Borthwick Creek 2013 Summary Report

Watershed Features	
Area	11.08 square kilometres 0.26% of the Rideau Valley watershed
Land Use	34% agriculture 2% urban 28% forest 35% wetlands 1% unclassified
Surficial Geology	28% clay 27% organic 45% sand
Watercourse Length and Type	*Watercourse Type:* 39% natural 61% channelized *Flow Type:* 100% permanent
Invasive Species	There were four invasive species observed by CSW staff in 2013: purple loosestrife, European frogbit, buckthorn, Manitoba maple
Fish Community	13 fish species have been captured in Borthwick Creek. No game fish species present

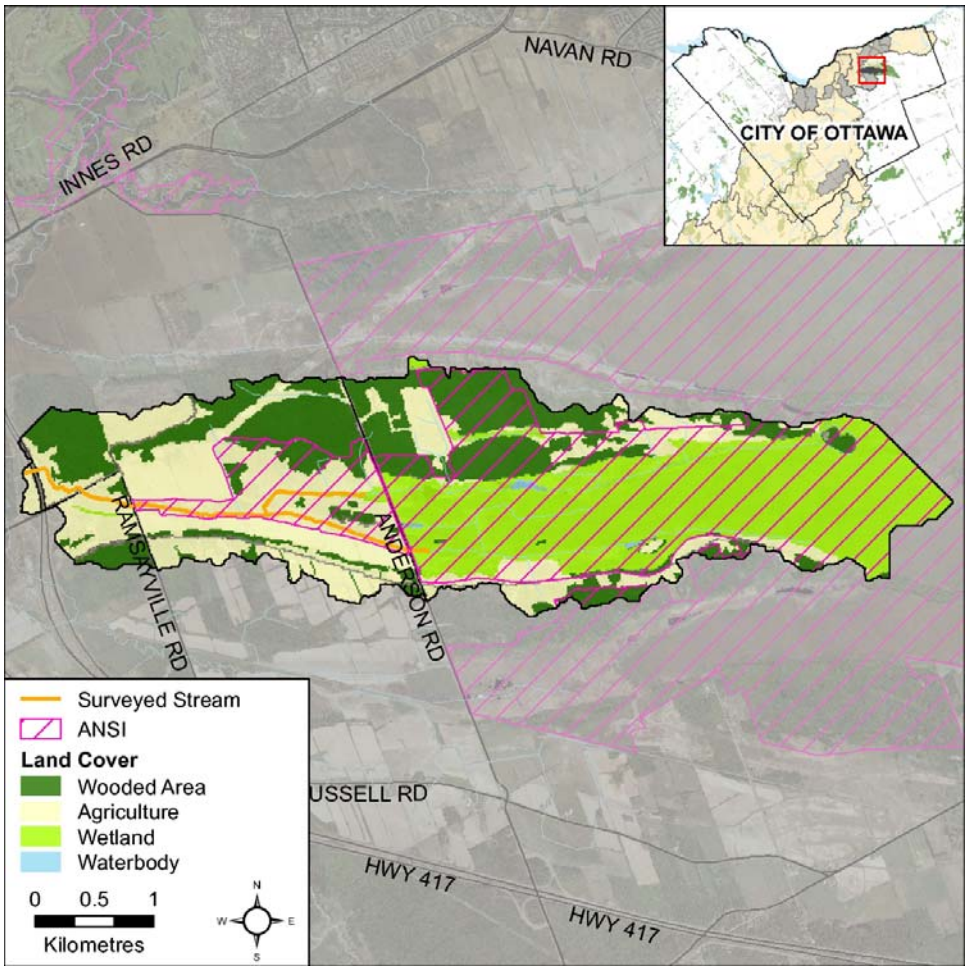

Figure 1 Land cover in the Borthwick Creek catchment

Wetland Cover
35% of the watershed is wetland
Wetlands make up 56% of the vegetation cover

Vegetation Cover		
Types	**Hectares**	**% of Cover**
Wetlands	392	56
Wooded Areas	295	42
Hedgerow	1	0
Plantation	12	2
TOTAL COVER		**100%**

Woodlot Cover		
Size Category	**Number of Woodlots**	**% of Woodlot Cover**
<1 ha	57	4
1-9 ha	18	16
10-30 ha	3	21
>30 ha	3	59
TOTAL COVER		**100%**

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 2013 City Stream Watch collaborative.

Introduction

Borthwick Creek is approximately four kilometres long and joins with Ramsay Creek to form Greens Creek north of Walkey Road. The headwaters of Borthwick Creek begin in the Mer Bleue wetland, which is a Provincially Significant Wetland, a Wetland of International Importance under the Ramsar convention, and an Area of Natural and Scientific Interest (ANSI). From it's headwaters, Borthwick Creek runs through property owned and managed by the National Capital Commission before it crosses Ramsayville Road, Walkley Road and Highway 417.

As part of the City Stream Watch monitoring activities in 2013, 32 sections of Borthwick Creek were surveyed by staff and volunteers. There was no clearly defined channel in the upper reaches as the creek transitioned to wetland therefore these sections were not surveyed. In addition, 15 sections of a secondary branch that runs parallel to Borthwick Creek were also surveyed this season. The results presented in this report are a summary of data collected from Borthwick Creek as well as the branch that was surveyed.

Borthwick 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. Borthwick Creek surpassed this target by having a buffer of greater than 30 meters along 78 percent of the right bank and 94 percent along the left bank. Figure 2 demonstrates the buffer conditions of the left and right banks separately.

