Credit Valley Conservation

**February** 2012

# Appendix 2

## DRAFT Fletchers Creek Restoration Study
## Restoration Report

CVC
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# Fletchers Creek Restoration Study
# Appendix 2
# Restoration Report

Credit Valley Conservation

**February 2012**

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City of Brampton
Town of Caledon
City of Mississauga
Region of Peel

Credit Valley Conservation would also like to acknowledge the Technical Committee for their contributions to this Restoration Study. Their expertise spans across a range of specialty areas.

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# 1.0 INTRODUCTION

The first Fletchers Creek Subwatershed Plan was completed in 1996 in collaboration with the City of Brampton, several property owners and the Credit Valley Conservation Authority (CVC). The Plan provided a strategy to protect and enhance the natural resource features as land use changed based on information available at the time.

Fletchers Creek has since undergone significant development in light of growth targets established in 2006 through Places to Grow. As a result, much of the recent and proposed development was not anticipated in the 1996 plan. In light of this additional growth, the City of Brampton, landowners and CVC initiated the Mount Pleasant Subwatershed Study in 2005 to develop an updated environmental management plan for Fletchers Creek and adjacent Huttonville Creek (east branch). The Mount Pleasant Subwatershed Study (2011) found that despite standard stormwater management practices stream levels of nutrients, metals, and suspended sediment, as well as erosion and flow regime were increasing within Fletchers Creek. The study recommended that stormwater retrofits within the existing urban area be implemented across the subwatershed to enhance and protect Fletchers Creek.

The recommendation of the Mount Pleasant Subwatershed Study is consistent with findings across the Greater Golden Horseshow area, as Mississauga, Toronto and Hamilton, among many other municipalities, are actively looking for opportunities to implement stormwater management retrofit measures in an attempt to improve water quality, reduce erosion and control runoff volume. The Ministry of Environment (MOE) in the 2003 SWM Guidelines, and more recently in the Lake Simcoe Act (2008), MOE's 2010 Policy Review of Municipal SWM in Light of Climate Change and the Water Opportunities Act (2010) have acknowledged a need to adopt a more aggressive approach to stormwater management through the use of lot level and conveyance controls in both new and existing urban areas. In light of this growing need, in 2007 CVC initiated a restoration study in Mississauga's Cooksville Creek and Sheridan Creek Watersheds to assist the City of Mississauga identify stormwater retrofit opportunities. In 2010, CVC under Board direction initiated a similar study, titled the Fletchers Creek Restoration Study, to provide assistance to the City of Brampton in light of the recommendations of the Credit River Water Management Strategy Update (CRWMSU) and Mount Pleasant Subwatershed Study.

The Fletchers Creek Restoration Study is intended to improve our collective understanding of the Fletchers Creek system and provide a restoration management strategy to address current issues and to manage for future conditions. The Fletchers Creek Restoration Study consists of two parts, Appendix 1 Characterization Report and this report, Appendix 2 Restoration Report. As such, the study is intended to inform and guide municipalities, provincial and federal governments, CVC, non-governmental organization and private landowners as they update their policies and practices for environmental protection, enhancement and stewardship.

## 1.1 Appendix 1 Characterization Report Overview

Appendix 1 Characterization Report summarizes and assesses existing subwatershed conditions in order to establish the form, function and linkages of the environmental resources to develop a comprehensive understanding of existing conditions, as well as assist in identifying priority areas for reducing contaminant loading.

Similar to the results of the Mount Pleasant Subwatershed Study, the Characterization Report identified that the health of the Fletcher's Creek Subwatershed is being impacted by urbanization despite the use of conventional stormwater management practices. Discharge in the upstream portion of the subwatershed is changing rapidly and maximum unit flows are increasing more than 10 fold. As a result, the upstream portion of Fletchers Creek is experiencing extensive bank slumping and erosion.

Despite the rapid changes in hydrology, the creek supports some populations of the endangered Redside Dace and in the lower reaches migratory Rainbow Trout. However, the aquatic habitat and fish communities in Fletcher's Creek are showing signs of degradation. Redside Dace are not as widespread as they once were and the population appears to be smaller in size – likely the result of degrading water quality.

Water quality in Fletcher's Creek subwatershed is threatened in terms of supporting healthy aquatic biota. The influence of highways, urban land use and high population density is apparent with median concentrations of the total phosphorus, metals, chlorides and bacteria markedly greater than their respective guideline or objective. The Water Quality Index indicates that the water quality at Steeles Avenue has been consistently poor over the thirteen year study period. As well, the water quality during wet weather is particularly bad, with WQI results poor for the entire subwatershed as a result of urban stormwater runoff.

Many of the valley lands associated with the creek are regenerating from open fields to thickets and woodlands. Restoration activities have helped aid in this process; however, there is a shortage of natural habitat that can allow for continued forest and wetland specialist species presence and basic unimpaired wildlife habitat functions. Impacts to natural features from human activities and disturbance will continue to degrade the quality of remaining habitat.

Further information and detailed description of results is provided in Appendix 1 Characterization Report.

## 1.2 Purpose of the Restoration Report

This report, Appendix 2 Restoration Report, presents priority stormwater retrofit, pollution prevention, and education and outreach opportunities for Fletchers Creek. As such, the study is intended to inform and assist the City of Brampton as they move forward with the implementation of there Environmental Master Plan and in the development of the Stormwater Management Retrofit and Enhancement Study.

A number of factors, including the placement of existing stormwater controls, monitoring results, age of development, land cover and land use were assessed to identify key opportunities. Restoration is often implemented as opportunities arise. For this reason, the Restoration Report presents baseline information on the land uses and land covers within the subwatershed for each of the four major land types – Residential, Public, Industrial and Commercial, and the Stream and Drainage Corridors. This Study describes issues related to the design and/or management of these land covers and presents a number of remediation opportunities.

The opportunities presented in this report are based on results presented in Appendix 1 Characterization Report, thorough desktop analysis, and table land and stream corridor in-field assessments. Field assessments were performed by CVC staff in the spring, summer, and fall of 2010.

This report is also intended to inform and guide land use management decisions for the City of Brampton, Town of Caledon and the City of Mississauga within Fletchers Creek, as well as other stakeholders including provincial and federal governments, non-governmental organization and private landowners as they update their policies and practices related to environmental protection, enhancement and stewardship.

Moreover, this report looks to assist the Region of Peel in meeting their objectives under the Region of Peel Climate Change Strategy and the Term of Council Priorities through improving stormwater management and building more resilient communities.

## 1.3 Recommendations from the 1996 Subwatershed Plan

The 1996 Subwatershed Plan for Fletchers Creek recommended a greenspace system and a series of management actions. When implemented together, the greenspace system and action items would provide a holistic strategy for meeting the goals and objectives and the environmental targets of the subwatershed study. Table 1.1 provides an overview of the status of recommendations. This table provides a basis for identifying next steps. Further information related to the status of the 1996 proposed greenspace system is provided in Appendix 1 Characterization Report.

**Table 1.2 Pollution Prevention and Restoration Practices Applicable to the Fletchers Creek Subwatershed**

| Practices | Technical Considerations | Environmental Benefits | Implementation Status (2010) |
|---|---|---|---|
| Greenspace System | | | |
| Meadowvale Station Woods ANSI and ESA | Protected through zoning | protects ecologically important areas | Meadowvale Station Woods remains a regionally significant Life Science ANSI, and an ESA. |
| High and Medium Function Habitat Units | Equivalent to Category 1 | Protects ecologically important areas | City of Brampton has implemented a number of these recommendations and continues to develop and support a greenspace system (now commonly referred to as a natural heritage system). For example, the City of Brampton has a Valley Naturalization Planting Program. |
| Low Function Habitat Units | Equivalent to Category 2 | Restoration opportunities | |
| High and Medium Function Corridor or Linkage | Category 1 | Protects ecologically important areas | |
| Low Function Corridor and Linkage Segments and Intermittent Watercourses | Category 2 | Restoration opportunities | |
| Lands within Regulatory Flood or Fill Line | Protected through zoning<br>Fill line mapping to be completed | natural heritage core area<br>backbone for linkages<br>hydrologic balance<br>aquatic habitat protection<br>terrestrial corridors and habitat<br>reduces flood risk | |
| Designated Stream Corridors and Setbacks<br>To be utilized where floodlines do not exist | To be determined at area plan level<br>Protected through zoning | Promotes natural stream valleys | |
| Riparian vegetation contiguous to a designated watercourse | Protected through zoning | Protects terrestrial habitat and its related function to the stream corridor | |
| Development Criteria | | | |
| Peak Flow Attenuation Storage for Development Area<br>Control peak discharge to pre-development levels for events up to the Regional Storm | Detention ponds to be constructed as development proceeds<br>Follow implementation guidelines for consolidation of SMW facilities | Flood control<br>Preserves hydrologic function of floodplain lands | Monitoring results are indicating the flow in Fletchers Creek is increasing. CVC and the City of Brampton have initiated studies to identify opportunity for attenuating flow. |

| Practices | Technical Considerations | Environmental Benefits | Implementation Status (2010) |
|---|---|---|---|
| Water Quality Storage<br>Requirements for Development<br>Provide extended detention storage for runoff from 20 mm event | Quality storage to be incorporated as development proceeds<br>SWMP guideline manual to be followed | Reduces suspended solids, metals and nutrient loadings<br>Protects aquatic habitat | Provides extended detention storage for runoff from 20 mm event. However, suspended solids, metals and nutrient loadings have increased in Fletchers Creek since 1996. |
| Erosion/Stream Morphology<br>Extended Detention Storage Requirements<br>Control peak discharge to one-half pre-development levels for events up to the 25-year rainfall event | Extended detention requirements as development proceeds | Minimizes stress on existing erosion sites<br>Prevents further excessive erosion | Peak flows are designed to be controlled to the pre-development peak flows.<br><br>CVC and TRCA have developed new stormwater management design criteria to provide further guidance to developers on how to maintain water balance. |
| Infiltration Facilities<br>Provide at-source infiltration where feasible for recharge of rainfall for events up to the 20 mm events | Subject favourable recharge conditions to be determined at the site plan level<br>Incorporation of soak-away-pits as development proceeds | Maintains groundwater discharge to streams<br>Minimizes impact to groundwater supply | To date the focus of infiltration efforts in Brampton has been on roof leaders disconnections and discharge to yards to promote infiltration. However, this is not sufficient to meet required recharge rates to maintain baseflows.<br><br>CVC and the City are working with developers to identify opportunities for LID approaches in new developments. Need to develop plans to promote on-site retention of frequent rainfall events to provide reduction in runoff volume and enhancement of infiltration and evaporation. |

| Practices | Technical Considerations | Environmental Benefits | Implementation Status (2010) |
|---|---|---|---|
| Erosion Control During Construction | Use of silt fencing, sedimentation basins and check dams during construction | Reduces sediment load to stream<br>Protects aquatic habitat | Most of the construction sites in the subwatershed use silt fencing, sedimentation basins and check dams during construction. |
| Construction Inspection | Staff will be required to inspect the appropriateness of erosion control measures | Ensures that management practices are constructed as per specification | CVC and the City of Brampton have been regularly been inspecting the ESC measures in the subwatershed since September 2005. |
| Environmentally Sensitive Site Planning Techniques | Minimizes grading<br>Tree preservation<br>Innovative SWM techniques | Maintains hydrologic balance<br>Provides community amenity<br>Provides terrestrial habitat<br>Reduces sediment and pollutant loading | Through the City of Brampton Stormwater Retrofit and Enhancement Study, and CVC's Fletchers Creek Restoration Study, a number of innovative SWM opportunities will be identified for implementation.<br><br>CVC and TRCA have developed new stormwater management design criteria to provide further guidance to developers on how to maintain water balance. |

| Practices | Technical Considerations | Environmental Benefits | Implementation Status (2010) |
|---|---|---|---|
| Development Restricted in Flood and Fill Line Regulated Areas | Avoids aggravation of current flood risk | Minimizes direct impact to valley lands and aquatic and terrestrial habitat | Flood damage centres exist in older developed areas in the mid-section of Fletchers Creek and monitoring results are indicating that peak flows are increasing despite conventional SWM practices. Further research is needed to identify contributing factors to increases in flows (i.e. improper design, time to peak flows, urban development). The Fletchers Creek Restoration Study identifies opportunities to reduce peak flow and meet water quality objectives. |
| Conservation and Management Practices | | | |
| Conservation Tillage | Farmers to modify tillage practices in high and medium erosion potential areas | Reduces soil loss, sediment and phosphorus loadings | N/A |
| Septic System Effluent | Existing septic systems need to be surveyed to identify problem systems | Reduces bacterial and nutrient loading | Not done – no septic system maintenance or monitoring program in place |
| Grassed Waterways | Streams in the upper reaches can be left grassed instead of ploughed | Reduces stream erosion<br>Flow moderation | Being addressed through the City of Brampton Urban Forest Study |
| Vegetated Buffer Strips | Buffer strip and setback requirement should be identified in rural areas | Reduces soil loss, sediment and phosphorus loading<br>Provides filtering of runoff<br>Improves aquatic habitat | Being addressed through the City of Brampton Urban Forest Study |
| Control Livestock Access | Off-line watering holes may need to be established | Reduces bank erosion<br>Improves water quality | N/A |

| Practices | Technical Considerations | Environmental Benefits | Implementation Status (2010) |
|---|---|---|---|
| Manure Management | Need to enforce OMAF guidelines for manure spreading<br>General problems of over-spreading of manure<br>Feedlot operations will need to control storm water runoff | Reduces bacterial and nutrient loadings | N/A |
| Natural Vegetation Succession | | | |
| Top Soil Preservation | Enforcement as development proceeds<br>Applicable within City boundary | Reduces soil loss and sediment loading<br>Provides retention of soil moisture<br>Preserves organic soil structure<br>Secondary benefit of reduced phosphorus loading to surface water | The City of Brampton topsoil bylaws was issued in 1992. Given the strong growth being experienced throughout the City of Brampton, and within Fletchers Creek, a review of the content and application/enforcement of the bylaw might be appropriate. |
| Municipal De-icing Programs | De-icing compounds (salt) can be replaced with sand in areas adjacent to streams<br>May require increased frequency of street sweeping and catch basin cleanouts | Reduces chloride load to stream<br>Reduces splash impact on vegetation | City of Brampton has completed an Operational Review and Winter Control Plan.<br><br>City of Brampton has made operational improvements over the last few years related to material use and equipment but there are still improvements that can be made. |

| Practices | Technical Considerations | Environmental Benefits | Implementation Status (2010) |
|---|---|---|---|
| Specific Projects and Programs | | | |
| Remediation of Significant Erosion Area<br>Establish vegetative buffer strips – Second Line to Ray Lawson Boulevard and restore creek to natural channel | Improve aquatic habitat<br>Improve fluvial geomorphology | Reduced sediment, nutrient and bacterial loading to stream | The City of Brampton and CVC continue to restore riparian areas throughout Fletchers Creek. Second Line to Ray Lawson is a very long stretch of the creek covering many reaches that significantly varies. Some portions still require restoration.1 Further identification of stream corridor restoration opportunities is provided in Appendix 2 Restoration Report (Section 5.4). |

1

| Reach | Location | Comment |
|---|---|---|
| FC1-3 | Second Line to SWM Pond | This reach could use bank stabilization, and habitat improvement and the buffer width is wide enough for floodplain terracing. The vegetation in the buffer strip was low shrubs and field plants full of invasive species and not providing much shade for the creek. |
| FC1-4 | SWM Pond to west of Mavis | This reach could use bank stabilization. Buffer width was wide enough for floodplain terracing. The buffer vegetation is much better then the previous reach consisting of more mature trees providing shading for the creek. |
| FC1-5 | West of Mavis to McLaughlin | Similar to the previous reach but more invasive species and not as much shading. Could use some buffer enhancement |
| FC1-6 | McLaughlin to reach FCT-16 | Same as previous |
| FC1-7 | Reach FCT-16 to South of Derry Rd | One of the most natural reaches on Fletchers. The creek runs in a deep steep sided and well vegetated valley. The buffer width is wide with mature trees. |
| FC1-8 | South of Derry to end of Golf Course | We did not walk this reach as it is the Derrydale Golf Course. |
| FC1-9 | North of Golf Course to 407 | Points Below are valid. Hydro Corridor. Large buffer width but poorly vegetated, lacking shade. |
| FC1-10 | 407 to EM-1 | Similar to above. Lots of trash, needs bank stabilization, habit improvement, buffer enhancement, invasive species management, has erosion problems |
| FC1-11 | EM-1 to just south of Ray Lawson | Points below are valid. There was a large beaver dam causing flooding in the city park. Fairly wide buffer could be better vegetated but not too bad. There are some mature trees providing shading but could use more. |

| Practices | Technical Considerations | Environmental Benefits | Implementation Status (2010) |
|---|---|---|---|
| Remediation of Significant Erosion Area<br>Establish vegetation buffer strip<br>McLaughlin Road to Highway 7 | Should be carried out in combination with restricted cattle access | Reduces sediment loading to watercourse<br>Improves aquatic habitat | The City of Brampton and CVC continue to restore riparian areas throughout Fletchers Creek. There is some erosion just south of Hwy 7, however, not significant. The reach could use habit improvement, buffer enhancement and trash cleanup. The buffer width is wide with a mix of well vegetated and poorly vegetated sections; there is erosion where it is poorly vegetated. Further identification of stream corridor restoration opportunities is provided in Appendix 2 Restoration Report. |
| Establish and restore riparian vegetation to creek areas from McLaughlin Road south of Derry Road to Second Line | Use of native and drought tolerant species should be given priority | Removes sediment loading to watercourses<br>Improves aquatic habitat<br>May result in naturalized concept for this reach | The City of Brampton and CVC have planted riparian vegetation along the creek areas from McLaughlin Road south of Derry Road to Second Line. Further identification of stream corridor restoration opportunities is provided in Appendix 2 Restoration Report. |
| Control cattle access upstream of Highway 7 | Off-line watering holes may need to be established | Reduces bank erosion<br>Improves water quality | N/A |

| **Practices** | **Technical Considerations** | **Environmental Benefits** | **Implementation Status (2010)** |
|---|---|---|---|
| Public Awareness Program | General public, landowners and agricultural community to be the focus | Builds support for ecosystem protection<br>Reduces human impact on natural areas | With the support of the City of Brampton, CVC has a number of programs that have focused on creating public awareness in Fletchers Creek, including Greening Corporate Grounds, Your Green Yard, Multi-cultural outreach, conservation youth corps and Save the Leopard Frog.<br><br>The City of Brampton also has a number of public awareness programs, including: the Green Education Program, the highschool green club council, and the park clean up program. |
| Practices | | | |
| Plant Riparian Vegetation | Program carried out by City Parks and Recreation Department and Interest groups<br>Promotes natural succession<br>Also applicable in rural areas to improve quantity and diversity of riparian vegetation | Reduces stream erosion<br>Improves aquatic habitat<br>Filters runoff | Throughout Fletchers Creek CVC has planted over 5000 trees and shrubs in public lands and over 1500 on private lands. |
| Erosion Monitoring | In stream monitoring program needs to b implemented under Conservation Authority jurisdiction | Provides feedback on success of fluvial geomorphology enhancement and erosion control measures | Yes – Effectiveness Monitoring and Fletchers Creek Monitoring Program have been implemented. |
| Disconnect Roof Leaders from Storm Sewers | Program to be carried out by City in existing urban areas | Augment filtration<br>flow moderation | Older developments mostly have downspouts connected. The CVC Restoration Report identifies this as a priority for restoration implementation. |

| Practices | Technical Considerations | Environmental Benefits | Implementation Status (2010) |
|---|---|---|---|
| Aquatic/Stream Restoration | Improves aquatic habitat<br>Improves fluvial geomorphology | Creates aquatic habitat | Created natural channels as part of the Fletchers Creek development in the Sandalwood/Chinguacousy area.<br><br>Coordinated with MNR Stewardship Rangers to remove woody debris and litter jams. |

## 1.4 Study Approach

Environmental management is a process of managing human activities and natural resources on a watershed basis through an interdisciplinary approach to address issues and stressors in a sustainable and holistic manner. Environmental management ensures integration of initiatives, programs and partnerships across stakeholders in order to maximize efforts.

The approach of environmental management focuses on the management of water and inter-related disciplines, including aquatic and terrestrial ecology, hydrogeology and fluvial geomorphology, in order to understand and respond accordingly to current and future management issues and opportunities, such as growth and climate change. The approach is applied through a cyclical process of developing, implementing, monitoring and updating management plans accordingly in order to adapt to a changing environment, new stressors and better management advancements.

Subwatershed management is embedded in the principles of environmental management. For CVC subwatershed studies are conducted with the intent to "ensure abundant, safe, clean water for environmentally, socially and economically healthy communities within the Credit River watershed". Subwatershed management establishes constraints, opportunities and approaches for input into land use planning decisions, as well as information to landowners on private stewardship programs for the management of the natural resources for all stakeholders.

Proper management of a subwatershed relies on monitoring. Monitoring provides a method for identifying the success of management plans and assists in adapting subwatershed management approaches. Through continues monitoring of Fletchers Creek, and more broadly the Credit River Watershed, each component studied assists in providing an overall understanding of the key environmental features and functions and establish existing conditions.

By establishing existing conditions scientific techniques, like modeling, can then be used to predict the subwatershed's future response to various stressors providing to inform management strategies to mitigate or enhance environmental conditions. Through the combination of long-term monitoring and updated modeling, CVC and partner municipalities can identify and implement the most appropriate management strategy to protect public and environment health.

### 1.4.1 FLETCHERS CREEK RESTORATION STUDY PROCESS

As previously stated, the Mount Pleasant Subwatershed Study (2011) found that despite standard stormwater management practices, monitoring results indicate that in-stream levels of nutrients, metals, and suspended sediment, as well as erosion and flow regime are increasing within Fletchers Creek. The study recommended that stormwater retrofits within the existing urban areas be implemented across the subwatershed to enhance and protect Fletchers Creek. In 2010, CVC under Board Direction initiated the Fletchers Creek Restoration

Study to provide assistance to the City of Brampton in light of the recommendations of the Credit River Water Management Strategy Update (CRWMSU) and Mount Pleasant Subwatershed Study.

Upon initiation, CVC began consolidating all existing monitoring data which meant, in some cases, gathering decades of information. The analysis and summarization of the data is presented in Appendix 1 Characterization Report. The results of the Characterization Report have been used to guide the identification of restoration opportunities and priority areas for implementation.

For this report, Appendix 2 Restoration Report, additional field analysis was done to characterize the land use and land cover of table lands and stream corridor. Along with the field assessments, desktop analysis and results from the Characterization Report were used to identify stormwater, pollution prevention, stewardship and education, and naturalization enhancement opportunities.

In moving forward, CVC will continue to work in partnership with the City of Brampton and watershed stakeholders to implement innovative stormwater management and pollution prevention practices and deliver education and stewardship programs, as well as continue to monitor Fletchers Creek.

## 1.5 Methodology

CVC defines watershed restoration as the application of any combination of pollution prevention, restoration and stewardship and education practices that can improve stream health, as measured by improvements in physical, hydrological, chemical, ecological, or social indicators of stream quality. Pollution prevention and restoration practices applicable to the Fletchers Creek subwatershed are broadly classified into eight major groups. These are introduced, defined and described in Table 1.2 below, and are key concepts used throughout this report.

**Table 1.2 Overview of Pollution Prevention and Restoration Practices Applicable to the Fletchers Creek Subwatershed**

**Pollution Prevention**

***Improved operation and maintenance of privately and publicly owned land, buildings, and infrastructure that will reduce pollution generation.***

Reduced Fertilizer and Pesticide Usage
Safe De-Icier Use
Car Fluid Recycling
Safe Pool Discharges
Dumpster Management
Cross Connection Elimination
Covered Fuel Stations
Secondary Containment

**2. Source Controls**

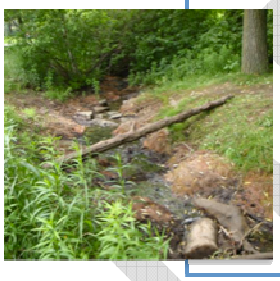
***On-site, small-scale stormwater treatment practices that capture and treat stormwater runoff from individual source areas, such as rooftops, parking lots, and street sections.***

Rain Gardens
Soakaway Pits
Planter Boxes
Green Roofs
Permeable Pavement
Parking Lot Bioretention
Curb Extensions

**3. Naturalization**

***Application of land reclamation and revegetation techniques to improve soil quality, increase stormwater infiltration, and increase urban tree canopy.***

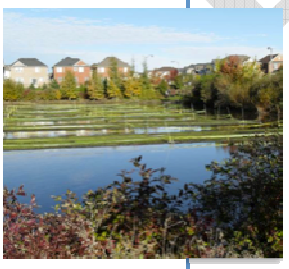
Fusion Gardens
Natural Landscaping
Invasive Species Management
Tree Planting



**4. Conveyance Controls**

***Enhanced and restored drainages that filter, infiltrate, and safely convey stormwater runoff.***

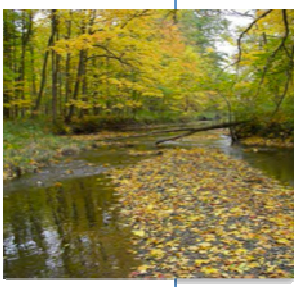
Dry Swales
Wet Swales
Grass Channels
Pervious Pipes
Daylighting



**5. End of Pipe Controls**

***Large-scale stormwater treatment practices installed within or near stream corridors to capture and treat stormwater runoff before it is delivered to the stream.***

Wet Ponds
Pond Wetland Systems
Constructed Wetlands
Wooded Wetlands
Cisterns
Underground Storage
Sand Filters



**6. Stream Corridor Restoration**

***Stream reclamation, floodplain enhancement, naturalization, and other techniques used to enhance the appearance, structure, or function of stream corridors.***

Stream Reclamation
Bank Stabilization
Aquatic Habitat Improvement Structures
Fish Barrier Removal
Grade Control
Floodplain Enhancement
Riparian Buffer Enhancement
Invasive Species Management

**7. Ecological Restoration**

***The application of landscaping concepts or techniques that allow for the conservation, restoration or enhancement of newly created, degraded, or altered landscapes within the watershed so that they have improved ecological functions.***

Improve Species and Habitat Diversity
Enhance or Increase Wildlife Habitat
Improve/Enhance Ecological Health of the Watershed
Habitat Creation
Enhancing/Caring for Existing Natural Area Remnants
Education and Public Outreach

Field assessments were conducted throughout the subwatershed in 2010 to identify restoration and pollution prevention opportunities. Field visits were made to representative areas for each land use type listed above. Within each land use, commonalities can be found, such as type and extent of different land covers, impervious and pervious area management schemes, typical sources of pollution, size of parcels, and predominant drainage patterns. In 2011, desktop analysis and findings presented in the Characterization Report were integrated with results from the field assessment to identify priority opportunities.

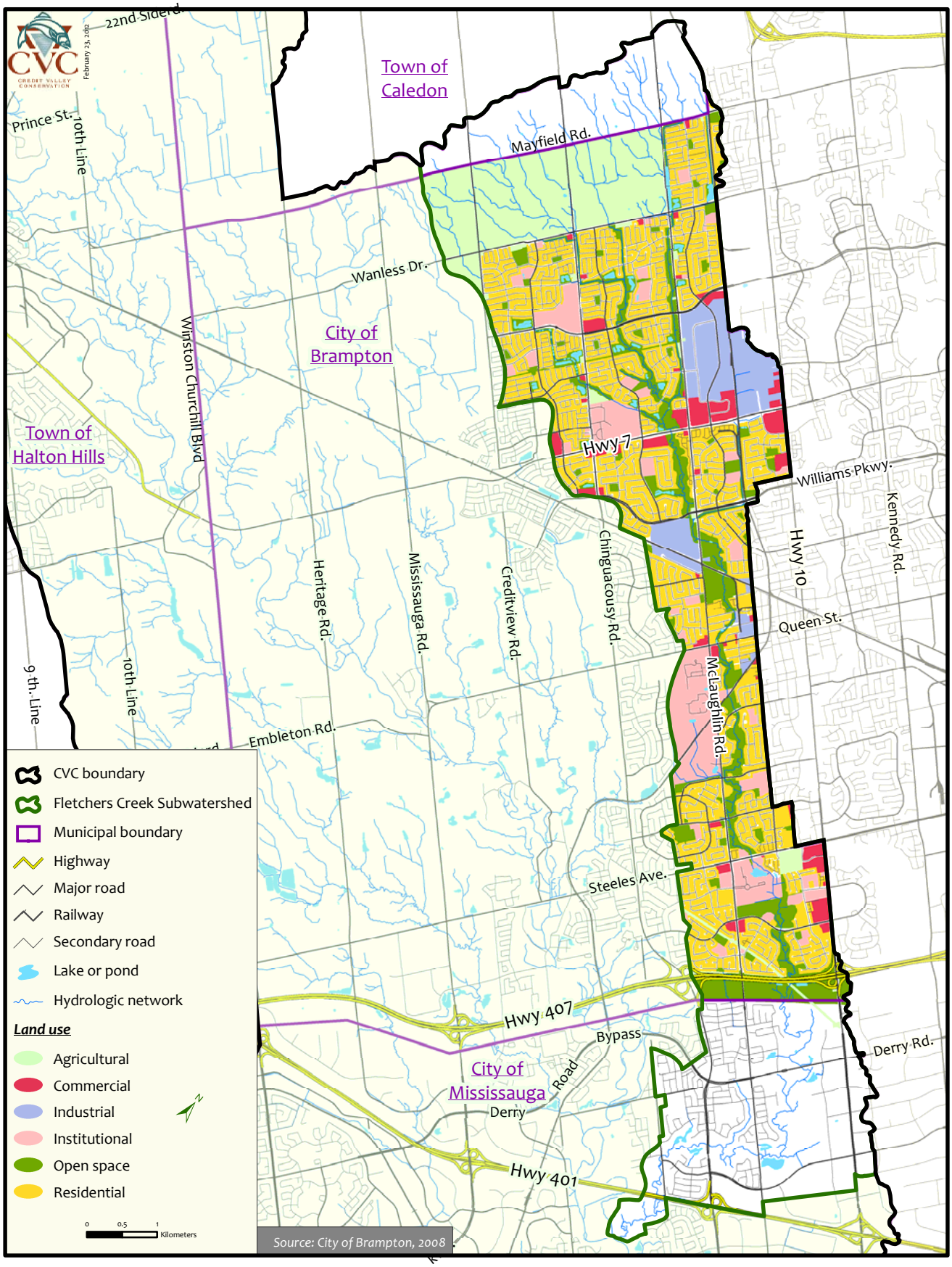

**Figure 1.1 Study Process**

## 1.6 Report Content

Identifying opportunities to implement pollution prevention, restoration and focus stewardship and education practices in an urban watershed is often daunting. However, examining an urban watershed from a land use perspective makes it less so as limited restoration opportunities will be applicable to any given land use. The following chapters, two through five, identify general pollution prevention, restoration, and stewardship and education opportunities applicable to each land use category (see figure 1.2 for a breakdown of land cover in Fletchers Creek), as well as specific examples that are unique to certain locations within the subwatershed. The last chapter provides an overview of current communication and stewardship initiatives. The following is an overview of each chapter:

- Chapter 2: Residential Lands;
- Chapter 3: Public Lands (Defined as Parks, Community Centres, and School Properties);
- Chapter 4: Industrial and Commercial Properties;
- Chapter 5: Stream and Drainage Corridors; and
- Chapter 6: Communication and Stewardship.

***Figure 1.2 Land Use Types***



# 2.0 RESIDENTIAL LANDS

Residential lands are the predominant land use in the Fletchers Creek subwatershed, covering approximately 31% of the area. This Chapter presents a characterization of the residential lands found within the subwatershed, including lands identified as low, medium and high density. The Chapter then presents an overview of the key pollution prevention opportunities for each of these designated land categories, followed by a more detailed description of each pollution prevention management technique. Lastly, the Chapter introduces the restoration opportunities that have been identified for low, medium and high density residential lands, followed by a detailed description and illustrations of key recommended restoration opportunities on these lands.

This Chapter presents:
1. Characterization
2. Overview of P2
3. Identification of P2
4. Overview of Restoration
5. Identification of Restoration

## 2.1 Characterization of Residential Lands

As noted, residential lands are the predominant land use in the Fletchers Creek subwatershed, covering approximately 31% of the area. Within residential lands, there are three main categories based on density: low, medium, and high. For this study, the neighbourhoods throughout the watershed were assigned to one of these three densities based on City of Brampton zoning designation. Table 2.1 presents these specific residential zones within Fletchers Creek subwatershed, per the City of Brampton Zoning By-Law. Refer to Figure 2.1 for location of residential zones.

