Mud Creek (GCk) 2012

Summary Report

Watershed Features

Area	15.54 square kilometres 0.37% of the Rideau River watershed
Land Use	48% agriculture 23% urban 22% forest 2% rural land-use 5% wetlands 1% unclassified
Surficial Geology	45% clay 3% diamicton 2% organic deposits 2% bedrock 48% sand
Watercourse Length and Type	*Total Length:* *Watercourse Type:* 77% natural 23% channelized *Flow Type:* 92% permanent 8% intermittent
Invasive Species	There were eight invasive species observed by CSW staff in 2012: purple loosestrife, garlic mustard, Manitoba maple, rusty crayfish, Japanese knotweed, European buckthorn, European frogbit, and flowering rush.
Fish Community	20 fish species have been captured in Mud Creek. Game fish species present include largemouth bass

Wetland Cover

5% of the watershed is wetland
Wetlands make up 19% of the vegetation cover

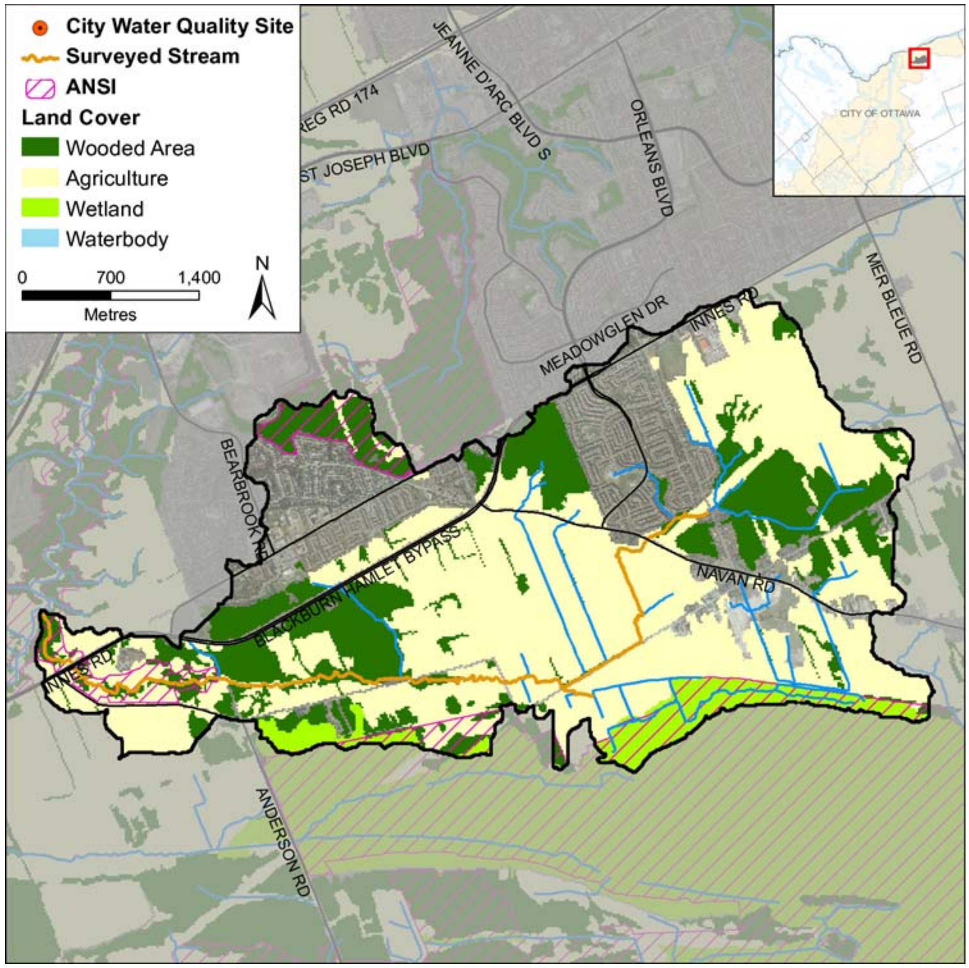

Figure 1. Land cover in the Mud Creek catchment

Vegetation Cover

Types	Hectares	% of Cover
Wetlands	81	19
Wooded Areas	327	79
Hedgerow	7	2
Plantation	2	0
TOTAL COVER		**100%**

Woodlot Cover

Size Category	Number of Woodlots	% of Woodlots
<1 ha	72	5
1-9 ha	3	50.8
10-30 ha	32	26.5
>30 ha	4	17.7

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 2012 City Stream Watch collaborative.

Introduction

Mud Creek (GCK) is approximately six kilometers long and is one of five major tributaries of Greens Creek in the east end of the City of Ottawa. The headwaters of Mud Creek begin in the Mer Bleue Wetland, which is a popular recreation destination as well as being recognized as a Wetland of International Importance by the Ramsar convention, an Area of Natural and Scientific Interest (ANSI) and a Provincially Significant Wetland. From it's headwaters Mud Creek flows through property owned by the National Capital Commission, crossing Renaud road three times and Innes road once before it empties into Green's Creek north of Innes road.

As part of the City Stream Watch monitoring activities in 2012, 61 sections along Mud Creek were surveyed by staff and volunteers. n addition, 26 sections of a tributary of Mud Creek that runs east towards Page road were also surveyed. The results presented in this report include data collected from Mud Creek as well as the tributary that was surveyed.

Low Water Conditions in the Rideau Valley Watershed

The Government of Ontario has set up the Ontario Low Water Response (OLWR), which ensures that the province is prepared for low water conditions in the future. The response plan is intended to help co-ordinate and support local response in the event of drought. Local teams are established in areas experiencing low water conditions so that the local community can carry out actions to reduce and better manage water use. As an important part of the Low Water Response Team for the watershed, the Rideau Valley Conservation Authority (RVCA) measures precipitation, stream flow and water levels which indicate the severity of low water conditions in the watershed. In 2012, the Rideau Valley Watershed was impacted by low water conditions. RVCA first declared Level 1 low water status on April 5, 2012. Level 1 status continued until July 13, 2012 when the status was increased to Level 2. On October 3, 2012 the Level 2 low water status was lifted for most of the watershed except for the Kemptville Creek subwatershed which remained at Level 1 status. This information is important to highlight as the drought impacted aquatic habitat conditions in the Rideau watershed in 2012.

