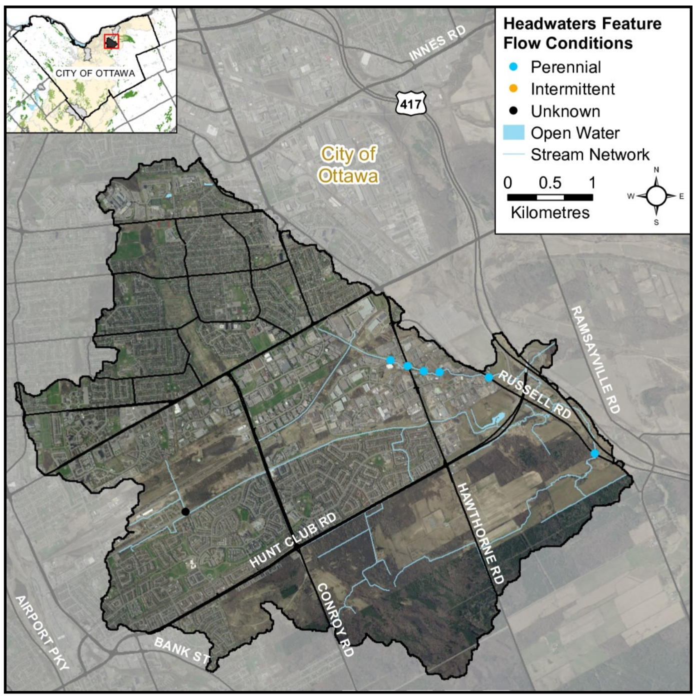


Figure 34 McEwan Creek HDF flow conditions

Perennial flow feature along the Mather Award drain (Ages Dr)

Feature Channel Modifications

Channel modifications were assessed at each headwater drainage feature sampling location. Modifications include channelization, dredging, hardening and realignments.

The majority of drainage features in the McEwan Creek catchment showed some level of modification, and included instances of dredging/straightening, channel hardening (ie. armor stone, gabions, etc), and pond modifications (Figure 35).

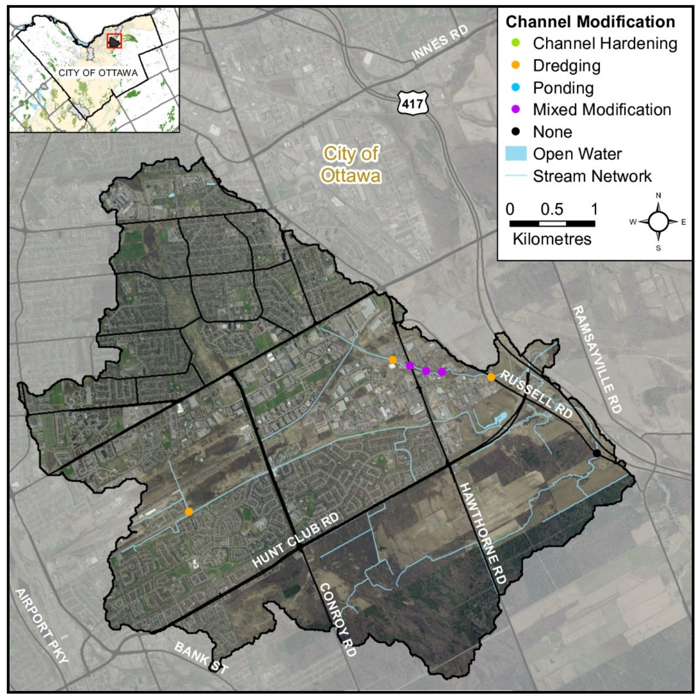


Figure 35 McEwan Creek HDF channel modifications

Channel straightening along the Mather Award drain (Ages Dr)

Headwater Feature Vegetation

Feature vegetation is evaluated as the dominant vegetation type found directly within the stream channel. Vegetation within the feature plays a significant role in flow and sediment movement, as well as providing critical aquatic and terrestrial habitat. Vegetation types include: no vegetation, lawn, wetland, meadow, scrubland and forest.

The majority of flow features within the McEwan Creek catchment were evaluated as having no defined vegetation, and account for 86% of the surveyed sites (Figure 36). Meadow vegetation was identified at a single site along Johnson Rd.