**Table 2.1 Residential Base Zones found in Fletchers Creek Subwatershed**

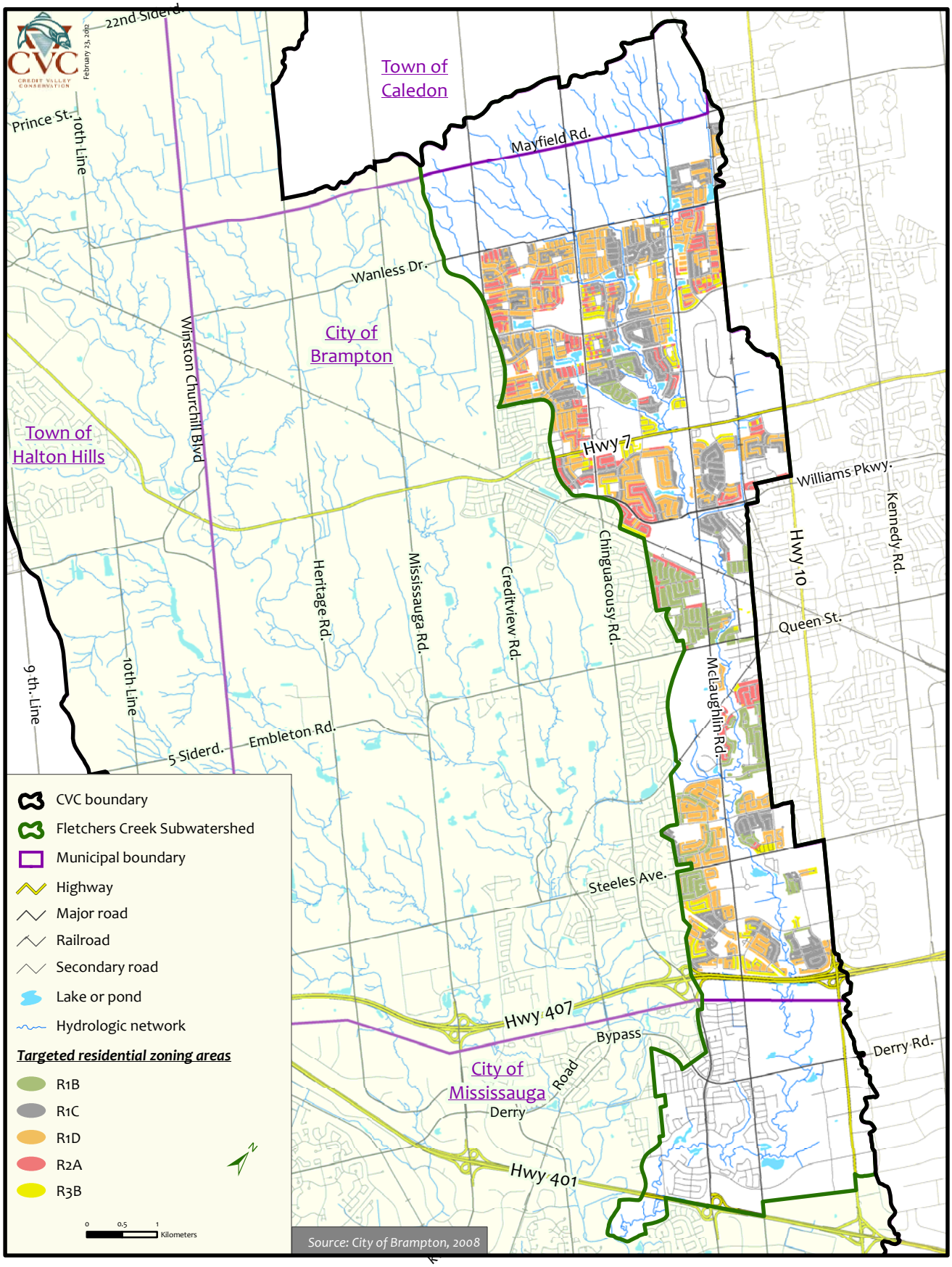
| Density | Residential Zones | Permitted Use | Area (% of watershed within Brampton) |
|---|---|---|---|
| Low | R1A | Single Detached | 0.11 |
| Low | R1B | Single Detached | 3.86 |
| Low | R1C | Single Detached | 7.63 |
| Low | R1D | Single Detached | 10.53 |
| Medium | R2A | Semi Detached | 3.92 |
| Medium | R2B | Single/Semi Extended | 0.14 |
| Medium | R2C | Semi Detached | 0.35 |
| Medium | R2D-X | Semi Detached | 0.00 |
| Medium | R2E-X | Semi Detached | 0.23 |
| Medium | R3A | Townhouse | 1.24 |
| Medium | R3B | Townhouse | 1.88 |
| High | R4A | Apartment | 0.73 |
| High | R4B | Apartment | 0.47 |
| High | RH | Residential Holding | 0.12 |

Certain parcels of these low, medium, and high density areas within the subwatershed have been targeted for pollution prevention and restoration. The selection of these areas was based on the Neighbourhood Source Assessment (NSA) methodology, which is a technique used to evaluate residential land use for rehabilitation opportunities. The NSA was conducted to evaluate pollution source areas, common behaviours, and restoration opportunities within individual residential areas.

Residential sites for assessment were identified through aerial photograph interpretation. Distinct neighbourhood units were delineated using land use data and digital orthophotos. Neighbourhood units in the subwatershed consisted of blocks with similar single-family residential housing density, physically defined communities, and apartment or town home complexes. The top five residential categories by total area within the subwatershed were selected for investigation. These included the R1B, R1C, R1D, R2A, and R3B zones. These areas, assessed in this study, are presented by zone in Figure 2.1 below.

The assessment, which involved a desk top review and site visits, looked specifically at yards, lawns, rooftops, driveways, sidewalks, and curbs. The neighbourhoods were assessed in terms of zoning, lot size, tree cover, drainage, lawn size, general upkeep, and evidence of resident stewardship (e.g., storm drain stencilling, pet waste management signage, etc.).

***Figure 2.1 Targeted Residential Zoning Areas***



As noted, each of these targeted residential zones (R1B, R1C, R1D, R2A, and R3B) falls into one of three density categories. The density categories are defined as follows.

**Low Density:** As presented in Table 2.1 above, the City of Brampton residential zones that are considered low density include: R1A, R1B, R1C, and R1D. Low density residential lands are characterized by larger lot sizes (typically 350m$^2$ or larger) with a single detached dwelling per lot. Larger lot sizes tend to be found in older neighbourhoods, whereas newer homes tend to be built on smaller lots. Typical lot configurations for each low density zone are displayed in Figures 2.2 through 2.5 below.

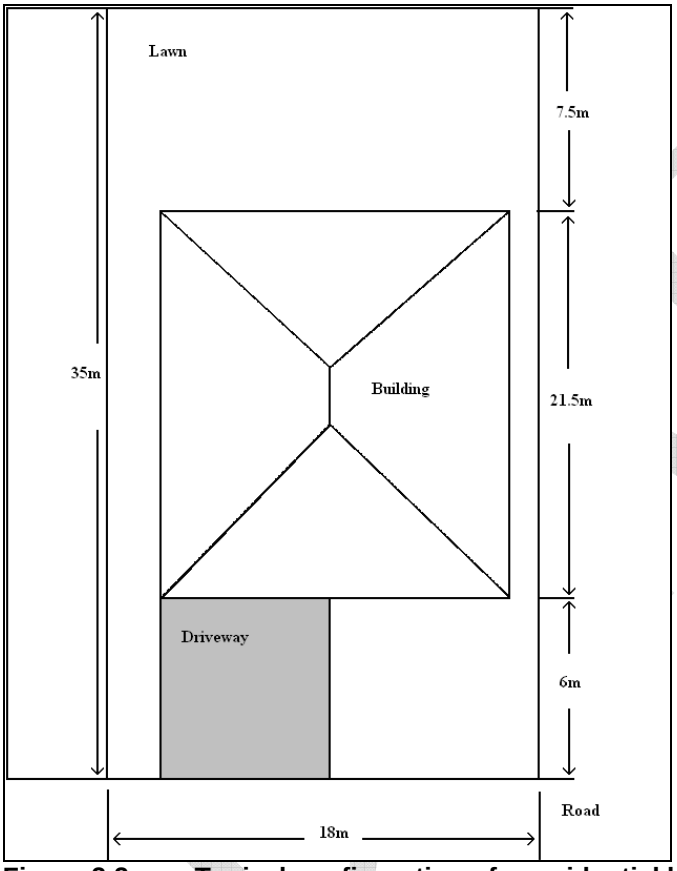



**Figure 2.2 Typical configuration of a residential lot zoned R1A.**

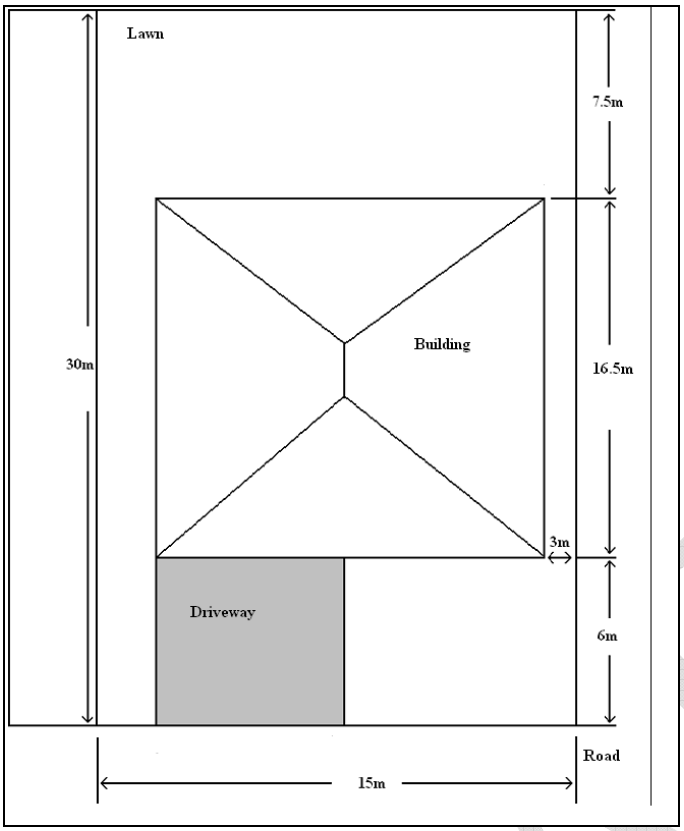



**Figure 2.3 Typical configuration of a residential lot zoned R1B**

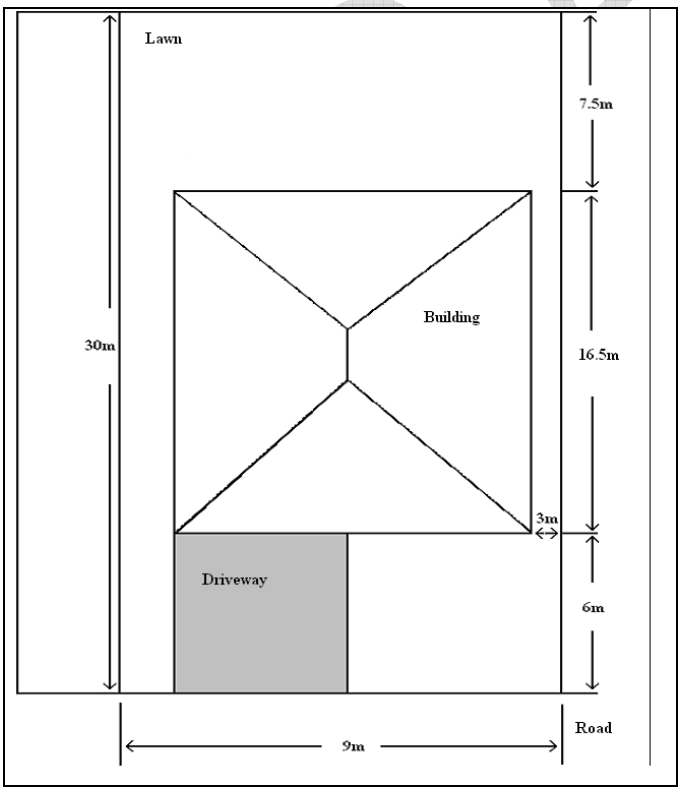



**Figure 2.4 Typical configuration of a residential lot zoned R1C**

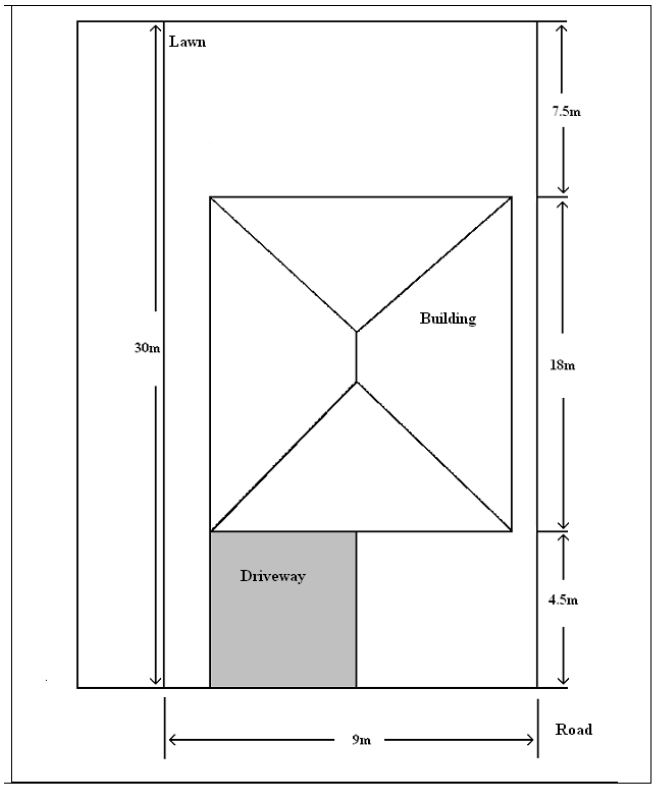
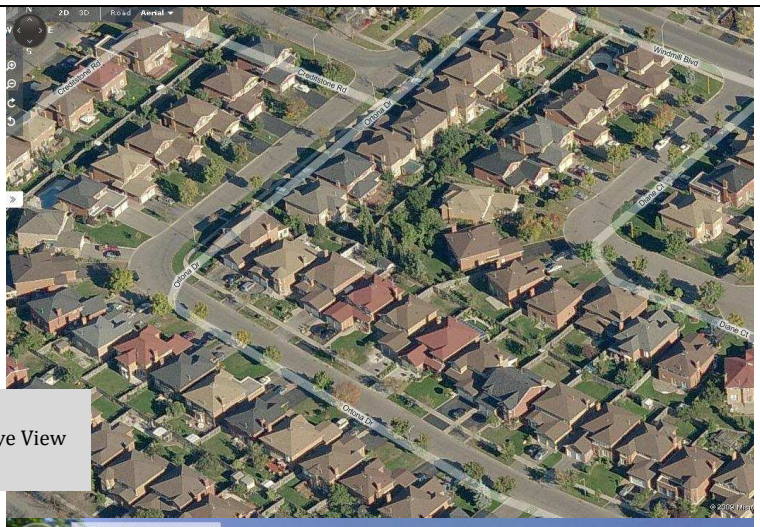
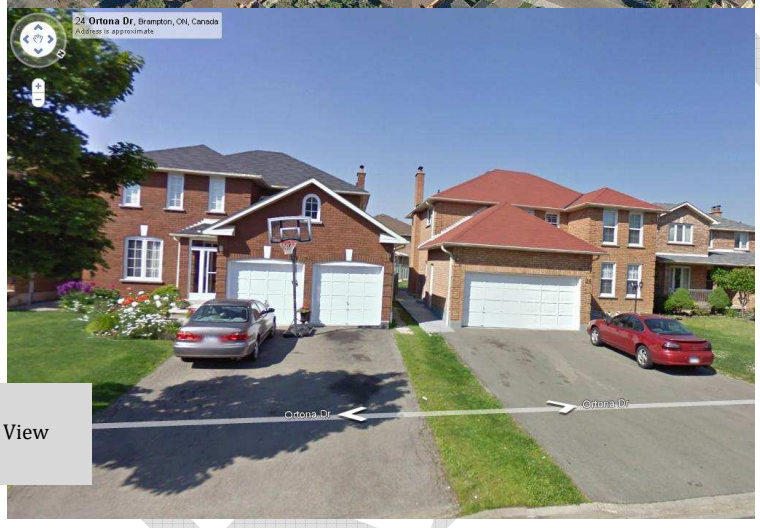



**Figure 2.5 Typical configuration of a residential lot zoned R1D**

The following images are presented to provide a visual display of the low density areas that have been targeted (R1B, R1C, and R1D) for pollution prevention and restoration. The bird's eye view provides an interesting perspective on overall lot arrangement and size, while the street view presents a good perspective on ground cover. Below each image is an overview of the zone/neighbourhood characteristics along with an initial listing of restoration opportunities.

Figure 2.6 represents one of the top five residential zones (R1B), by area, in the Fletchers Creek subwatershed (see Figure 2.1).




**Zone Characteristics**

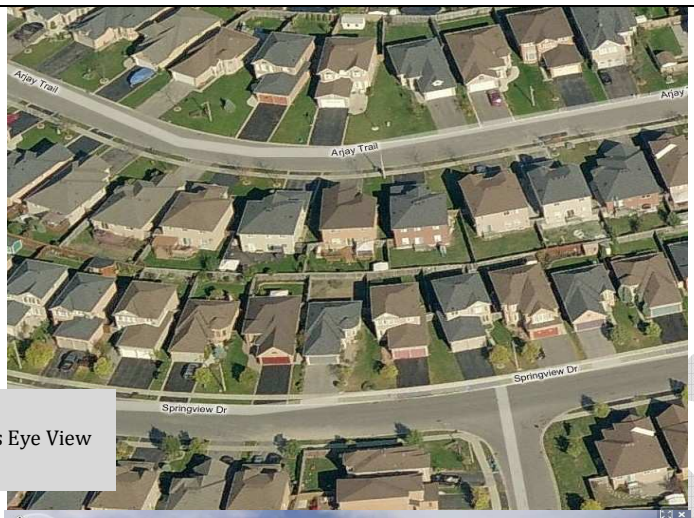
- **Lawns –** Medium/High input[2]
- **Driveways –** Large; Asphalt; Some oil stains
- **Sidewalks –** Yes, on 1 side depending on the street
- **Roadway –** Curb and gutter
- **Pools –** No
- **Measurements of Frontage –** 6m (house to curb)
- **Permeable / Impermeable (%) –** 10% / 90%
- **Gutter Connected/Disconnected –** Connected

**Restoration Opportunities**

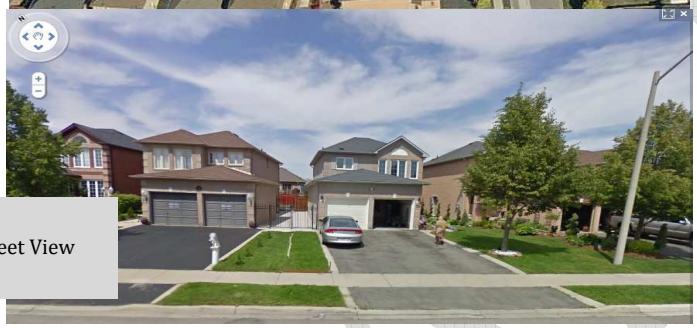
- Pollution Prevention Outreach, Pervious Driveways, Better Landscaping, Rain Gardens, Some Driveway Widening Issues (increased imperviousness)

**Figure 2.6 R1B – McGlaughlin Rd. and Steeles Ave (Source: Bing Maps and Google Maps 2010)**

[2] Input refers to the level of fertilizers, mowing, and watering required.




Bird's Eye View



Street View

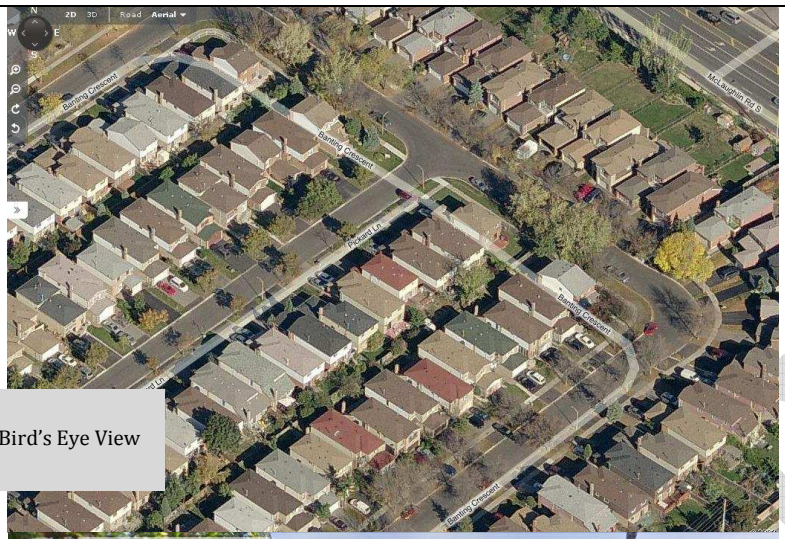
**Zone Characteristics**

- **Lawns –** Medium to High input
- **Driveways –** Large; Asphalt; Some oil stains
- **Sidewalks –** Yes, usually both sides
- **Roadway –** Curb and gutter drainage
- **Pools –** No, unless lot size permits (corner lots)
- **Measurements of Frontage –** 6-12m (house to curb)
- **Permeable / Impermeable (%) –** 20% / 80%
- **Gutter Connected/Disconnected –** Generally connected in areas south of Williams Parkway and disconnected in areas north of Williams Parkway

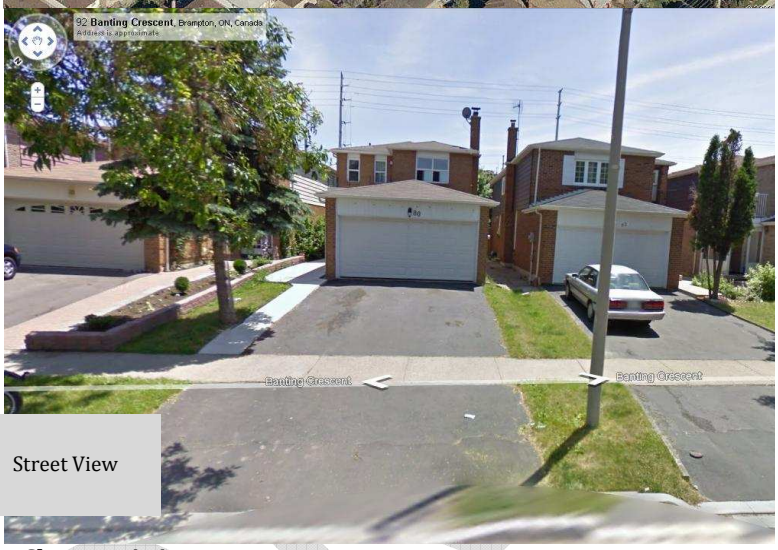
**Restoration Opportunities**

- P2 Outreach, Pervious Driveways, Better Landscaping Practices, Rain Gutter Disconnection or Redirection Program, Rain Gardens (where lot size permits), Some Driveway Widening Issues

**Figure 2.7 R1C – McGlaughlin Rd. and Williams Parkway (Source: Bing Maps and Google Maps 2010)**




Bird's Eye View




Street View

**Zone Characteristics**

- **Lawns –** Medium input
- **Driveways –** Large; Asphalt; Some oil stains
- **Sidewalks –** Yes, on 1 side depending on the street
- **Roadway –** Curb and gutter
- **Pools –** No
- **Measurements on Frontage –** 4.5m (house to curb)
- **Permeable / Impermeable (%) –** 5% / 95%
- **Gutter Connected/Disconnected –** Connected

**Restoration Opportunities**

- P2 Outreach, Pervious Driveways

**Figure 2.8 R1D – McGlaughlin Rd. and Steeles Ave (Source: Bing Maps and Google Maps 2010)**

**Medium Density:** The City of Brampton residential zones considered medium density include: R2A, R2B, R2C, R2D-X, R2E-X, R3A, and R3B. Medium density residential lands include semi detached dwellings, townhouses, or other units with more than two dwellings per lot. A typical lot configuration for a townhouse community is displayed in Figure 2.9.

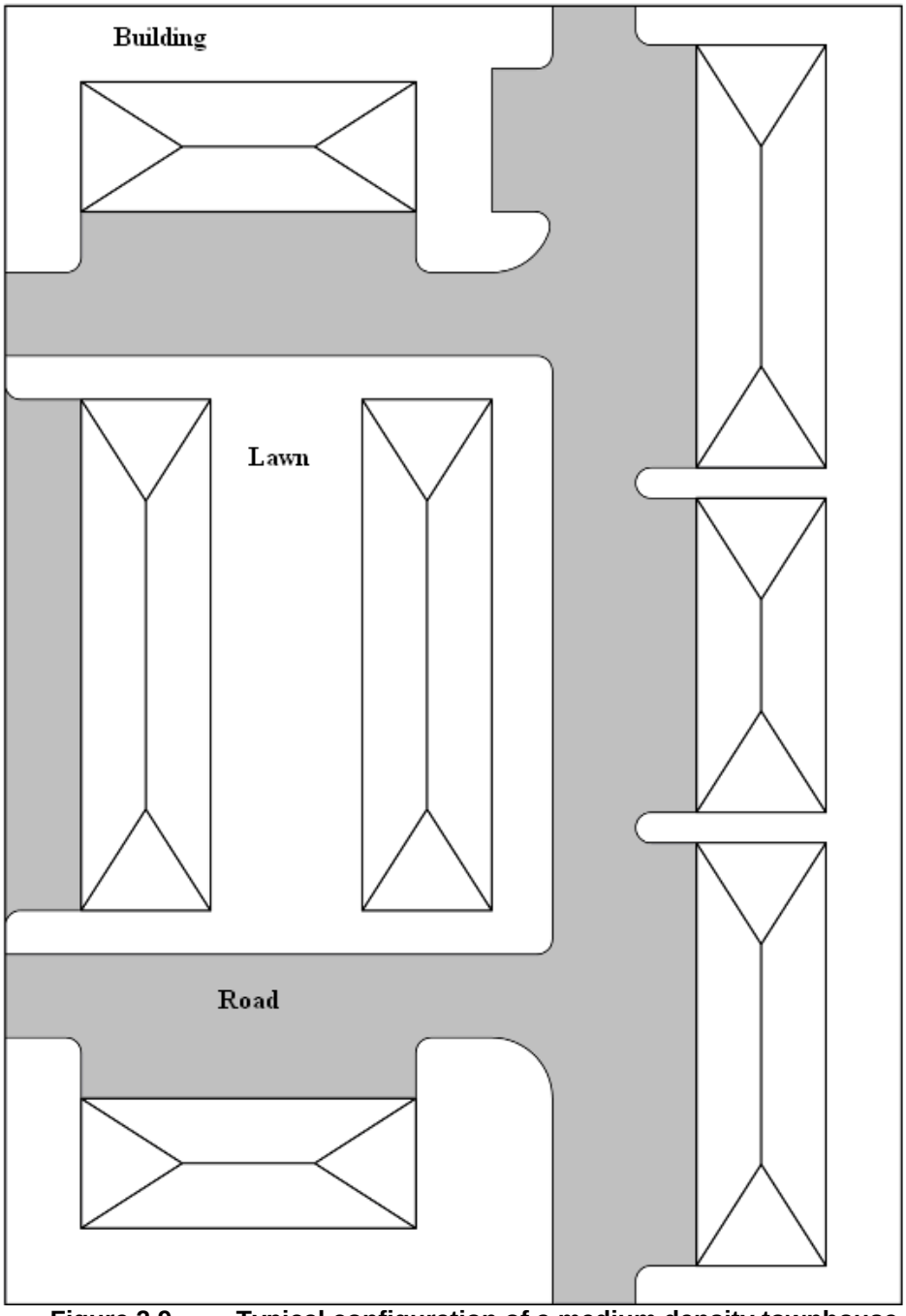
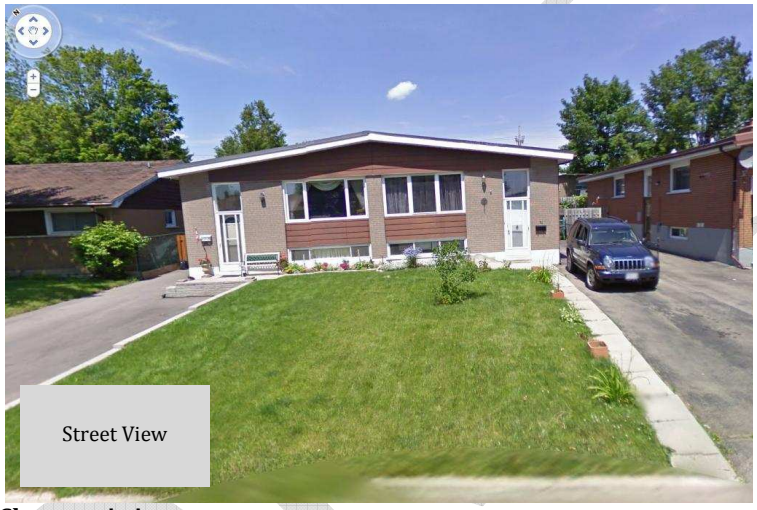



**Figure 2.9 Typical configuration of a medium density townhouse community**

The following images are presented to provide a visual display of the medium density areas that have been targeted (R2A and R3B) for pollution prevention and restoration.

Figure 2.10 represents one of the top five residential zones (R2A), by area, in the Fletchers Creek subwatershed (see Figure 2.1)


**Zone Characteristics**

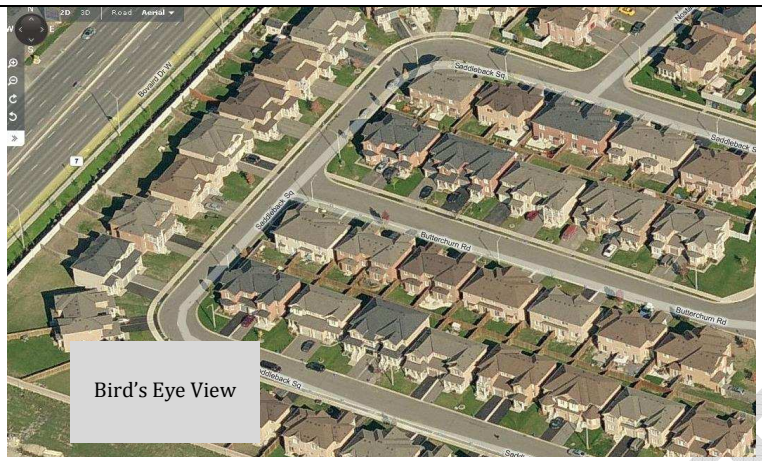
- **Lawns –** Medium input
- **Driveways –** Large; Asphalt; Some oil stains
- **Sidewalks –** No
- **Roadway –** Curb and gutter
- **Pools –** <5%
- **Measurements on Frontage –** 6m (house to curb)
- **Permeable / Impermeable (%) –** 5% / 95%
- **Gutter Connected/Disconnected –** Disconnected

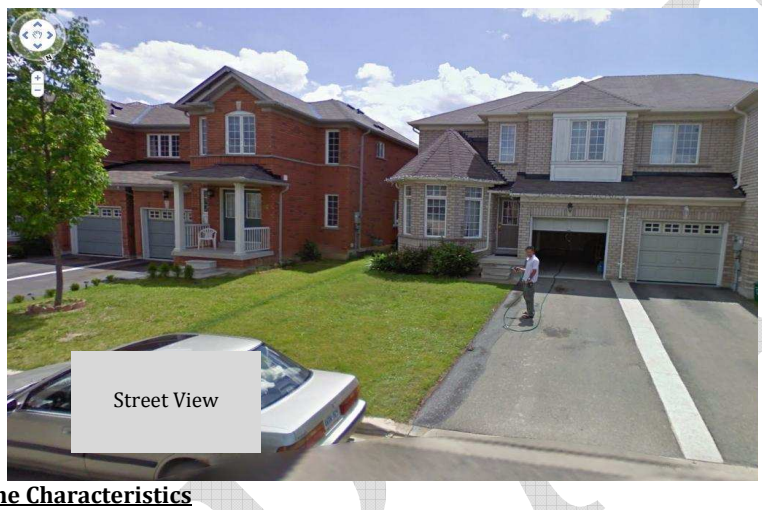
**Restoration Opportunities**

- P2 Outreach, Pervious Driveways

**Figure 2.10 R2A – McGlaughlin Rd. and Queen St. (Source: Bing Maps and Google Maps 2010)**

Figure 2.11 represents one of the top five residential zones (R3B), by area, in the Fletchers Creek subwatershed (see Figure 2.1).




**Zone Characteristics**

- **Lawns –** Medium/High input
- **Driveways –** Medium; Asphalt; Some oil stains
- **Sidewalks –** No
- **Roadway –** Curb and gutter
- **Pools –** No
- **Measurements on Frontage –** 6m (house to curb)
- **Permeable / Impermeable (%) –** 5% / 95%
- **Gutter Connected/Disconnected –** Disconnected

**Restoration Opportunities**

- P2 Outreach, Better Landscaping, Rain Gardens, Pervious Driveways

**Figure 2.11 R3B – Mclaughlin Rd. and Highway 7 (Source: Bing Maps and Google Maps 2010)**

**High Density:** The City of Brampton residential zones considered high density include R4A, R4B, and RH. High density residential lands include apartment complexes with more than four units per lot. Most apartment complexes are high rise units, with at least 10 floors and underground parking. A typical configuration for an apartment complex is displayed in Figure 2.12.

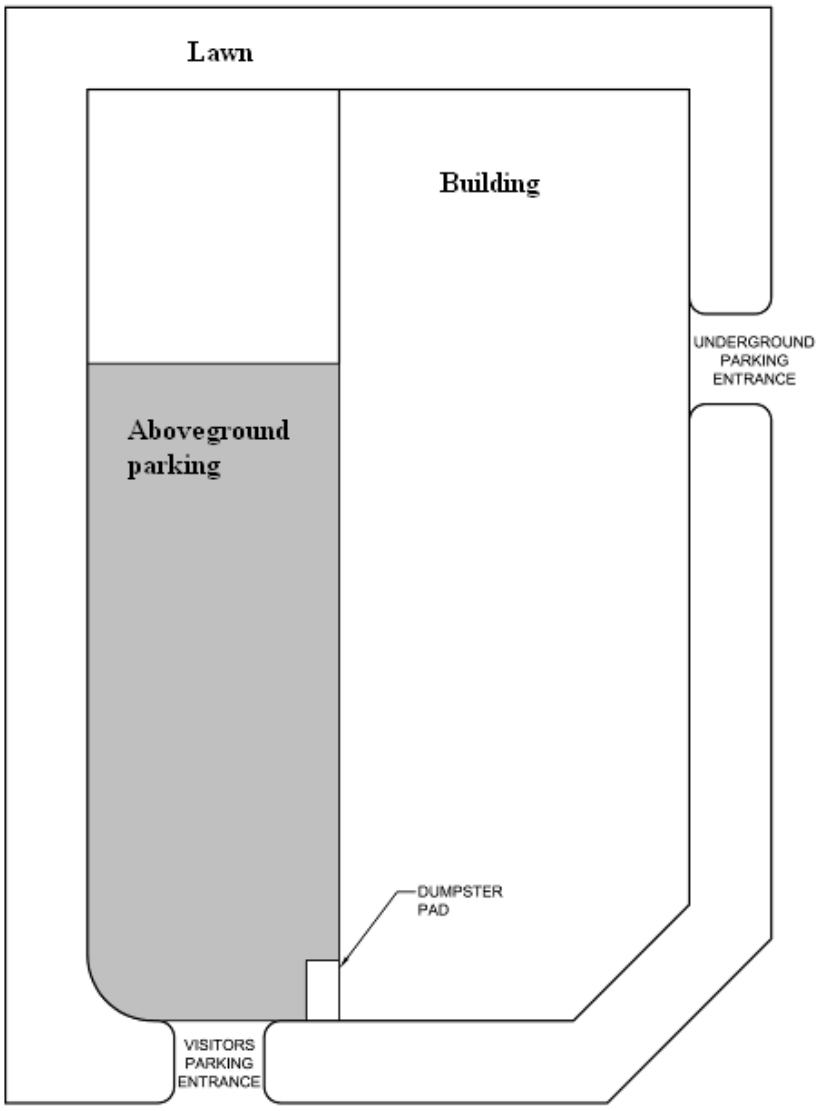



**Figure 2.12 Typical configuration of a high density apartment complex.**

The pollution prevention and restoration options, presented in this chapter, have been organized according to these density categories. As was seen in the map presented in Figure 2.1, certain residential areas have been targeted for pollution prevention and restoration efforts. Figures 2.13 through 2.15 below present higher resolution maps showing some of these locations for the targeted low (R1B, R1C, R1D) and medium (R2A, R3B) density zones.