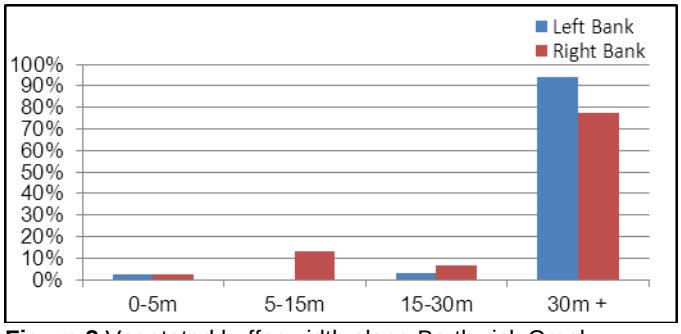

Figure 2 Vegetated buffer width along Borthwick Creek

Well vegetated buffer along Borthwick Creek

Adjacent Land Use

The RVCA's Stream Characterization Survey Program identifies six different land uses beside Borthwick Creek (Figure 3). Surrounding land use is considered from the beginning to end of the survey section (100m) 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 90 percent of the stream, characterized by forest, scrubland, meadow and wetland. Eight percent of the land use was abandoned field and the remaining two percent of the land use consisted of infrastructure.

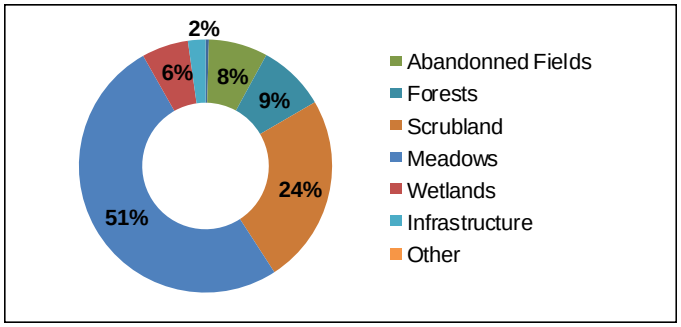

Figure 3 Land use along Borthwick Creek

Infrastructure along Borthwick Creek where it crosses Highway 417

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 that bank erosion was very limited along Borthwick Creek. There were low levels of bank erosion observed between Walkley Road and Ramsayville Road, and virtually no bank erosion observed along the rest of the surveyed 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 Borthwick Creek had low levels of undercut banks along many sections of the creek. No bank undercutting was observed in the creek sections that flowing east of Ramsayville Road as well as the secondary branch that was surveyed, whereas moderate levels of undercut banks were observed along a stretch of the tributary downstream of Anderson Road.

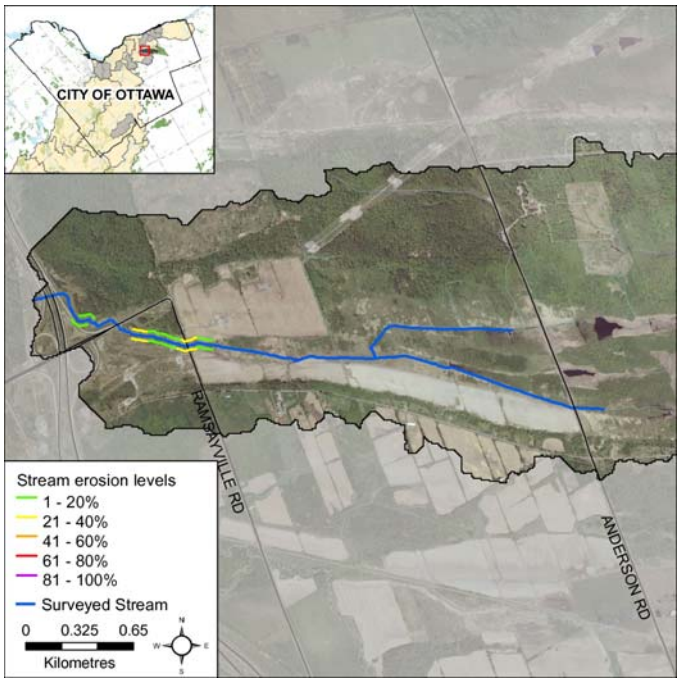

Figure 4 Erosion along Borthwick Creek

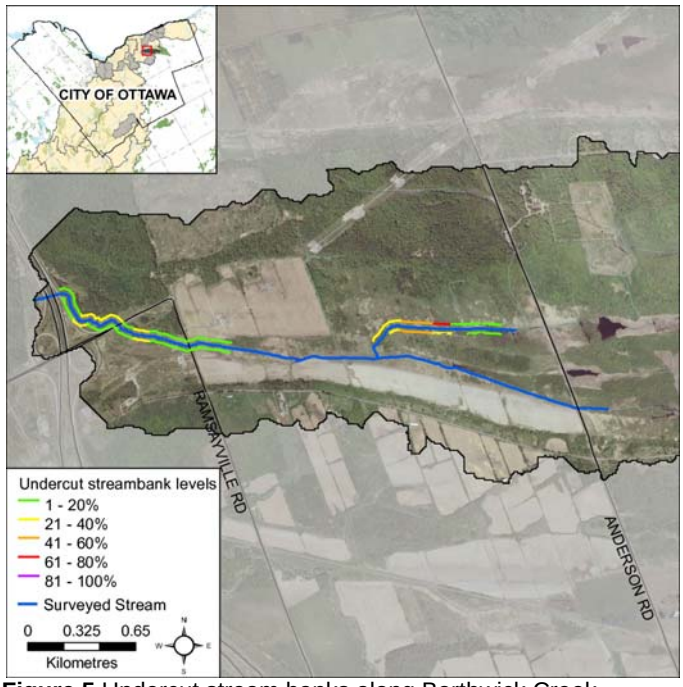

Figure 5 Undercut stream banks along Borthwick Creek

Low level stream bank undercutting along Borthwick Creek between Walkley Rd. and Ramsayville Rd.

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 Borthwick Creek. Low to moderate levels were seen along most of the creek. High levels of shading were observed in areas where the creek narrowed and overhanging grasses provided shade.