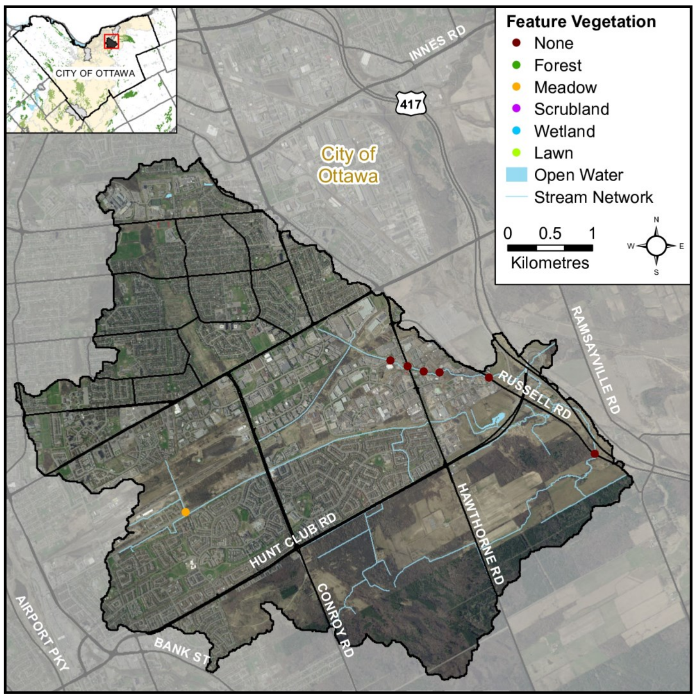


Figure 36 McEwan Creek HDF feature vegetation

Instream meadow vegetation along Johnston Rd

Headwater Feature Riparian Vegetation

Riparian vegetation is evaluated as the dominant vegetation type observed within 3 standardized shoreline zones. The vegetative community is assessed at 0-1.5m, 1.5-10m and 10-30m from the stream bank.

Riparian conditions within the McEwan Creek catchment were predominantly modified, with 86% of sites evaluated as having some degree of buffer loss (Figure 37). Natural riparian conditions were observed at a single site along Russell Rd.

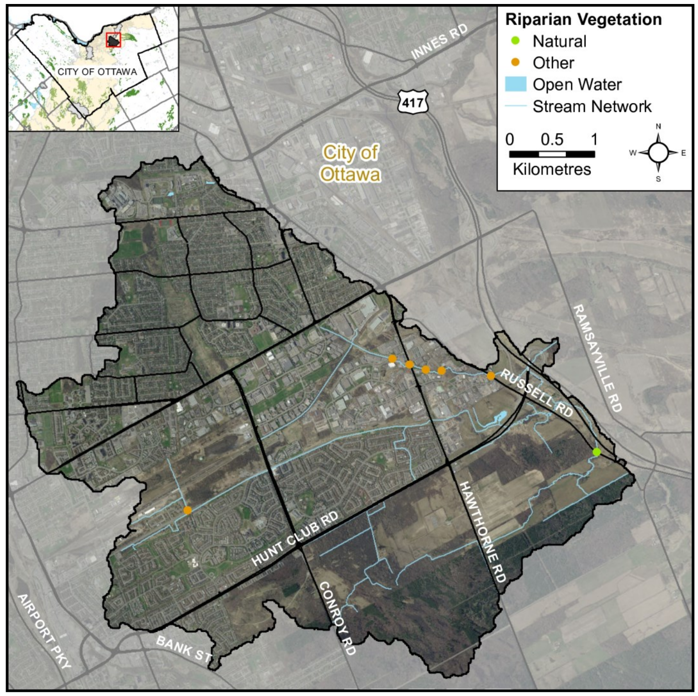


Figure 37 McEwan Creek HDF riparian vegetation

A natural scrubland buffer along Russell Rd

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 for further assessment and potential implementation of best management practices.

Sediment deposition within the McEwan Creek catchment was assessed at moderate to extensive in greater than 70% of monitoring sites (Figure 38). Features along the Mather Award Drain accounted for the majority of observations, with moderate to extensive levels observed along all surveyed sites.