***Figure 2.13 Ta rgeted Residential Zoning Areas- Highway 7 to Mayfield***

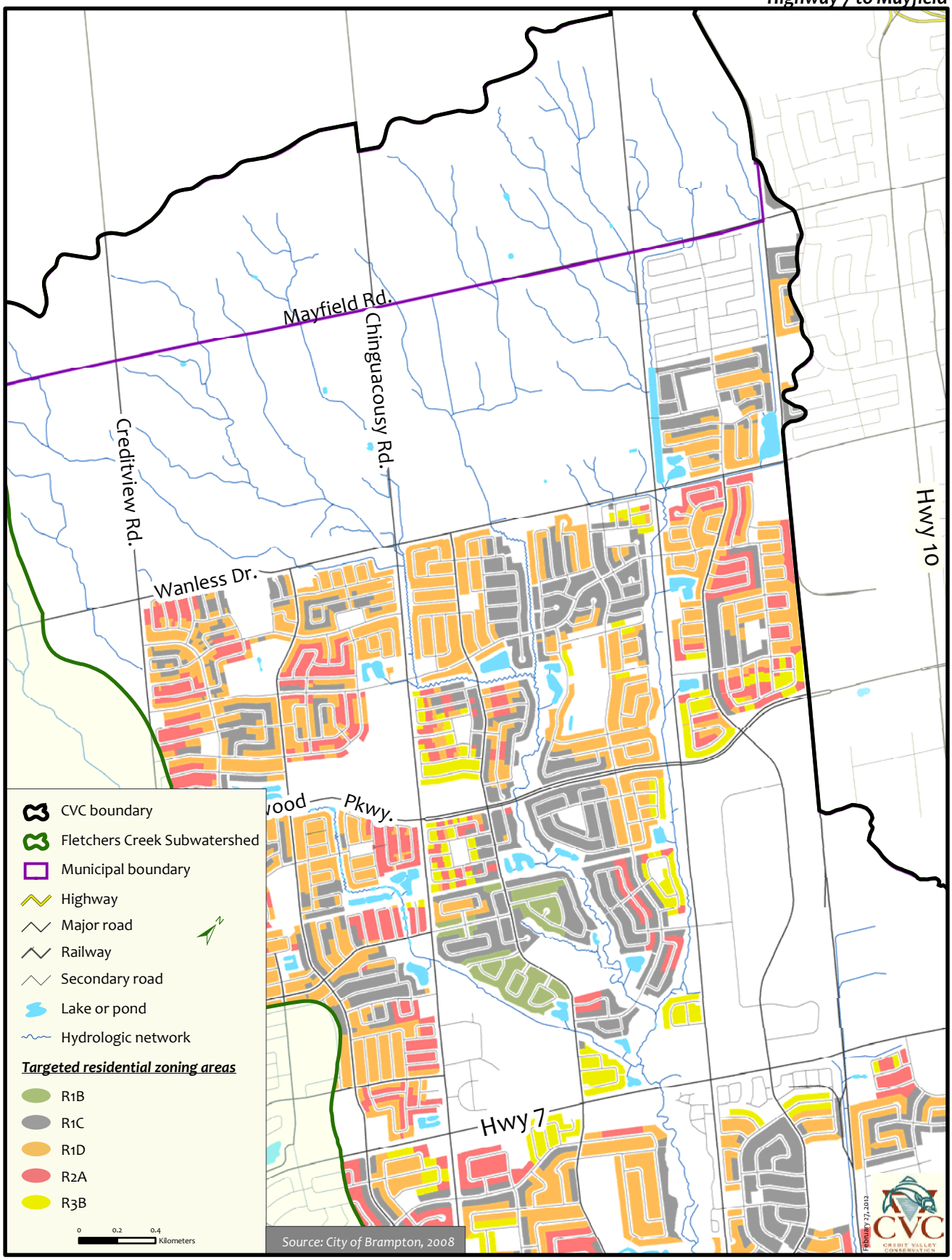


***Figure 2.14 Targeted Residential Zoning Areas- Steels to Highway 7***

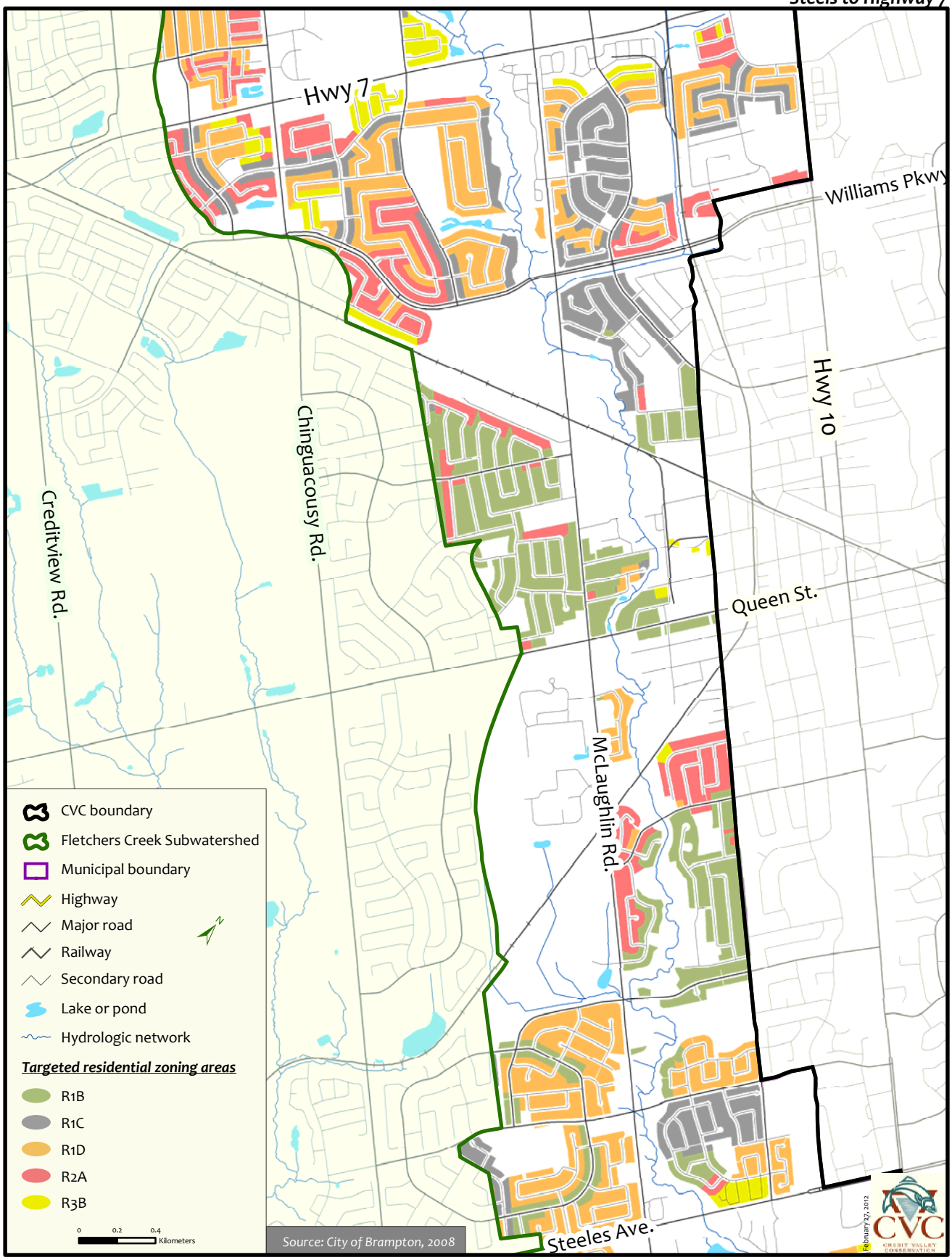
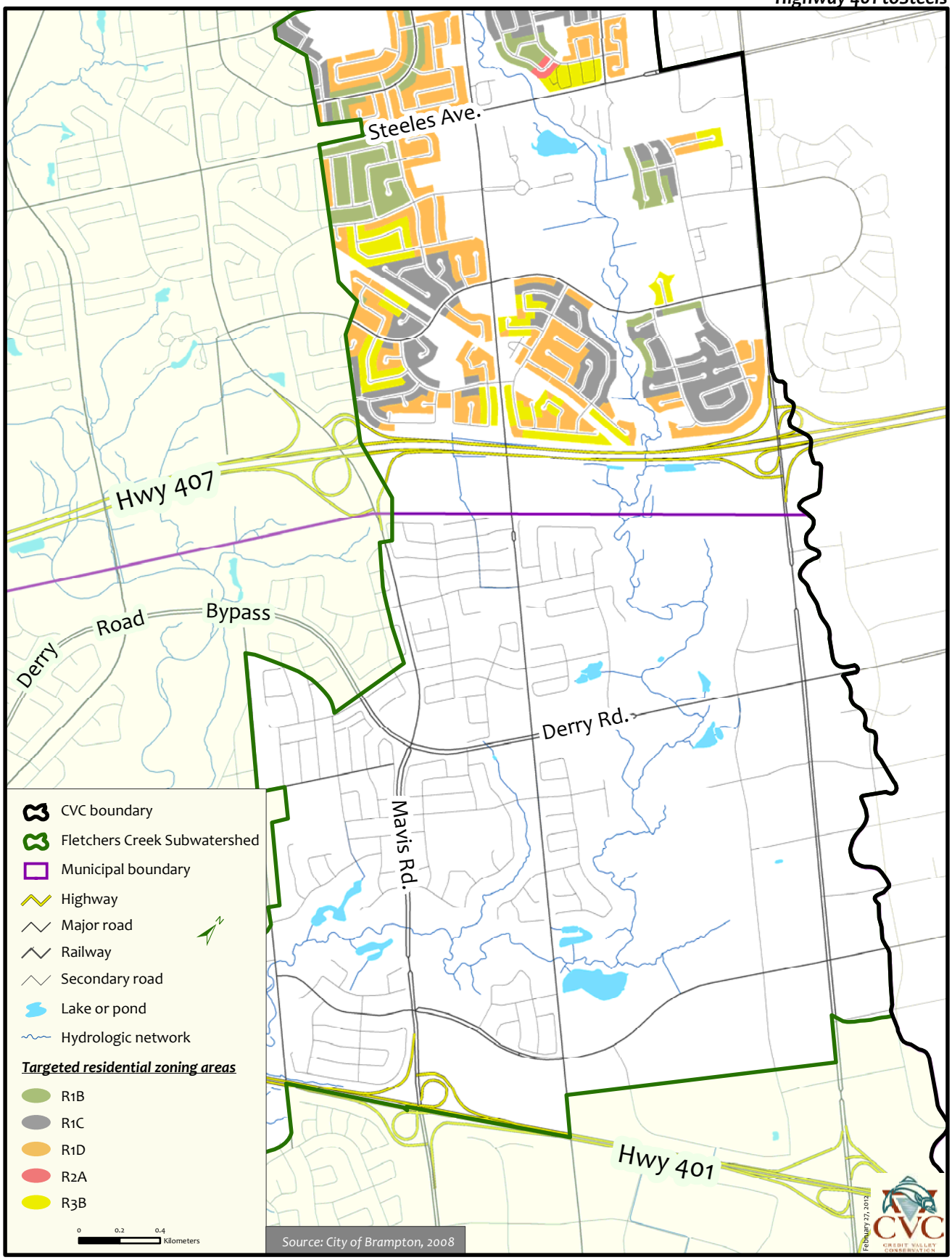


***Figure 2.15 Ta rgeted Residential Zoning Areas- Highway 401 toSteels***



## 2.2 POLLUTION PREVENTION – OVERVIEW OF OPPORTUNITIES BY DENSITY TYPE

This sub-section presents the pollution prevention opportunities identified as being relevant to the subwatershed within each residential density category: low, medium, and high density. Information is presented in the text, followed by a summary table highlighting management techniques, objectives, and key opportunities for pollution prevention in each of these three residential density categories.

### 2.2.1 POLLUTION PREVENTION OPPORTUNITIES FOR LOW DENSITY HOUSING

There are several typical pollution issues in low density housing areas. Most residences within the low density category have traditional landscaping, with an average of 80% of the lot consisting of impervious area. These areas also typically have high maintenance lawns, which are defined as lawns which require high input of fertilizers, regular mowing, and frequent watering. Another issue, noted in the neighbourhoods that were surveyed, is that a high percentage of houses have downspouts directly connected to the storm drain.

Pollution Prevention Factsheets for the following practices can be found in Appendix G:

- Dumpster Management
- Parking Lot Maintenance
- Turf Management
- Landscaping and Grounds Care
- Vehicle Maintenance and Repair
- Vehicle Washing
- Snow and Ice Management

These types of issues can be relatively easily addressed. For example, encouraging a decreased use of fertilizer and de-icer would be considered a top priority for pollution prevention in low density housing areas. An education program on proper usage of these materials and potential alternatives for homeowners could reduce the amount of improper use. There is also great opportunity for downspout disconnection.

### 2.2.2 POLLUTION PREVENTION OPPORTUNITIES FOR MEDIUM DENSITY HOUSING

Medium density residential neighbourhoods in the Fletchers Creek subwatershed have a moderate potential to generate pollutants. On a typical medium density residential lot, at least 95% of the lot is impervious with a garage and driveway in the front and a patio in the back. Most lots have some landscaping and many newer homes have disconnected roof leaders that drain to a catch basin. Primary pollution prevention opportunities identified for medium density residential neighbourhoods include reduced fertilizer and safe de-icer use. A targeted education program in the proper usage of these materials and potential alternatives can reduce the amount of improper use.

### 2.2.3 POLLUTION PREVENTION OPPORTUNITIES FOR HIGH DENSITY HOUSING

High density residential neighbourhoods in the Fletchers Creek subwatershed have a higher potential to generate pollutants. Parcels in high density areas are typically 95% impervious,

with some formal landscaping and turf. The building rooftops tend to drain internally. Primary pollution prevention opportunities identified for high density residential neighbourhoods include improved dumpster management and car fluid recycling. An education program should be targeted to residents on proper techniques for car repair and fluid disposal. In addition, property owners should be educated on better techniques for managing dumpsters.

Pollution Prevention Opportunities for Residential Lands include:

1. Proper Fertilizer Use
2. Lawn Watering
3. Winter Maintenance Procedures
4. Vehicle Maintenance
5. Dumpster Management

Table 2.2 summarizes priority opportunities for pollution prevention for residential land use.

***Figure 2.16 Summary of Restoration Opportunities on Residential Areas***

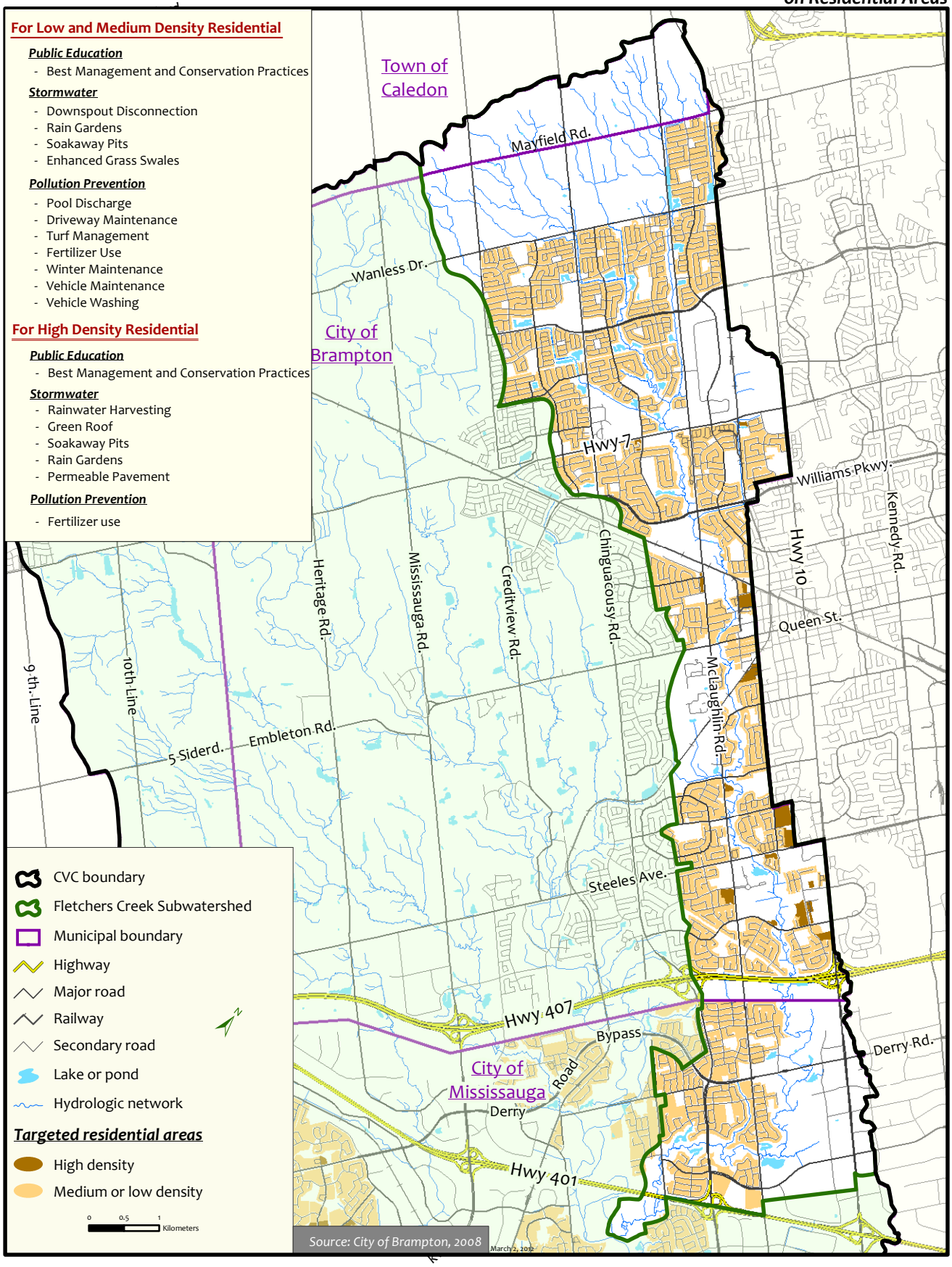


**Table 2.2 Summary of priority opportunities for pollution prevention for residential land use**

| Management Technique | Topic | Objective | Recommended Opportunity | Priority Areas (Density Type) | Resources |
|---|---|---|---|---|---|
| Education | Fertilizer Use | Decrease fertilizer use through educational initiatives. | Develop and display educational material on the City of Brampton website and provide brochures on how to:<br>• Choose the right fertilizer<br>• Proper application rates and techniques<br>• Opportunities for reducing fertilizer use.<br>Use school programs to reach the greater community. | Low , Medium and High Density Residential Lands | The Landscape Ontario website provides information and 'Seven Simple Steps' to maintaining your lawn. This information can assist in developing a simple strategy for promoting proper use of fertilizer by the residential community.<br>http://landscapeontario.com/how-to-maintain-a-healthy-lawn<br>CVC has developed a community based social marketing strategy aimed to improving behaviours related to lawn maintenance based on feedback received from Brampton residents. Further information can be found in Section 5.1 of the Fletchers Creek Characterization Report. |
| | Winter Maintenance | Decrease over application of winter de-icers through educational initiatives. | Develop educational material on proper winter preparedness and use of de-icers.<br><br>Some potential initiatives include:<br>• Winter Tires<br>• Alternative de-icers<br>• Reduced winter speeds<br>• Proper storage of de-icing chemicals.<br><br>Change behaviours by setting an example. Reduce salt application or level of service on minor roads. Many salt studies including CVC's have identified that reducing the impact of salt on the environment can only be properly met by reducing salt application. | Low , Medium and High Density Residential Lands | The Region of Waterloo is a leader in Road Salt Management. They have set a target of 25% reduction in road salt use and have implemented many initiatives to support a decreased use in road salt. |
| | Dumpster Management | Reduce impact of runoff from dumpsters. Dumpsters can be a major source of pollutants that can affect area water quality. Dumpsters are often left open to the air, allowing rainwater to mix with the trash, resulting in a leaking fluid, or "dumpster juice" that can contain toxic organic and inorganic materials. | Provide educational material landowners regarding proper dumpster management. | High Density Residential Lands | CVC has developed pollution prevention educational material which can be circulated to landowners. Refer to Appendix G. |

| Management Technique | Topic | Objective | Recommended Opportunity | Priority Areas (Density Type) | Resources |
|---|---|---|---|---|---|
| | Pool Drainage | Encourage proper drainage of pools | Pool maintenance can result in water being discharged into the storm drain system. Pool water should be encouraged (and enforced through a Storm Sewer Bylaw) to be disposed of through the sanitary system. | Low , Medium and High Density Residential Lands | Refer to Appendix H for a comparison of Storm Sewer Bylaws. |
| Program | Outdoor Water Use Program | Increase water conservation. | Development of a Low Water Response Program will encourage residents to reduce outdoor water use when water supplies are limited due to an extended period of drought.<br><br>Develop a water restriction or water conservation policy | Low , Medium and High Density Residential Lands | *Ontario Low Water Response* is the provincial plan intended to ensure preparedness in the event of a drought. The plan facilitates coordination and support between the province and local governments.[3] The City should work with province to develop their local plan.<br><br>The City of Guelph has had success through their 'Outdoor Water Use Program'. This program recommends decreased use depending on dry weather and watershed conditions. |
| | Outdoor Water Use Program | Increase water conservation. | Develop Irrigation Standards | High Density and Residential Lands | LEED Irrigation System Guidelines |
| | Efficient Landscaping Program | Adopt an ecologically based landscaping program that is aimed at changing behaviours. | Adopt and widely implement an efficient landscaping program | Low , Medium and High Density Residential Lands | There are a number of successful programs that can provide guidance:<br>1. Region of Peel Fusion Landscaping<br>2. City of Guelph Healthy Landscape<br>3. Credit Valley Conservation Green My Yard<br>4. Evergreen Urban Naturalization in Canada – a Policy and Program Guidebook |
| Policy | Storm sewer protection | Reduce unregulated storm sewer discharges. | Develop a bylaw that prohibits runoff from driveway car washing from entering the storm sewer.<br><br>Develop a bylaw that prohibits pool drainage from entering the storm sewer | Low , Medium and High Density Residential Lands | Many cities throughout Ontario have developed a bylaw prohibiting washing your car in your drive-way including the City of Toronto and Brantford. These bylaws could be used as examples. Comparison of updated storm sewer by-laws are included in Appendix H. |
| | Winter Maintenance Plans | For any new developments the developer should be required to develop a salt management plan. | Develop winter maintenance plans for all new developments<br><br>Require salt management plans to incorporate proper drainage to minimize ice formation in new parking lots. It has been identified that inadequate parking lot design greatly contributes to excessive winter salt use as a result of poor drainage measures. | Low , Medium and High Density Residential Lands | The Region of Waterloo requires all new developments to have a winter maintenance plan. This policy could be used as an example.<br><br>Encourage Landowners to employ contractors trained under the Smart About Salt Program. |

[3] Ontario Low Water Response, revised July 2003 (http://www.mnr.gov.on.ca/stdprodconsume/groups/lr/@mnr/@water/documents/document/mnr_e002322.pdf)

## 2.3 Detailed Description of Pollution Prevention Opportunities on Residential Lands

The preceding section presents an overview of potential and high priority pollution prevention opportunities on residential lands of low, medium, and high density. As seen in the summary tables above, most pollution that is encountered on residential lands is the result of fertilizer application, winter use of de-icer on sidewalks and driveways, and car repair activities. This sub-section provides further information on the typical issues and a description of each specific opportunity for pollution prevention.

### 2.3.1 PUBLIC EDUCATION

**Issue: Public is unaware of environmental impact**
**Opportunity: Increase awareness and understanding of environmental impacts**

Public education and outreach is fundamental to improving the state of Fletchers Creek. A great example of the impacts and possibilities of public outreach and education is the Save the Leopard Frog program, implemented by CVC in partnership with schools in the Fletchers Creek subwatershed. The purpose of the Fletchers Creek School Program is to help create public awareness of the Fletchers Creek subwatershed by:

- Providing students with an understanding of the subwatershed within which they live;
- Creating interest in the role and importance of the Fletchers Creek subwatershed;
- Introducing local natural areas that students can explore and learn from in order to encourage stewardship; and
- Discouraging activities that harm the watershed and promoting those that do not.

The Fletchers Creek School Program activities consist of an interactive, authentic learning experience that enhances the grades four to six science and technology curriculum. Through an in-school and outdoor program, students discover the importance of the plants, animals, land, and water in their own community and learn about ways that they can make a difference.

In the spring and fall of 2009, 1800 students throughout the Fletchers Creek subwatershed participated in the Save the Leopard Frog school program. This included a class presentation and a half-day field tour of Fletchers Creek. In 2010, the program reached 2,032 students throughout the Fletchers Creek subwatershed.

Along with being a classroom education program, the Save the Leopard Frog Program has further developed into a community engagement program. The program objective is to engage residents and the community to further understand and begin to implement the use of lot-level stormwater controls and pollution prevention by implementing pilot site rain gardens on school properties. CVC has worked with Green Glades Public School to construct a rain garden on school property and post interactive educational signage. CVC is working with schools in Fletchers Creek to develop more pilot sites. Further information on this portion of the Save the Leopard Frog program is provided in section 3.2.3.4.

The Fletchers Creek School Program compliments a community-based social marketing campaign and CVC's Multicultural Outreach and Education Program to raise environmental awareness, increase CVC's public presence and change behaviours of residents in the subwatershed in order to protect and conserve water (see Chapter 6 for further information).

**Figure 2.17 Educational outreach to students in primary school in Fletchers Creek**

### 2.3.2 FERTILIZER USAGE

**Issue: Excess fertilizer use**
**Opportunity: Reduced or no fertilizer use**

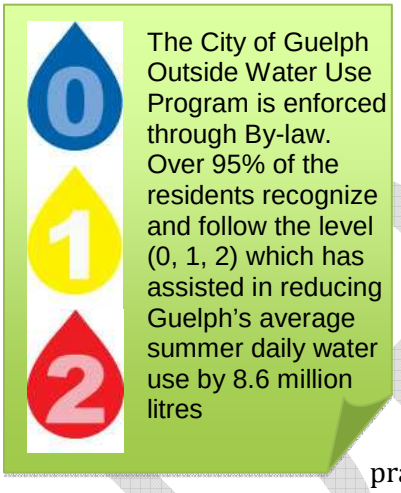
The ideal lawn is often seen as a uniform cover of green turf that may only contain one species of grass. Many landowners spend significant time and expense to achieve the "ultimate" lawn, often resulting in over fertilizing. Excess fertilizer that is not absorbed by the lawn is washed off when it rains, flowing into the storm drain system and eventually into receiving streams and lakes. Fertilizer is high in phosphorus and nitrogen, which can lead to eutrophic conditions in surface water.

While the preferred approach for pollution prevention from a water quality perspective is zero fertilizer application, there are areas where this idea is met with opposition. In this case, the next best method for pollution prevention is to emphasize using limited amounts of chemicals that are safer, and encouraging proper application methods and timing. A safer fertilizer is considered to be one that is produced from natural organic material as opposed to a chemical fertilizer. It is important to note, that since the banning of pesticides, the use of fertilizers has generally believed to increase. To mitigate potential future issues, encouraging proper use of fertilizers is highly recommended, for example through educational programs. Another method that is gaining in popularity is to change the type of residential landscaping to a more "natural" landscaping. For example, the Region of Peel developed the Fusion Garden Program, providing educational materials and guidelines for the residents on the Region's website. Fusion Gardens are described in further detail in section 2.3.3.

### 2.3.3 LAWN WATERING

**Issue: Excess water use for lawn watering**
**Opportunity: Conservation of water**

A market research study, titled Action Plan for Sustainable Practices: Implementation Strategies for the Residential and Business Sectors in the Greater Toronto Area, completed by Freeman Associates on behalf of CMHC found that people place a high importance on their home's landscape (refer to Appendix J for further information).[4] One important element that was identified in the study was a well-groomed, green lawn. These types of lawns tend to be high maintenance and unfortunately require significant watering causing strain on municipal water supply and energy. In addition to high levels of lawn watering throughout residential neighbourhoods, it is often not done properly and can therefore wash pollutants into the storm sewer system and into the receiving creek. An example of improper lawn watering is seen in Figure 2.18. Non-target irrigation is also a common issue. This is when watering devices sprinkle water across impervious surfaces such as sidewalks and driveways (as seen in Figure 2.19). In this situation, the water is not only wasted, but pollutants are also flushed into the storm sewer system and the receiving creek.




Ontario is increasingly experiencing extended periods of drought, low rainfall and high temperatures. These weather conditions have led to some of the lowest lake and river levels and driest soils recorded over the past several decades. Pollution prevention opportunities include encouraging citizens to conserve water, through reduced outdoor water use, which can assist in ensuring a safe water supply for the City in the future and help to reduce pollutants that are entering the sewer systems and receiving streams. Several options to achieve this include encouraging reduced water application or use of efficient landscaping practices, for example through educational programs.

It is also important to recognize the importance of reducing water use during drought conditions. The Ontario Low Water Response guidelines were produced with the intention of ensuring provincial preparedness in the event of a drought (Appendix B). Aside from identifying the roles, responsibilities, and response process, the guidelines identify the requirement of the municipality to promote a strong water conservation message. Many municipalities, like the City of Guelph, have found success in an outdoor water use program that is aimed at notifying residents when outdoor use should be limited or stopped. In the City of Guelph, over 95% of the residents recognize and follow recommended water use

[4] http://publications.gc.ca/collections/collection_2011/schl-cmhc/nh18-1/NH18-1-359-2006-eng.pdf

notification which has led to over 8.6 million litre reduction in average summer daily water use.

**Figure 2.18 Example of a high maintenance lawn and activities**

**Figure 2.19 Example of driveway washing, non-target irrigation**

### 2.3.4 DE-ICER USE

**Issue: Excess use of de-icer**
**Opportunity: Proper application and alternative solutions**

Ontario experiences severe winter weather with large amounts of snowfall and ice build up. The common practice to deal with icy surfaces (driveways, walkways, roadways) often includes application of de-icer. De-icer is usually made from rock salt. Rock salt and other common de-icer's (e.g., Calcium Magnesium Acetate, Calcium Chloride, Urea, Sand, Potassium Chloride, etc.) can have negative impacts on water quality and the environment, including:

- Threat to groundwater contamination in source water protection areas;
- Increased metal mobilization, ion exchange, and decreased soil pH caused by sodium concentrations that bind to the soil particles (Löfgren, 2001; Novotny et al., 2007 ); "Drought like" conditions for plants, as the salt disrupts water and nutrient uptake, The condition in plants is characterized by leaf scorch, leaf curling, leaf drop, stem dieback and plant death (Roth and Wall, 1976); and
- Loss of soil fertility and permeability due to salt application.

Similarly, many alternative de-icers, like sand, can also impact the environment in the following ways:

- Only a small proportion of the sand is collected in the spring through catchbasin cleaning, and street sweeping;
- Sand-salt mixtures have been found to leach phosphorus; and
- As compared to a treated MgCl salt de-icer, sand-salt mixture was found to result in high cumulative loads of Chloride, Total Suspended Solids and Total Phosphorus.

The following example illustrates the possible extent of this type of pollution in the region. To date, CVC has carried out three studies on the use of de-icer products in Mississauga. From several years of data in the Credit River watershed, a clear increasing trend in chloride concentration can be seen. In parking lot catchbasins draining directly to Sheridan Creek, CVC has found alarming chloride concentrations that peak at nearly twice the salinity of the Ocean, as seen in Figure 2.20.

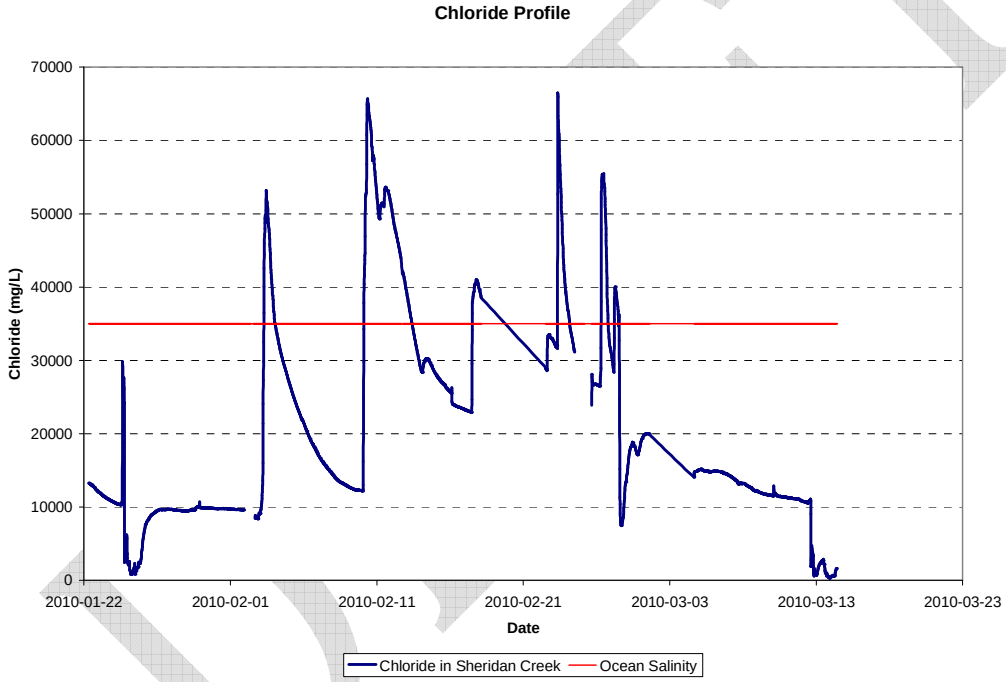



**Figure 2.20 Chloride concentrations in a catchbasin draining a parking lot directly to Sheridan Creek (blue) compared to typical Ocean concentrations (red)**

With respect to Fletchers Creek, the majority of Chloride ($Cl^-$) loading stems from road salt (NaCl) used for de-icing in the winter. As seen in the graph below, Chloride concentrations in Fletchers Creek have steadily increased over the last 35 years.