Droughts are natural events that occur periodically over time. In the past, periods of dry weather and low water levels were relatively uncommon happening every decade or so. But with changing weather patterns, low water levels may occur more often, especially with increasing demand for water. It can be argued that "many species of biota, both terrestrial and aquatic, have evolved many different adaptations to contend with drought" (Humphries, 2003). However it is important to keep in mind that drought conditions can "enhance siltation, change the composition of aquatic vegetation, alter channel shape and affect water chemistry" (Lake, 2003). These changes may result in direct and indirect impacts on vegetation, fish species, invertebrates and amphibians (Lake, 2003).

Overbank Zone

Riparian Buffer along Mud Creek

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.
Figure 2 demonstrates the buffer conditions on Mud Creek for the left and right banks separately. Results show that 56 percent of the left bank and 58 percent of the right bank of Mud Creek has a buffer width greater than 30 meters.

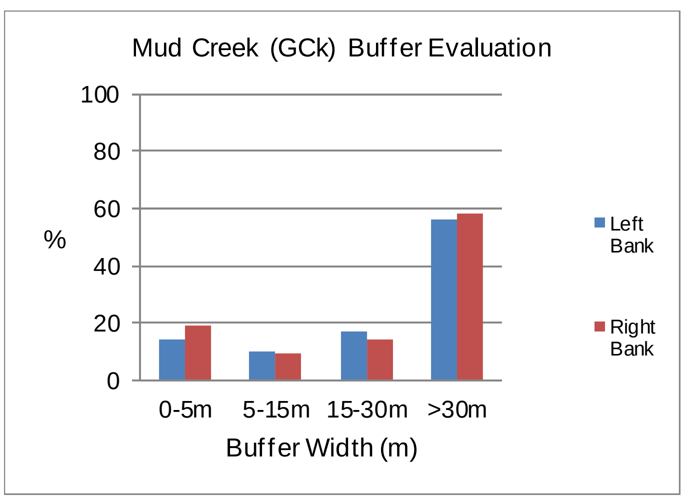

Figure 2. Vegetated buffer width along Mud Creek

Land Use beside Mud Creek

Figure 3 demonstrates the seven different land uses identified along the banks adjacent to Mud Creek. Surrounding land use is considered from the beginning to end of the survey section (100 metres) and up to 100 metres 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 66 percent of the stream, characterized by forest, scrubland and meadow. The remaining land use consisted of agriculture, residential, infrastructure, and industrial/commercial. It is important to note that the percentage of natural areas surrounding Mud Creek has decreased since this area was last surveyed in 2007. Also, residential land use is expected to continue to rise along the tributary of Mud Creek that was surveyed as development is taking place in this area.

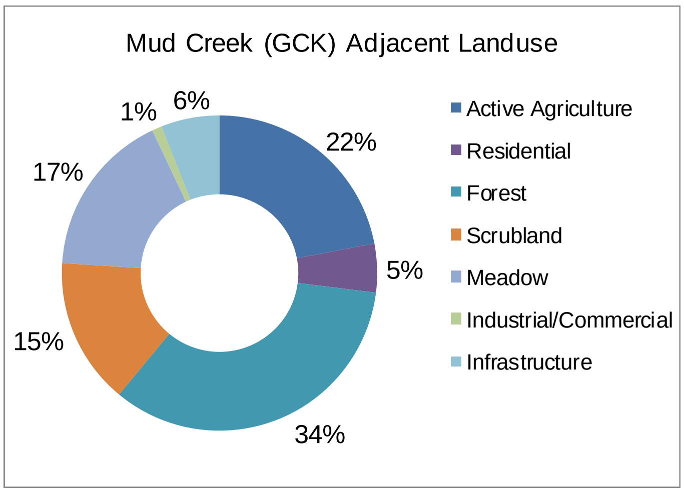

Figure 3. Landuse alongside Mud Creek

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. Bank stability indicates how much soil has eroded from the bank into the stream. 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. Thirty-one percent of the left bank and 37 percent of the right bank was considered unstable along Mud Creek. Figure 4 shows the observed erosion locations along Mud Creek and demonstrates that there were some locations where CSW staff and volunteers noted highly unstable banks and evidence of major slope failure.

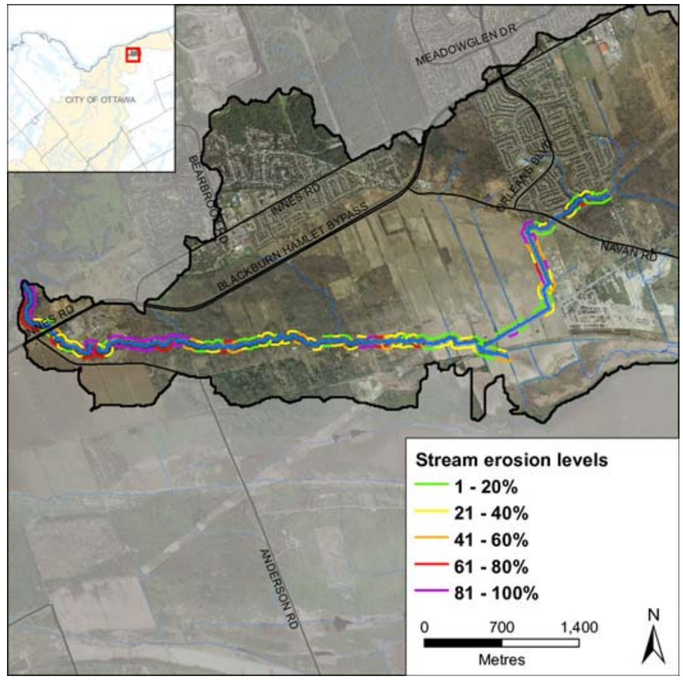

Figure 4. Erosion along Mud Creek

Streambank Undercutting

Undercut banks are a normal and natural part of stream function and can provide excellent refuge areas for fish. Figure 5 shows that Mud Creek has several locations with identified undercut banks.