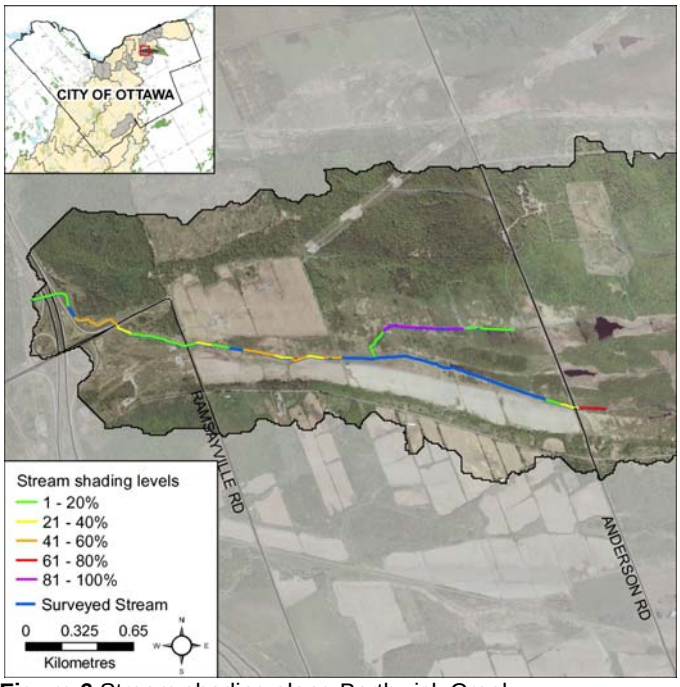

Figure 6 Stream shading along Borthwick Creek

Stream shade along Borthwick Creek

Instream Woody Debris

Figure 7 shows that many sections along Borthwick Creek had low levels of instream woody debris in the form of branches and trees. Instream woody debris is important for fish and benthic habitat, by providing refuge and feeding areas.

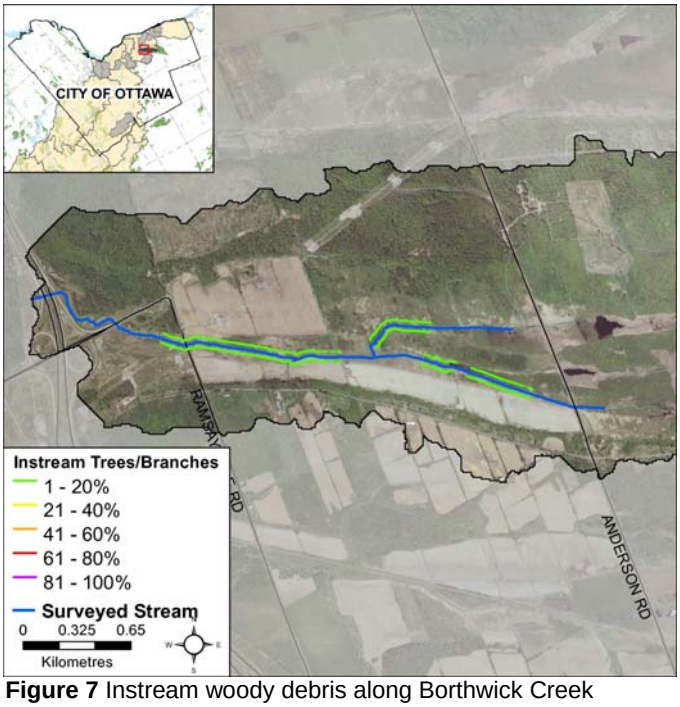

Figure 7 Instream woody debris along Borthwick Creek

Instream woody debris resulting from beaver activity on Borthwick Creek

Overhanging Trees and Branches

Figure 8 shows that some sections of Borthwick Creek had low levels of overhanging branches and trees. The limited amounts of overhanging trees and branches are likely due to the fact that much of the creek is bordered by meadow and scrubland with very little tree cover. Overhanging branches and trees provide a food source, nutrients and shade which helps to moderate instream water temperatures.

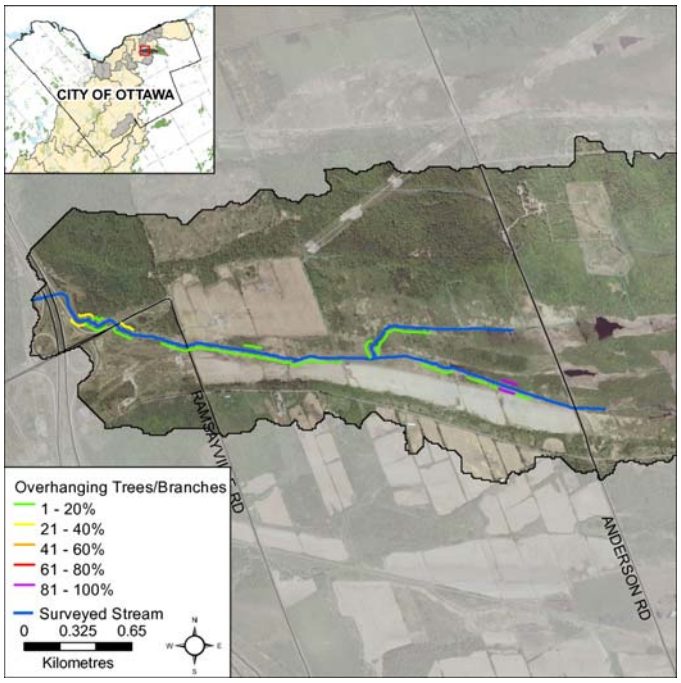

Figure 8 Overhanging trees and branches

Overhanging trees and branches on Borthwick Creek

Anthropogenic Alterations

Figure 9 shows that 25 percent of the sections on Borthwick Creek remain “unaltered” or "natural". Sections considered "altered" account for two percent of the stream, while 73 percent of the sections sampled were considered “highly altered”. The high percentage of highly altered sections is due to channelization of Borthwick Creek east of Ramsayville Road. Areas classified as altered included existing road crossings, shoreline/instream modifications such as channelization and areas with little or no buffer.