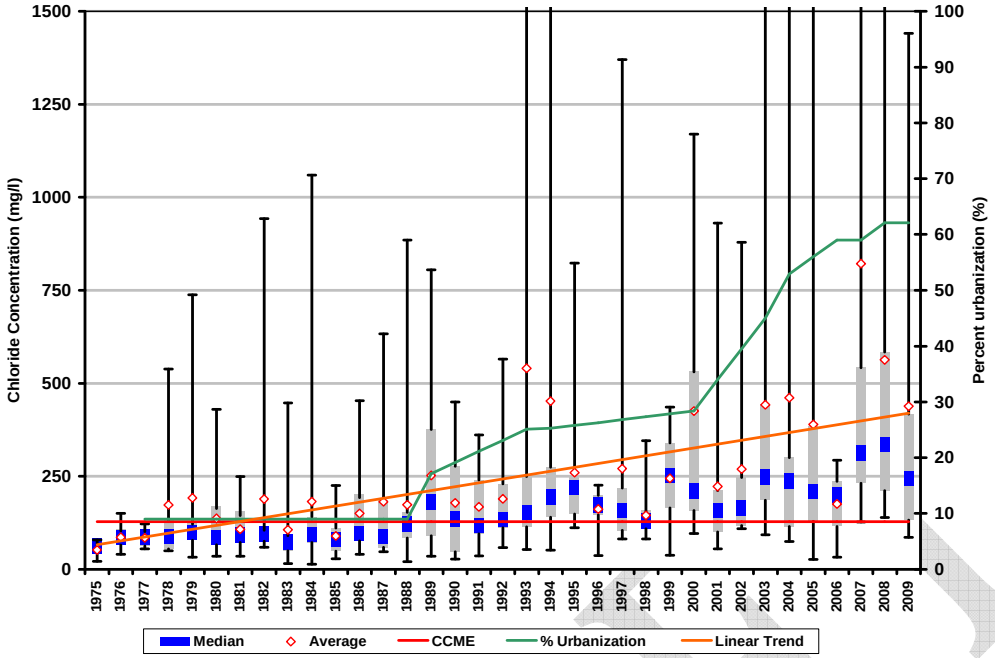



**Figure 2.21 Chloride concentrations for Fletchers Creek downstream of Steeles Ave. (1975-2009) as compared to percent urbanization and CCME guideline for aquatic life (120mg/L).**

Another contributor of these pollutants in the Fletchers Creek subwatershed is homeowners. Many homeowners apply salting products and alternatives indiscriminately, assuming that more is better. Snow and ice removal should involve shovelling and limited/sparing application of de-icers after removal of the snow. Homeowners will also commonly store de-icer products in an unsafe way, allowing for leaching and spillage, as seen in Figure 2.22.

**Figure 2.22 Common salt storage found in the Fletchers Creek subwatershed**

Applications from homeowners, businesses, contractors, and road crews provide significant inputs of de-icer to the Fletchers Creek subwatershed. Public education is a critical pollution prevention opportunity to teach proper and sufficient use of de-icers as well as reduce expectations regarding "bare pavement" and what the cost of this expectation is to Fletchers Creek. Public education is also important in teaching citizens about alternative, more

environmentally friendly products. It is recommended that more studies be carried out on potential alternative products. For example, CVC is currently investigating Fusion liquid de-icer (beet juice based de-icer) on their own parking lot at the CVC main office (Figure 2.23).

It is important to note that when educating and managing the use of de-icer products, additional issues other than pollution will need to be addressed, such as liability regarding public safety.

**Figure 2.23 Fusion de-icer spreading at CVC main office**

A good example of a successful education and salt management program is *Smart About Salt*. The Region of Waterloo was among the first large Ontario municipalities to recognize the impact of winter road salt application and to take action. The Region of Waterloo developed a strategy that went above and beyond the recommendations set forth in the Transportation Association of Canada Road Salt Best Management Practices. In addition, the Region of Waterloo developed the *Smart About Salt* program which since has become an independent council working throughout Ontario, supported by Landscape Ontario Horticultural Trades Association and Building. The *Smart About Salt* program is designed to teach private contractors and property managers best management practices related to salt management in order to reduce use while still ensuring public safety. All private contracts awarded through the Region of Waterloo, and the municipalities within the region, require *Smart About Salt* certification.

By becoming Smart About Salt certified, contractors gain many benefits including:

- Public listing on the Smart About Salt website;
- Eligbility for insurance discount programs;
- Smart About Salt window and truck stickers;
- Individual wall certificates;
- Proprietary use of logos and use of the website member only section; and
- Access to special weather information websites.

### 2.3.5 POOL DISCHARGE

**Issue: Pool discharge into the storm drain system**
**Opportunity: Safe pool discharge**

Currently there is no available data on the number and location of backyard swimming pools for the City of Brampton. The availability of this data would be helpful in conducting further analysis and identifying the impact of pools to the natural environment.

Routine and seasonal maintenance of both freshwater and saltwater pools can cause chlorinated water, saltwater or filter back flush water to be discharged into the storm drain system, and ultimately, a receiving stream or lake. Pool water typically contains high levels of chlorine as well as other chemicals to control pH and reduce bacteria and algae. The discharge of pool water can be toxic to aquatic life in small streams.

The preferred approach to safely draining swimming pools for pollution prevention is to discharge chlorinated water or salt water to the sanitary sewer system. Chlorinated water may also be held for a week or more and then spread over a pervious surface. Educational materials and campaigns could help improve pool maintenance and discharge practices in the area.

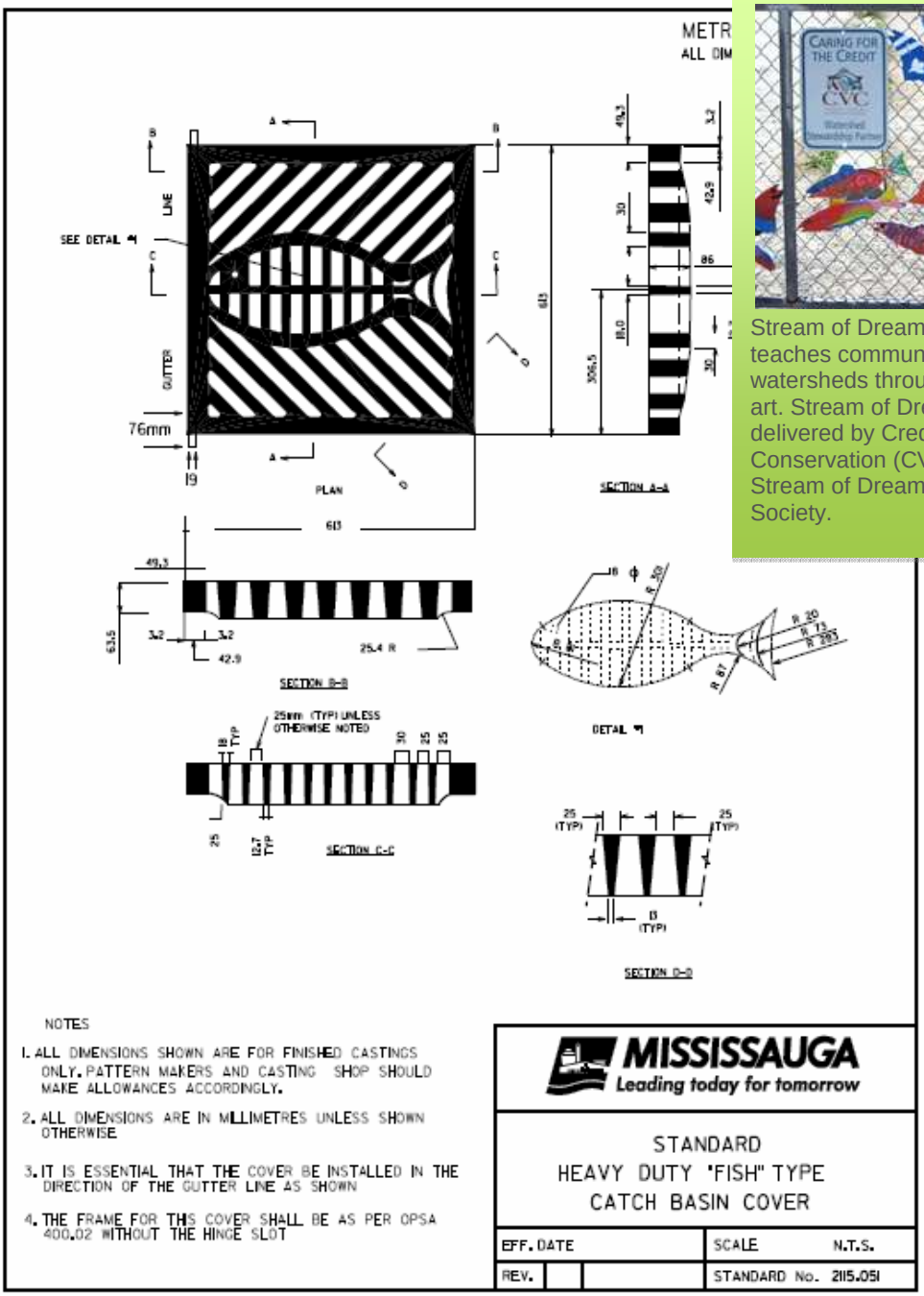
### 2.3.6 CAR FLUIDS

**Issue: Improper disposal of car fluids**
**Opportunity: Car fluids recycling**

To save time and money, many car owners change their own oil or antifreeze at home. If proper facilities are not available, this can lead to disposal of the by-products in storm drains or being stored improperly. Automotive fluid by-products are a major source of heavy metal pollutants and are toxic to living organisms in streams.

For pollution prevention, it is preferred for car maintenance and repair to be undertaken at a commercial car facility, which uses proper disposal methods. If this is not available, the next best opportunity for pollution prevention is to perform car maintenance under cover within a garage, and to carefully dispose of all oil, antifreeze, and other fluids at approved recycling facilities.

Many communities have undertaken educational programs which have proven successful in reducing the amount of improper disposal. For example, there are many municipalities that have participated in Trout Unlimited's *Yellow Fish Road* program. The *Yellow Fish Road* program is a nation-wide education program that aims to teach the public that storm drains are the "doorways to our rivers, lakes and streams" (Trout Unlimited) and that by preventing pollution from entering the storm sewers, we are protecting our water resources. Some municipalities have taken this initiative even further and have changed the look of the catchbasin cover in order to provide a visual reminder of the connection between sewers and water-ways. For example, the City of Mississauga has changed their catchbasin cover to look like a fish, as seen in Figure 2.24.







Stream of Dreamsis program teaches communities about their watersheds through community art. Stream of Dreams is delivered by Credit Valley Conservation (CVC) and the Stream of Dreams Murals Society.

**Figure 2.24 City of Mississauga Catch Basin Cover – acts as a reminder that storm sewers are directly linked to water-ways.**

### 2.3.7 DUMPSTER MANAGEMENT

**Issue: Pollutants released from unmanaged/unmaintained dumpsters**
**Opportunity: Safe dumpster management**

In high density areas, dumpsters can be a major source of pollutants, affecting area water quality. Dumpsters are often left open to the air, allowing rainwater to mix with the trash, resulting in a leaking fluid or "dumpster juice" that can contain toxic organic and inorganic materials (pictured in Figure 2.25). If not treated, this dumpster juice can enter the storm drain system, contributing to poor water quality in the receiving streams. In addition, dumpster storage areas are often unsightly, emit unpleasant odours, and can contribute to higher populations of vermin.

Pollution prevention opportunities for dumpster management include: covering the dumpsters; creating a secondary containment system by installing a berm or fence around the dumpster; and emptying the dumpster on a frequent basis. Alternatively, for high density residential areas dumpsters can be kept inside until pick-up. There is an opportunity to encourage or enforce all new developments to plan for dumpster storage inside.

**Figure 2.25 Replacement of a leaky dumpster and increasing the size of the dumpster storage to avoid over filling**.

## 2.4 Restoration Opportunities on Residential Lands

This section presents an overview of the recommended restoration opportunities on residential lands. Residential source control and naturalization restoration opportunities are present throughout the Fletchers Creek subwatershed. The types of restoration opportunities applicable to a residential lot are dependent on housing density, lot size, and the type of dwelling.

This section identifies the types of source control and naturalization restoration opportunities that are applicable to each residential density type and then provide details about each type of source control and naturalization restoration opportunities.

### 2.4.1 RESTORATION OPPORTUNITIES FOR LOW AND MEDIUM DENSITY HOUSING

Low and medium density residential lands are characterized by larger lot sizes with a single detached dwelling per lot. This density offers a diversity of restoration opportunities such as roof leader disconnects, rear yard catch basin retrofits, rain barrels, and rain gardens. In addition, practices such as Fusion gardens, natural landscaping, and tree planting should be encouraged, along with opportunities to use permeable pavement for patios and walkways.

Medium density lots tend to be smaller with single family, semi detached or townhomes. Within medium density residential areas, the reduced lot sizes reduce opportunities for roof leader disconnects, but the other restoration opportunities suitable to low density areas are still considered highly applicable, such as rain barrels, Fusion gardens, natural landscaping, etc. Some medium density areas also present opportunities for parking lot retrofits, namely, permeable pavement and perimeter and island landscaping retrofits.

### 2.4.2 RESTORATION OPPORTUNITIES FOR HIGH DENSITY HOUSING

Restoration priorities in high density neighbourhoods generally focus on parking lot retrofits. Impervious cover reduction, permeable pavement, and perimeter and island landscaping retrofit opportunities are abundant in apartment complex parking lots throughout the Fletchers Creek subwatershed. In addition, similar to low and medium density areas, fusion gardens and natural landscaping are considered priorities. Treatment of rooftop runoff is generally considered a lower priority in these areas, but opportunities do exist for cisterns, rainwater harvesting, and green roofs.

Table 2.5 summarizes high priority opportunities for restoration for both low, medium and high density housing.

**Table 2.3 Summary of high priority restoration opportunities for residential land use**

| Management Technique | Topic | Objective | Recommended Opportunity | Priority Areas (Density Type) | Resources |
|---|---|---|---|---|---|
| Education | Landscaping Improvements | To increase lot-level infiltration and filtration that will protect our water resources. | Provide additional education resources on the Brampton website to encourage the adoption of the Region of Peels Fusion Landscaping program. | Low, Medium and High Density | The Fusion Landscaping program uses a marketing strategy tailored to the residential sector to encourage lot-level infiltration practices. Appendix C has additional information about this program. |
| | Water Conservation | Engage the public to reduce the amount of water lost through leaks, specifically through leaky toilets.<br><br>Environment Canada estimates that Canadian communities are losing an average of 13% of municipal water to leaks and various unmetered uses[5]. | Reduce real water losses (leaks) through adoption of the Blue Dot Campaign. | Low, Medium and High Density | *One Change* engages and connects volunteers, community groups and leaders and then mobilizes them in their own communities to deliver the free 'This Blue Dot' kits and other water conservation messages. This education campaign can be adopted/promoted by the City. |
| Program | Downspout Disconnection Program *(Note: This program is mainly applicable to Low Density Housing)* | To encourage proper disconnection of downspouts connected to the storm sewer, thereby reducing flow directly to the storm sewer. | Develop a downspout disconnection program | Low and Medium Density | A list of existing programs and resources is provided in Appendix A |
| | Rainwater Harvesting | Adopt a Rainwater Harvesting Rebate program. | Encourage rainwater harvesting | High Density | The City of Guelph offers a $2,000 rebate for an approved all-season rainwater harvesting system for the residential sector. This program could be used as an example. |
| | Efficient Landscaping Program | Adopt an ecologically based landscaping program that is aimed at changing behaviours related to mowing and watering. This initiative will not only reduce the amount of contaminants entering the waterway but will also decrease emissions and water use. | Adopt and widely implement an efficient landscaping program | Low, Medium and High Density | There are a number of successful programs that can be adopted or can provide guidance:<br>1. Region of Peel Fusion Landscaping<br>2. City of Guelph Healthy Landscape<br>3. Credit Valley Conservation Green My Yard<br>4. Evergreen Urban Naturalization in Canada – a Policy and Program Guidebook |
| | Save the Leopard Frog | One part of the program is to introduce natural areas for students to explore and learn from. Construction of rain gardens on school grounds sets an example to the community and encourages greater uptake of similar gardens on private property.<br><br>A successful program must first convince residents to adopt landscape best management practices before attempting to educate or inform them on "how to". | Widely promote and implement the Save the Leopard Frog outdoor classroom program | Low, Medium and High Density | Lessons learned on implementation can be taken from previous experience. CVC is working with two schools in the Fletchers Creek subwatershed to construct rain gardens on the school properties. Further information on this program can be found in the Industrial, Commercial and Institutional Chapter. |

[5] Environment Canada Freshwater Website. www.ec.gc.ca/water/images/manage/effic/a6f7e.htm

| Management Technique | Topic | Objective | Recommended Opportunity | Priority Areas (Density Type) | Resources |
|---|---|---|---|---|---|
| | Green Your Yard | Encourage ecological landscaping and gardening through native plant gardening, environmental maintenance and green outdoor buildings. | Widely adopt and promote the Your Green Yard program | Low and Medium Density | Your Green Yard program provides workshops and other resources to assist homeowners to naturalize their property. This program could be adopted/promoted by the City. More information can be found on the CVC website.[6] |
| Policy | New Development Infiltration/Filtration Practices | For any new development, the developer should be required to complete a low impact development checklist that identifies opportunities for inclusion of LID. | Develop low impact development (LID) requirements for all new development to encourage lot-level infiltration and filtration. | Low, Medium and High Density | Halton Hills has developed a LID checklist which is required for all new developments. The LID checklist identifies any opportunities for including practices within the development. Example of this check list is provided in Appendix D. |
| | Green Roof | Reduce impervious cover of high density developments, which reduces heat island effect and filters stormwater. | Develop a Green Roof Bylaw | High Density | The City of Toronto is the first City in North America to have a bylaw to require and govern the construction of green roofs on new development. It was adopted by Toronto City Council in May 2009, under the authority of Section 108 of the City of Toronto Act. This bylaw could be used as an example. |
| | Rainwater Harvesting | Reduce waste of potable water. This will save on energy consumed to pump water to and from homes, as well as reduce strain on stormwater infrastructure. | Develop a Rainwater Harvesting policy for new developments. All new high density developments should include a rainwater harvesting system which can supply water for irrigation and/or toilets. | High Density | The City of Guelph has developed a *Residential RainwaterHarvesting Design and Installation Best Practices Manual* that can be viewed through the following website: http://www.guelph.ca/living.cfm?itemid=78750&smocid=2338 |



[6] Credit Valley Conservation http://www.creditvalleyca.ca/your-land-water/green-cities/your-green-yard/

## 2.5 Detailed Description and Illustration of Restoration Opportunities on Residential Lands

The preceding section presents an overview of potential and high priority restoration opportunities on residential lands of low, medium, and high density. As seen in the summary tables above, most restoration in these areas involves increasing the amount of infiltration and filtration, through opportunities such as efficient landscaping and use of permeable surfaces. The following figures (2.26 through 2.29) illustrate details with respect to restoration opportunities for each density that were summarized in the above tables and are more thoroughly described below the tables.

LID Fact Sheets for the following practices are provided in Appendix F:

- Rainwater Harvesting
- Green Roof
- Downspout Disconnection
- Soakaway, Infiltration, Trenches, Chambers
- Bioretention
- Vegetated Filter Strips
- Permeable Pavement
- Enhanced Grass Swale
- Dry Swale
- Perforated Pipe

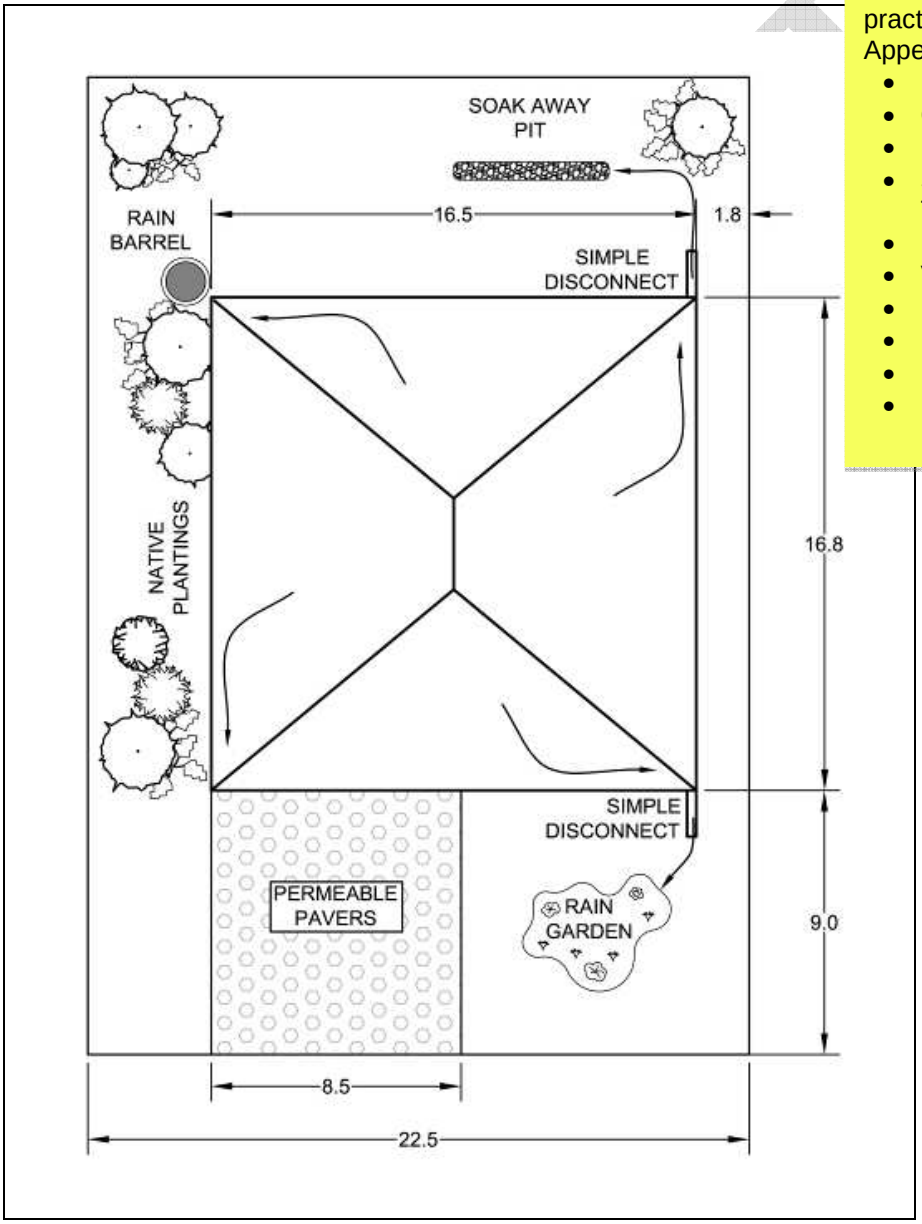



**Figure 2.26 Restoration opportunities for low density development (single family)**

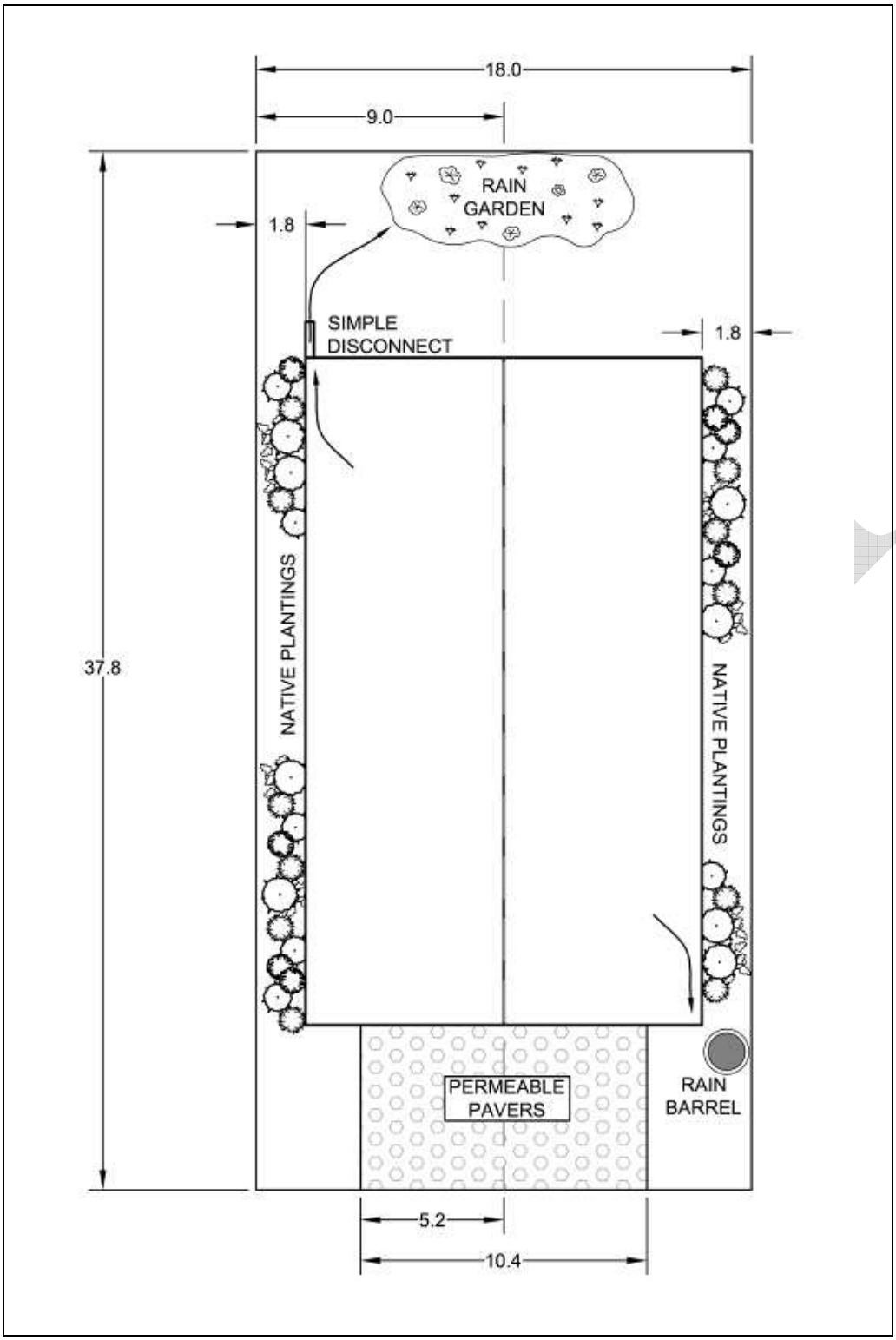



**Figure 2.27 Restoration opportunities for medium density development (semi detached)**

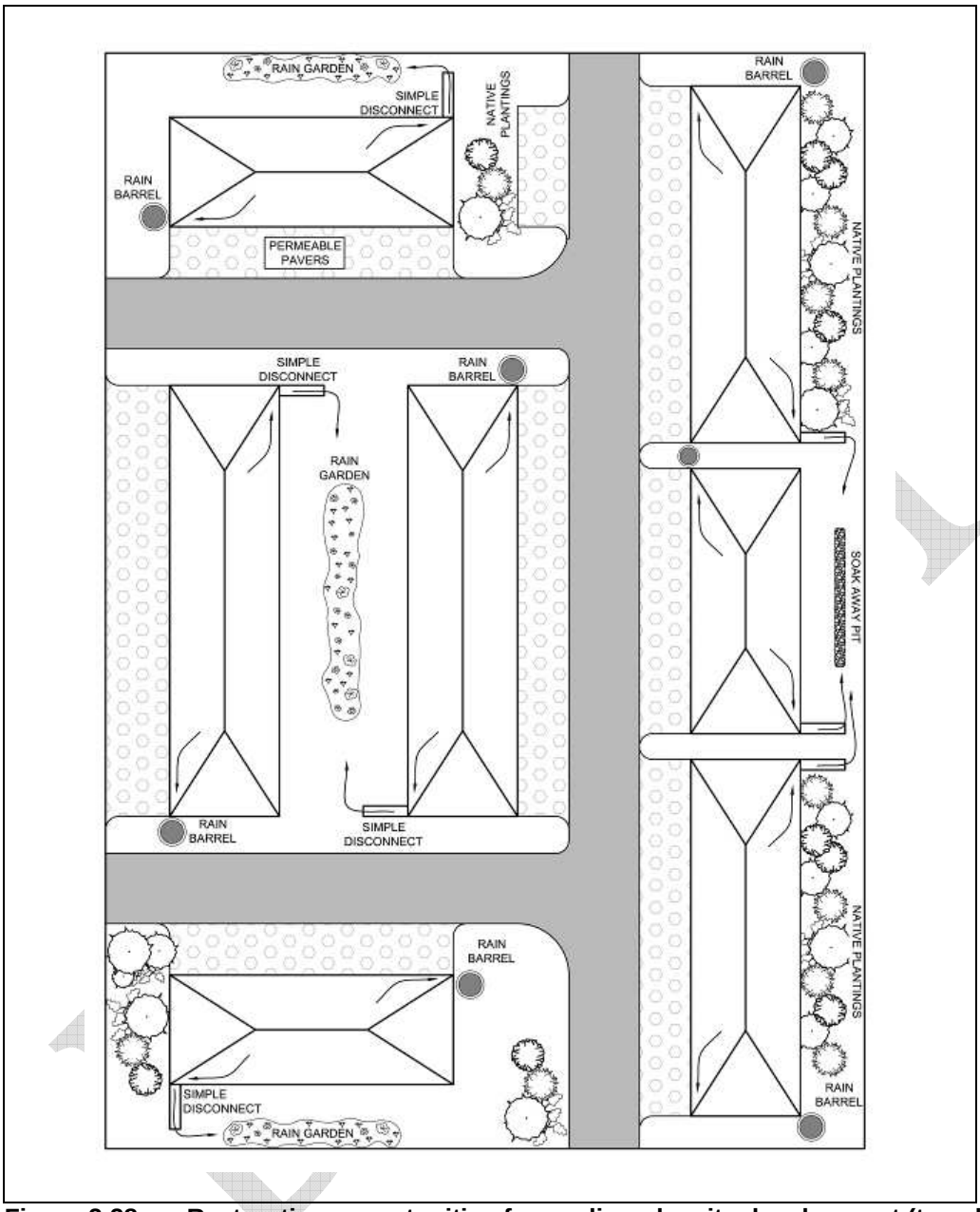



**Figure 2.28 Restoration opportunities for medium density development (townhouse complex)**

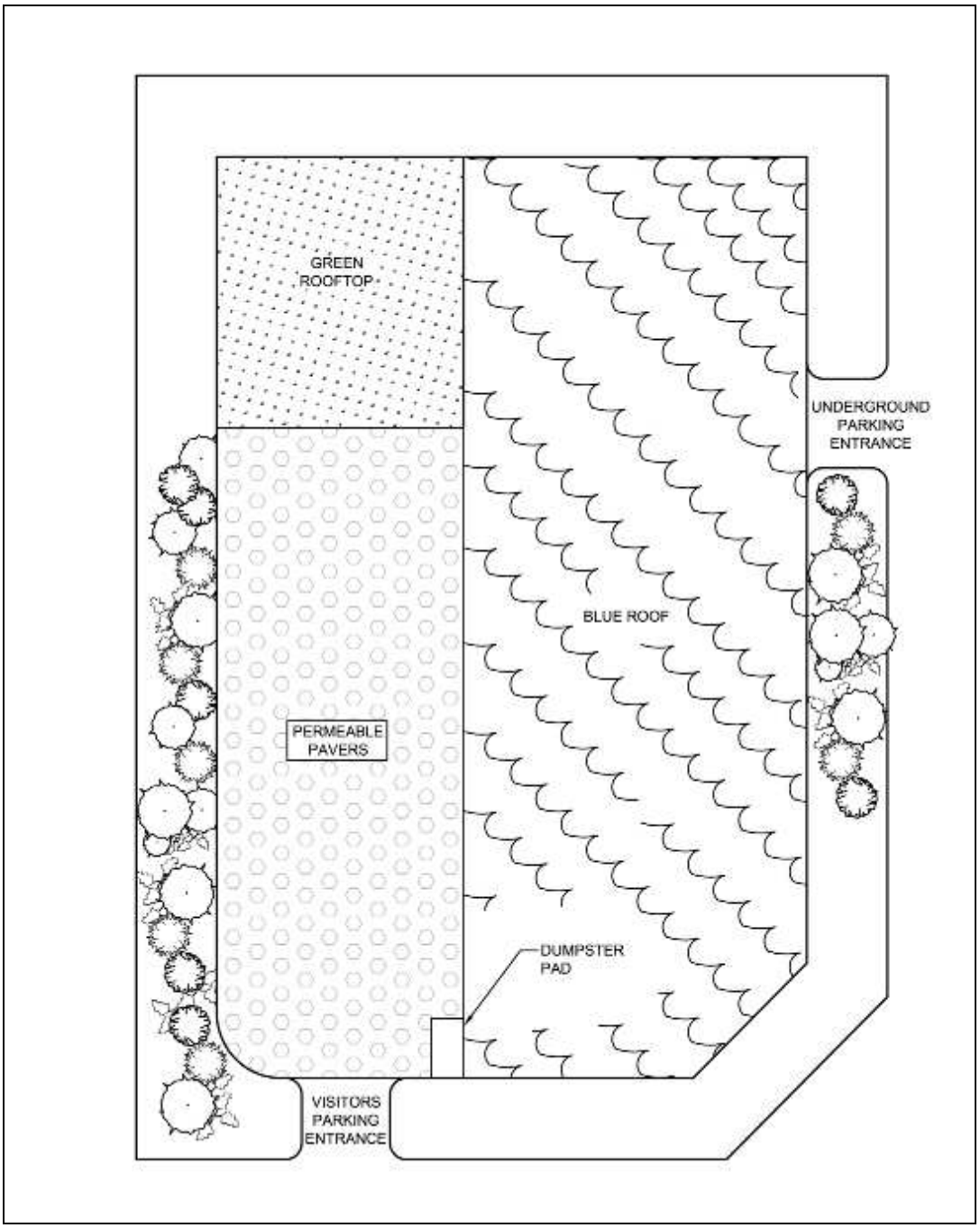



**Figure 2.29 Restoration opportunities for high density development (apartment complex)**

The remainder of this section provides further information on the restoration practices highlighted in the summary tables, namely source controls and naturalization. Source controls are on-site, small-scale stormwater treatment practices that capture and treat stormwater runoff from individual source areas, such as rooftops, parking lots, and street sections. Naturalization is the application of land reclamation and revegetation techniques to improve soil quality, increase stormwater infiltration, and increase the urban tree canopy.