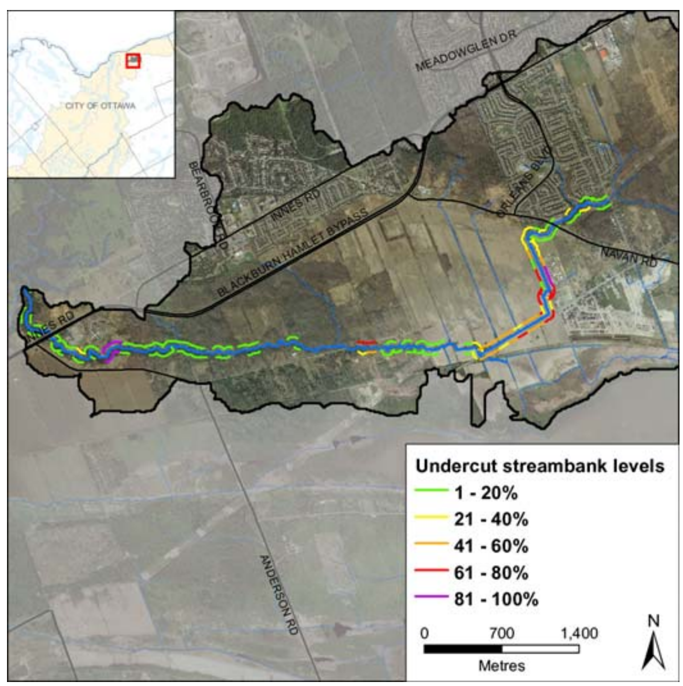

Figure 5. Undercut streambanks along Mud Creek

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 the stream shading locations along Mud Creek.

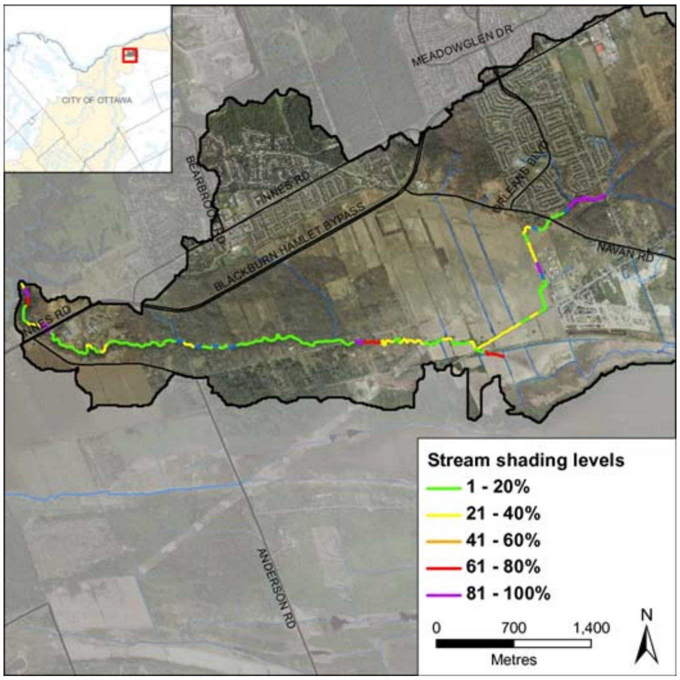

Figure 6. Stream shading along Mud Creek

Human Alterations

Figure 7 shows that 48 percent of Mud Creek remains “unaltered.” Sections considered “natural” with some human changes account for 15 percent of sections. "Altered" sections accounted for seven percent of the stream, with the remaining 30 percent of sections sampled being considered “highly altered” (e.g., include road crossings, shoreline/instream modifications and little or no buffer).

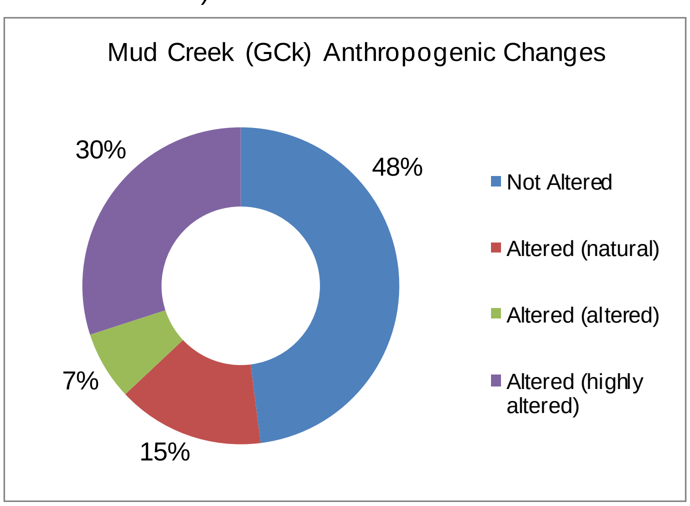

Figure 7. Alterations to Mud Creek

Overhanging Trees and Branches

Figure 8 shows that the majority of Mud Creek has varying levels of overhanging branches and trees. Overhanging branches and trees provide a food source, nutrients and shade which helps to moderate instream water temperatures.

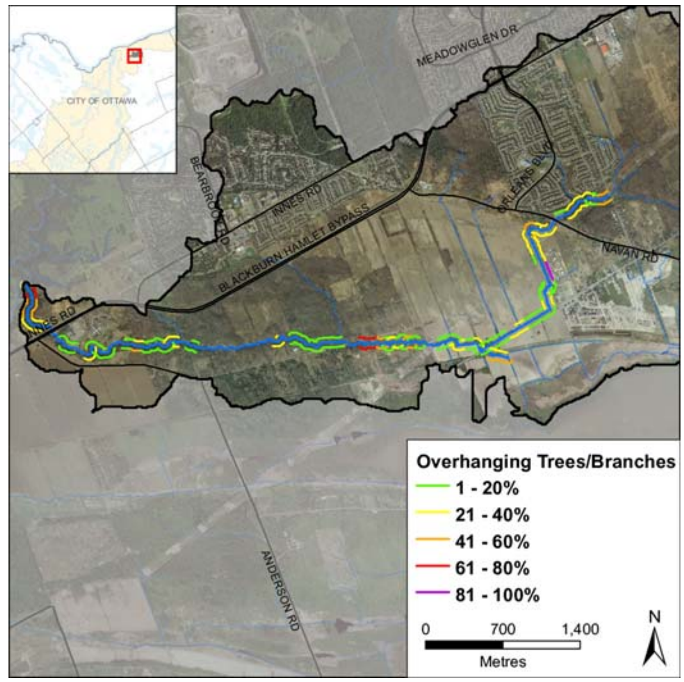

Figure 8. Overhanging trees and branches

Instream Woody Debris

Figure 9 shows that the majority of Mud Creek has varying levels of instream woody debris in the form of branches and trees. The most instream woody debris was recorded along the Mud Creek tributary between Navan road and Page road. Instream woody debris is important for fish and benthic habitat, by providing refuge and feeding areas.