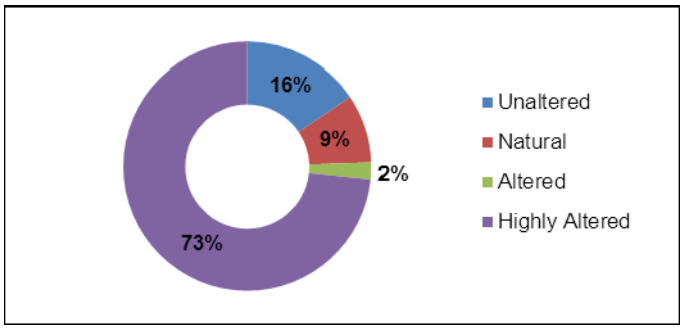

Figure 9 Anthropogenic alterations along Borthwick Creek

Stream channelization along Borthwick Creek

Borthwick Creek Instream Aquatic Habitat

Habitat Complexity

Streams are naturally meandering systems and move over time; there are varying degrees of habitat complexity, depending on the creek. Examples of habitat complexity include variable 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. Twenty-one percent of Borthwick Creek was considered heterogeneous, as shown in Figure 10.

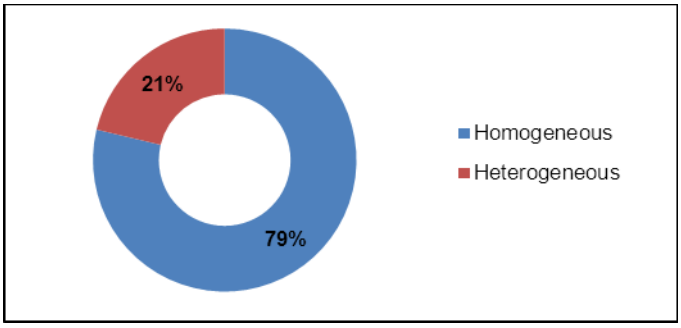

Figure 10 Instream habitat complexity in Borthwick Creek

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).
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 12 shows that cobble and boulder substrate was only found in the first few sections of Borthwick Creek near Highway 417 and Walkley Road.

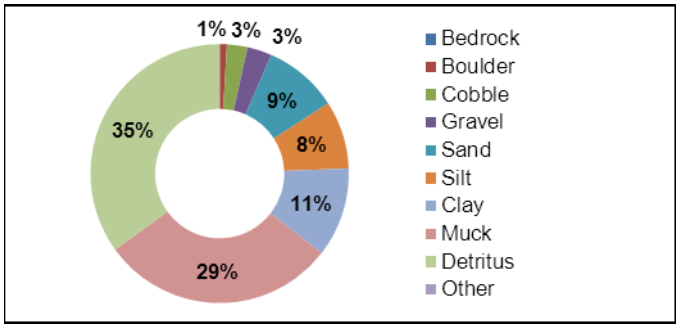

Figure 11 Instream substrate along Borthwick Creek

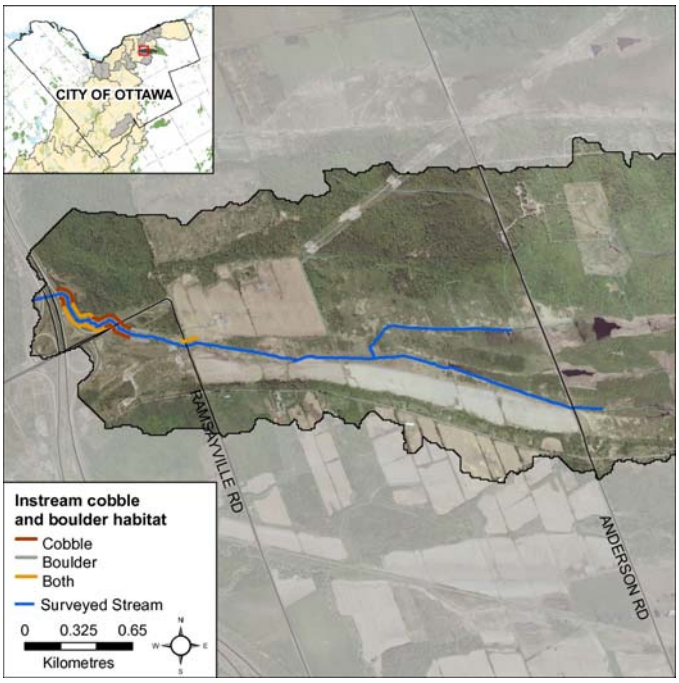

Figure 12 Instream substrate along Borthwick Creek

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 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 13 shows that Borthwick Creek has minimal instream morphology variability; 67 percent consists of runs, 33 percent consists of pools and no riffles were recorded .

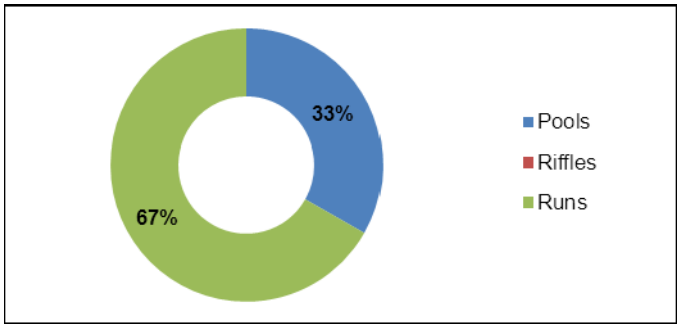

Figure 13 Instream morphology along Borthwick Creek

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 shoreline protection from wave action and important rearing habitat for species of 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 and can keep temperatures cool while reducing algae growth. Borthwick Creek has high diversity of instream vegetation. The dominant vegetation type, recorded at 41 percent, is submerged plants. Figure 14 depicts the plant community structure for Borthwick Creek.