### 2.5.1 SOURCE CONTROLS FOR ROOFTOP RUNOFF

**Issue: Water quality and quantity impacts to urban environment**
**Opportunity: Lot-level infiltration and filtration of stormwater**

Many rooftops within the Fletchers Creek subwatershed are connected directly to the storm sewer system. Instead of allowing stormwater runoff to infiltrate into the ground, the runoff is carried directly to the stream system. The loss of infiltration lowers the groundwater table; resulting in an increased base flow in streams, which affects water quality and habitat. Drainage systems connected directly to the storm sewer system also increases the amount of pollutants entering the stream system and increases erosion.

Disconnecting downspouts from the storm sewer system and redirecting the flow, using a restoration stormwater practice, will allow for increased infiltration of runoff. The following on-lot rooftop retrofits are applicable to a range of residential land uses in the Fletchers Creek subwatershed, and will allow for increased infiltration and filtration of rooftop runoff.

The Low Impact Development Stormwater Management Planning and Design Guide, developed by CVC and TRCA, should be referred to for further details on source control practices.

- *Simple Disconnects*. Disconnecting the downspout and directing flow to a pervious area.
- *Rain Barrels*. Rain barrels are placed at a downspout to collect and store stormwater.
- *Rain Gardens*. Rain gardens are small, landscaped depressions that capture, filter, and infiltrate stormwater runoff from rooftops, patios, walkways, driveways.
- *Soakaway Pits*. Soakaway pits are underground infiltration trenches that serve a single residential lot. Runoff is directed to the soakaway pit via a roof leader and is contained in the gravel reservoir until infiltrating into the surrounding soil.
- *Rear Yard Catch Basin Retrofits*. Some neighbourhoods could have rear yard catch basins that collect stormwater runoff and direct it into the storm drain system. Retrofitting these catch basins will allow for ponding and infiltration of stormwater runoff.
- *Cisterns and Rainwater Harvesting*. Cisterns capture and reuse rooftop runoff from building rooftops.
- *Green Roofs*. Green roofs, also known as living roofs or eco-roofs, consist of a thin layer of vegetation and soil installed on top of a conventional roof.

Figure 2.30 provides a visual example of a disconnected downspout.

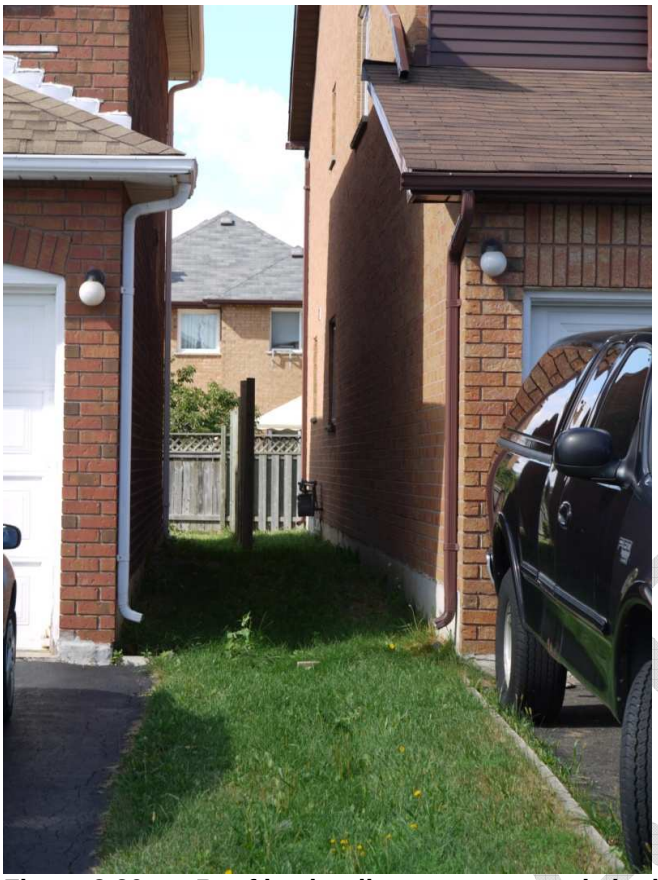


**Figure 2.30 Roof leader disconnect example in the Fletcher`s Creek subwatershed**

### 2.5.2 SOURCE CONTROLS FOR PARKING LOTS

**Issue: Thermal and pollutant impact to receiving water-way (as well as heat island effect)**
**Opportunity: Infiltration and filtration of stormwater, reduction in heat absorptive surfaces**

Parking lots in townhouse and apartment complexes throughout the Fletchers Creek subwatershed present additional restoration and retrofit opportunities. Parking lots can be a major source of pollutants to a stream system. These pollutants include oil and grease from automobiles, salt and other chemicals from use of de-icer products, as well as temperature spikes from the runoff flowing across hot pavement in the summer.

Three methods of retrofitting a parking lot that apply to medium and high density residential areas in the Fletchers Creek subwatershed include: impervious cover removal; permeable pavement; and perimeter and island landscaping retrofits. These are further described here:

- *Impervious Cover Reduction*. Impervious cover reduction is the removal of unnecessary pavement from areas of the parking lot where there is no vehicular traffic.

- *Permeable Pavement*. Permeable pavement treats or reduces runoff using a porous or semi-porous material, and may include permeable asphalt or concrete, grass paving blocks, interlocking concrete modules, and brick pavers.
- *Perimeter and Island Landscaping Retrofits*. Perimeter and island landscaping retrofits involves the conversion of landscaped areas into vegetated stormwater treatment areas. (Figure 2.33 presents an example).

Figure 2.31 presents an example of permeable pavement. Figure 2.32 presents an example of perimeter and Island landscaping retrofits.

**Figure 2.31 Permeable pavement at CVC main office, in Mississauga**

**Figure 2.32 Example of an island landscaping retrofit at Riverwood Conservancy, in Mississauga. This can be applied to apartment buildings**

### 2.5.3 NATURALIZATION

**Issue: Minimal ecologically viable refuge, habitat and food sources, disconnection of natural hydrological cycle**
**Opportunity: Inclusion of the natural environment into urban fabric**

Both landscapes and hardscapes on a residential lot present opportunities for naturalization, as there are issues with both. For example, excess fertilizers applied to landscaped areas and turf may wash off into the storm drain and ultimately be discharged to the receiving stream. Hardscapes, such as driveways, sidewalks and patios, may collect automobile fluids, de-icers, pet waste, and other pollutants that will also be washed off into the storm drain and discharged to the receiving stream. In addition, the impervious cover of hardscapes will reduce opportunities for stormwater infiltration.

Several naturalization or eco-landscaping opportunities can be found in the landscapes and hardscapes of residential areas throughout the Fletchers Creek subwatershed. These are described below.

- *Fusion Gardens*. Fusion gardens use native plants that require little or no supplemental irrigation. (An example is presented in Figure 2.33).
- *Natural Landscaping*. Natural landscaping is the use of native species of annual, perennials, shrub, and forest cover in mulched beds.

- *Tree Planting*. Many newer neighbourhoods in the Fletchers Creek subwatershed are lacking a mature, native tree cover. Trees help improve air quality, water quality, lower the amount of storm runoff, and reduce the urban heat island affect.

**Figure 2.33 An example of a Fusion Garden: before (bottom photo) and after (top photo)**

### 2.5.4 EXAMPLE OF LOT-LEVEL STORMWATER CONTROL

In 2008 Freeman Associates conducted a market research study within the City of Mississauga examining the constraints and opportunities around the adoption of sustainable lot-level stormwater controls by owner-occupants of single-family residential dwellings. The study explored new options and processes for enhanced stormwater control, including lot-level measures. The study's findings can assist in developing a successful landscaping program. Some of the study's findings include:

- It was identified that homeowners have a strong emotional connection to their home and landscape;
- Homeowners see lawns, gardens, trees and other features of their landscape as a reflection of their home and themselves;

- The beauty of their home's landscape is of significant importance to homeowners;
- Being able to tap into the homeowners intrinsic emotional connection to their landscape will assist in successful implementation of a landscaping program;
- Homeowners do not understand, nor favourably respond to words like, sustainable landscapes, water efficient or naturalized landscapes;
- Stakeholders, retail and landscape processionals are trusted sources for providing advice;
- Landscape advisory services should be given consideration as a tool to assist homeowners move towards incorporating lot-level best management practices;
- A beautiful and aesthically pleasing landscape design is lush, green manicured lawn, with lots of colourful flowers in a neat, tidy and clean design;
- Homeowners were found to have an aversion to rain barrels.

The study identified that a successful program must first convince residents they want a landscape incorporating best management practices before attempting to educate or inform them on "how to". This study's findings indicate that this could possibly be a management technique for restoration applicable to this subwatershed, however further study is warranted.

**Figure 2.34 Examples of lot-level stormwater controls**

# 3.0 PUBLIC LANDS

Public lands represent significant contributions to the value of a community and watershed. Public lands, defined in this report as parks, community centres, schools, conservation areas and open spaces, provide diverse opportunities for the public to congregate, recreate and experience the natural (and often no-so-natural) environment. These areas have important social and health benefits for people, as well as for the small wildlife that often lives in these areas. However, if not protected properly, public lands can be inhibited from fulfilling important environmental/ecological functions such as stormwater management and aquifer regeneration, air quality filtration, and provision of natural habitat.

These important ecological functions are more likely to be diminished when the public lands are located in urban or suburban areas, compared to those in rural areas. For example, parks, community centers and schools are similar in character, and are often located adjacent to each other with overlapping and shared uses. In addition, most of the public lands in this region were not originally designed to manage stormwater impacts. Watershed health, and managing land on a watershed basis is not yet mainstream practice. Often schools, community centres, parks, recreational areas and open spaces are designed to serve the needs of the community for recreational opportunities. Many public lands therefore have impervious surfaces such as roofs and pavement draining directly into the storm drains. Most also have extensive areas of turf that is kept mown to a very short height, and therefore less permeable, but also most likely requiring frequent fertilizer application and management. Tree canopy is also fairly absent, with the few trees present often showing signs of high use around them with compacted soils.

This chapter will present some of the options to improve management and possibly restore degraded public lands – in particular parks, conservation areas, and open spaces, with a particular focus on recommendations for stormwater management to improve overall watershed health. Site visits to public lands were conducted by CVC staff in 2010. Data sheets were filled out to characterize each site, and additional notes were taken on aerial photographs and in sketch form. The information presented in this chapter is primarily based on these site visits, as well as analysis of GIS data.

## 3.1 PARKS

### 3.1.1 CHARACTERIZATION

Parks in this region vary in size and layout but almost all are dominated by extensive areas of turf. Programmed park spaces may include tennis courts, children's play areas, and sports fields. Parks are often partnered with schools or community centers so that there is no visible distinction between the properties, and uses of the spaces are fluid and overlapping. Some parks contain small parking lots, while many depend on-street parking. The amount of trees vary from park to park, with some parks having groves of established trees, or a few trees near the street, but on the whole most parks have fairly sparse tree

cover. Decorative planting, flower beds, and shrubs were only seen in a few parks during field surveys, and only a few parks had remnant spaces of natural areas such as riparian forest or wetlands. In instances where parks were adjacent to a creek, there was often a very narrow band of riparian vegetation with turf coming quite close to the stream, often right up to the top of bank. There were no instances where a creek was integrated into the design of the park, or the park functioned as an extension of the creek hydrologically or ecologically.

General design and management of the parks observed do not include parameters to address stormwater management in terms of allowing rainwater to percolate. Instead designs used aim to remove stormwater off site as quickly as possible. Stormwater is typically drained from the turf areas into large area drains or directly into the creek. While turf is useful, it does not have much value in stormwater management when kept very short. Overall, general conditions observed in parks were detrimental to watershed and creek health.

### 3.1.2 PROPOSED SOLUTIONS

The following example presents a typical park in Fletchers Creek Subwatershed. Many of the parks are good candidates for improved stormwater management practices, including establishing no-mow zones or naturalization. Some simple adjustments in management of turf can result in significant improvements in stormwater management. Additionally increasing the planting diversity by simply planting trees or creating flower beds and planting perimeter shrubs can also result in improvements in watershed health.

Figure 3.1 presents an example of a typical park that is a good candidate for eco-landscaping. Woodview Park, located on Harold Street near McLaughlin Drive has established simple no-mow zones. This park also has many open areas which could also provide opportunity for additional tree planting.

**Figure 3.1 Woodview Park in the Fletcher's Creek subwatershed provides an excellent opportunity for establishing no-mow zones**

### 3.1.3 EXAMPLES OF PARK RETROFITS

#### 3.1.3.1 LAKESIDE PARK – CITY OF MISSISSAUGA

Another important method to improve stormwater management in open spaces is through naturalization. A good example of a park that includes naturalization is Lakeside Park, located in the City of Mississauga. Lakeside Park is a demonstration area for the inclusion of green technologies in public spaces. The rehabilitation of Lakeside Park is a part of the Mississauga Waterfront Park Strategy that aims to use sustainable, creative and resourceful planning, conservation and development practices for sustainable park management. A key strategic goal in this strategy is to promote a stronger relationship between parks and the existing natural system. The Park includes:

- Two children's play areas with one splash pad – water from the splash pad is retained within a pond and used for irrigation;
- A comfort station with washrooms witha green roof on the building;
- A leash free dog area – runoff from this area settles within a swale for increased infiltration;
- Flexible open space, with a designated area for events;
- A multi-use trail;
- Permeable pavement parking lot;
- A bioretention cell for stormwater treatment;
- Public education information on prevention of erosion ;
- An open lawn area – irrigated by reused water;
- Naturalized meadow and restoration areas – includes many native plant species which provides a good resting location for migrating birds and butterflies;
- Demonstration gardens; and
- Picnic areas.

**Figure 3.2 Swale draining off-leash dog park (left) and bioretention cell receiving runoff from parking lot (right) at Lakeside Park in the City of Mississauga.**

**Figure 3.3 Green Roof over washroom building (left) and receiving pond area retaining water used for irrigation (right) at Lakeside Park in the City of Mississauga.**

#### 3.1.3.2 RIM PARK – CITY OF WATERLOO

RIM Park, located in the City of Waterloo, is a 500-acre park with 18 outdoor sports fields, a multi-purpose recreational building, trails, park land, gold course, and heritage and public art exhibits. The park was designed with a number of innovate water conservation practices. Among many features, the park was designed with an outdoor sports facility featuring two international quality artificail turf sports fields that function to retain and harvest stormwater that naturally falls on the fields (design completed by Principle Water Resources Inc.). The sports field irrigation system uses stormwater that is collected from the artifical turf fields which is then stored beneath the artifical field in a clear stone storage layer. The objective of the project was to conserve potable water and to apply the optimum amount of stored rainwater to keep the sports fields healthy during dry events.

### 3.1.3 SUMMARY OF IMPROVED MANAGEMENT OPPORTUNITIES FOR PARKS

Figure 3.4 and Table 3.1 (overleaf) presents an overview of priority areas and key opportunities , respectively, to improve stormwater management in park lands through better management practices or park restoration with a broad objective of improving sustainability of park lands.

Figure 3.5 presents a diagram of a park that incorporates some of the management practices identified in Table 3.1.

***Figure 3.4 Summary of Restoration Opportunities on Public Lands and Schools***

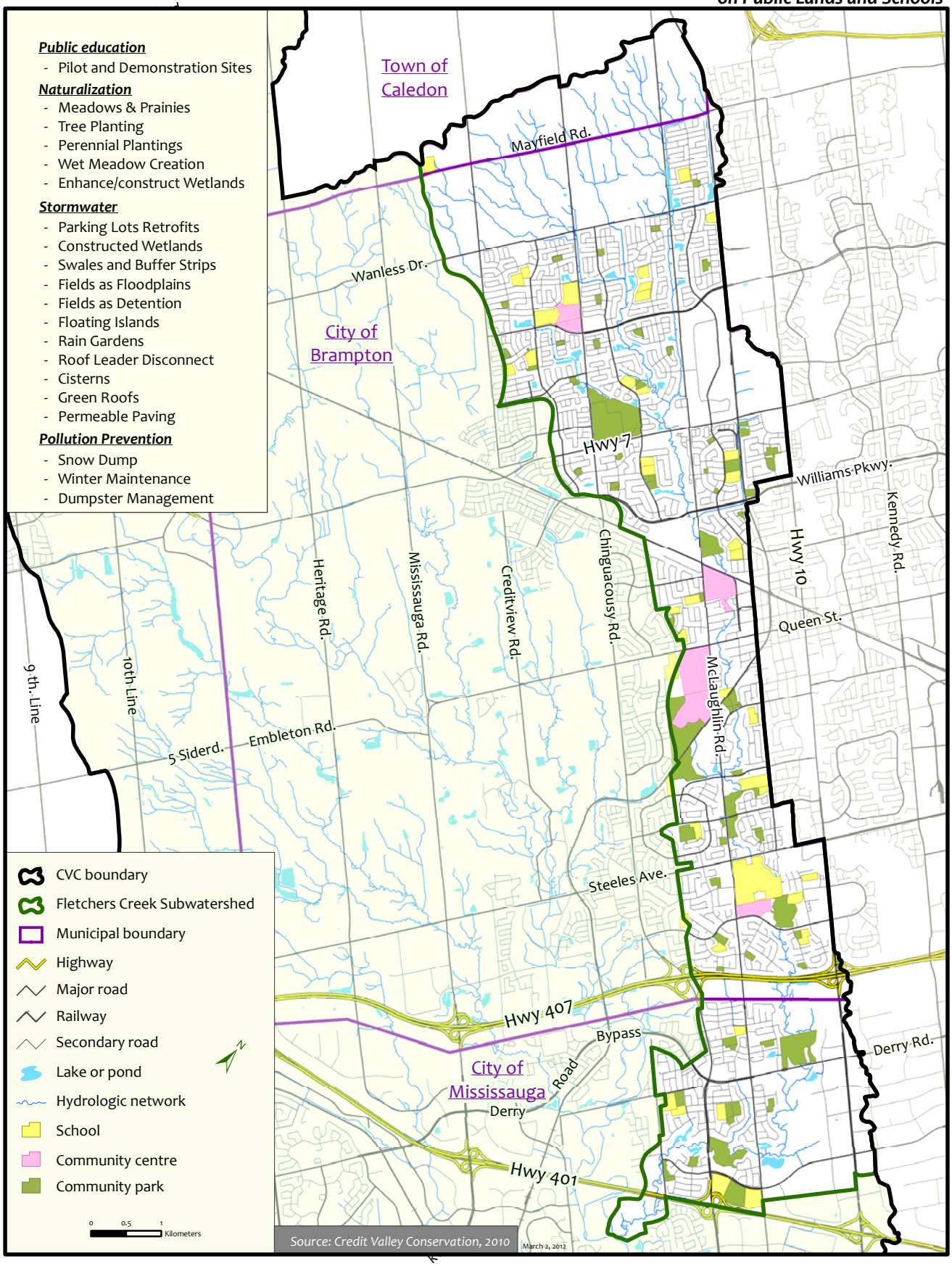


**Table 3.1 Key Opportunities for Park Sustainability**

| Management Technique | Topic | Objective | Recommended Opportunity | Resources |
|---|---|---|---|---|
| Program | Property Edge and Street Frontage | Change practices and retrofit existing park lands to manage stormwater more sustainably and improve soil health. | Use public spaces as examples of practices that can be implemented on private property. Change practices and retrofit existing park lands in the following ways:<br>• Mow less often<br>• Use native grass as turf<br>• Reduce fertilizer use<br>• Plant meadows or prairies (naturalize)<br>• Plant more trees<br>• Increase perennial planting<br>• Develop a rain garden<br>• Use constructed wetlands<br>• Use swales and buffer strips<br>• Disconnect roof leaders | Construction of rain gardens on school grounds through the Save the Leopard Frog program sets an example to the community and encourages greater uptake of similar gardens on private property. Freeman Associates conducted a study which identified that a successful program must first convince residents they want a sustainable landscape before attempting to educate or inform them on “how to”. |
| Program | Parking Lot Retrofit | Retrofit existing parking lots to improve stormwater retention and reduce pollutant loading in receiving watercourses | Retrofit existing parking lots with best management practices to provide stormwater management. Initiatives would include:<br>• Plant more trees along edge<br>• Install swales and buffer strips along edge<br>• Pervious paving<br>• Drain to landscape<br>• Reduced salt use | The City of Toronto has developed Design Guidelines for ‘Greening’ Surface Parking Lots (See Appendix E). This report provides polices related to improving public spaces , enhancing pedestrian safety and comfort, increasing shade, enhancing the quality of landscaping, encouraging on-site stormwater management and promoting use of sustainable technologies and materials. This report may be helpful in acting as a guide. |
| Policy | Sports field Management | Manage stormwater more sustainably and improve soil health. | Change existing policies and practices to manage sports fields with best management practices such as: using native grass as turf and reducing fertilizer use on sports fields; retrofiting sports fields to act as a flood plain and detention during large storm events. | Rim Park in the City of Waterloo uses Sports Fields neighbouring a pond as detention for large storms. |
| | Greening Parks | Actively rehabilitate open spaces to manage stormwater more sustainably and improve soil health. | Change existing policies and practices to manage multi-use fields with best management practices such as the following:<br>• Mow less often<br>• Use native grass as turf<br>• Reduce fertilizer use<br>• Plant meadows or prairies naturalize)<br>• Plant more trees<br>• Use swales and buffer strips<br>• Fields as flood plains<br>• Fields as detention | The City of Brampton actively naturalizes riparian areas. The next active step would be to actively rehabilitate open field areas. This would not only minimize emissions generated from mowing but would also provide infiltration/filtration of |

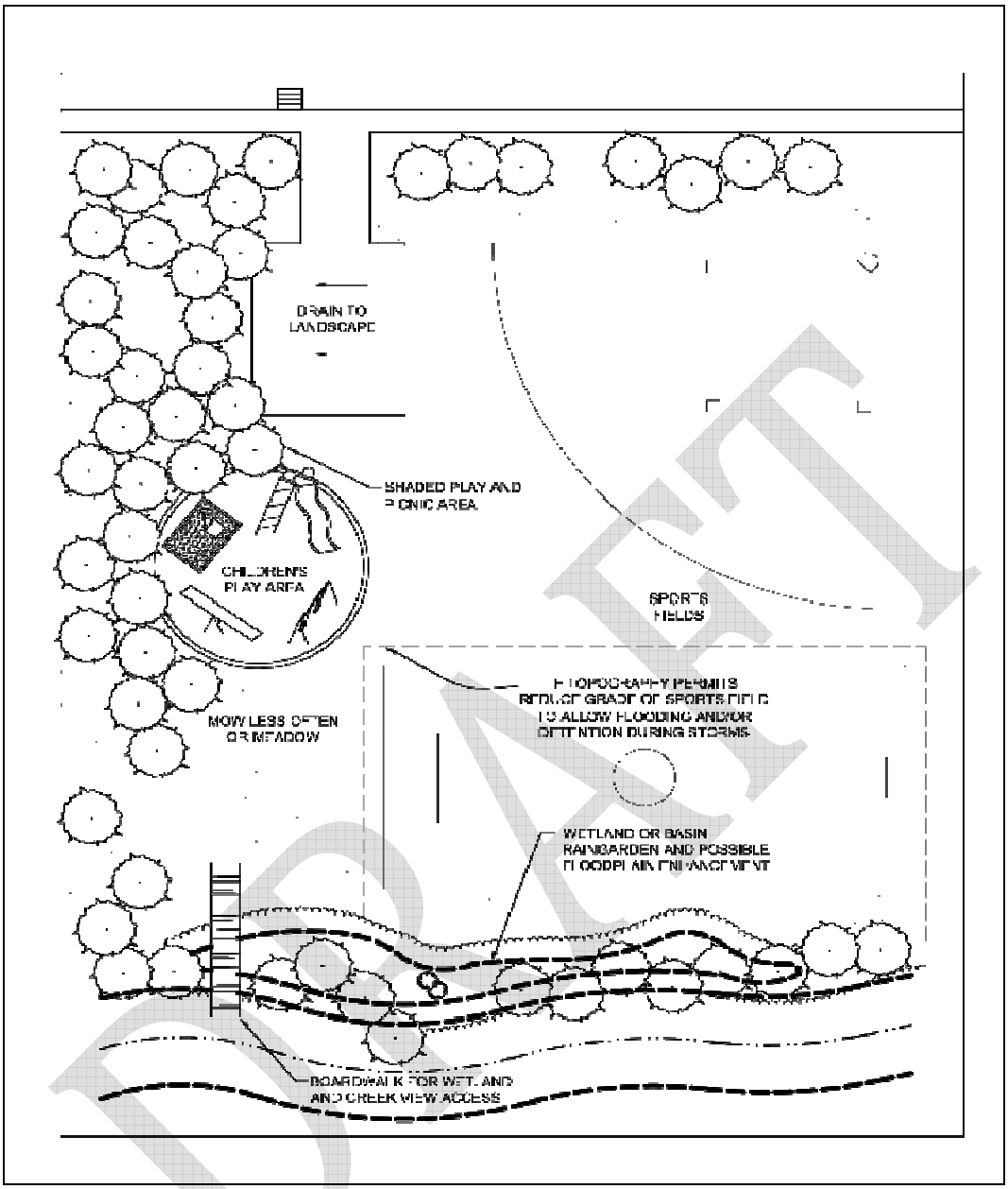



**Figure 3.5 Example application of restoration opportunities to a typical park**

## 3.2 SCHOOL PROPERTIES

### 3.2.1 CHARACTERIZATION

There are approximately 43 schools located within the Fletcher's Creek subwatershed. Figure 3.6 presents a map showing the locations of all the schools within the Fletcher's Creek subwatershed. Whether elementary, middle or secondary school, these properties usually include the following general elements: a street side front yard planted in turf, a large flat roofed building, a parking lot, large paved area for play, and large flat areas of turf primarily dedicated to sports fields.

Buildings, depending on age and design either have an internal roof drain connected directly to a storm drain, or external perimeter roof leaders connected directly to a storm drain. Newer buildings with internal roof drains are required to have drains that limit the volume of runoff, temporarily detaining stormwater on the roof during heavy storms to limit volume impacts to the storm sewer and creeks. Of the schools with perimeter roof drain leaders, a few had them disconnected from the storm drain to drain into the landscape.

Parking lots and paved play areas usually drain to area drains within the paved area, sometimes also collecting runoff from adjacent turf areas. Turf areas were also drained by large area drain. Most schools had few, if any trees; and perennial plantings and shrubs were often nonexistent.

In general, the design and management of school grounds observed do not include parameters to address stormwater management in terms of allowing rainwater to percolate into the ground. |Rather, designs used aim to remove stormwater off site as quickly as possible. Overall, general conditions observed were detrimental to watershed and creek health.

Figure 3.7 provides examples of unsustainable stormwater management practices observed at Cherry Tree Public School, a typical school representative of the school design generally found throughout Fletchers Creek Subwatershed, including surface inlets /catchbasins, sediment draining to catch basins, and mowed grass draining to catch basin.

***Figure 3.6 Schools with in Fletchers Creek Subwatershed***

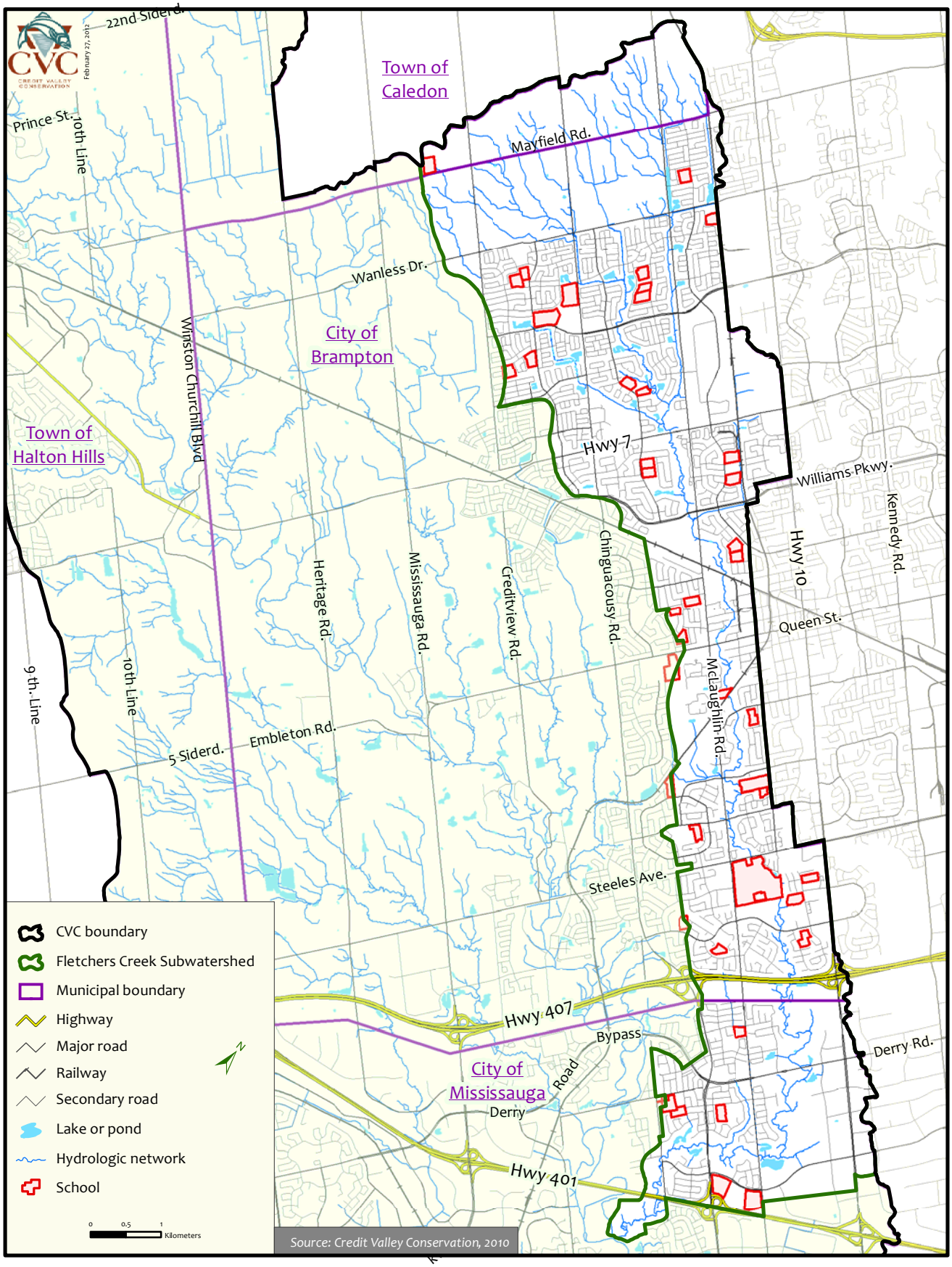


**Figure 3.7 Examples of unsustainable drainage features at Cherry Tree public school: sediment draining to catch basin, mowed grass draining to catch basin**

### 3.2.2 PROPOSED SOLUTIONS

Opportunities to improve stormwater management at these schools include the installation of rain gardens, fusion gardens, and tree plantings. These types of initiatives would provide both more sustainable stormwater control and in addition, could provide educational opportunities for students.

Key opportunities to demonstrate watershed sustainability improvements that are possible if implemented on school properties are described in Table 3.2 (overleaf).

See Figure 3.4 for identification of priority areas to implement recommendations presented in Table 3.2.

**Table 3.2 Key Opportunities on School Properties**

| Management Technique | Topic | Objective | Recommended Opportunity | Resources |
|---|---|---|---|---|
| Education | School based education programs | Promote an understanding and appreciation of the watershed and the role we can all play in protecting the environment. | Support and assist in the implementation of the Stream of Dreams and EcoSchools program in schools throughout Fletchers Creek. | The following are examples of programs that can assist in making our schools ecologically friendly:<br>1. The Stream of Dreams Mural Society provides an understanding of our connection to water and fish habitat, as well as how to make behavioural changes to protect streams, rivers and lakes.<br><br>2. Ontario EcoSchools is an environmental education and certification program for grades k-12 that helps school communities become environmentally responsible citizens and reduce their ecological footprint. |
| Program | Green Education Fund as a financial incentive | To support a school in developing an appreciation of the environment and of the beneficial use of green technologies. | Develop a green education fund to assist schools implement best management practices | There are a number of existing grant programs from which a new program could be modeled:<br>1. WWF-Canada is proud to announce the fourth cycle of the Green Community School Grants Program. Through the generous support of Loblaw Companies Limited, WWF-Canada will grant $600,000 over three years, up to $200,000 a year, to Canadian elementary and secondary schools. The grant program aims to support school projects that will connect students with nature, help reduce a community's impact on the environment, increase understanding of environmental issues and solutions, stimulate environmental leadership, and inspire students and communities to take action.<br>2. The Town of Caledon established the Community Green Fund in 2006 to assist local, not for profit or volunteer groups carry out important environmental work. |
| | Save the Leopard Frog Rain Garden Program | Use rain gardens to promote sustainable gardening practices in the community as well as develop environmental awareness, and provide an onsite educational opportunity | Partner with Schools to construct living outdoor classrooms on school properties | The Save the Leopard Frog program actively works with the parent council, teachers, students and school board to design and incorporate learning though the entire process. At the pilot site, Green Glades Public School in Mississauga, all classes were involved including the art class. |
| | Property Maintenance Program | Enhance stormwater management onsite, and contribute to overall environmental sustainability of the watershed. | Work with schools to make changes to the way that school properties are maintained to promote:<br>• Mowing less often<br>• Using native grass as turf<br>• Reducing fertilizer use<br>• Planting meadows or prairies (naturalize)<br>• Planting more trees<br>• Increasing perennial planting<br>• Establishing a rain garden<br>• Constructing wetlands<br>• Constructing swales and buffer strips<br>• Disconnecting roof leaders<br>• Installing a green roof<br>• Use of pervious paving | |

| Management Technique | Topic | Objective | Recommended Opportunity | Resources |
|---|---|---|---|---|
| Policy | | Use schools as an outreach platform for educating the public about sustainable technologies and green buildings | Contribute to the development of standards that promote the construction of sustainable schools. | Development standards provide definitive efficiency thresholds which must be complied with. Alternatively it may be pertinent to first develop guidelines to test out suggested standards. Typical standards include:<br>• Site Sustainability: selection, development, stormwater control, mitigation of heat island effect<br>• Energy Efficiency: efficiency of building and appliances, on-site renewable energy system<br>• Indoor Environmental Quality: air quality, ventilation, thermal comfort, daylighting, low emitting material<br>• Water Efficiency: landscape irrigation, vegetated green roof, water reuse<br><br>The David Suzuki Secondary School is a model school that others in Fletchers can use as an example. |

### 3.2.3 EXAMPLES OF SCHOOLS STORMWATER RETROFITS

#### 3.2.3.4 GREEN GLADES PUBLIC SCHOOL PILOT STUDY

CVC has worked with the Green Glades Public School in the City of Mississauga to construct rain gardens as part of the Save the Leopard Frog outdoor classroom project. Green Glades Public School in Mississauga is located adjacent to Rattray Marsh, a provincially significant wetland. The project has served as a demonstration site for the local community and City of Mississauga.