Photo 1. Instream trees and branches on Mud Creek Tributary

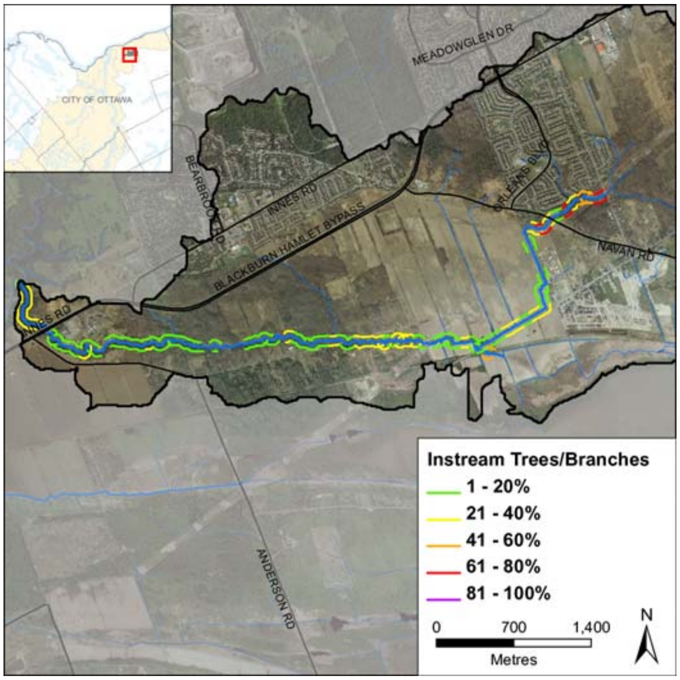

Figure 9. Instream trees and branches

Instream Aquatic Habitat

Habitat Complexity

Streams are naturally meandering systems and move over time. As such, there are varying degrees of habitat complexity depending on the creek. A high percentage of habitat complexity (heterogeneity) typically increases biodiversity of aquatic organisms within a system. Twenty-six percent of Mud Creek was considered heterogeneous as shown in Figure 10.

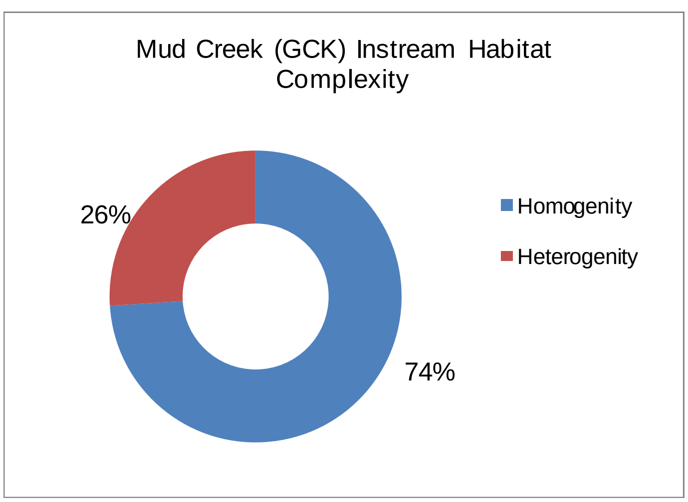

Figure 10. Instream habitat complexity in Mud Creek

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 demonstrates that the composition of the substrate in Mud Creek was mostly clay, sand and silt.

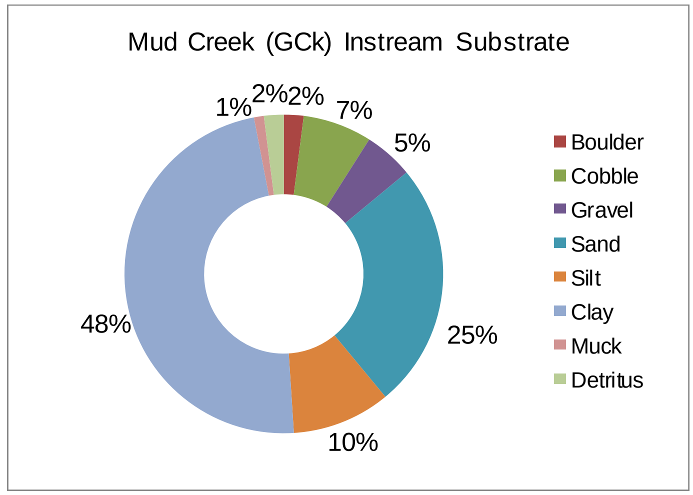

Figure 11. Instream substrate in Mud Creek

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 various locations where cobble and boulder substrate is found in Mud Creek.

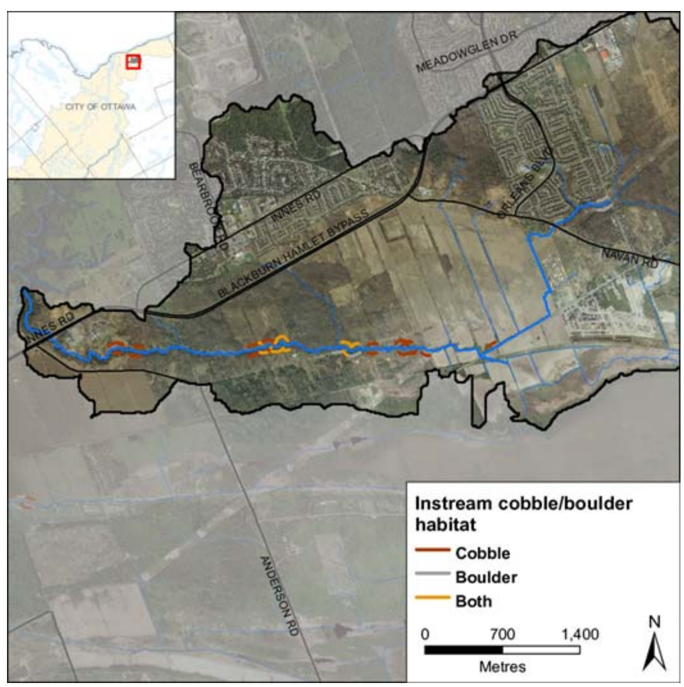

Figure 12. Cobble and boulder habitat along Mud Creek

Instream Morphology

Pools and riffles are important features for fish habitat. Riffles are areas of agitated water that 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 pools 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 Mud Creek is somewhat variable; consisting of runs at 82 percent, riffles at 12 percent and pools at six percent.