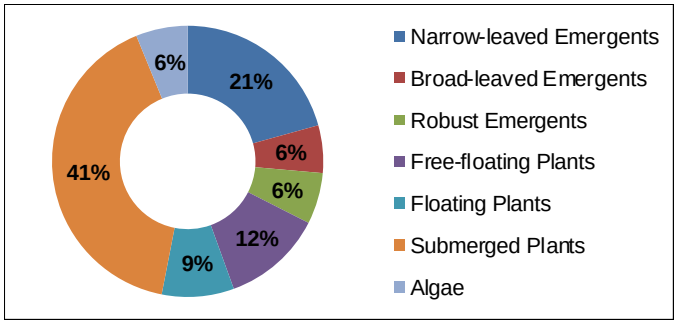

Figure 14 Vegetation types along Borthwick Creek

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 15 demonstrates that Borthwick Creek has moderate to high levels of instream vegetation with extensive and common levels accounting for 59 percent. High levels of vegetation are the result of invasive European frogbit being present in the creek.

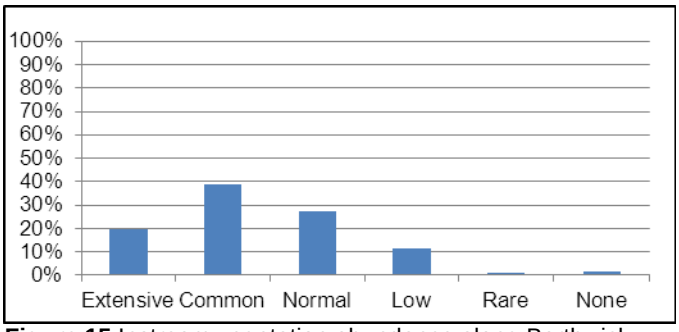

Figure 15 Instream vegetation abundance along Borthwick Creek

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. Seventy-seven percent of the sections surveyed along Borthwick Creek had invasive species (Figure 16). The invasive species observed along Borthwick Creek were Manitoba maple (*Acer negundo*), purple loosestrife (*Lythrum salicaria*), buckthorn (*Rhamnus),* and European frogbit (*Hydrocharis morsus-ranae)*.

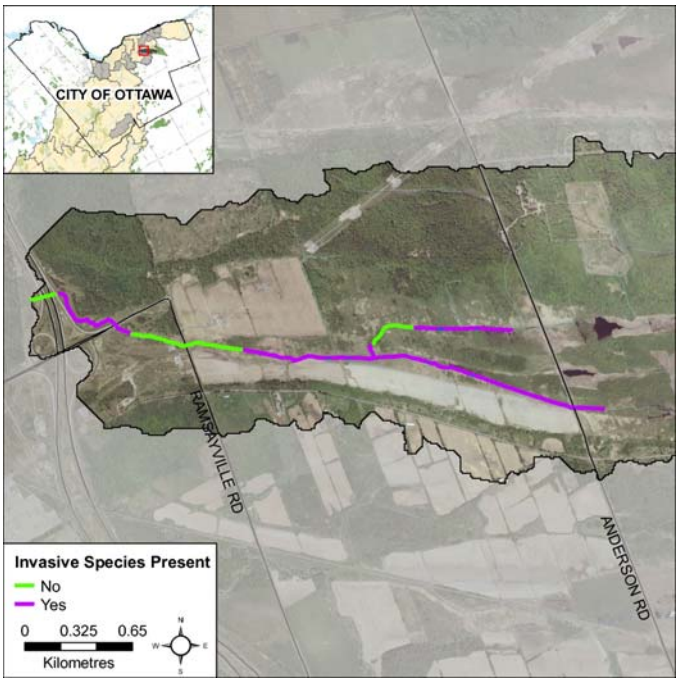

Figure 16 Invasive species along Borthwick Creek

European frogbit is an invasive species found on Borthwick Creek

Wildlife

The diversity of fish and wildlife populations can be an indicator of water quality and overall stream health. Table 1 is a summary of all wildlife observed during stream surveys.

Wildlife	Observed
Birds	mallard, great blue heron, green heron, blue jay, common yellow throat, white throated sparrow, robin, chipping sparrow, yellow warbler, crow, goldfinch, red-winged black bird, killdeer, song sparrow, mourning dove, catbird, downey woodpecker, swallow, black-capped chickadee, turkey vulture
Mammals	deer, raccoon tracks, mole
Reptiles/Amphibians	green frog, tadpoles, bull frog, toad, garter snake
Aquatic Insects	water strider, water scorpion
Other	dragonfly, damselfly, clubtail dragonfly, cabbage white butterfly, sulfer butterfly, monarch butterfly, mosquito, deerfly, bumblebee, horsefly, cricket, wasp, ladybug, snails, spider, leech, beetle

Table 1 Wildlife observed along Borthwick Creek

Pollution

Figure 17 demonstrates the incidence of pollution/ garbage in Borthwick Creek. Pollution and garbage in the stream is assessed visually and noted for each section where it is observed. Borthwick creek is a fairly pristine system that is largely free from pollution. Eighty-seven percent of the sections on Borthwick Creek did not have any observable garbage. Two percent had floating garbage, and 4 percent had garbage on the stream bottom. The few sections where garbage was observed were located where the creek runs close to Highway 417.