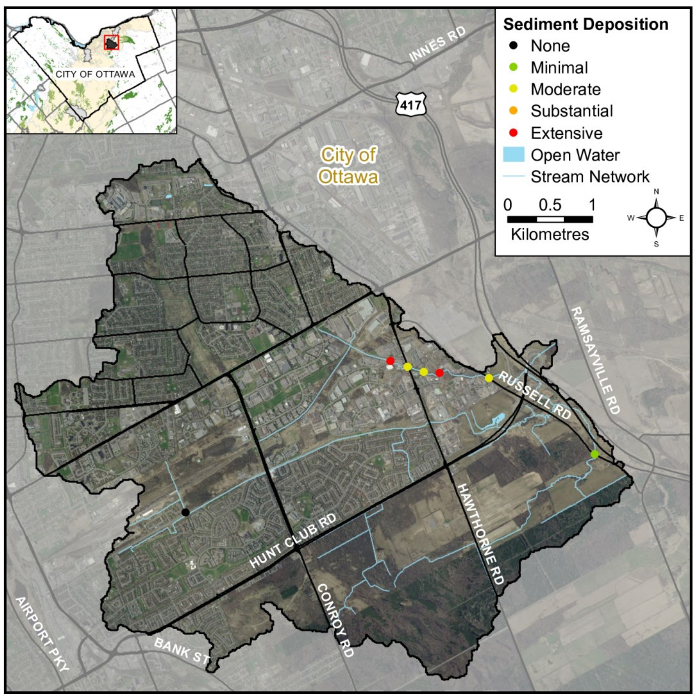


Figure 38 McEwan Creek HDF sediment deposition

Extensive sediment deposition observed along the Mather Award drain (Overton Dr)

Headwater Feature Upstream Roughness

Feature roughness is a measure of the amount of material within the bankfull channel capable of slowing water velocity and stabilizing flows (OSAP, 2013). Materials on the channel bottom that provide roughness include vegetation, woody debris and boulders/cobble substrates. Roughness can promote for reduced erosion downstream of the feature, as well as providing important habitat to aquatic organisms.

Feature roughness was predominantly low, with minimal instream cover present identified (Figure 39). Extreme levels were identified at a single site, and correspond with dense emergent vegetation within the feature.

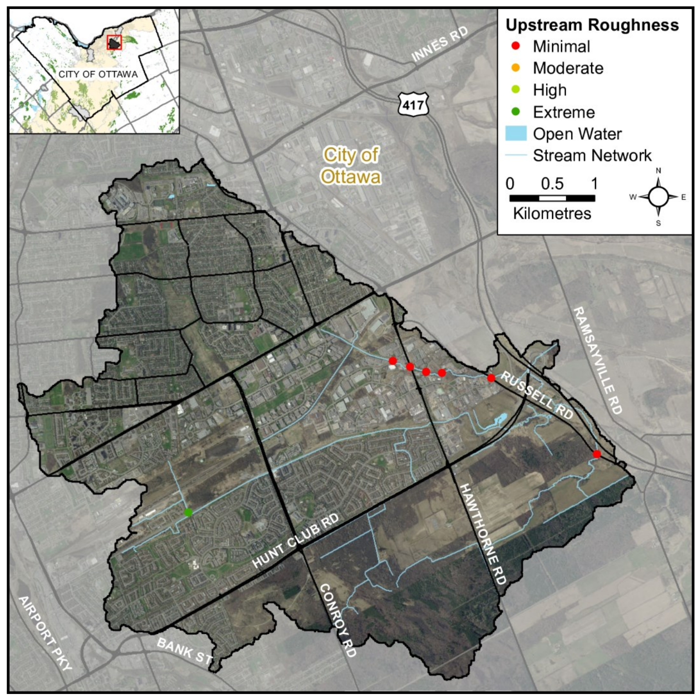


Figure 39 McEwan Creek HDF feature roughness

Minimal feature roughness observed along the Mather Award drain (Hawthorne Rd)

Stream Comparison Between 2010 and 2016

The following tables provide a comparison of observations on McEwan Creek between the 2010 and 2016 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.

Water Chemistry

Water chemistry parameters are tracked throughout the entire surveyed stream and reflect the general conditions, stability and quality of the environment. Shifts in these conditions can be indicative of general ecological changes within the environment, but also enable us to better understand the natural level of variability within the system (Table 3).