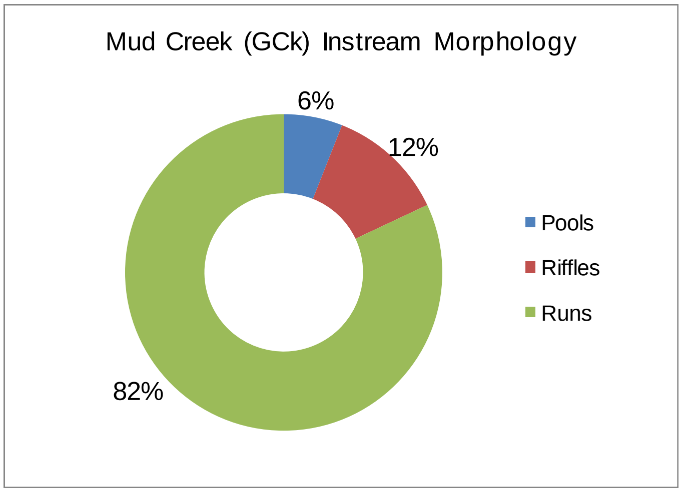

Figure 13. Instream morphology in Mud Creek

Types of Instream Vegetation

The majority of Mud Creek has limited diversity of instream vegetation, as seen in Figure 14. The dominant vegetation type at eighty-four percent consisted of algae. A total of eight percent of the vegetation community was recorded as narrow-leaved emergent vegetation. Broad-leaved emergent vegetation was recorded at three percent. A total of three percent of the vegetation community was recorded as submerged vegetation. Robust emergents made up the remaining two percent of the vegetation community. The limited diversity of instream vegetation in this creek is likely the result of the dominant clay substrates present along the majority of the system.

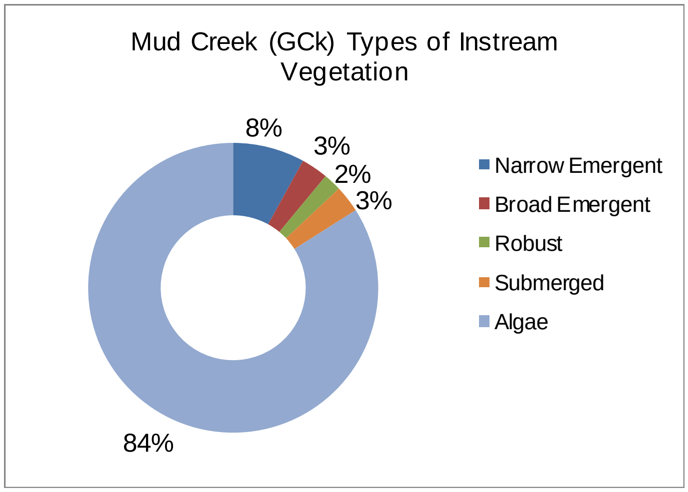

Figure 14. Instream vegetation types in Mud Creek

Amount of Instream Vegetation

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 the frequency of instream vegetation in Mud Creek. Mud Creek has low levels of instream vegetation for most of its length. Eighty-six percent of the creek had low, rare or no vegetation abundance levels. The remaining 14 percent had normal or common levels of vegetation. Low vegetation levels in Mud Creek are likely due to clay substrate and reduced water clarity due to sedimentation which would not allow sunlight to penetrate to the stream bottom.

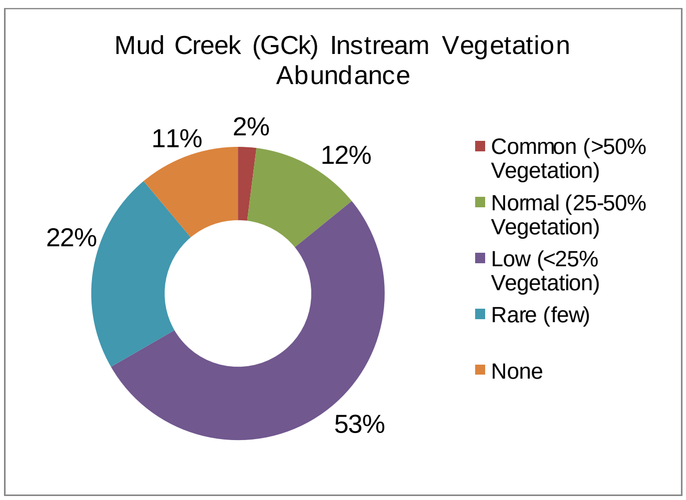

Figure 15. Vegetation abundance in Mud Creek

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. In Mud Creek, invasive species were observed in 66 percent of the sections surveyed, and often more than one species was present in the same area (Figure 16). The species observed in Mud Creek include purple loosestrife (*Lythrum salicaria)*, garlic mustard (*Alliaria petiolata)*, Manitoba maple (*Acer negundo)*, rusty crayfish (*Orconectes rusticus)*, Japanese knotweed (*Fallopia japonica)*, European buckthorn (*Rhamnus cathartica)*, European frogbit (*Hydrocharia morsus-ranae)*, and flowering rush (*Butomus umbellatus)*.

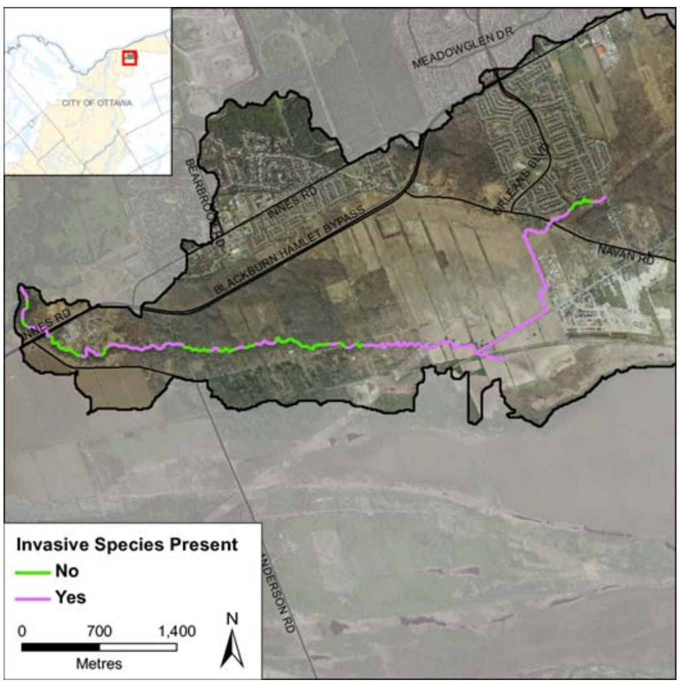

Figure 16. Invasive species along Mud Creek

Wildlife

The diversity of fish and wildlife populations can be an indicator of water quality and overall stream health. Table 5 is a summary of all wildlife observed during stream surveys.