For the pilot study the property was retrofitted with a fusion garden, a Water Smart Peel low maintenance gardening program, and a rain garden. The fusion garden is located in the front of the school in a large area that was previously predominately mowed grass. The area was converted to a low maintenance fusion garden that uses a variety of drought tolerant species. The rain garden was designed to accept runoff from a small flat roof above the school's front entrance and a portion of the parking lot area directly in front of the main entrance. Before the retrofit water would pond in front of the entrance during rain events and winter thaw that would not only lead to puddles and ice formation, but created unsafe conditions and a need for excessive salt use.

The construction of the rain garden involved organizing the parent council, teachers, students, and school board to participate in the design and assist with key decision making processes. The proposed rain garden (bioretention area) absorbs problem stormwater and alleviates unsafe ice conditions. The rain garden was designed with the following technical guidelines presented in Figure 3.8.

| Parameter | Design |
|---|---|
| Contributing Drainage Area<br>(m2)<br>(ha) | 318<br>0.03 |
| Water Quality Volume to be Treated | 7.95m3<br>(25mm event) |
| Maximum Ponding Depth | 150mm |
| Engineering Media Designed Infiltration Rate | 50mm/hr |
| Native Soils Infiltration Rate | 75mm/hr |
| Shredded Hardwood Mulch Depth | 75mm |
| Drawdown Time | 24hrs |
| Total Facility Depth | 1.2m |
| Bioretetion Surface Area | 11m2 |
| Perforated HDPE observation well | 200mm |

**Figure 3.8 Technical Parameters for the Rain Garden at Green Glades Public School**

Effort was made to include the students in multiple ways.

- Students planted the fusion garden.
- Art work made by the students and educational signage was added to the rain garden.

The added art work plays a critical role in involving the greater school community. Art classes at the school were engaged early in the planning stages so artwork could be incorporated prominently into the landscape design. Artwork by the students portrayed the local environment, including plants, birds and animals found in Rattray Marsh, a provincially significant wetland.

Figures 3.9 are before and after pictures of the rain garden at Green Glades Public School and figure 3.10 are construction pictures of the rain garden. Note the ponding of the water at the entrance of the walk way.

**Figure 3.9 Before and after shots of the rain garden at Green Glades Public School.**

**Figure 3.10 Construction of the rain garden at Green Glades Public School**

Figures 3.11 and 3.12 are the engineering drawings used for the project at Green Glades Public School.

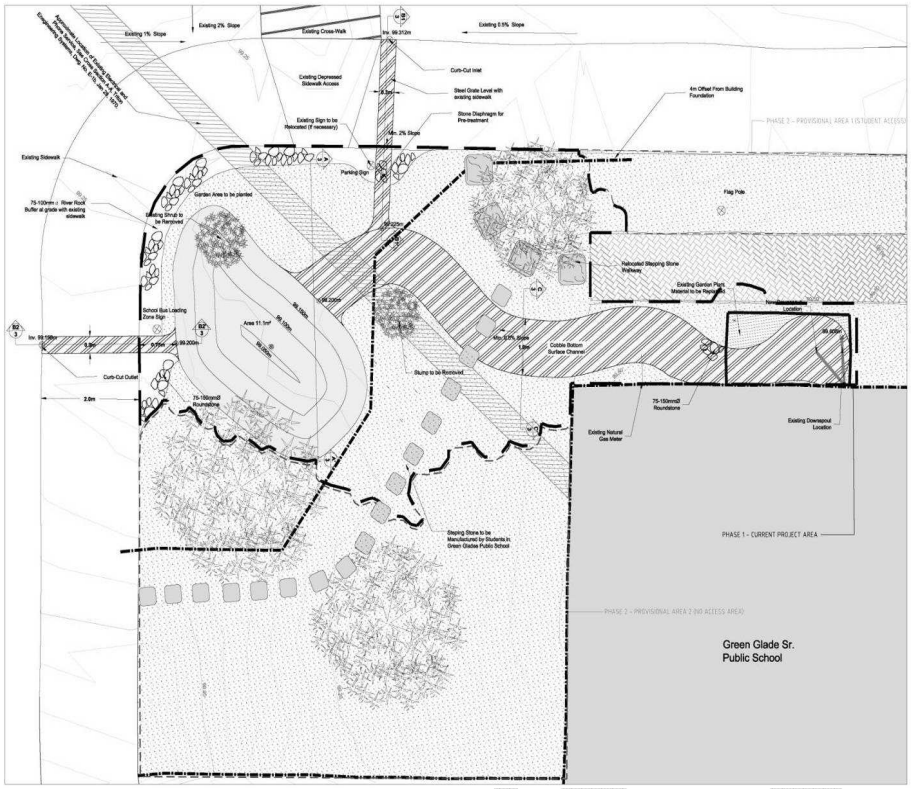



**Figure 3.11 Engineering Drawings (1) for Green Glade Public School**

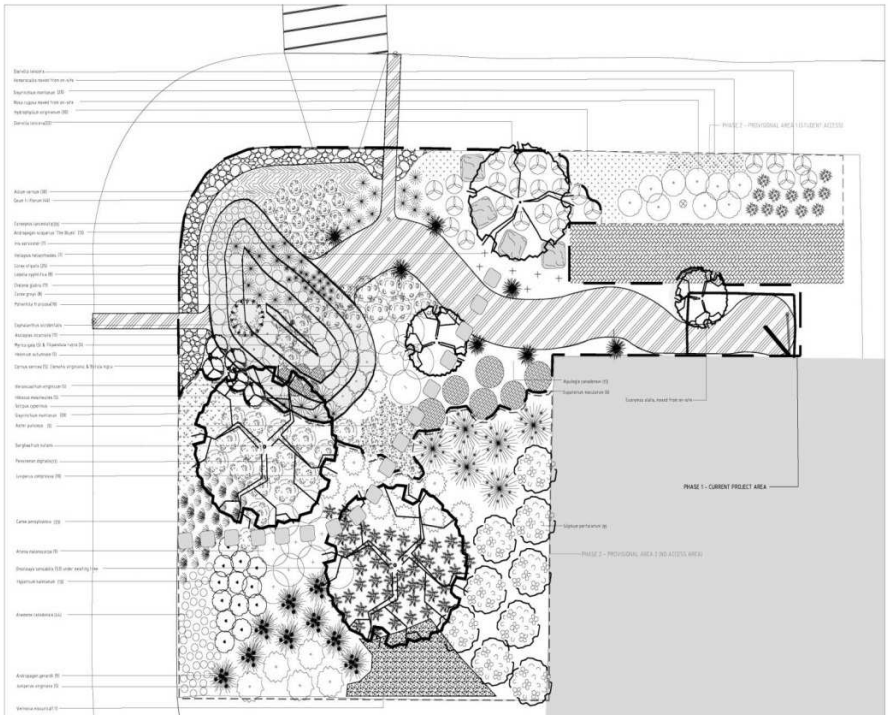



**Figure 3.12 Engineering Drawings (2) for Green Glade Public School**

## 3.3 COMMUNITY CENTER PROPERTIES

### 3.3.1 CHARACTERIZATION

Field assessments reviewing the status of the community centers in the subwatershed region was not undertaken during the period for which this report is being completed. However, they are slated to be reviewed in the summer of 2012 and will be the subject of another future report.

Through desktop analysis, it was determined that the general design and management of community centres is the same as schools in that they do not typically address stormwater management. Rather, designs aim to remove stormwater off site as quickly as possible. Community Centre properties in the area are similar to schools in layout and include large buildings usually with flat roofs, parking lots, some paved play areas and a landscape dominated by turf.

As indicated for parks, while turf is useful, it does not have much value in stormwater management when kept very short. Some simple adjustments in management of turf can result in significant improvements in stormwater management. Additionally increasing the planting diversity with additional trees, creating flower beds and planting perimeter shrubs can also result in improvements in watershed health.

### 3.3.2 PROPOSED SOLUTIONS

There are specific retrofits for stormwater management that can be incorporated in an aesthetic manner that can provide additional improvements not only in stormwater management, but also in creating a unique sense of place, creating a strong identity for each site.

Table 3.3 (overleaf) presents some key opportunities for improving stormwater management on community centre properties, thereby enhancing sustainability of the subwatershed.

See Figure 3.4 for identification of priority areas to implement recommendations presented in Table 3.3.

**Table 3.3 Key Opportunities for Community Centre Properties**

| Management Technique | Topic | Objective | Recommended Opportunity | Resources |
|---|---|---|---|---|
| Education | Save the Leopard Frog Rain Garden Program | Use rain gardens to promote sustainable gardening practices in the community as well as develop environmental awareness | Partner with Community Centers to construct living rain gardens on public properties | The Save the Leopard Frog program actively works with the partners to promote environmentally sustainable practices through the use of demonstration projects. |
| Program | Maintenance and Retrofit Program | Implement retrofits to:<br>• Improve soil health<br>• Improve stormwater management<br>• Improve receiving water quality | Create partnerships to retrofit community centre properties education-numerous low impact techniques could be included including:<br>• Mow less often<br>• Use native grass as turf<br>• Reduce fertilizer use<br>• Plant meadows or prairies (naturalize)<br>• Plant more trees<br>• Increase perennial planting<br>• Rain Garden<br>• Constructed wetlands<br>• Swales and Buffer Strips<br>• Disconnect roof leader<br>• Green Roof<br>• Pervious Paving | |
| Policy | Community Centre Development Standards | Use community centres as a platforms for reaching the greater public and educating them about sustainable technologies | Development standards provide definitive efficiency thresholds which must be complied with. Typical standards include:<br>• Site Sustainability: selection, development, stormwater control, mitigation of heat island effect<br>• Energy Efficiency: efficiency of building and appliances, on-site renewable energy system<br>• Indoor Environmental Quality: air quality, ventilation, thermal comfort, daylighting, low emitting material<br>• Water Efficiency: landscape irrigation, vegetated green roof, water reuse | |

## 3.3.3 EXAMPLE OF A COMMUNITY CENTRE PARKING-LOT RETROFIT

### 3.3.3.1 MISSISSAUGA VALLEY COMMUNITY CENTRE

Community Centres, as well as other public areas, usually have vast non-permeable pavement surfaces for parking and pedestrian walk-ways. These surfaces increase the loading of contaminants via stormwater to surface waters and seriously undermine water quality and further degrade aquatic ecosystems. Finding an effective means of increasing infiltration of stormwater while maintaining effective traffic flow for both cars and pedestrians and ensuring the usability of the lot itself is a challenge all municipalities face when repairing parking areas at municipal buildings, parks and other public facilities. Municipal and private parking lot operations and repair activities currently employ the traditional and harmful approach of concentrating stormwater in a storm sewer, where it is re-directed to a receiving water course.

CVC has been working with its municipal partners to retrofit existing parking lots with best management practices. For instance, CVC developed a plan to retrofit the Mississauga Valley Community Centre parking lot (see figure 3.13). The project is a demonstration project that aims to achieve a natural water balance by promoting infiltration, transpiration and evaporation.


**Figure 3.13 Total redesign of the main parking area to Provides water balance and water quality and quantity control**

The project design incorporates a number of low impact development (LID) features, including:

- Infiltration galleries;
- Permeable pavement;
- Enhanced tree canopy;
- Bio-retention feature;
- Rainwater harvesting;
- Enhanced swales;
- Pedestrian Walkway; and
- Capture of roof water for reuse

By utilizing the above LID techniques, runoff from the main parking area as well as the east and lower parking areas will be treated and managed. Innovative techniques for managing runoff from the roof-top of the community centre are being investigated, including use of harvested water to use for toilet flushing or re-surfacing the ice rink.

Co-benefits of greenhouse gas (GHG) emissions reduction and reduced heat island effects of pavement are also being realized. A decrease in greenhouse gas (GHG) emissions will be achieved through rain water harvesting for irrigation purposes, which reduces the pumping needs for potable water from the purification plant. The use of tree canopy and bioswales will both reduce the heat island effect and sequester carbon dioxide. Use of solar voltaics for lighting the parking areas will also reduce energy use. See Figure 3.13 for the proposed design of the site.

The idea of the bioretention features are that they will capture the runoff from the parking lot and other hard surfaces allowing for infiltration and treatment of stormwater. Bioretention cells are best practice technology and when used in concert with the other approaches to be employed for the LID retrofit of the facility and surrounding property significant improvements in stormwater management can be achieved. Figure 3.14 presents a detailed profile of a biorentention cell.

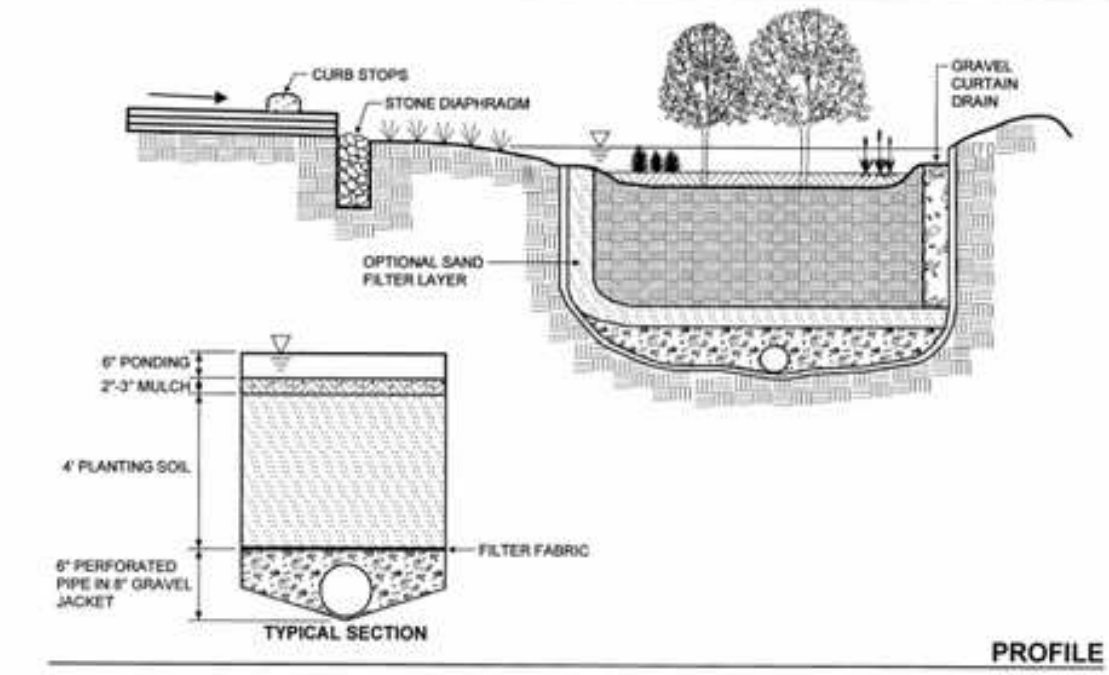



**Figure 3.14 Schematic of Bioretention Cell**

Expected benefits of this demonstration project include:

- Identification of preferred innovative stormwater and water conservation technology, fixtures and approaches that can be employed at comparable facilities
- An improvement in surface water quality and in the quality of municipal drinking water supplies located close to the facility;
- Public awareness and education related to the demonstration site that showcases an "in the ground" project;
- Members of the public and other stakeholders to gain knowledge and experience that can be applied to their properties, as well as other parts of the watershed and beyond pertaining to innovative stormwater management and protecting surface water municipal drinking sources.
- Provision of a template to facilitate innovative stormwater management and water conservation retrofits by municipalities and private sector building owners/managers.

Figure 3.15 below provides a comparison of benefits of different sustainable practices that could be implemented in parking lot retrofit projects.

| Description | Area Treated | Treatment Provided | | | | | |
|---|---|---|---|---|---|---|---|
| | | Contributes to Water Balance | Approximate Runoff Reduction | Provides Water Quality Control for 15mm Event | Provides Water Quality Control for 25mm Event | Level of TSS Removal | Provides Treatment for Runoff from Mississauga Valley Blvd. |
| *Concept 1*<br>Basic Retrofit for Water Balance Runoff Volume of 15mm Storm Event<br><br>Includes:<br>- Infiltration Galleries<br>- Permeable Pavement<br>- Plantings Along Islands<br>- Bio-Retention Feature | Treats Main Parking Area Only | YES | Approximately 45% Runoff Reduction | YES | NO | Provides 60% - 75% TSS Removal | YES |
| *Concept 2*<br>Enhanced Retrofit for Water Balance Runoff Volume of 25mm Storm Event<br><br>Includes:<br>- Infiltration Galleries<br>- Permeable Pavement<br>- Enhanced Tree Canopy<br>- Bio-Retention Feature<br>- Rainwater Harvesting<br>- Enhanced Swales | Treats Main Parking Area, as well as the East and Lower Parking Areas<br><br>Addresses Rooftop Runoff | YES | Approximately 45% Runoff Reduction | YES | YES | Provides 60% - 75% TSS Removal | YES |
| *Concept 3*<br>Parking Lot Re-Design to Achieve a Sustainable Parking Lot<br><br>Includes:<br>- Infiltration Galleries<br>- Permeable Pavement<br>- Enhanced Tree Canopy<br>- Bio-Retention Feature<br>- Rainwater Harvesting<br>- Enhanced Swales<br>- Pedestrian Walkway | Treats Main Parking Area, as well as the East and Lower Parking Areas<br><br>Addresses Rooftop Runoff | YES | Approximately 45% Runoff Reduction | YES | YES | Provides 60% - 75% TSS Removal | YES |

**Figure 3.15 Comparison of benefits of different sustainable practices that could be implemented in parking lot retrofit projects.**

## 3.4 OVERVIEW AND DETAILED DESCRIPTION OF POLLUTION PREVENTION AND RESTORATION OPPORTUNITIES

This section presents additional detail on the management techniques included in the overview tables found in previous sections of this chapter (Table 3.1 in section 3.1, Table 3.2 in Section 3.2, and Table 3.3 in section 3.3). The management techniques described in the tables referenced above could be applied to all types of public lands, including parks, school properties and community centres as described earlier in this chapter, and for this reason the detailed descriptions on these techniques are summarized together.

As previously stated in earlier sections of this Chapter, the dominant landscape feature common to all public areas including parks, school properties, and community center properties is usually turf. There are many potential management strategy changes or minor retrofits that could improve stormwater management of landscaped areas on turf including: mowing less often or not as short; not mowing all of the lawn area every mow; replacing areas of turf with local meadow or prairie planting (naturalization); replacing turf areas with perennial and annual plant beds; and using native prairie grass species as turf grasses. Furthermore, a high amount of fertilizer use can have negative impacts on local water bodies, adding more nutrients than the system can naturally handle. Reduction in the amount and how often fertilizer is applied is a key property management change. The decision regarding which management strategies to employ will ultimately depend upon the unique characteristics of each site. For example, it is important to consider the type of turf planted on the site – and if planting new turf choose one that is adaptable to the site specific conditions of the property (i.e. soil type and sunlight available).

### 3.4.1 NATURALIZATION

**Issue: Minimal ecologically viable refuge, habitat and food sources, disconnection of natural hydrological cycle, under minimum MOE targets**
**Opportunity: Inclusion of the natural environment into urban fabric**

#### 3.4.1.1 PLANT MEADOWS OR PRAIRIES

Locations best suited to this management strategy include:

- along street frontage;
- around parking areas;
- along property edges;
- near buildings;
- in areas not designated as sports fields or multi use fields; and
- in some multiuse fields.

Parks or schools that have extensive passive turf areas may want to consider planting meadows or prairies. They can be an aesthetic transition while still remaining open usable space for picnicking and walking. These areas will significantly reduce runoff and also increase habitat for butterflies, bees, and birds. They are also, when properly maintained, very aesthetic. Examples of naturalization are displayed in Figure 3.16.

**Figure 3.16 Example of Naturalization at Hickory Wood public school in Brampton**

#### 3.4.1.2 PLANT MORE TREES

Locations best suited to this management strategy include:

- along street frontage;
- around parking areas;
- in clusters in open spaces such as between or on the edge of sports and multi-use fields;
- along property edges; and
- near buildings.

While some parks in this sub-watershed have a few trees they are often few and far between. Trees are very good at managing stormwater because they will improve infiltration of soils with their root structure, and take up a lot of infiltrated water for transpiration. The tree canopy is a complex and diverse structure which also intercepts a great deal of rain, reducing the speed and amount of rain that falls to the ground thereby reducing runoff. When the tree canopy overlaps paved areas such as parking areas and walkways it has the potential to very effectively reduce runoff. Trees can also provide a shady place in summer months, when placed strategically near buildings they can result in substantial reductions in energy use for cooling, and in addition, they can even provide habitat for birds and other small animals. Trees can also provide shelter in winter months, so if they are planted in strategic locations

to block cold winter winds it can potentially reduce the need for extra plowing from snow drifts, and for extra heating inside the building. When choosing trees to maximize the sun available for a building in winter, consider deciduous trees. Some examples of tree plantings are shown in Figure 3.17.

**Figure 3.17 Examples of Tree Planting in Brampton with CYC**

### 3.4.1.3 INCREASED PERENNIAL PLANTING

Locations best suited to this management strategy include:

- along street frontage;
- around parking areas;
- along property edges;
- near buildings; and
- in areas not designated as sports fields or multi use fields.

The technique of increasing perennial planting includes designating more areas for perennials, shrubs, and flowers. Areas along the edge of properties and buildings, and especially areas between paved paths and fences of buildings are ideal places to increase planting structure. Increased perennial planting in these areas also contributes to the aesthetics of the building as a secondary benefit. The primary benefit is that the increased plant structure reduces stormwater runoff through increased interception and increased water uptake for transpiration. These areas, particularly if in a low spot or near a roof leader downspout, can also be ideal spots for rain gardens. Some examples of perennial plantings are shown in Figure 3.18.

**Figure 3.18 Examples of Perennial Plantings at Green Glades Public School (top) and Lushes Ave (bottom) in Mississauga**

#### 3.4.1.4 WET MEADOW CREATION

Areas in the watershed where wet soggy lawns were observed included numerous parks and schoolyards. There exists an opportunity to work with the drainage characteristics of the site to convert some portions of a site from mowed grass to natural wet meadow habitat. These habitats would provide both a stormwater and ecological function, provided that it also allows for school requirements such as outside gym time and school sports. This could include converting a lawn into a wet meadow habitat capable of supporting amphibians, birds, and insects among many other types of flora and fauna.

### 3.4.15 PIT AND MOUND TOPOGRAPHY

Habitat pools are areas that may appear to be isolated puddles but in fact can support aquatic life in headwater areas where continuous flowing water is not available. Land grading for development or agriculture can remove or alter these pools, thus reducing available aquatic habitat. Depending on the location of a property within the watershed and the types of soils found on it, the source of water supporting habitat pools can be either groundwater or surface runoff. Habitat pools created in the headwater areas of the watershed remain wet when the water tables are closer to the surface. Alternatively, properties that receive significant surface runoff with heavier underlying soils would likely remain wet for a portion of the year.

This technique would provide a hydrologic function by mimicking some of the natural hydrologic pathways including depression storage, infiltration, and evapotranspiration. The ecological benefits would include habitat for a variety of flora and fauna that may require this type of habitat to fulfil parts of their lifecycle. For example, the American Toad is often found within urban areas and successfully breeds in areas that are allowed to temporarily flood in the spring and maintain water long enough for eggs to hatch and tadpoles to emerge. Figure 3.19 presents an example of pit and mound landscapes.

**Figure 3.19 Examples of Pit and Mound Landscapes**

### 3.4.1.5 RESTORATION OF FOREST UNDERSTORY

Throughout the subwatershed, there are areas that were once forested but are now managed as treed parkland. These sites are often characterized by native tree species with sparse lawn that is mowed frequently. These locations could be enhanced to restore some of the ecological functions that have been lost. In some cases, the soils have become compacted and soil erosion is occurring because of foot traffic and lawn maintenance equipment. In areas such as these, there is a good opportunity to restore the ecological health of the urban forest ecosystem. Urban forests in other parts of the watershed that have remained intact contain woodland species such as Trilliums, Jack in the Pulpit, Ostrich Fern, and trout lilies. The understory provides refuge for amphibians, reptiles, and birds.

### 3.4.1.6 WETLAND ENHANCEMENT AND CREATION

Approximately seventy percent (70%) of the wetlands in southern Ontario have been lost since European settlement. The total wetland area in the Fletcher's Creek subwatershed is very low, which causes concern since the habitat guidelines recommended by Environment Canada call for greater than 10% for a watershed. Figure 3.20 provides an illustration of a wetland profile.

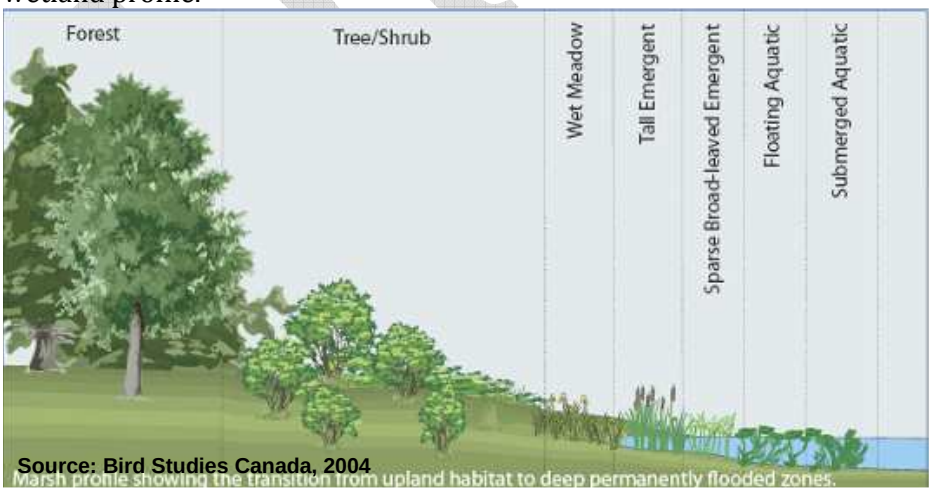



**Figure 3.20 Profile of a Wetland**

### 3.4.2 STORMWATER CONTROL MEASURES

**Issue: Water quality and quantity impacts to urban environment**
**Opportunity: Mimic Natural Ecological Processes – Increased infiltration and filtration of stormwater**

#### 3.4.2.1 CONSTRUCTED WETLANDS

Locations best suited to this management strategy include:

- along street frontage;
- around parking areas;
- along property edges;
- in areas not designated as sports fields or multi use fields;
- in low areas; and
- near creeks or natural drainage channels.

Constructed wetlands can be a focal feature in a park or public space that also has stormwater management benefits and increased habitat value. These can be small areas or large features. They can be designed with a variety of water sources, including such sources as local runoff from impervious areas, daylighting or bypass water form a local storm sewer, or with groundwater next to a creek. An example of a constructed wetland is displayed in Figure 3.21.

**Figure 3.21 Example of a constructed wetland being established in Mississauga**

#### 3.4.2.2 SWALES AND BUFFER STRIPS

Locations best suited to this management strategy include:

- along street frontage;
- around or next to parking areas;
- along or next to paved areas such as play courts;
- along property edges;
- near buildings; and
- in areas not designated as sports fields or multi use fields.

Ideally all paved or impervious surfaces should be drained from the landscape into a swale, buffer strip or rain garden prior to reaching an area storm drain. This initial slowing and

filtering can result in significant improvements in watershed health if implemented regionally. Swales and buffer strips are simply stormwater runoff conveyance and filtering areas in the landscape.

For more information on these practices, please refer to the Low Impact Development Stormwater Management Planning and Design Guide by CVC and Toronto Region Conservation Authority (TRCA). An excerpt from this guide relating to design of dry swales and grass swales is presented in Appendix F.

Figures 3.22 and 3.23 present pictures as examples of the construction of swales.

CVC is completing Case Studies on a large number of Low Impact Development 'in the ground' projects across Ontario. The project will identify and address the barriers to the adoption of LID by discussing issues and barriers faced by Municipalities, developers, designers and contractors.

**Figure 3.22 Example of a Typical Swale within the Watershed**

**Figure 3.23 Examples of enhanced swales**

#### 3.4.2.3 FIELDS AS FLOOD PLAINS

Locations best suited to this management strategy include:

- fields adjacent to creeks; and
- fields on low area of property.

Sports fields and lawn areas adjacent to a creek may be close in elevation and be able to be retrofitted to act as a flood plain. Allowing the creek to spill over its banks and into the field slows the velocity and reduces the volume of water in the creek, and significantly reducing flooding and erosion downstream.

#### 3.4.2.4 FIELDS AS DETENTION

Locations best suited to this management strategy include:

- fields on flat lots;
- fields on low area of property; and
- fields near creeks or open drainages.

Many multi-use and sports fields are carefully graded and prepared for quick drainage, but even so, are not always used in rainy weather (depending on the municipal guidelines). Sportsfields encompass large areas, and could also be used as detention basins in some instances – for lower priority sites (i.e. those sites not booked more than 80% of the season. The design of field itself could include a slightly sunken trough surrounding the field with overflow drains or volume restricting drains allowing flooding in heavy storms, slowing runoff. Fields can also be designed for subsurface detention, with either vaults or aggregate base course with overflow or limited volume drains. This allows water to drain from the surface of the field quickly, but remain held in the subsurface area below the field for infiltration or to slow input into the storm sewer.

#### 3.4.3.5 FLOATING ISLANDS

### THERMAL IMPACT OF URBANIZATION INCLUDING PREVENTATIVE AND MITIGATION TECHNIQUES

There is increasing recognition that some of the design considerations required to remove suspended solids from surface runoff in stormwater management facilities, most notably increased water storage and retention time, can also result in warming of the stored surface water. In turn, the discharge of this warmer water can have a detrimental effect on the aquatic habitat in the nearby receiving stream (see figure 3.24). Stormwater management ponds (SWMPs) have become a widely adopted technique to remove suspended solids in developing areas of southwestern Ontario. Several municipalities have hundreds of SWMPs within a single watershed with the potential for cumulative impacts on aquatics.

The Thermal Impacts of Urbanization, including Preventative and Mitigation Techniques, developed by CVC can be accessed through www.creditvalleyca.ca

In addition, urban hydrology is likely to be significantly changed as a result of climate change. In Ontario and the Great Lakes basin, total annual precipitation increased 5- 35% since 1900 (Zhang et al. 2000). High intensity rainfall events are projected to be more frequent and intense (Trenberth et al. 2003). Warmer winters will result in less snowpack and more winter runoff (Great Lakes Water Quality Board 2003; Mekis and Hogg 1999). These changes will affect the demands placed upon stormwater management systems and the receiving water courses.

CVC, in partnership with the Ministry of the Environment, completed a study on the thermal impacts of urbanization. The purpose of this document is to provide an overview of urban sources of thermal loads, an overview of preventative and mitigation measures and discussion on design considerations in light of climate change projections. The study identified a number of techniques, including Floating Islands, that could be employed as mitigative measures.

## FLOATING ISLANDS

Credit Valley Conservation (CVC) is participating in a three-year research project in Brampton to improve water quality in stormwater management (SWM) ponds by using an innovative green technology called floating islands. Thermal pollution has become an emerging concern as reports from the Ministry of Environment and CVC has shown that water temperatures can differentiate up to 5° C between SWM pond inlet and outlet.

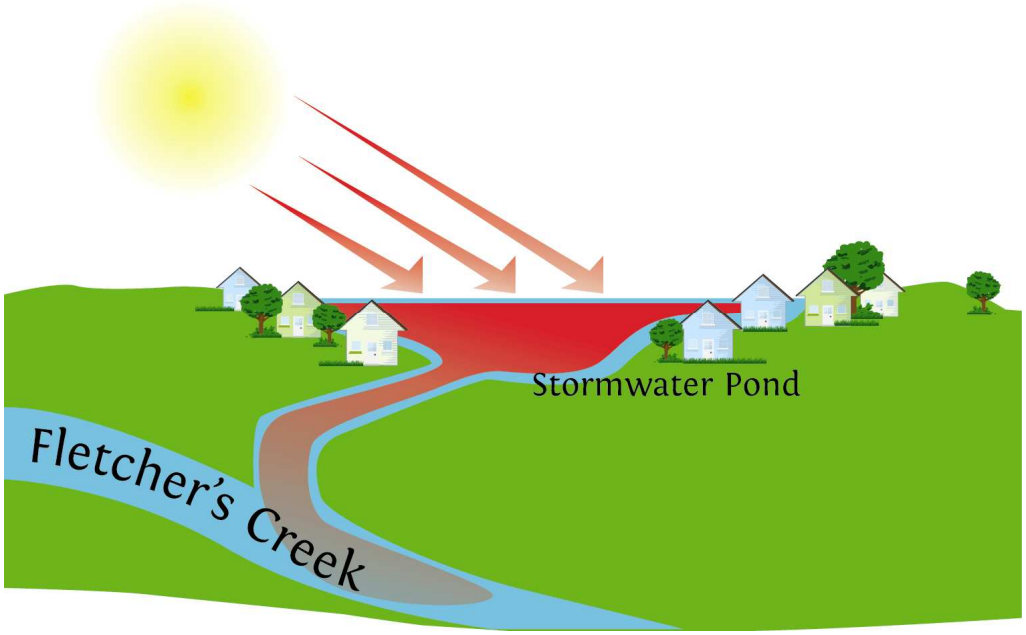



**Figure 3.24 The Thermal Pollution of Stormwater Ponds and its Impact on Receiving Streams**

Floating islands occur naturally but they can also be constructed artificially by anchoring aquatic plants to a floating mat or mesh structure so plant roots can grow down into the water. The research project will try and determine if floating islands are effective at removing pollution and reducing pond water temperature. An added benefit is that they are aesthetically attractive and can support a diversity of aquatic plant species.