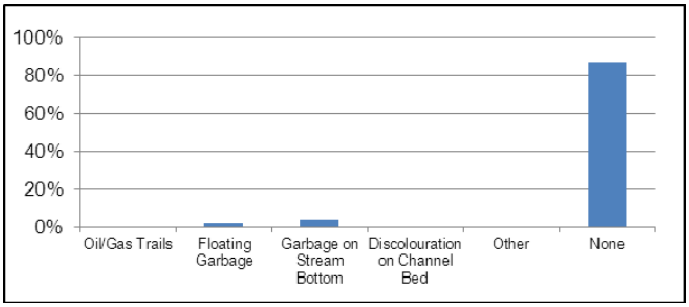

Figure 17 Pollution observed along Borthwick Creek

Water Chemistry

During the stream characterization survey, a YSI probe is used to collect water chemistry, as follows:

- Dissolved Oxygen is a measure of the amount of oxygen dissolved in water. The lowest acceptable concentration of dissolved oxygen is 6.0 mg/L for early stages of warm water fish and 9.5 mg/L for cold water fish (CCME, 1999).
- A saturation value (concentration of oxygen in water) of 90 percent or above is considered healthy. Saturation levels above one hundred percent are not uncommon in sections of stream where there are high amounts of algae and other aquatic plants.
- Conductivity is the ability of a substance to transfer electricity. This measure is influenced by the presence of dissolved salts and other ions in the stream.
- pH is a measure of relative acidity or alkalinity, ranging from 1 (most acidic) to 14 (most alkaline/ basic), with 7 occupying a neutral point.

2013 data for these four parameters is summarized in Table 2. Water chemistry data is only available for the month of July on Borthwick Creek because all of the stream surveys were conducted during that month.

Month	Range	DO (mg/L)	DO(%)	Conductivity (µs/cm)	pH
July 2013	Low	0.15	1.66	19.50	5.02
	High	7.62	84.57	1985.00	7.42

Table 2 Water chemistry collected along Borthwick Creek

Volunteers measuring water chemistry parameters using a YSI

Thermal Classification

Many factors can influence fluctuations in stream temperature, including springs, tributaries, precipitation runoff, discharge pipes and stream shading from riparian vegetation. Water temperature is used along with the maximum air temperature (using the Stoneman and Jones method) to classify a watercourse as either warm water, cool water or cold water.

Two temperature loggers were installed on Borthwick Creek from April until September. Logger 1 was installed upstream of highway 417 and logger 2 was installed at Anderson Road. Analysis of the data collected indicates that Borthwick Creek is classified as a cool water system with warm water reaches. The warmwater reaches were recorded by the logger located close to Highway 417.

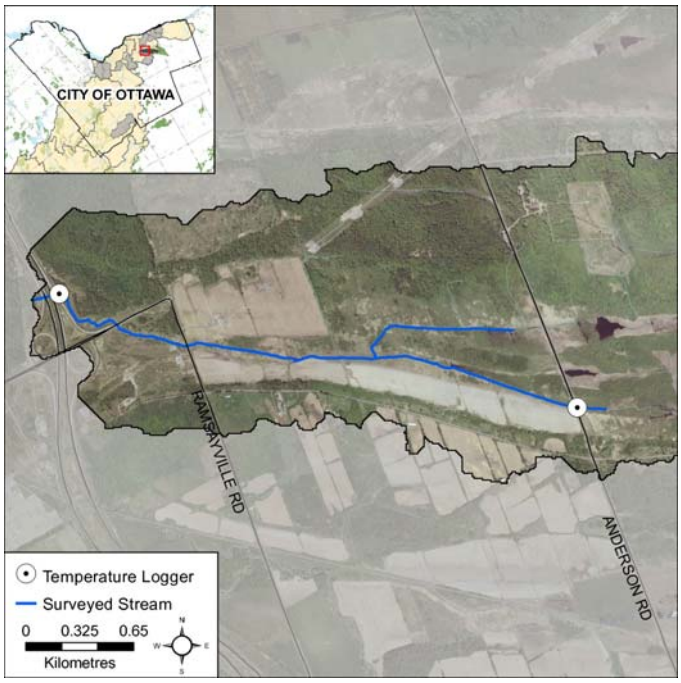

Figure 18 Temperature loggers along Borthwick Creek

Temperature logger installed near Highway 417

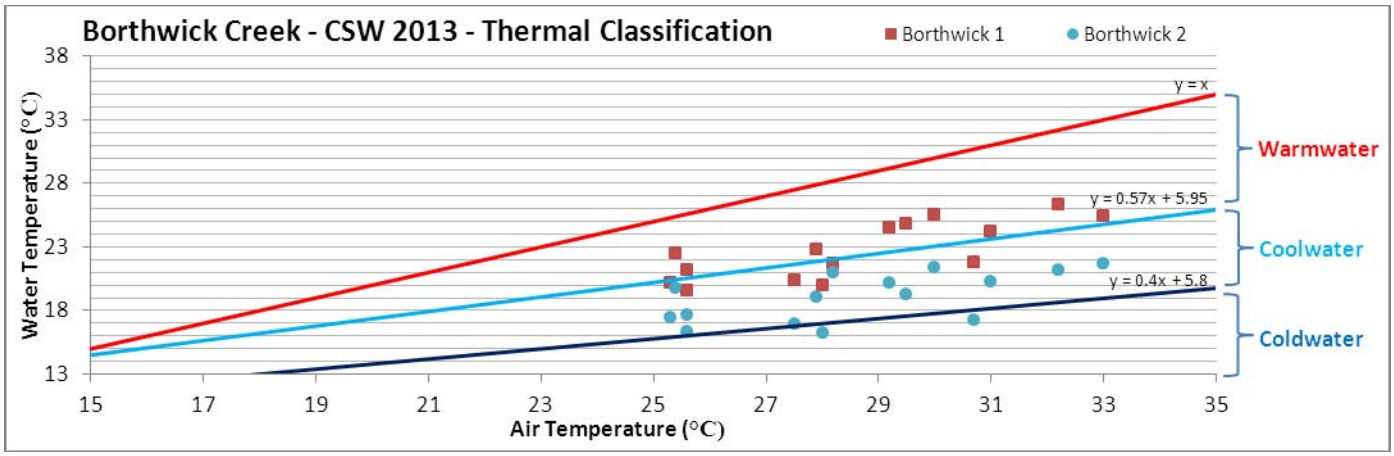

Figure 19 Thermal Classification for Borthwick Creek

Each point on the graph represents a temperature that meets the following criteria:

- Sampling dates between July 1st and September 7th
- Sampling date is preceded by two consecutive days above 24.5°C
- Water temperatures are collected at 4pm
- Air temperature is recorded as the maximum temperature for that day

Fish Sampling

Fish sampling sites located along Borthwick Creek are shown in Figure 20. The provincial fish codes shown on the following map are listed (in Table 3) beside the common name of those fish species identified in Borthwick Creek. Borthwick Creek is classified as a cool/warm water system with 13 fish species observed.