Wildlife	Observed
Birds	bobolink, redwing blackbird, phobe, robin, catbird, cowbird, great blue heron, crow, cardinal, chickadee, bluejay, wood pecker, sparrow, hawk, belted kingfisher
Mammals	deer, raccoon, porcupine, squirrel, coyote, beaver, small mammal tracks
Reptiles/Amphibians	green frog, american toad, bullfrog, tadpole
Aquatic Insects	waterstrider, crayfish, water boatman
Other	jewelwing, admiral butterfly, cabbage white, monarch, damselfy, moth, mosquito, clam, snail, bumblebee, crayfish, deerfly, cricket, hornet, spider, stinkbug, wasp

Table 5. Wildlife observed along Mud Creek

Pollution

Figure 17 demonstrates the incidence of pollution/ garbage in Mud Creek. Pollution and garbage in the stream is assessed visually and noted for each section where it is observed. Only ten percent of the sections did not have any observable garbage. Forty-six percent had floating garbage, 79 percent had garbage on the stream bottom and one percent of the sections had discoloration on the channel bed. During stream surveys CSW staff and volunteers noted much of the garbage found Mud Creek had been there for a long time (scrap metal, car parts, glass bottles etc.). Sections of the creek would benefit from a stream garbage cleanup but access may be a limiting factor as most of the creek is located far from roads.

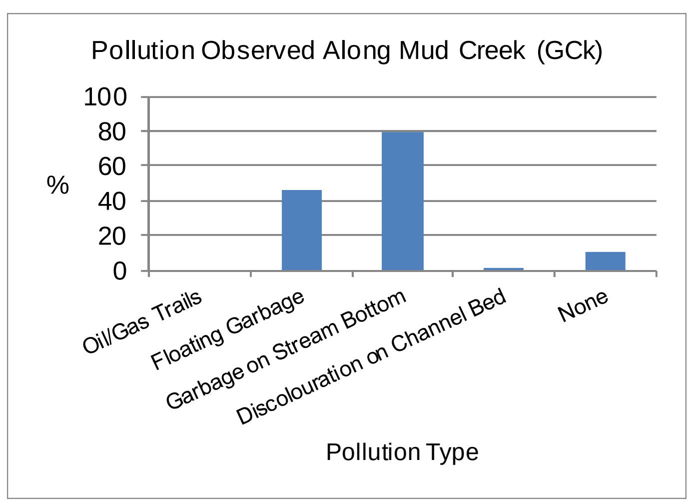

Figure 17. Pollution observed along Mud Creek

Thermal Classification

Temperature is an important parameter in streams as it influences many aspects of physical, chemical and biological health. Figure 18 shows where two temperature dataloggers were deployed in Mud Creek from April to late September 2012 to give a representative sample of how water temperature fluctuates.

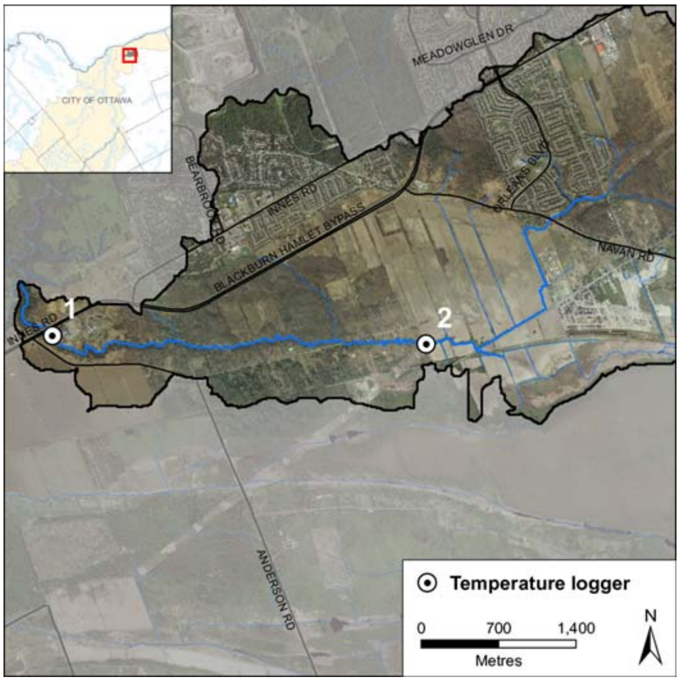

Figure 18. Temperature dataloggers along Mud Creek

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 warmwater, coolwater or cold water. Figure 19 shows the thermal classification of Mud Creek. Analysis of the data collected indicates that Mud Creek is a warmwater system.

Photo 2. The location where a temperature datalogger was deployed on Mud Creek near Renaud road.

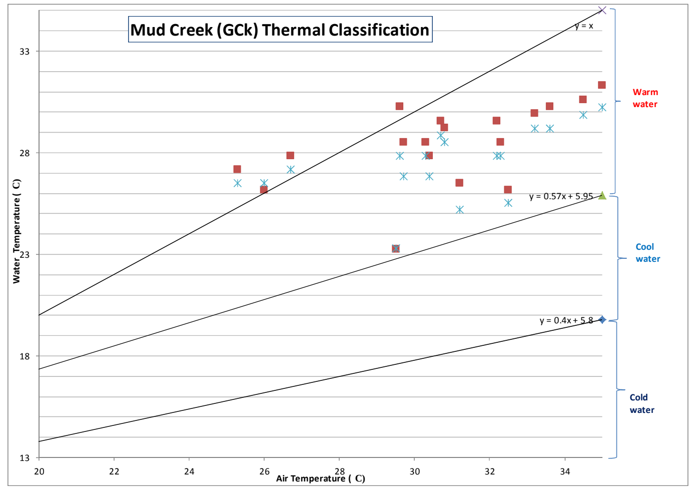

Figure 19. Thermal Classification for Mud Creek

Fish Sampling

Fish sampling sites located along Mud Creek and its tributary are shown in Figure 20. Fish sampling was conducted by the Rideau Valley Conservation authority and the City of Ottawa. The provincial fish codes shown on the map are listed (in Table 6) beside the common name of those fish species identified in Mud Creek and its tributary.