Between 2010-2016, average pH levels on McEwan Creek were comparable, with little variation between the two study periods. Conversely, stream conductivity was found to have increased significantly by an average of 337 µs/cm. Dissolved oxygen conditions were found to be in decline, with an average decrease of 1.16 mg/L. Changes in the stream conductivity and dissolved oxygen indicate a potential shift towards reduced ecological function, however given the limited scale of the data set (2 sampling years), it is difficult to determine if this trend falls within a natural level of variability or is a result of impairment.

Stream temperatures were monitored via stationary temperature loggers (*see thermal classification—Page 13)* and concurrently during stream sampling. General temperature observations identified a significant increase in stream temperatures by an average of 4.65 ºC. In order to account for differences in climate factors such as daily air temperature and precipitation, a standardized stream temperature assessment[1] was also utilized. Between 2010-2016, the stream temperature factor was found to be comparable, with a slight trend towards warmer temperatures.

Table 3 Water chemistry comparison (2010/2016)

Water Chemistry (2010—2016)				
YEAR	**PARAMETER**	**UNIT**	**AVERAGE**	**STND ERROR**
2010	pH	-	7.87	+/- 0.01
2016	pH	-	7.85	+/- 0.02
2010	Sp. Conductivity	us/cm	1021	+/- 65
2016	Sp. Conductivity	us/cm	1358	+/- 41
2010	Dissolved Oxygen	mg/L	9.78	+/- 0.13
2016	Dissolved Oxygen	mg/L	8.62	+/- 0.15
2010	Water Temperature	ºC	16.13	+/- 0.18
2016	Water Temperature	ºC	20.78	+/- 0.35
2010	Standardized Stream Temperature[1]	ºC Water / 1ºC Air	0.77	+/- 0.02
2016	Standardized Stream Temperature[1]	ºC Water / 1ºC Air	0.80	+/- 0.01

[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
- All temperatures points to be collected in July/August
- Logger must be deployed in flowing waters

Invasive Species

Invasive species presence was compared between 2010-2016 to determine if the overall distribution of these species had changed (Table 4). In general, invasive species presence was observed to have increased within McEwan Creek. Species such as *common buckthorn, flowering rush, Himalayan balsam,* and *wild parsnip* were identified in more than double the amount of sites observed in the previous study year (2010). Conversely, *garlic mustard* and *purple loosestrife* were found to be in decline and may be associated with on-going management efforts.

Table 4 Invasive species presence (2010/2016)

Invasive Species	2010 (%)	2016 (%)	+/-
Total	96%	100%	▲
Common buckthorn	4%	64%	▲
Flowering rush	4%	12%	▲
Garlic Mustard	63%	52%	▼
Himalayan balsam	42%	96%	▲
Manitoba maple	34%	56%	▲
Poison/Wild parsnip	13%	88%	▲
Purple loosestrife	63%	36%	▼

Pollution

Garbage accumulation on McEwan Creek was found to be in decline from 2010 –2016 (Table 5). In 2010, garbage was identified in 100% of all surveyed sections. By comparison, 88% of sites in 2016 were found to have some form of garbage/pollution. Efforts were also undertaken in 2016 to further reduce potential waste within McEwan Creek. Clean up efforts accounted for 36% of the identified waste areas, further reducing the overall levels observed.

Table 5 Pollution levels (2010/2016)

Pollution/Garbage	2010 (%)	2016 (%)	+/-
Total	100%	88%	▼
Floating garbage	54%	32%	▼
Garbage on stream bottom	83%	64%	▼
Other	0%	4%	-

Instream Aquatic Vegetation

Aquatic vegetation presence was compared between 2010-2016 to determine if the overall distribution of these plant communities had changed (Table 6) The presence of emergent and submergent plant communities was found to have increased in 2016 and may be associated with favourable habitat due to low water conditions. In addition, algae coverage was found to have decreased by 12% over the surveyed area.