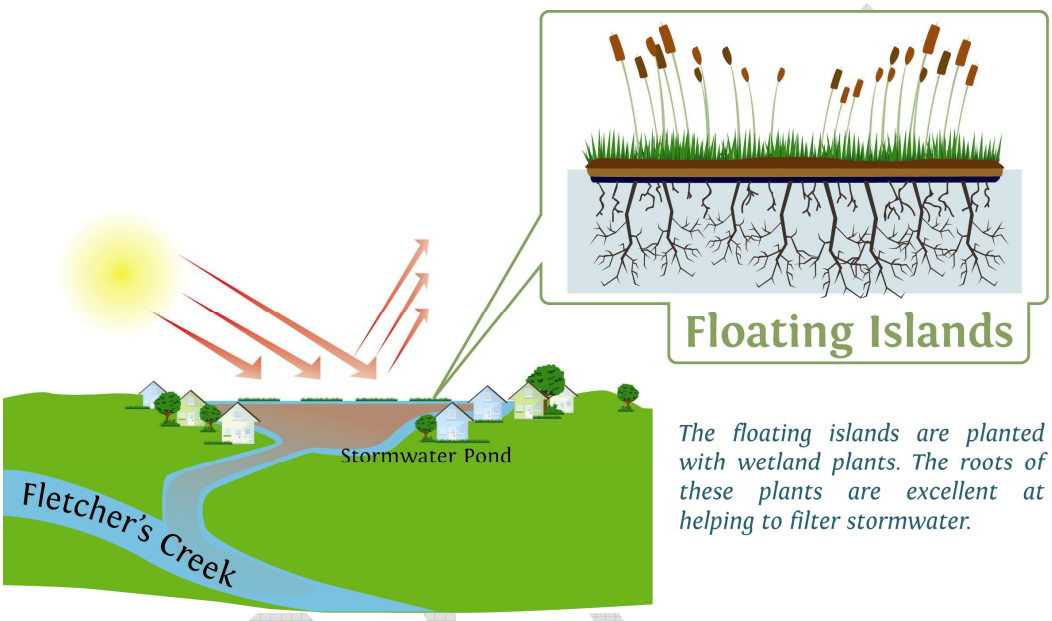



**Figure 3.25 Floating Islands May Reduce Stormwater Ponds Thermal Pollution**

The stormwater pond being used for the research project is located in the Fletcher's Meadow Subdivision in northwest Brampton. The pond flows into a small tributary of Fletcher's Creek (home to the Endangered Red Side Dace), and eventually the Credit River. The pond is surrounded by single-family homes and a secondary and elementary school. The project began in the spring of 2010 and has attracted the attention of residents who are interested in being involved with the project. Figure 3.26 below provides a depiction of the floating islands project.

**Figure 3.26 8,000 ft$^2$ of Floating Island Installed at Pond 10 in Northwest Brampton**

Over the next three years, CVC will be part of a project team that includes: City of Brampton, Trent University, Queen's University, Fleming College, C&M Aquatics, and Greenland Engineering to install and monitor the effectiveness of floating islands. Visual Arts Brampton is also working with CVC to develop art work that will be used to create an outdoor gallery and also help develop interpretive signage to educate the public.

Floating Islands could play a critical role to help improve water quality and reduce water temperature in SWM ponds and connecting waterways. Floating islands can also help protect the endangered Reside Dace - a cool water species of fish found in pools and slow-flowing areas of small headwater streams. This unique project will also help educate municipalities on how to manage stormwater ponds and the environment in light of climate change.

### 3.4.3 LOT-LEVEL STORMWATER CONTROL MEASURES

**<u>Issue:</u> Buildings design promotes the movement of stormwater off-site as quickly as possible resulting in impacts to stormwater quality and quantity**
**<u>Opportunity:</u> Increase filtration and infiltration of stormwater where it falls mimicking the natural hydrologic cycle**

#### 3.4.3.1 RAIN GARDENS

Locations best suited to this management strategy include:

- along street frontage;
- around parking areas;
- along property edges;
- near buildings at downspouts;

- in areas not designated as sports fields or multi use fields;
- in low areas; and
- near storm drains.

A rain garden is a flower bed or landscaped area designed to collect, filter and infiltrate stormwater from roof downspouts or other impervious areas as well as landscaped areas. Depending on soil conditions and permeability some soil amendment may be necessary, and they can also be constructed with an overflow drain or underdrain. Plants often need to be chosen that can tolerate the site-specific soil conditions along with occasional dry spells and inundation. Figure 3.27 shows an example of a rain garden.

**Figure 3.27 Example of a rain garden**

Refer to Appendix F for a Factsheet on Bioretention

### 3.4.3.2 DISCONNECTION OF ROOF LEADERS ON SCHOOLS OR COMMUNITY BUILDINGS

Locations best suited to this management strategy include external roof leaders on buildings. Many buildings have roof leaders that connect directly to the storm sewer. This practice creates negative impacts to stormwater infrastructure and creeks through the increased volume and fast pace of water entering the system. When roof drains are on the exterior of buildings they can easily be disconnected to drain into the landscape, thereby increasing infiltration onsite, and decreasing negative impacts to receiving waters. However, an alternative option is to drain roof leaders into cisterns to collect water for other uses or into rain gardens to increase local infiltration and detention. An example of a disconnected roof leader is displayed in Figure 3.28.

**Figure 3.28 External roof leaders draining to lawns in the watershed**

#### 3.4.3.3 CISTERNS OR RAIN BARRELS

Locations best suited to this management strategy include:

- at building downspouts;
- below parking areas or landscaped areas; and
- where water can be reused on site for landscape irrigation or other non-potable uses (toilet flushing).

Cisterns, either above or below ground can be integrated into a building and landscape design to collect roof runoff from roofs or landscaped areas for use as irrigation water, or for other non-potable uses. Rain barrels are smaller versions of cisterns that can be easily placed at the bottom of a roof downspout.

Refer to Appendix F for a Factsheet on Cisterns and Rain Barrels.

#### 3.4.3.4 GREEN ROOFS

Locations best suited to this management strategy include:

- flat roofs;
- low to medium pitched roofs; and
- where building structure can handle additional roof load or can be retrofit for additional roof load.

Green roofs have many benefits, and come in many varieties. They can be as small as two inches deep with select plants such as sedums, or as large as six inches deep with native grasses or perennials, or anything in between. Generally, they cost more than a standard roof, or roof replacement; however they have many benefits both ecological and financial. Green roofs generally have a much longer lifespan than a standard roof, and therefore need to be maintained or replaced less often. Green roofs can also have significant insulating properties, reducing heating and cooling needs, and affiliated energy costs. Green roofs have significant stormwater runoff reduction, resulting in significant reduction in negative creek impacts. The associated reduction in local stormwater infrastructure requirements reduces municipal and regional government spending to repair or manage creek flooding, erosion and other impacts, ultimately avoiding the need to increase local taxes or water utility bills specifically for managing new stormwater infrastructure requirements. Green roofs also have other positive

impacts such as reducing the Urban Heat Island (UHI) effect, and creating habitats for birds and insects. In addition there can be government grants and funding sources available to help pay for the capital cost of a green roof retrofit.

Refer to Appendix F for a Factsheet on Green Roofs

**Figure 3.29 Example of a green roof being installed at GO Transit in Mississauga**

### 3.4.12 PERMEABLE PAVING

Locations best suited to this management strategy include:

- parking lots;
- paved play areas;
- emergency vehicle access (fire lanes);
- pathways and trails; and
- pervious soils or low pervious soils with constructed subsurface detention.

Permeable paving is pavement that allows water to pass though the surface to reach subsurface detention or pervious soils. Permeable paving can include sand set bricks or pavers, as well as pervious concrete and asphalt, unstabilized gravel, and paving substrate that includes voids for turf or gravel. By some accounts pervious asphalt and concrete sometimes result in reduced winter maintenance such as ploughing and salting. Permeable paving essentially eliminates or significantly reduces runoff into storm drains. An example of permeable paving is displayed in Figure 3.30.

**Figure 3.30 Example of pervious paving at CVC main office, in Mississauga**

### 3.4.4 POLLUTION PREVENTION

Many of the pollution prevention practices discussed in Section 2 Residential Lands also apply to public lands. For example, many schools and community centres have open dumpsters that are not only prone to dumping of elicit material but are old, worn and often leak. Effort should be taken to educate facility managers on proper dumpster maintenance. Likewise, these properties are prone to overuse of winter de-icing salt to ensure public safety. Measures can be taken to properly train winter maintenance contractors, as well as ensure proper drainage of the site. Other pollution prevention initiatives that should be considered include:

Detailed pollution prevention opportunities is provided in Appendix

- Parking Lot Maintenance
- Landscaping and Grounds Care
- Turf Management
- Building Maintenance

Information on the listed pollution prevention practices, as well as snow and ice management, and dumpster management is provided in Appendix G.

### 3.4.5 SNOW DUMPS

Snow dumps, both public and private, have many management concerns including location, access, public safety and meltwater management. This section looks specifically at watershed health impacts and so focuses on watershed health concerns related to storage and meltwater management.

#### 3.4.5.1 CHARACTERIZATION OF SNOW DUMPS

### PUBLIC SNOW DUMPS

While size and location vary considerably, public snow dump areas typically drain directly to a storm drain. The surface conditions vary from site to site, with some dump sites being paved, some graveled, and some with native ground. There are no filters or pre-treatment of water before it is drained from the site, and therefore it may contain trash, sediments and sands from road sanding or the dump site substrate, as well as any mixed or dissolved pollutants. Rapid drainage of meltwater is used as a way to ensure appropriate dilution of pollutants in ground and surface waters. On some sites infiltration does occur, but is often discouraged due to concerns of soil and groundwater contamination.

### PRIVATE SNOW DUMPS

Private snow dumps are typically designated locations on a property where snow piles are stored. Alternatively, these may be commercially run areas that persons can pay to haul their snow to, or snow is commercially hauled to. Similar to public snow dumps these vary in size and location, and have a variety of substrates such as paving, gravel or native soil.

## 3.4.5.2 POLLUTION PREVENTION OPPORTUNITIES ON SNOW DUMPS

Snow dumps can have considerable impacts to watershed health, particularly impacts to streams, as well as groundwater in certain geologic conditions (See Table 3.4 below for an overview of opportunities). Depending on the spring melt characteristics, snow dumps can contribute gradual, steady runoff into the stormwater system and local streams, or they can have large volume inputs similar to a heavy storm. The heaviest volume impacts can be had with rain on top of snow melt in sudden warm weather. In addition, melt times often occur while much of the ground is still frozen, and so effectively impervious. This runoff occurs before spring vegetation is established along stream banks, and therefore can increase the velocity and erosion potential of the runoff because of the limited interception and slowing as well as soil protection the dead or dormant surface vegetation allows.

One of the additional and important concerns with snow dumps are the pollutants that can accumulate in the snow, and then runoff into the local streams. Pollutant loads are often very high in snowmelt and introduced into the system in a concentrated burst. Salt and sand are the obvious concerns, along with trash. The type of salt used can have a large variation in impact. Chlorides are in high concentration in snowmelt. Runoff high in chlorides will be heavier than fresh water, and can remain at the bottom of the water column in slow moving water, not mixing and in extreme cases creating a bottom dead-zone. Salt in winter runoff will also affect plant species health when in high concentrations, and can damage soil structure reducing its perviousness. Snow also accumulates polycyclic aromatic hydrocarbons (PAHs) from car exhaust, fireplace and wood stove use, furnace and power plant exhaust, which remains in the meltwater.

Some opportunities exist for limiting meltwater impacts to watershed health, but many factors must be considered when choosing a specific strategy, such as ground water level, geology of the site, existence of local wells, local wildlife habitats, and stormwater infrastructure.

The City of Toronto conducted an Environmental Assessment study into the conceptual design of environmental mitigation measures at nine snow disposal sites. The study includes proposed plans and recommendations for managing snow dumps. The report as well as plans and figures can be found on the City's website http://www.toronto.ca/wes/techservices/involved/transportation/snow_study/snow_study.htm

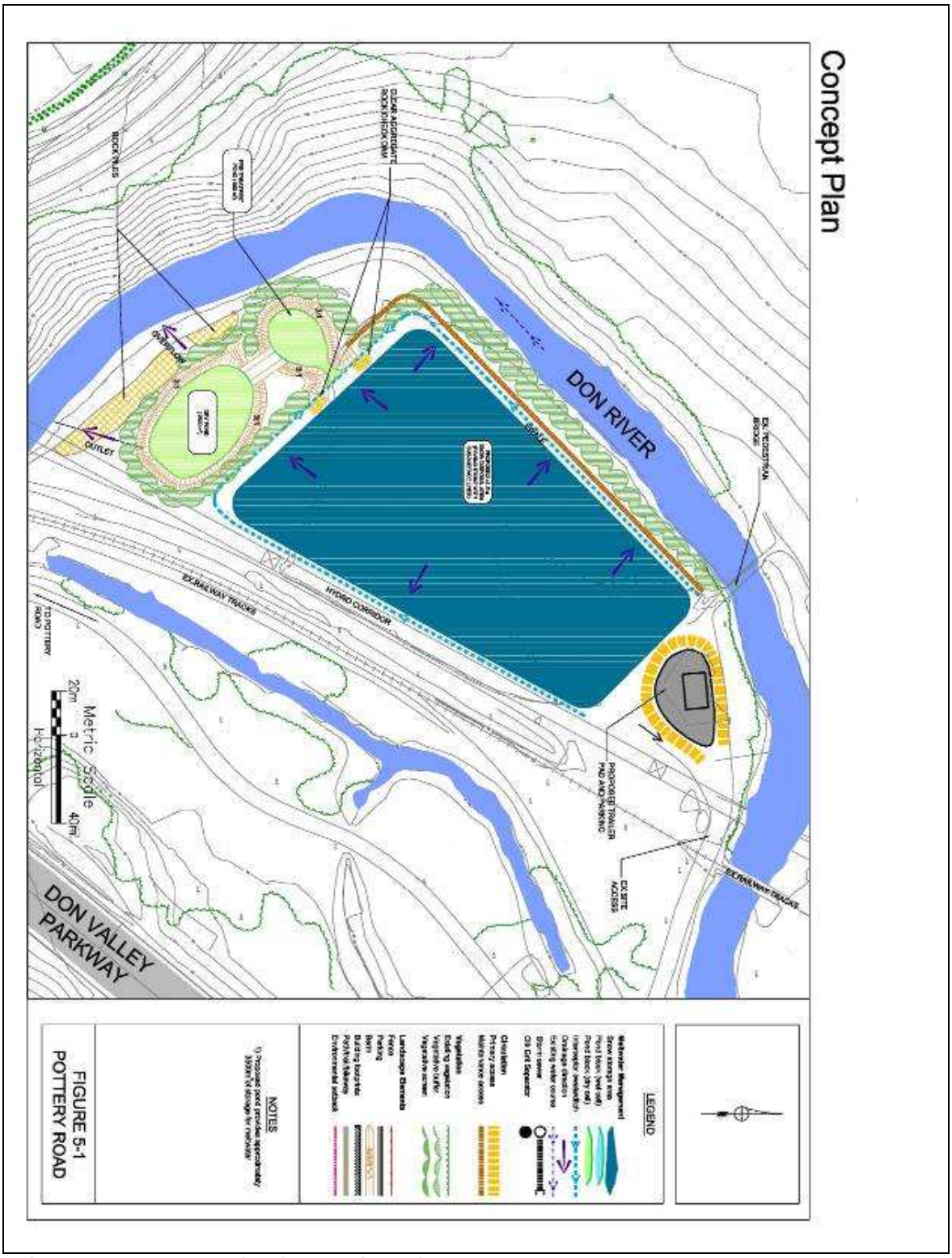



**Figure 3.31 Example of snow dump layout**

From City of Toronto Snow Disposal Sites Environmental Mitigation Measures Conceptual Design

## PUBLIC SNOW DUMPS

The biggest opportunity to reduce snow dump watershed impacts is to filter the meltwater to reduce sediment loads and trash. This can be done through off-the-shelf stormwater treatment practices, such as trash racks and catch basins inserts designed to separate and catch trash and sediments. These must be appropriately sized and maintained regularly, especially during spring melt. Some types of catch basin inserts will also assist with the removal of oil based pollutants.

Biological filtration can have some of the best results in filtering both sediment and pollutants. Filtering meltwater through soil and plant material or through stormwater ponds with a natural substrate and plants allows the diverse plant, microbe and chemical breakdown and filtration of meltwater runoff. Ponds also allow the meltwater to slow allowing sediments to drop out. However, this requires careful engineering to ensure proper function. Stormwater ponds with forebays also work well if the water is deep enough to ensure that only the surface of the pond freezes in winter months.

If infiltration is desired, careful preparation and planting of the soil must be undertaken. Vehicle traffic, snow loads, and salt concentrations can impact soil structure and health, influencing the infiltration capacity and biological and chemical filtering of the meltwater. The organic content and plant cover will also influence the timing and depth of the ground freeze and thaw, and therefore its ability to infiltrate.

A final consideration for managing meltwater is to restrict or regulate the volume of water entering the storm sewer system. Volume restricting drain inlets or detention and pond outlets can reduce the volume of water entering the storm sewer or local creeks at one time reducing velocity and erosion potential as well as the possibility of floods.

## PRIVATE SNOW DUMPS

Pollution prevention for private snow dumps are the same as those for public snow dumps and should include trash and sediment filtration and control, as well as meltwater volume control entering the local storm sewer or streams. At a minimum, property owners that plow their parking and paved areas into big piles on top of the pavement could greatly improve the management of runoff if instead they dedicated a pervious area within their property for the snow.

Given that the private dumps are privately managed, they should be permitted under strict regulations, such as standard development and construction erosion control regulations to ensure compliance. It is imperative to consider meltwater volume calculations. This will help to ensure the ability of a private dump site to manage the amount of runoff effectively without negatively impacting neighbours with localized flooding.

On-site snow management should be addressed at the permit stage of a development project. Snow management planning, such as whether and where snow will be stored on-site should

be specified. Site plan should clearly defined snow storage areas as well as ensuring there is appropriate drainage with sediment and pollutant controls.

**Table 3.4 Pollution prevention opportunities for snow dumps**

| | | |
|---|---|---|
| Clearly mark site Boundaries | Tall poles<br>Flags<br>Fencing | Reduces impact to neighboring land use and landscape |
| Site Design | Edge berms<br>Edge swales<br>Vegetated site, swales and buffers<br>Appropriate Substrate<br>• Gravel<br>• Pervious paving<br>• Geogrid<br>• Impervious liner<br>Asphalt | Controls and directs runoff<br>Buffers runoff and views of site<br>Reduces soil compaction, muddy conditions, sediment control<br>Controls the amount of infiltration |
| Control Runoff sediment | Detention basins<br>Settlement ponds<br>Check dams in swales or drainage path<br>Oil-grit separators<br>Sediment fencing<br>Filter fabric | Reduces sediment and pollutant loads in runoff draining into stormdrain, creeks, and Lake Ontario |
| Control Trash | Drain inlet grates/ trash racks<br>Fencing | Reduces trash and pollutants entering storm drain and creeks. Also reduces flood hazard through reduction of accidental damming of drainage path with trash or other debris. |

**Figure 3.32 Examples of snow plowed off paved areas onto grassy areas**

## SNOW MELTING FACILITIES

While there are no known snow-melting facilities within the watershed, these are becoming popular in some areas and should be permitted and managed with appropriate watershed

impact considerations. Considerations should include sediment and trash filtration and removal prior to entering the storm sewer system, and volume control to reduce high water inputs or other highly erosive events.

## 3.5 COMPLIMENTARY MEASURES

In addition to the technical features described in all of the above sections, lessons learned by CVC demonstrate that there are additional important contributions to ensure successful projects such as the use of a conservation plan, an outreach and social marketing plan and a project monitoring plan.

### 3.5.1 CONSERVATION PLAN

*T*he use of a water audit contractor to complete a thorough audit of the facilities on the property being retrofitted to identify water conservation and related energy conservation opportunities is valuable. Often, this service can include a complete cost-benefit analysis in the contractor's assessment and a Water Conservation Plan for the facility. A conservation plan also serves as a template for similar facilities in municipalities across Ontario, providing guidance on water auditing, cost-benefit analysis and identification of viable technology and fixtures suitable for use in comparable facilities.

### 3.5.2 OUTREACH AND SOCIAL MARKETING

If a site is in a high traffic area in proximity to both a community centre and a public library then the opportunities for public engagement through targeted outreach are excellent. There could be opportunities to showcase the benefits of implementing the innovative infrastructure techniques described in this chapter and how, if done right, LID effectively mitigates many environmental issues associated with urbanization and can revitalize an urban area while protecting vulnerable watersheds. Signage, tours and media exposure could all be incorporated in the Outreach and Marketing Plan and will ensure stakeholders and the broader public witness and appreciate innovative infrastructure at work.

The communication activities implemented in an outreach and social marketing plan should respond to community and stakeholder needs as determined by the participating parties. Initiatives and activities should be designed based on the type of information that needs to be presented as the research progresses. Examples of activities that are likely to be implemented include:

- Presentations by participating staff and/or project team members to special interest groups, such as evening homeowner association meetings, professional development training sessions for municipal staff, etc.;
- Open houses and informational workshops for both the public and for professional stakeholders that utilize a variety of communications approaches tailored to the audience;

- Public programming, such as neighbourhood walks to visit the demonstration site;
- Demonstration site field visits to discuss specific project details of the project open to all interested stakeholders but specifically targeting municipal personnel and facility owners/managers;
- Posting of public information signs at the proposed location;
- Development of a project website;
- Distribution of educational resources;
- Advertisements and articles in local newspapers, homeowner newsletters and select trade publications;
- Partnerships with educators, both at the local level involving elementary and secondary students and at the post-secondary level (for students in such programs as engineering, environmental studies, hydrogeology, etc.) to learn about the project and where appropriate, to have students conduct parts of the field work and monitoring program.

### 3.5.3 MONITORING AND EVALUATION

A monitoring program should be developed to assess the efficacy of the individual technologies and practices employed at the site. Wherever third party laboratory analysis or testing is required, it will be undertaken by a certified laboratory. Soil analysis and ground water sampling are some examples of the sampling and lab testing that will likely be required. Any water conservation initiatives undertaken at the facility will be monitored through a metering and sub-metering program.

A comprehensive monitoring program should be initiated prior to construction to collect baseline data for the parking lot to characterize existing water quality and quantity conditions. Both this monitoring and the conservation metering should continue throughout construction and one year after the site has been constructed. All results of the monitoring and metering programs should be compiled, evaluated and published.

## 4.0 COMMERCIAL AND INDUSTRIAL ZONES

Small commercial and industrial areas are scattered throughout the Fletcher's Creek subwatershed. Although these districts cover a relatively small portion of the subwatershed (about 10% of the watershed combined) they are still considered to be an important land use that affects stormwater management and overall watershed health.

Commercial properties found in the Fletchers Creek Subwatershed include, but are not limited to: malls, retail, automotive services, and restaurants. Commercial land use varies based on location, zoning and age of development.

Industrial properties found in the Fletchers Creek Subwatershed include manufacturing, retail trade businesses and wholesale trade areas.

This Chapter will review the background and issues observed with commercial and industrial properties with respect to stormwater management and pollution control in the Fletchers Creek subwatershed, and will present some proposed solutions. Commercial and industrial properties in the watershed were evaluated through a desktop analysis. The results of this analysis are presented in this Chapter.

Figure 4.1 provides a map of the Fletcher's Creek subwatershed highlighting the various industrial and commercial base zones in green and orange.

**Figure 4.1 Commercial and Industrial Areas**

## 4.1 CHARACTERIZATION

Both commercial and industrial zones within this subwatershed have a high percentage of impervious cover, with the most permeable area being turf. This lack of permeable cover minimizes infiltration and filtration opportunities. Further detail pertaining to the specific characteristics of both commercial and industrial land in the subwatershed is presented following.

### 4.1.1 COMMERCIAL LANDS

Small commercial properties are scattered throughout the Fletchers Creek Subwatershed. Commercial land uses vary based on location, zoning and age of development. For the purposes of the subwatershed study, commercial zones have been subdivided into four main types:

- Box Malls;
- Small Strip Malls;
- Automotive Businesses (gas stations, automotive repair, sales and washes); and
- Restaurants.

**Box Malls** are commercial shopping centres that have a number of retail businesses and large parking lots. The buildings are typically single storey with large, flat roofs. Parking lots dominate these areas and some landscaping – usually turf – is present. Parking lots generally have curb and gutter, and most of the properties drain to private storm drains. Box Mall properties are usually maintained by a facilities manager. Operations and characteristics that have the potential to impact water quality include dumpster management, outdoor materials storage, maintenance practices used in large parking lots, excessive runoff from rooftops, turf and landscaping runoff and management, and snow and ice management.

**Small Strip Malls** typically contain just a few small businesses, and can be found throughout the subwatershed. Parking lots generally have curb and gutter surface drainage, but few properties have private storm drains. Landscaping is typically limited in these areas and the lot is typically dominated by the single or multi-storey building.

Some strip malls may be maintained by a facilities manager. Often, maintenance is through the collective effort of individual business managers. Operations and characteristics that have the potential to impact water quality include dumpster management, outdoor materials storage, maintenance regimes used for parking lots , and snow and ice management.

**Automotive businesses** in the subwatershed include gas stations, service stations, wash facilities, and repair facilities. These automotive businesses have similar operations that have the potential to impact water quality, through car repair activities, and use of washing and fuelling facilities. In addition, dumpster management and outdoor material storage can impact surface run off and are therefore important priorities for pollution prevention.

**Restaurants** are also found throughout the subwatershed. Common practices related to restaurant management identified in the area that have the potential to impact surface water quality through surface run off of stormwater include dumpster management and grease disposal. In addition, some restaurants have large parking lots that have large impervious surfaces. .Snow and ice management is also important to consider at restaurant properties in the area.

### 4.1.2 CHARACTERIZATION OF INDUSTRIAL PROPERTIES

Similar to commercial properties, industrial properties have high percentage of impervious cover. The most permeable area is turf, minimizing infiltration and filtration opportunities.

The various industrial properties in the area contain a diversity of different business types and staff sizes. Businesses include manufacturing, retail trade businesses and wholesale trade areas. Properties found in the industrial areas of Fletchers Creek typically include large buildings with large parking lots for employees and customers, and large turf areas.

Some properties drain stormwater to perimeter swales which lead to ditch inlet catch basins while others rely on private closed storm drainage systems (i.e. buried pipes). Parking lots generally have curb and gutter, and most of the properties drain to private storm drains. With few exceptions, turf areas typically undergo high maintenance regimes which means the grass is kept short and typically fertilized and watered regularly; these activities have an impact on the quality and quantity of water draining off the site.

## 4.2 PROPOSED SOLUTIONS FOR BOTH COMMERCIAL AND INDUSTRIAL LANDS

The types of pollution prevention and restoration opportunities applicable to commercial and industrial properties is dependent on the size and type of use of the commercial or industrial property as well as the maintenance activities used at the site for facilities and property. Some of the possible opportunities for improved stormwater management and pollution prevention at these sites are described in Table 4.1.

Figure 4.2 for identification of priority areas to implement recommendations presented in Table 4.1.

***Figure 4.2 Summary of Restoration Opportunities on Commercial and Industrial Areas***

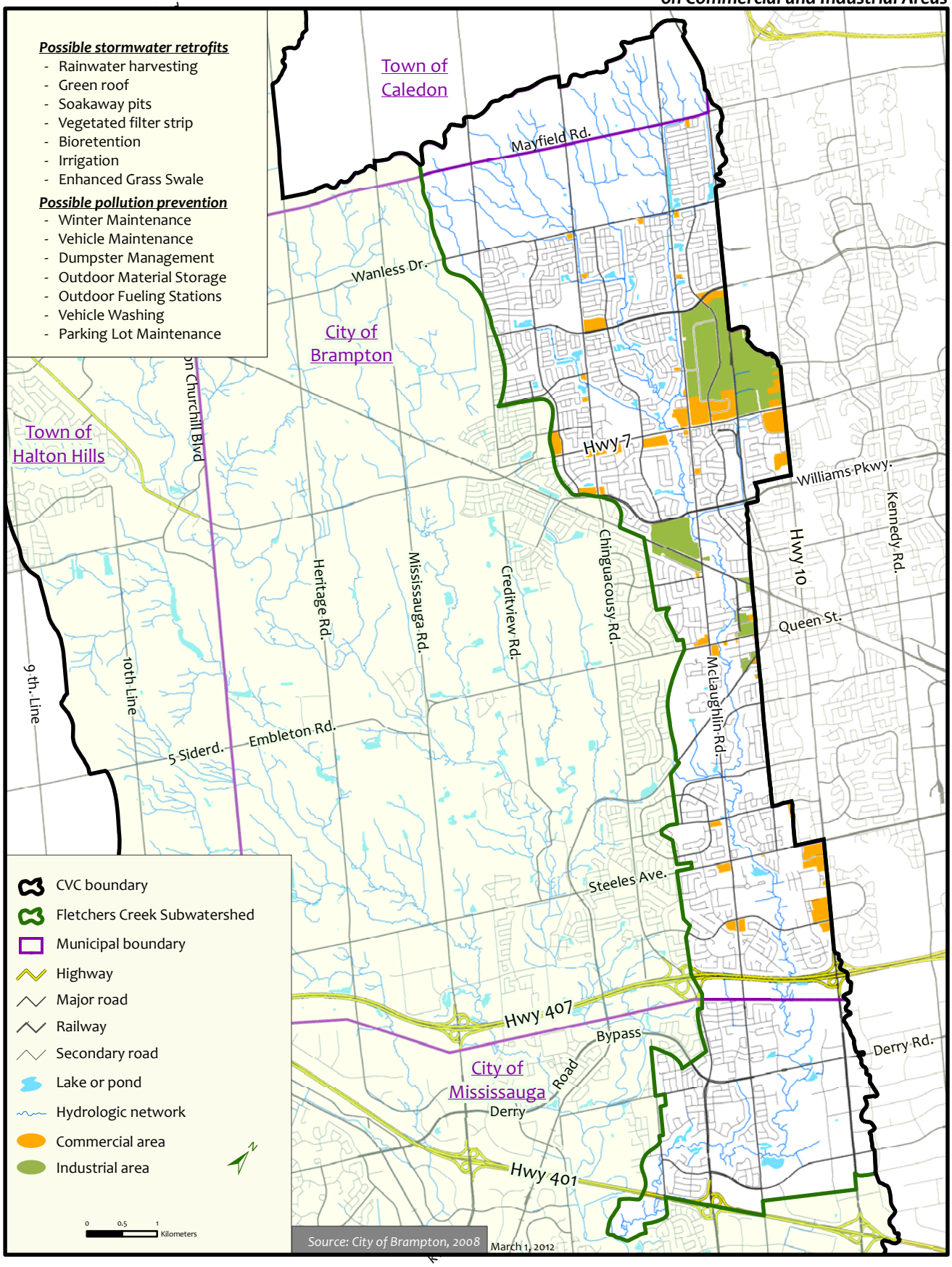


**Table 4.1 Recommended Opportunities for Pollution Prevention and Stormwater Management at Commercial and Industrial Sites**

| Management Technique | Topic | Objective | Recommended Opportunity | Resources |
|---|---|---|---|---|
| Education | Pollution Prevention Education | To raise awareness around pollution prevention and what it means at the individual level. | Develop education and outreach campaigns | |
| Policy | Storm sewer bylaw | To protect public health and the environment from deleterious substances entering the storm sewer system and local watercourses. | Update the Storm sewer bylaw | The City of Brampton current sewer bylaw was enacted in 1975 with no known updates. Updated storm sewer bylaw should give the City of Brampton more authority to review stormwater issues and regulate spills. |
| Program | Restoration | Reduce industrial and commercial property footprint through retrofitting with best management practices. | Work with business to retrofit existing property to support urban ecology. These measures may include:<br>• Rainwater harvesting<br>• Green roofs<br>• Soakaways, trenches, chambers<br>• Bioretention<br>• Vegetated filter strips<br>• Permeable pavement<br>• Enhanced Grass swales<br>• Dry swales | Refer to case studies provided below for additional information on how to implement LID on commercial and industrial properties.<br><br>CVC, TRCA and Evergreen offer Greening Corporate Grounds, a program that provides workshops, seminars and factsheets, as well as assists in improving landscaping practices through the adoption of ecological practices. More information on this program can be found in Chapter 6 or at http://www.creditvalleyca.ca/your-land-water/green-cities/greening-corporate-grounds/ |
| | Pollution Prevention Assessments | Identify point source pollution impacts to Fletchers Creek and provide recommendations for mitigative measures to reduce pollution. | Conduct pollution prevention assessments in a partnership between CVC, the City of Brampton and property owners. These measures may include:<br>• Irrigation practices<br>• Winter de-icing<br>• Vehicle maintenance<br>• Dumpster management<br>• Outdoor material storage<br>• Outdoor fuelling station<br>• Vehicle washing<br>• Parking lot maintenance | Pollution prevention assessments identify activities and practices that could result in pollutants entering the storm drainage system/receiving waterways. Potential threats to surface water could include outdoor fueling stations, outdoor material storage areas, outdoor vehicle washing areas, loading/unloading areas, application of fertilizers and pesticides, use of rock salt and snow disposal areas among others. |

## 4.3 EXAMPLES OF RETROFITS ON INDUSTRIAL PROPERTIES

This section presents a series of case studies including demonstration projects undertaken by CVC. The industrial demonstration projects are presented first, followed by the commercial demonstration projects.

### 4.3.1 INDUSTRIAL DEMONSTRATION PROJECTS

CVC entered into a grant funding agreement with Ministry of the Environment and worked with City of Mississauga to provide technical and financial assistance to small and medium sized businesses within the Cooksville Creek and Sheridan Creek Watersheds to implement and showcase storm water best management practices for source water protection. Three demonstration sites were constructed:

1. Unifay-Fedar Investments – located within the Sheridan Creek Watershed within the City of Mississauga.
2. Bernardi Building Supply Ltd. – located within the Sheridan Creek Watershed within the City of Mississauga.
3. Armstrong Manufacturing Inc. – located within the Cooksville Creek Watershed within the City of Mississauga

There were four key objectives for these projects:

1. Remove and reduce threats to surface water and municipal drinking water supplies;
2. Empower stakeholders to take action and protect municipal drinking water supplies through implementation of "on the ground" projects;
3. Increase public and community awareness of the importance of pollution prevention and making the connection between stormwater drainage and municipal drinking water supplies; and
4. Gain knowledge and experience that can be applied to future watershed studies pertaining to innovative pollution prevention and protecting surface water municipal drinking sources.

A number of pollution prevention and restoration opportunities were identified at these sites including:

- invasive species removal (phragmites, European buckthorn, Manitoba maple);
- swale enhancement;
- creation of sediment traps;
- measures to improve snow storage;
- measures to improve dumpster management practices;
- measures to improve outdoor storage of supplies and equipment;
- installation of a shut off valve (close storm sewer);

- implementation of measures to reduce illegal dumping;
- installation of fuel station spill containment measures;
- installation of secondary spill containment measures; and
- installation of signage to raise public awareness and other public education initiatives to support pollution prevention.