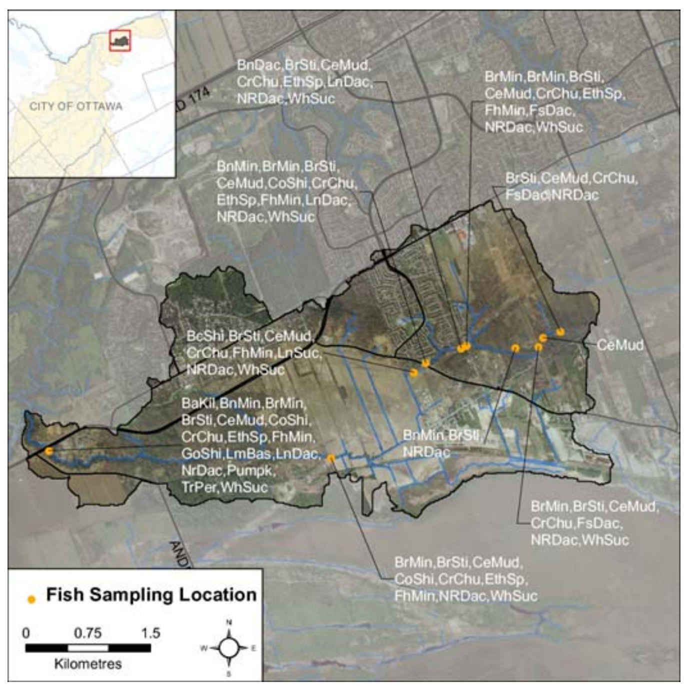

Figure 20. Fish species observed in Mud Creek

Species Legend			
BaKil	banded killifish	**FhMin**	fathead minnow
BcShi	blackchin shiner	**FsDac**	finescale dace
BnDac	Eastern blacknose dace	**GoShi**	golden shiner
BnMin	bluntnose minnow	**LmBas**	largemouth bass
BrMin	brassy minnow	**LnDac**	longnose dace
BrSti	brook stickleback	**LnSuc**	longnose sucker
CeMud	central mudminnow	**NRDac**	Northern redbelly dace
CoShi	common shiner	**Pumpk**	pumpkinseed
CrChu	creek chub	**TrPer**	trout-perch
EthSp	*Etheostoma sp.*	**WhSuc**	white sucker

Table 6. Fish species observed in Mud Creek

Photo 3. A volunteer measuring across a large debris dam on Mud 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. Figure 21 shows that Mud Creek has a high incidence of migratory obstructions especially debris dams. This is likely because the creek is prone to excessive erosion and slope failures have become common.

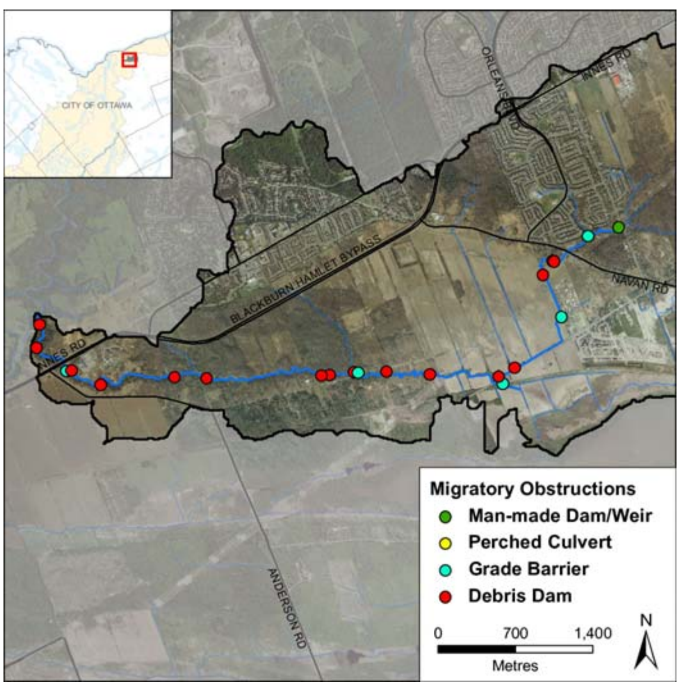

Figure 21. Migratory obstructions in Mud Creek

Water Chemistry

During the macrostream 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 warmwater fish and 9.5 mg/L for cold water fish (CCME, 1999). A saturation value of 90 percent or above is considered healthy
- 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 2012
- pH is a measure of relative acidity or alkalinity, ranging from one (most acidic) to 14 (most alkaline/ basic), with seven occupying a neutral point

2012 data for these three parameters is summarized in Table 7.

Month	Range	DO (mg/L)	DO (%)	Conductivity (µs/cm)	pH
May	low	-	-	-	-
	high	-	-	-	-
June	low	6.4	72.1	966	7.9
	high	14.62	164.7	1553	8.77
July	low	5.27	61.04	693	6.87
	high	12.1	140.15	1744	8.63
August	low	7.31	81.71	506	7.4
	high	9.87	110.33	897	8.01

Table 7. 2012 Water chemistry collected along Mud Creek

Stream Comparison Between 2007 and 2012

The following tables provide a comparison of Mud Creek between the 2007 and 2012 survey years. In 2007, the tributary of Mud Creek was not surveyed, therefore for this comparison only results from the mouth of the creek to just past the third Renaud Road crossing have been included. In addition, in 2007 no fish sampling was completed on Mud Creek so a comparison of fish species is not available.

Anthropogenic Changes

Table 8 shows that between 2007 and 2012 anthropogenic alterations along Mud Creek increased moderately. Some of this change can be attributed to changes in the macro stream protocol that is used. In 2010 anthropogenic alterations were further defined in the protocol, which would have caused some land uses to shift categories.

Anthropogenic Alterations	2007 (%)	2012 (%)
None	72	68
"Natural" conditions with minor human alterations	18	15
"Altered" with considerable human impact but significant natural portions	10	5
"Highly altered" by humans with few natural portions	n/a	13

Table 8. Comparison of anthropogenic alterations along Mud Creek between 2007 and 2012

Bank Stability Changes

According to observations bank stability has increased overall since 2007. In 2007, 33 percent of the banks were considered stable. In 2012, 63 percent of the left bank is stable and 58 percent of the right bank is stable. It is important to note that although there has been an improvement in erosion levels on Mud Creek overall, there has been an increase in sites with extreme erosion and bank instability.