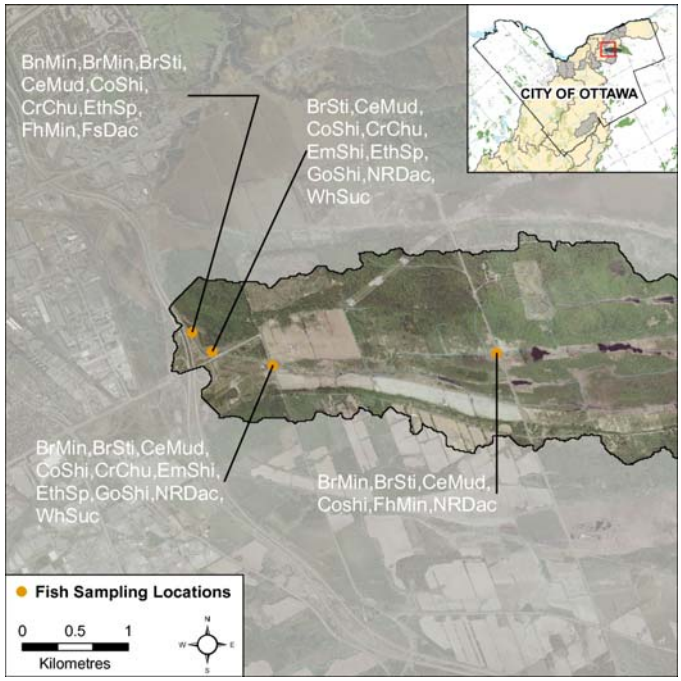

Figure 20 Borthwick Creek fish sampling

Species observed in Borthwick Creek (with fish code)			
bluntnose minnow.....	BnMin	fathead minnow.....	FhMin
brassy minnow.....	BrMin	finescale dace.....	FsDac
brook stickleback.....	BrSti	emerald shiner.....	EmShi
central mudminnow...	CeMud	golden shiner.....	GoShi
common shiner.....	CoShi	northern redbelly dace	NRDac
creek chub.....	CrChu	white sucker.....	WhSuc
Etheostoma sp.....	Ethsp		

Table 3 Fish species observed in Borthwick Creek

Northern redbelly dace captured on Borthwick Creek

Migratory Obstructions

It is important to know locations of migratory obstructions because these can prevent fish from accessing important spawning and rearing habitat. Migratory obstructions can be natural or manmade, and they can be permanent or seasonal. No migratory obstructions were observed on Borthwick Creek.

Headwater Drainage Feature Sampling

The Headwater Drainage Feature sampling protocol is a rapid assessment method characterizing the amount of water, sediment transport, and storage capacity within headwater drainage features (HDF). An HDF is a depression in the land that conveys surface flow. As a result of their importance and a lack of information for headwater drainage features the City Stream Watch program has incorporated monitoring of these systems at six sites in the Borthwick Creek catchment (Figure 21).

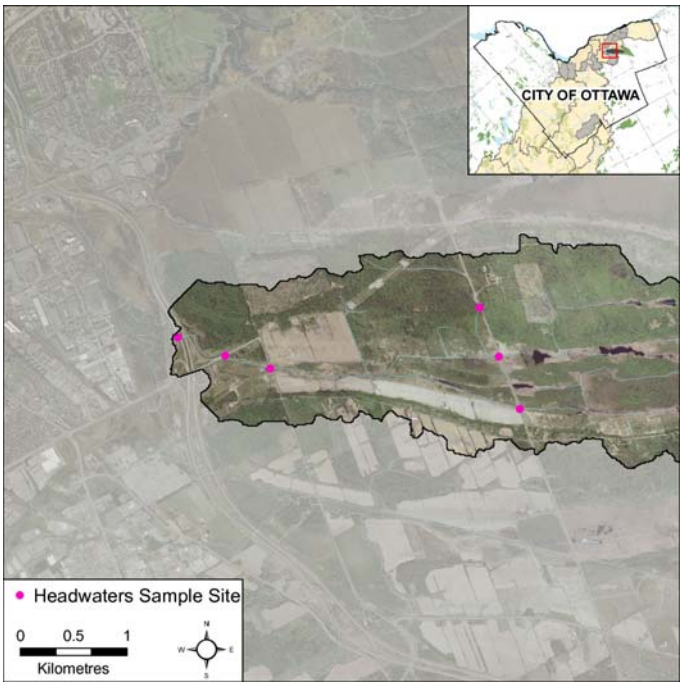

Figure 21 HDF sampling sites on Borthwick Creek

Borthwick Creek at Anderson Road during spring HDF sampling

Stream Comparison Between 2007 and 2013

The following tables provide a comparison of Borthwick Creek between the 2007 and 2013 survey years. In 2007, the secondary branch of Borthwick Creek was not surveyed, therefore for this comparison only sections that were surveyed in both years have been included.

Anthropogenic Changes

Table 4 shows that between 2007 and 2013 anthropogenic alterations along Borthwick Creek have increased. This change can be attributed to 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.

Anthropogenic Alterations	2007 (%)	2013 (%)
No anthropogenic alterations	28	13
"Natural" conditions with minor human alterations	50	13
"Altered" with considerable human impact but significant natural portions	16	3
"Highly altered" by humans with few natural portions	6	70

Table 4 Comparison of anthropogenic alterations along Borthwick Creek between 2007 and 2013

A channelized section of Borthwick Creek considered highly altered in 2013

Bank Stability Changes

According to observations bank stability has increased slightly overall since 2007. In 2007, 85 percent of the banks were considered stable. In 2013, 96 percent of both the left and right banks are stable. Borthwick is a very stable system overall due to its low banks and well vegetated riparian areas.