Table 6 Instream aquatic vegetation (2010/2016)

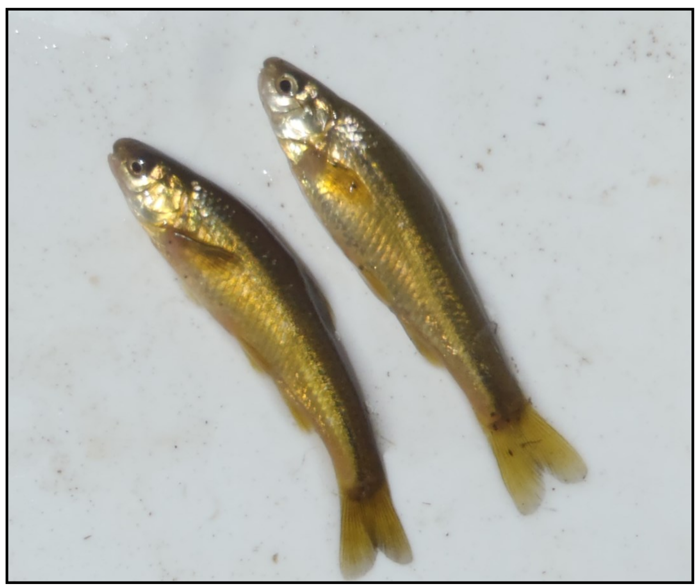
Instream Vegetation	2010 (%)	2016 (%)	+/-
Narrow-leaved emergents	17%	32%	▲
Broad-leaved emergents	0%	12%	▲
Robust emergents	0%	28%	▲
Free-floating plants	0%	0%	-
Floating plants	0%	0%	-
Submerged plants	25%	60%	▲
Algaes	96%	84%	▼

Fish Community

Fish sampling was conducted on McEwan Creek by the City Stream Watch program in 2010 and 2016 (Table 7). In total, 16 species of fish have been captured through City Stream Watch fish sampling efforts. In 2010, 7 species were captured with all species recaptured in the following sample sessions. In 2016, 16 fish species were identified, as sampling efforts were increased significantly. No species of note or special consideration were identified.

Table 7 Comparison of fish species caught in 2010 and 2016

Species	Code	2010	2016
Banded killifish	BaKil		X
Blacknose dace	BnDac	X	X
Bluntnose minnow	BnMin		X
Brassy minnow	BrMin		X
Brook stickleback	BrSti	X	X
Cyprinid Spp	CA_MI		X
Central mudminnow	CeMud	X	X
Common shiner	CoShi		X
Creek chub	CrChu	X	X
Etheostoma Sp.	EthSp	X	X
Fathead minnow	FhMin		X
Finescale dace	FsDac		X
Lepomis Sp.	LepSp		X
Longnose dace	LnDac	X	X
Northern redbelly dace	NRDac		X
Trout-perch	TrPer		X
White sucker	WhSuc	X	X



Brassy minnows captured in McEwan Creek

Monitoring and Restoration

Monitoring and Restoration Projects on McEwan Creek

Table 8 highlights recent monitoring and restoration work that has been done on McEwan Creek by the Rideau Valley Conservation Authority. Potential restoration opportunities are listed on the following page.

Table 8 Monitoring and Restoration on McEwan Creek

Accomplishment	Year	Description
City Stream Watch Stream Monitoring	2010	24 stream surveys completed on McEwan Creek
	2016	25 stream surveys completed on McEwan Creek
City Stream Watch Fish Sampling	2010	5 fish community sites were sampled in McEwan Creek
	2016	8 fish community sites were sampled in McEwan Creek
City Stream Watch Thermal Classification	2010	2 temperature probes were deployed in McEwan Creek
	2016	3 temperature probes were deployed in McEwan Creek
City Stream Watch Headwater Drainage Feature Assessment	2016	9 headwater drainage feature sites were sampled in the McEwan Creek catchment
City Stream Watch Stream Cleanups	2016	City stream watch volunteers assisted in cleaning over 950m of shoreline during 2 cleanup sessions
City Stream Watch Invasive Species Removal	2016	City stream watch volunteers assisted in the removal of Himalayan balsam over 1 removal session

Volunteer assisting with stream surveys on McEwan Creek

Temperature probe installation in McEwan Creek

Potential Riparian Restoration Opportunities

Riparian restoration opportunities were assessed in field and include potential enhancement through riparian planting, erosion control, invasive species management and/or wildlife habitat creation (Figure 40).