Bank Stability	2007	2012 Left Bank	2012 Right Bank
Stable	33	63	58
Unstable	67	38	42

Table 9. Comparison of bank stability between 2007 and 2012

Photo 4. Erosion and bank instability observed in 2012

Changes in Instream Vegetation

Table 10 shows that there has been a moderate increase in instream vegetation in Mud Creek since 2007. The amount of low and rare levels of vegetation totaled 93 percent in 2007. In 2012, that number decreased to 80 percent even with the addition of a new category for no vegetation.

Instream Vegetation	2007 (%)	2012 (%)
Extensive	3	0
Common	2	3
Normal	2	17
Low	22	56
Rare	71	14
None	n/a	10

Table 10. Comparison of instream vegetation levels between 2007 and 2012

Changes in Pollution and Garbage

Overall the amount of pollution and garbage in Mud Creek has increased since 2007. Table 11 shows that the number of sections surveyed that were free from garbage has increased slightly since 2007. However, the number of sections that had floating garbage has increased significantly from 10 to 51 since 2007.

Pollution/Garbage	2007	2012
None	8	13
Floating Garbage	10	51
Garbage on Stream Bottom	82	82
Oil or Gas Trails	0	0
Discoloration of Channel Bed	n/a	0

Table 11. Comparison of pollution/garbage levels between 2007 and 2012

Monitoring and Restoration

Past Monitoring and Restoration Projects on Mud Creek

Table 12 below highlights the monitoring and restoration work that has been done on Mud Creek to date by the Rideau Valley Conservation Authority and other agencies.

Accomplishment	Year	Description
City Stream Watch Monitoring	2007	62 macro stream surveys were completed by City Stream Watch volunteers and staff
City Stream Watch Monitoring	2012	61 macro stream surveys were completed on Mud Creek and 26 macro stream surveys were completed on a tributary of Mud Creek by CSW volunteers and staff
City Stream Watch Fish Sampling	2012	6 sites were sampled for fish on Mud Creek and 1 site was sampled for fish on a tributary of Mud Creek
City Stream Watch Thermal Classification	2012	Two temperature data logger were deployed in Mud Creek between April and September
National Capital Commission Green's Creek Restoration	2012	Identification of high level watershed goals and restoration opportunities, design and development of three priority projects. Covers middle and lower Greens Creek, Mud Creek and McEwan Creek.
National Capital Commission Erosion Threshold Analysis	2012	Analysis covers Mud Creek and part of McEwan Creek

Table 12. Past Monitoring and Restoration on Mud Creek

Potential Riparian Restoration Opportunities

Figure 22 depicts the locations where City Stream Watch staff and volunteers made note of opportunities for future riparian restoration activities.

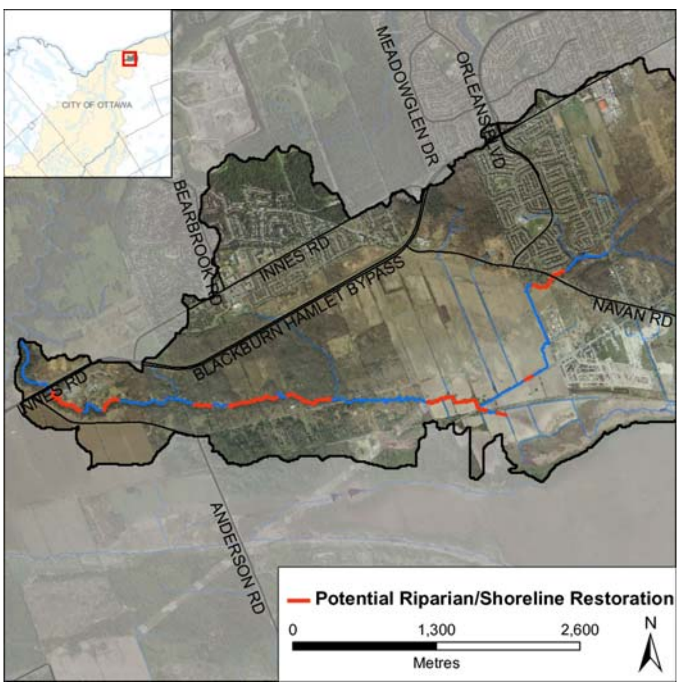

Figure 22. Mud Creek riparian restoration opportunities

Potential Instream Restoration Opportunities

Figure 23 depicts the locations where City Stream Watch staff and volunteers made note of various instream restoration opportunities.

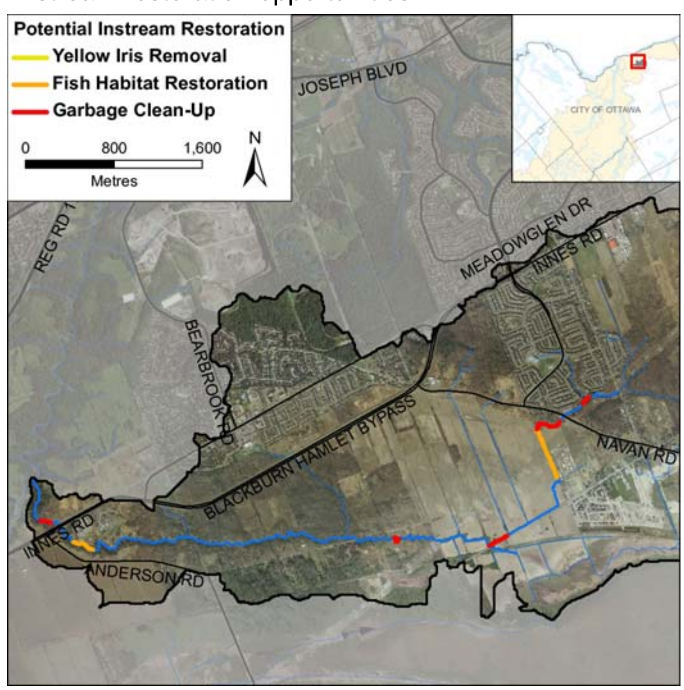

Figure 23. Potential instream restoration opportunities

In 2012, the National Capital Commission (NCC) initiated the Greens Creek Restoration Study and Erosion Threshold Analysis. The Green's Creek Restoration Study involves the identification of high level watershed goals and restoration opportunities, as well as the design and development of three priority projects for middle and lower Greens Creek, Mud Creek and McEwan Creek. The Erosion Threshold Analysis covers Mud Creek and part of McEwan Creek the information contained in this report will provide the existing aquatic habitat conditions and will contribute as background information to achieving the NCC's restoration goals for Mud Creek.



References

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For more information of the overall 2012 City Stream Watch Program and the volunteer activities, please refer to the City Stream Watch Summary Report 2012.

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