Bank Stability	2007 (%)	2013 (%) Left Bank	2013 %) Right Bank
Stable	85	96	96
Unstable	15	4	4

Table 5 Comparison of bank stability between 2007 and 2013

Borthwick Creek is dominated by a wetland environment making it a very stable system with little change over time

Changes in Instream Vegetation

Table 6 shows that there has been a decrease in instream vegetation in Borthwick Creek since 2007. The amount of extensive levels of vegetation totaled 25 percent in 2007, and that number has decreased to 10 percent in 2013. In addition the number of areas classified as having normal levels of vegetation has increased from 16 percent in 2007 to 33 percent in 2013.

Instream Vegetation Abundance	2007 (%)	2013 (%)
Extensive	25	10
Common	47	46
Normal	16	33
Low	9	8
Rare	3	1
None	n/a	2

Table 6 Comparison of instream vegetation levels between 2007 and 2013

Changes in Pollution and Garbage

Overall the amount of pollution and garbage in Borthwick Creek has decreased since 2007. Table 7 shows that the number of sections surveyed that were free from garbage has increased from 78 to 88 percent since 2007.

Pollution/Garbage	2007 (%)	2013 (%)
None	78	88
Floating garbage	6	9
Garbage on stream bottom	16	6
Oil or gas trails	0	0
Discoloration of channel bed	n/a	0

Table 7 Comparison of pollution/garbage levels between 2007 and 2013

Much of Borthwick Creek is located far away from road crossings and residential/urban areas so the amount of pollution and garbage is low

Fish Community Comparison

Fish sampling was conducted on Borthwick Creek by the City Stream Watch program in 2007 and 2013. In 2007, nine species were caught at one site by electrofishing. In 2013, 10 species were caught using a variety of methods (electrofishing, seining) at four different sites. Three species caught in 2007 were not found in 2013, which are common shiner, emerald shiner and golden shiner. This does not mean the species have disappeared from this creek but could be influenced by location, weather conditions or time of sampling.

Species	Code	2007	2013
bluntnose minnow.....	BnMin		X
brassy minnow.....	BrMin		X
brook stickleback.....	BrSti	X	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
emerald shiner.....	EmShi	X	
golden shiner.....	GoShi	X	
northern redbelly dace	NRDac	X	X
white sucker.....	WhSuc	X	X

Table 8 Comparison of fish species caught in 2007 and 2013

Finescale dace caught in Borthwick Creek in 2013

Monitoring and Restoration

Monitoring and Restoration Projects on Borthwick Creek

Table 9 below highlights the monitoring and restoration work that has been done on Borthwick Creek to date by the Rideau Valley Conservation Authority.

Accomplishment	Year	Description
City Stream Watch Monitoring	2007	32 stream surveys were completed by City Stream Watch volunteers and staff
	2013	47 stream surveys were completed on Borthwick Creek and a branch of Borthwich Creek by City Stream Watch volunteers and staff
City Stream Watch Fish Sampling	2007	One site was sampled on Borthwick Creek
	2013	Four sites were sampled on Borthwick Creek
City Stream Watch Thermal Classification	2007	Two temperature loggers were deployed from June to September
	2013	Two temperature loggers were deployed from April until September
City Stream Watch Headwater Drainage Feature Sampling	2013	Six headwater drainage feature sites were sampled in the Borthwick Creek catchment

Table 9 Monitoring and Restoration on Borthwick Creek

Potential Riparian Restoration Opportunities

Figure 22 depicts the locations where City Stream Watch staff and volunteers made note of riparian restoration opportunities. As much of the creek is not very well shaded and is surrounded my meadow and scrubland there are many opportunities for potential shoreline planting to increase the cover from trees and shrubs.

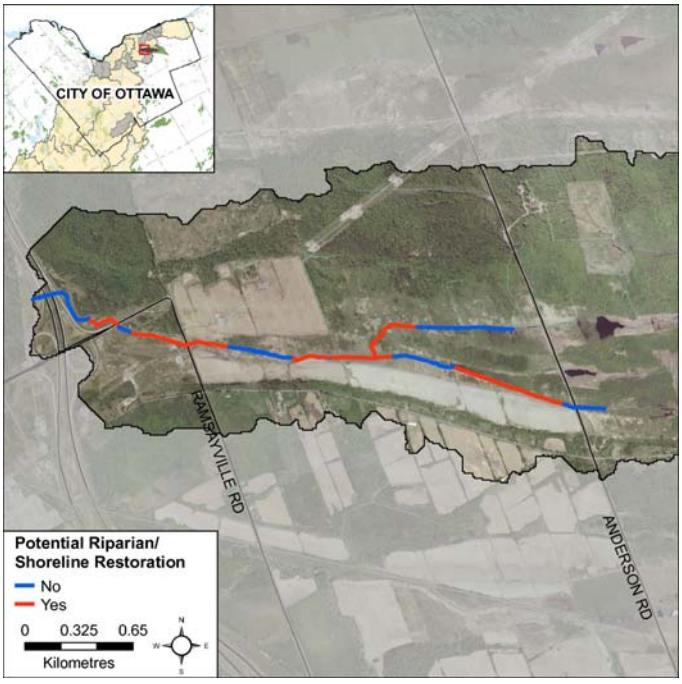

Figure 22 Potential riparian restoration opportunities

Potential Instream Restoration Opportunities

Borthwick Creek is a relatively pristine system which flows through the NCC greenbelt. No potential instream restoration opportunities were noted for this creek at this time.

Borthwick Creek



References

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For more information of the overall 2013 City Stream Watch Program and the volunteer activities, please refer to the City Stream Watch 2013 Summary Report.

To view the stream characterization protocol used, please see the City Stream Watch website: http://www.rvca.ca/programs/streamwatch/index.html