Invasive Species Control

Invasive species were widespread across the catchment, with several regions of high relative density. *Himalayan balsam* was identified over 96% of the surveyed stream, and was found to be present in several headwater locations. Effective management will require targeted removal into the upper reaches of the system.

Riparian Planting

Riparian planting locations were identified in regions of low relative diversity. The shoreline zones downstream of the HWY 417 crossing could benefit from enhanced riparian cover.

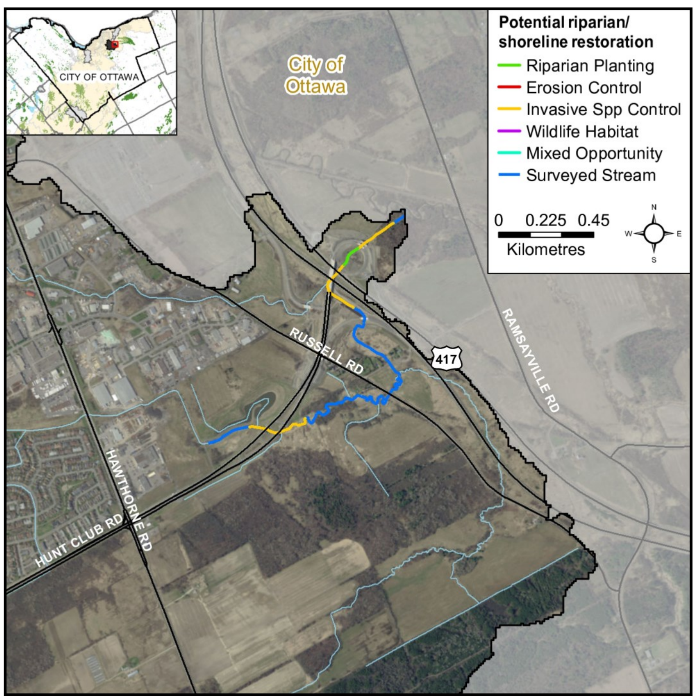


Figure 40 Potential riparian/shoreline restoration opportunities

Himalayan balsam identified along the shoreline of McEwan Creek

Potential Instream Restoration Opportunities

Instream restoration opportunities were assessed in field and include potential enhancement through channel modification, stream cleanups and fish habitat creation (Figure 41).

Stream Cleanup

Efforts were employed to remove garbage in 2016, however several locations still exist which could benefit from a cleanup. Garbage accumulation was identified in proximity to Hunt Club Rd, Russell Rd and Overton Dr.

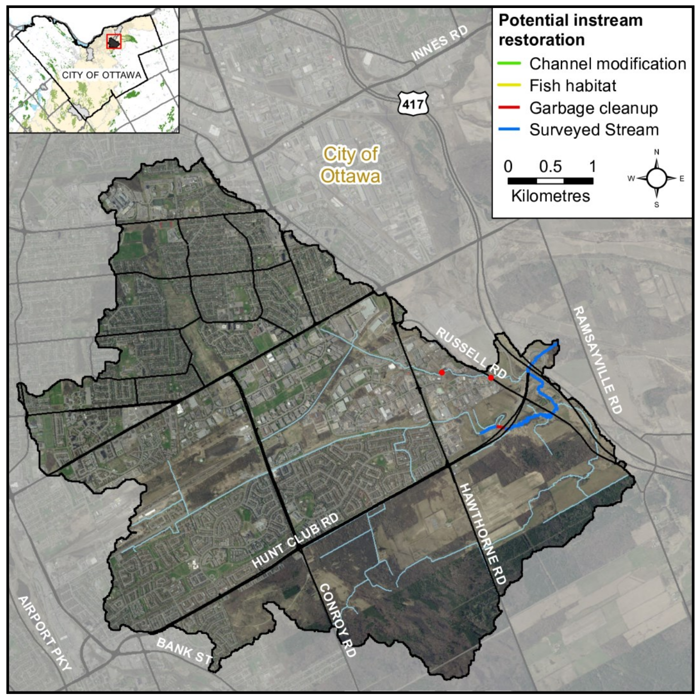


Figure 41 Potential instream restoration opportunities

Low diversity riparian area along McEwan Creek



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For more information on the overall 2016 City Stream Watch Program and the volunteer activities, please refer to the City Stream Watch 2016 Summary Report.