Specific examples of these opportunities are presented in the following three case study demonstration projects, profiled on the following pages. Each case study includes: a description of how the project was implemented; the overall strategy or objectives for the project; a description of the pollution prevention activities that were implemented on the site; a description of any treatment measures installed on the site, and a summary table of the strategies implemented. The case studies presented are as follows:

- Case Study 1: Unifay-Fedar Investments
- Case Study 2: Bernardi Building Supply
- Case Study 3: Armstrong Manufacturing

# Clear Water Projects in Sheridan Creek Watershed

## Unifay-Fedar Investments

### What is a Watershed?

No matter where you are, you are in a watershed. A watershed is the area of land that catches rain and snow which travels over land or through soil into a marsh, stream, or lake. Another way to understand a watershed is to think of an area of land that drains to a low point such as a stream, marsh, creek or lake.

### Sheridan Creek Watershed

Sheridan Creek starts at Highway 403 and flows approximately five kilometers through Mississauga into Lake Ontario. Sheridan Creek Watershed has many unique natural features and important water resources. Did you know Sheridan Creek flows into Rattray Marsh, a provincially significant wetland, which represents one of the few remaining examples of a coastal wetland along the western side of Lake Ontario? Nestled within the city, Sheridan Creek Watershed faces many challenges as a result of urbanization.

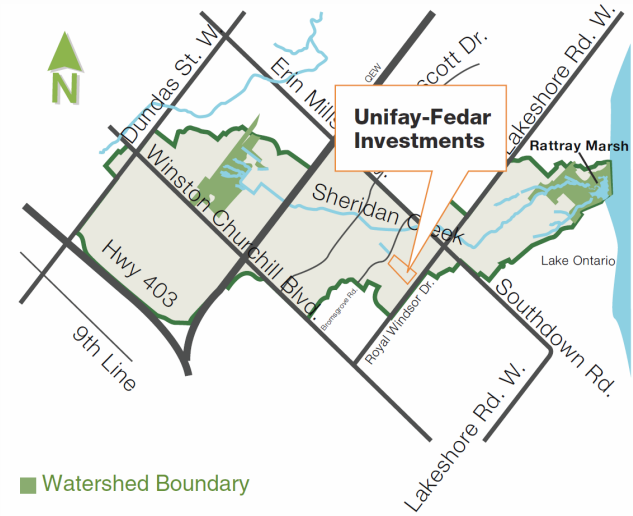
Rattray Marsh

Sheridan Creek

To protect Rattray Marsh and Sheridan Creek, it is important to have clean water. One threat to clean water is rain water that washes across lawns, parking lots and roads carrying with it sediment, lawn fertilizers, pesticides, metals and pollution such as road salt. Pollutants are then washed into Sheridan Creek impacting environmental health and Lake Ontario, the source of Mississauga's drinking water.

### Leading the Charge

The good news for restoration is that leaders like **Unifay-Fedar Investments** (in partnership with the City of Mississauga and Ministry of the Environment) are implementing projects on their property that will help to protect the health of Sheridan Creek and Lake Ontario.




Unifay-Fedar Investments is located at 2265 Royal Windsor Dr., Mississauga in Sheridan Creek Watershed

## Implementation Planning

### Funding

Unifay-Fedar Investments, in partnership with CVC and the City of Mississauga, received funding from the Ministry of the Environment to implement in-the-ground projects to protect surface water supply for small and medium sized businesses.[1]

Through development of demonstration sites, the goals were to:

- remove and reduce threats to surface water and municipal drinking water supplies;
- empower stakeholders to take action and protect municipal drinking water supplies by implementing projects;
- increase public and community awareness of the importance of pollution prevention and making a connection between stormwater drainage and municipal drinking water supplies;
- gain knowledge and experience to apply to future watershed studies pertaining to innovative pollution prevention and protecting surface water municipal drinking sources.

### Demonstration Site Selection

Demonstration sites were selected based on building a community where a number of properties could showcase pollution prevention practices. Each landowner could be an expert on pollution prevention measures implemented on their own property and could be a resource to other property owners within their community.

## Strategy

The following sections describe potential sources of pollutants that may wash into the storm sewer system and strategies for keeping water clean.

**Prevention** is stopping or avoiding pollutants and waste from coming into contact with water in the first place. CVC's initiatives take a multi-faceted approach to prevent negative water quality impacts.

**Treatment** is implementing measures that filter and treat rainwater runoff before entering Sheridan Creek.

## Prevention

A first line of defence is education to discourage detrimental actions that have a direct impact on Sheridan Creek, Rattray Marsh and Lake Ontario.

### Education

Education is a preventative measure that raises awareness and understanding of how certain activities affect the environment. Education helps increase environmental awareness, changes attitudes and behaviours and provides knowledge for making change.

### Fact Sheets

Fact sheets are an educational tool to provide technical information about how to change a particular behaviour or practice. Fact sheets have been developed to show businesses actions they can take to improve operations and protect watershed health. This includes:

- Outdoor fueling stations
- Outdoor material storage
- Parking lot maintenance

Fact sheets are accessible online at www.creditvalleyca.ca/sustainability/.

[1] **This project has received funding support from the Government of Ontario. Such support does not indicate endorsement by the Government of Ontario or the contents of this material.**

Credit Valley Conservation POLLUTION PREVENTION • FACT SHEET #1

Dumpster Management

IN INDUSTRIAL & COMMERCIAL DISTRICTS

Dumpsters can be a major source of pollutants that can affect area water quality. Dumpsters are often left open to the air, allowing rainwater to mix with the trash, resulting in a leaking fluid, or "dumpster juice" that can contain toxic organic and inorganic materials.

If not treated, this dumpster juice can enter the storm drain system, contributing to poor water quality. In addition, dumpster storage areas are often unsightly, can contribute to higher populations of vermin, and have unpleasant odours associated with them.

Examples of uncovered dumpsters with evidence of leakage and "dumpster juice" trails leading to nearby storm drain inlets.

Pollution prevention opportunities include:

- Locate dumpsters in secure areas to prevent illegal dumping.
- Locate dumpsters on a flat concrete surface that does not slope or drain to the storm drain system.
- Install a secondary containment system such as a berm or curb around the dumpster if it is close to the storm drain.
- Install protective covers or lids to keep rainfall from accumulating in the dumpster or secondary containment area.
- Close lids at dumpsters located at vehicle service areas, fast food restaurants, and convenience stores.
- Install an oil and grease separator or sump pit for dumpsters that receive waste with a high moisture content.
- Place clear and visible signs on dumpsters indicating what kind of waste can be accepted.
- Never throw oil and grease or other liquids into a dumpster - provide alternative disposal locations for impermissible substances.
- Close and secure lids properly when the dumpster is not being loaded or unloaded.
- Empty dumpsters frequently to prevent overfilling or storage outside the dumpster.
- Repair leaking or damaged dumpsters immediately.
- Never use bleach and soap to clean the container unless the wash water is sent to the sanitary sewer system.
- Pick up and sweep trash and litter from around the dumpster regularly.
- If you use a service provider, add language to protect water quality in the maintenance contract.
- Consider adding secondary containment around dumpsters.

www.creditvalleyca.ca

Example of the fact sheets available on CVC's website

## Signs

Different signs have been created to reach the greatest audience. This was done in three tiers, with a large sign notifying passersby that there is a clear water project on site. The next type of sign was posted either in front or inside the business to provide more information about the type of technology implemented. The third type, warning signs, alert people on site of the project and discourage illegal activities.

### Informational Signs

This sign provides facts about the site and connections to the local watershed including:

- Who the project partners are
- Connection to Sheridan Creek Watershed
- Site map
- Projects implemented
- Where to get more information

### Warning Signs

Many businesses are faced with the challenge of controlling waste being illegally dumped after regular business hours. This issue can be attributed to a lack of public understanding about the local environment and how pollution impacts the health of Sheridan Creek Watershed. Drainage features, such as swales, may appear as a convenient location to dispose of waste far from the property owner's line of vision.

Illegal dumping on site

Educating with warning signs is a simple solution to discourage illegal dumping. Signs educate everyone about the direct connection between Unifay-Fedar Investments' property with Sheridan Creek, Rattray Marsh and Lake Ontario. Signs also inform potential offenders dumping is an illegal activity subject to fines under Mississauga's Storm Sewer By-Law 259-05 (with fines up to $100,000).


Example of the signage to be installed

### Preventing Illegal Dumping

Existing site conditions were the result of combined factors. Illegal dumping was one of many prevalent issues. The building didn't have a tenant or any customers. There was a lack of understanding about the local environment. There were no signs or demarcation buffers and the property was covered with invasive plants, such as common reed grass, which provided a convenient opportunity to hide trash in the swale far from the property owner's line of vision.

Illegal dumping on site

### New Fencing

After removing invasive species and cleaning up the property, the landowner installed fencing to discourage illegal dumping of waste materials.

New fencing installed

## Waste Management

### New Dumpsters

Dumpsters are a common fixture in urban environments and if not properly maintained can result in pollutants washing into storm sewers.

CVC worked with Unifay-Fedar to remove the cracked, rusted and leaky dumpsters to eliminate contaminants to Sheridan Creek, as waste materials or "dumpster juice" drained to a receiving catch basin. In addition, other dumpsters on site were too small for the amount of waste tenants produced.

Leaky dumpsters after it has rained

Replacing old dumpsters with new dumpsters prevented fluids from escaping. The waste management provider is the responsible for maintaining dumpsters in reasonable condition. If waste materials are escaping from a dumpster then it should be immediately replaced by the company providing the waste management service free of charge. A properly sized dumpster also prevents the lid from being left open or putting items beside the dumpster, which would otherwise be left uncontained and susceptible to washing away.


New dumpsters installed

## New Waste Oil Storage

New spill containment pads were provided to place under the oil drum. Guidance and instructions were provided on how to safely dispose of waste oil, where to dispose it and applicable regulations tenants should be aware of.

New spill containment pads installed

## Paint and Solvent Storage

Replacing outdoor storage units with better containment and indoor storage helps prevent materials from spilling or leaking into the environment.

Former openly stored paints and solvents

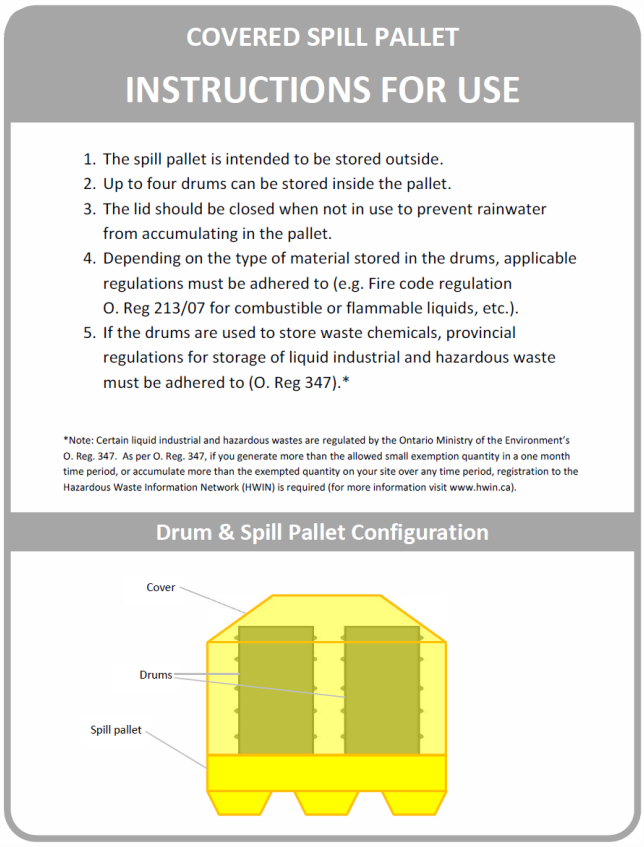
Properly stored chemicals in closed cabinets will contain possible spills. New storage bins were provided to prevent any impact to water quality.

## Spill Containment

Improving practices inside the facility prevents materials from leaving the building.

Spill pallets were provided for one tenant to demonstrate containment and awareness around safe material storage and spill containment. The pads can contain spills or leaks from 100 gallon drums.

New covered spill pallet for 100 gallon drums



COVERED SPILL PALLET

INSTRUCTIONS FOR USE

1. The spill pallet is intended to be stored outside.
2. Up to four drums can be stored inside the pallet.
3. The lid should be closed when not in use to prevent rainwater from accumulating in the pallet.
4. Depending on the type of material stored in the drums, applicable regulations must be adhered to (e.g. Fire code regulation O. Reg 213/07 for combustible or flammable liquids, etc.).
5. If the drums are used to store waste chemicals, provincial regulations for storage of liquid industrial and hazardous waste must be adhered to (O. Reg 347).*

*Note: Certain liquid industrial and hazardous wastes are regulated by the Ontario Ministry of the Environment's O. Reg. 347. As per O. Reg. 347, if you generate more than the allowed small exemption quantity in a one month time period, or accumulate more than the exempted quantity on your site over any time period, registration to the Hazardous Waste Information Network (HWIN) is required (for more information visit www.hwin.ca).

Drum & Spill Pallet Configuration



**Covered spill pallet instructions**

Instructions have been developed to provide direction for on-site prevention measures, including the covered spill pallet. The instructions cover how to use the spill pallet and provincial regulations that apply to waste storage.

## Treatment

A second line of defense incorporates features into the site to filter and treat rainwater and snow melt before it reaches Sheridan Creek, Rattray Marsh and Lake Ontario.

### Clear Water Buffer Creation

To reduce sediment loading into the drainage swale, establishing buffers aides in filtering any rainfall runoff and melt water originating from the snow dump. Buffer creation included the following components:

- Removing invasive species
- Establishing vegetated clear water buffers
- Consideration of snow storage areas and snow melt treatment
- Demarcation

#### Clear Water Buffer Strips

Where space is permitted, clear water buffer strips were enhanced or created to help filter runoff before reaching swales and catch basins that drain to the storm sewers. Buffer strips were prepared by excavating and disposing 300 mm of compacted soil and replacing it with 300 mm of clean topsoil. Lab tests were performed on the new topsoil to ensure it had desired characteristics. Soil amendments and buffers filter runoff coming from the gravel laneway. The rate of overland flow will be reduced while promoting infiltration.

Buffer strip and soil amendments

Working with landowners on adjacent properties, features were designed to function in unison. Runoff through the system begin on Unifay-Fedar's property, through buffer strips and soil amendments, to Bernardi Building Supply's enhanced swales and sediment traps.

#### Invasive Species Removal

Invasive plants out-compete local species, grow aggressively and reproduce rapidly. After direct habitat loss, invasive plants are the next primary threat to native biodiversity. Common reed grass, European buckthorn, and Manitoba maple (all invasive plants), were well established throughout the site and were a seed source to downstream areas, especially Rattray Marsh, which is a provincially significant wetland.

Invasive species on the east side of the property prior to removal

Invasive species were sprayed with weed killer (Roundup) and remaining plants were physically removed. To prevent plants from re-establishing, remaining seeds and roots were eliminated by removing 300 mm of soil and adding 300 mm clean soil.

Invasive species removed, buffers created and protected

Overgrown invasive species created a thick wall of vegetation that hid illegal dumping. Removing the Reed grass and other invasive species (Manitoba maple, European buckthorn and Purple Loosestrife) established a clear view of swales and buffers creating a visible link to the area's condition. In addition, a clear sightline to the buffer deters dumping and helps the property owner and tenants quickly recognize when illegal dumping has occurred.

After soil amendments, buffer creation, and local species planted

### Plant Local Species

Once invasive plants have been cleared, the site will be planted and seeded with local species. The following are some native species that will be planted on swales and buffers:

- Eastern white cedar
- Red osier dogwood
- Nannyberry
- Serviceberry
- Grasses/sedges/wetland species

### Buffer Protection

Demarcating swales clearly indicates where the buffer starts with established posts and stones. It provides a physical barrier to snow being dumped or pushed into the swale. This will also prevent encroachments into the buffer and discourage illegal dumping.

### Signs

Signs indicate the property's link with Sheridan Creek, Rattray Marsh and Lake Ontario, which is the source of our drinking water. Signs help prevent snow from being dumped directly in drainage swales.

## Summary

Table 1 below provides a summary of all restoration opportunities for Unifay-Fedar Investments. Following the table is a diagram that shows how the features work together (Figure 1).

| Summary of Strategies Implemented at Unifay-Fedar Investments | | |
|---|---|---|
| **Opportunity** | **Prevention** | **Treatment** |
| **Fact Sheets** | ✓ | |
| **Prevention of Illegal Dumping** | ✓ | |
| **Signs** | ✓ | |
| **Buffer Protection** | ✓ | |
| **Removal of Invasive Species** | | ✓ |
| **Clear Water Buffer Strips** | | ✓ |
| **Plant Local Species** | | ✓ |

**Table 1:** Summary of Strategies Implemented at Unifay-Fedar Investments

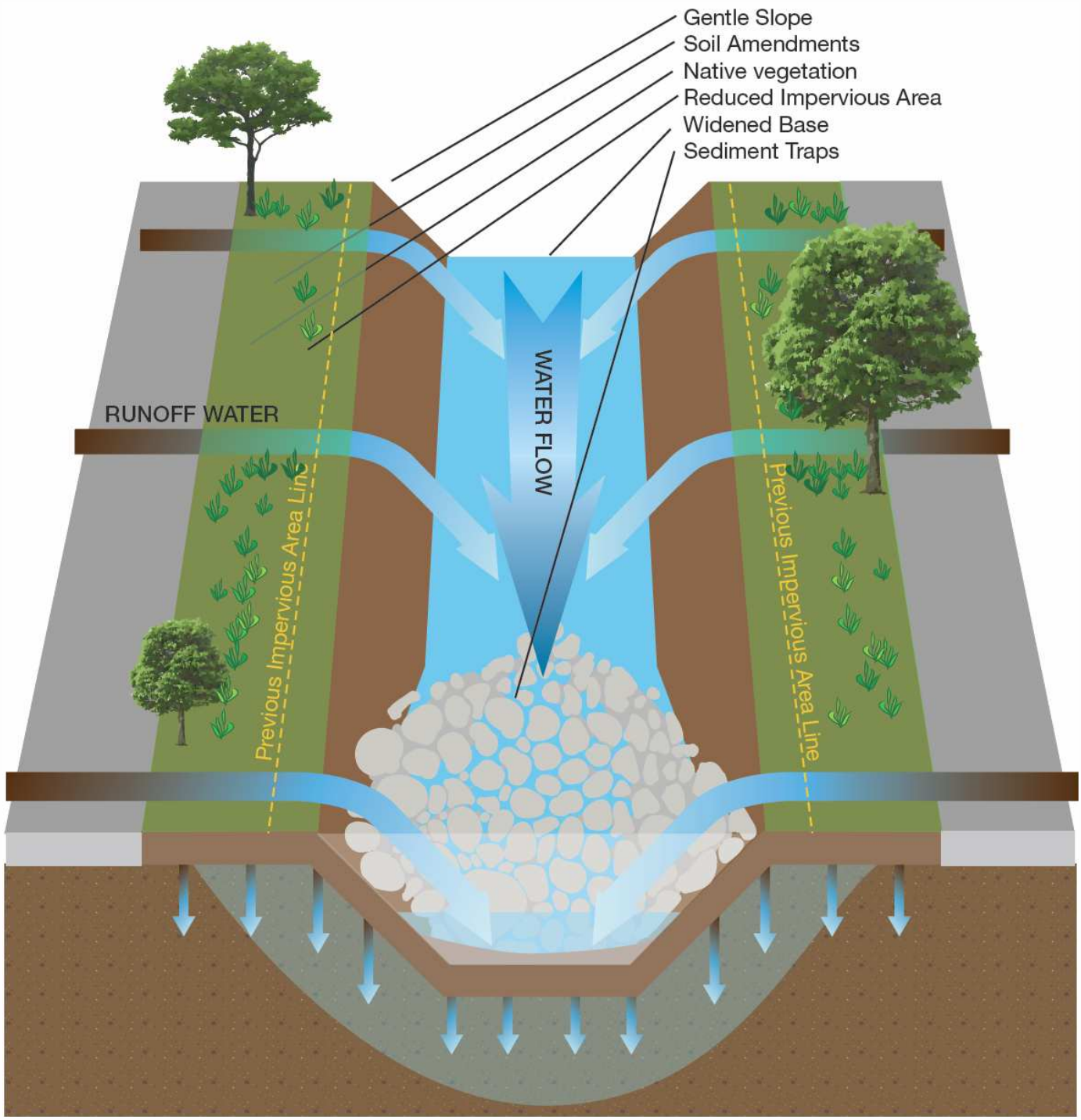



**Figure 1:** Runoff water from Unifay-Fedar is filtered as it flows laterally through newly constructed clear water buffers, soil amendments, and native vegetation (local species). Runoff then flows to enhanced swales and sediment traps on Bernardi Building Supply, allowing particulates to settle before draining to the catch basin.

## Lessons Learned

Reflecting on original objectives of the project, the following are some lessons learned.

- Empower stakeholders to take action and protect municipal drinking water supplies through implementing projects.

- Successful implementation of in-the-ground projects requires full-time construction inspection to ensure project success. Often times the contractor has questions regarding project design and intent of the project. Having an inspector on site to help answer questions helps the construction process move smoothly and the contractor can verify questions or concerns directly on site. This also provides a much smaller potential for errors since the contractor will not be using assumptions.

- Maintaining constant dialogue between the landowner and contractor also ensured questions and/or concerns could be addressed promptly. Unexpected issues can arise that require adjustments to the design to ensure project success. There were a number of instances when the landowner was able to shed light on activities that took place on site that could impact the project. Minor modifications were made to the design to ensure project success.

- Through the construction process, modifications were made to facilitate future maintenance issues. For example, higher densities of invasive species were present on some of the sites. Seed mixtures were replaced with mulch to suppress re-colonization of invasive species. Additional native vegetation was planted to form dense thickets to help invasive species from re-invading the site.

- Landowner cooperation was an integral part of the success of this project. Unifay-Fedar Investments assisted by preparing the site for construction by removing all equipment and obstacles to ensure the contractor could complete work without interruption.

- Provide operation and maintenance instructions for landowners and tenants.

- Increase public and community awareness of the importance of pollution prevention and make a connection between storm water drainage and municipal drinking water supplies.

- Based on feedback from participating landowners, interpretive signs were modified to incorporate more images and less text.

- Once you have captured public attention, offer additional education materials such as fact sheets and case studies to provide more detailed information.

- Landowners were consulted on how to name and market future workshops to encourage a broad variety of stakeholders. Choosing appropriate words is important to ensure education events are appealing to a broad audience.

- For additional tips to landowners and property managers interested in pursuing a clear water project, please see CVC's "Recommendations for Future Clear Water Projects". Details can be found on: Management Agreements, Tenders, Maintenance, Constructing to Specification, and Permits

### Benefits of Partnership

This partnership will help to:

- Support MOE with source water protection initiatives and guidelines given this site drains to Lake Ontario – Mississauga's drinking water supplies;
- Support City of Mississauga with pollution prevention efforts, storm sewer bylaws; Storm water Quality Strategy Update, and Green Development Strategy, among others;
- Support Region of Peel's Sanitary Sewer Bylaw;
- Support and complement low impact development initiatives;
- Support the municipality, region and MOE when dealing with spill response and preparedness.

This partnership also supports the vision, goals and objectives of Mississauga's Strategic Plan "Our Future Mississauga" by ensuring healthy and attractive communities, natural environments and drinking water supply. These features would benefit even more by using pollution prevention strategies. This is also consistent with the vision of "Our Future Mississauga". As an environmentally responsible community, the City of Mississauga is committed to environmental protection, conducting its corporate operations in an environmentally responsible manner and promoting awareness of environmental policies, issues and initiatives.

## More Information

For more information on this demonstration site or general information on clear water projects and source water protection please visit the following websites:

**Ministry of the Environment (MOE)**

- Sewer Use Best Management Practices (BMP) Documents http://www.ene.gov.on.ca/en/publications/forms/index.php#bmp
- Snow Disposal and De-icing Operations in Ontario (1994) http://www.ene.gov.on.ca/envision/gp/0412e.pdf
- Guidelines for Snow Disposal and De-icing Operations in Ontario (1975) http://www.ene.gov.on.ca/envision/gp/B4-1.pdf
- Ontario Stewardship Drinking Water Program http://www.ene.gov.on.ca/en/water/cleanwater/index.php

**Region of Peel**

- Sanitary Sewer Use Bylaw http://www.peelregion.ca/pw/water/sewage-trtmt/seweruse-bylaw.htm

**Credit Valley Conservation**

- Strategies for Sustainability http://www.creditvalleyca.ca/sustainability/

**City of Mississauga**

- Storm Sewer Use Bylaw http://www.mississauga.ca/file/COM/Storm_Sewers.pdf
- Protect Our Water http://www.mississauga.ca/file/COM/Protect_Our_Water_brochure.pdf

**The Bloom Centre for Sustainability (Formerly OCETA)**

- http://www.bloomcentre.com

**Canadian Centre for Pollution Prevention (C2P2)**

- http://www.c2p2online.com/
- http://www.c2p2online.com/main.php3?session=&section=39&heading=84

**Landowners and property managers** interested in pursuing a pollution prevention project, please see helpful tips in CVC's Recommendations for Future Pollution Prevention Projects:

- http://www.creditvalleyca.ca/sustainability/pollutionprevention/index.html

# Clear Water Projects in Sheridan Creek Watershed

## Bernardi Building Supply Ltd.

### What is a Watershed?

No matter where you are, you are in a watershed. A watershed is the area of land that catches rain and snow which travels over land or through soil into a marsh, stream, or lake. Another way to understand a watershed is to think of an area of land that drains to a low point such as a stream, marsh, creek or lake.

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Sheridan Creek starts at Highway 403 and flows approximately five kilometers through Mississauga into Lake Ontario. Sheridan Creek Watershed has many unique natural features and important water resources. Did you know Sheridan Creek flows into Rattray Marsh, a provincially significant wetland, which represents one of the few remaining examples of a coastal wetland along the western side of Lake Ontario? Nestled within the city, Sheridan Creek Watershed faces many challenges as a result of urbanization.

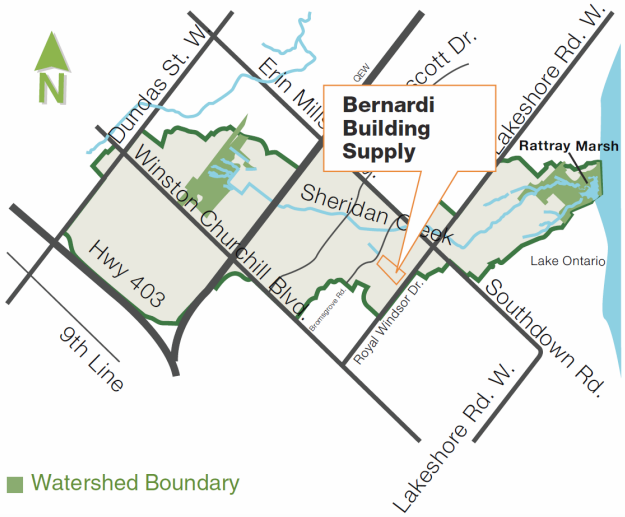
Rattray Marsh

Sheridan Creek

To protect Rattray Marsh and Sheridan Creek, it is important to have clean water. One threat to clean water is rain water that washes across lawns, parking lots and roads carrying with it sediment, lawn fertilizers, pesticides, metals and pollution such as road salt. Pollutants are then washed into Sheridan Creek impacting environmental health and Lake Ontario, the source of Mississauga's drinking water.

### Leading the Charge

The good news for restoration is that leaders like **Bernardi Building Supply** (in partnership with the City of Mississauga and Ministry of the Environment) are implementing projects on their property that will help to protect the health of Sheridan Creek and Lake Ontario.




Bernardi Building Supply Ltd is located at 2235 Royal Windsor Dr., Mississauga in Sheridan Creek Watershed

## Implementation Planning

### Funding

Bernardi Building Supply, in partnership with CVC and the City of Mississauga, received funding from the Ministry of the Environment to implement in-the-ground projects to protect surface water supply for small and medium sized businesses.[1]

Through development of demonstration sites, the goals were to:

- remove and reduce threats to surface water and municipal drinking water supplies;
- empower stakeholders to take action and protect municipal drinking water supplies by implementing projects;
- increase public and community awareness of the importance of pollution prevention and making a connection between stormwater drainage and municipal drinking water supplies;
- gain knowledge and experience to apply to future watershed studies pertaining to innovative pollution prevention and protecting surface water municipal drinking sources.

### Demonstration Site Selection

Demonstration sites were selected based on building a community where a number of properties could showcase pollution prevention practices. Each landowner could be an expert on pollution prevention measures implemented on their own property and could be a resource to other property owners within their community.

## Strategy

The following sections describe potential sources of pollutants that may wash into the storm sewer system and strategies for keeping water clean.

**Prevention** is stopping or avoiding pollutants and waste from coming into contact with water in the first place. CVC's initiatives take a multi-faceted approach to prevent negative water quality impacts.

**Treatment** is implementing measures that filter and treat rainwater runoff before entering Sheridan Creek.

[1] **This project has received funding support from the Government of Ontario. Such support does not indicate endorsement by the Government of Ontario or the contents of this material.**

## Prevention

A first line of defence is education to discourage detrimental actions that have a direct impact on Sheridan Creek, Rattray Marsh and Lake Ontario.

### Education

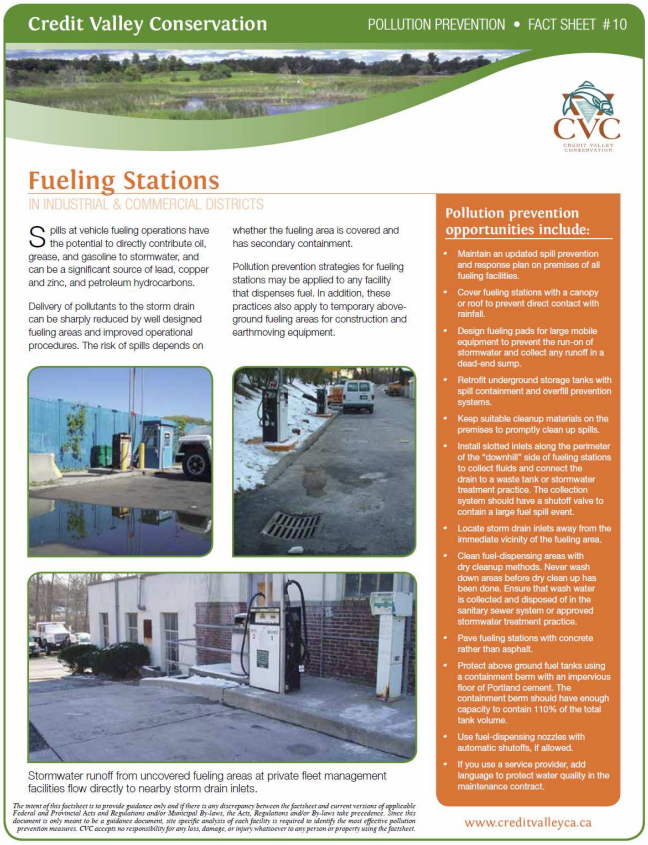
Education is a preventative measure that raises awareness and understanding of how certain activities affect the environment. Education helps increase environmental awareness, changes attitudes and behaviours and provides knowledge for making change.

### Fact Sheets

Fact sheets are an educational tool to provide technical information about how to change a particular behaviour or practice. Fact sheets have been developed to show businesses actions they can take to improve operations and protect watershed health. This includes:

- Outdoor fueling stations
- Outdoor material storage
- Parking lot maintenance

Fact sheets are accessible online at www.creditvalleyca.ca/sustainability/.



Credit Valley Conservation POLLUTION PREVENTION • FACT SHEET #10

Fueling Stations

IN INDUSTRIAL & COMMERCIAL DISTRICTS

Spills at vehicle fueling operations have the potential to directly contribute oil, grease, and gasoline to stormwater, and can be a significant source of lead, copper and zinc, and petroleum hydrocarbons.

Delivery of pollutants to the storm drain can be sharply reduced by well designed fueling areas and improved operational procedures. The risk of spills depends on whether the fueling area is covered and has secondary containment.

Pollution prevention strategies for fueling stations may be applied to any facility that dispenses fuel. In addition, these practices also apply to temporary above-ground fueling areas for construction and earthmoving equipment.

Pollution prevention opportunities include:

- Maintain an updated spill prevention and response plan on premises of all fueling facilities.
- Cover fueling stations with a canopy or roof to prevent direct contact with rainfall.
- Design fueling pads for large mobile equipment to prevent the run-on of stormwater and collect any runoff in a dead-end sump.
- Retrofit underground storage tanks with spill containment and overfill prevention systems.
- Keep suitable cleanup materials on the premises to promptly clean up spills.
- Install slotted inlets along the perimeter of the "downhill" side of fueling stations to collect fluids and connect the drain to a waste tank or stormwater treatment practice. The collection system should have a shutoff valve to contain a large fuel spill event.
- Locate storm drain inlets away from the immediate vicinity of the fueling area.
- Clean fuel-dispensing areas with dry cleanup methods. Never wash down areas before dry clean up has been done. Ensure that wash water is collected and disposed of in the sanitary sewer system or approved stormwater treatment practice.
- Pave fueling stations with concrete rather than asphalt.
- Protect above ground fuel tanks using a containment berm with an impervious floor of Portland cement. The containment berm should have enough capacity to contain 110% of the total tank volume.
- Use fuel-dispensing nozzles with automatic shutoffs, if allowed.
- If you use a service provider, add language to protect water quality in the maintenance contract.

Stormwater runoff from uncovered fueling areas at private fleet management facilities flow directly to nearby storm drain inlets.

*The intent of this factsheet is to provide guidance only and if there is any discrepancy between the factsheet and current versions of applicable Federal and Provincial Acts and Regulations and/or Municipal By-laws, the Acts, Regulations and/or By-laws take precedence. Since this document is only meant to be a guidance document, site specific analysis of each facility is required to identify the most effective pollution prevention measures. CVC accepts no responsibility for any loss, damage, or injury whatsoever to any person or property using the factsheet.*

www.creditvalleyca.ca

Example of the fact sheets available on CVC's website

## Signs

Different signs have been created to reach the greatest audience. This was done in three tiers, with a large sign notifying passersby that there is a clear water project on site. The next type of sign was posted either in front or inside the business to provide more information about the type of technology implemented. The third type, warning signs, alert people on site of the project and discourage illegal activities.

### Informational Signs

This sign provides facts about the site and connections to the local watershed including:

- Who the project partners are
- Connection to Sheridan Creek Watershed
- Site map
- Projects implemented
- Where to get more information

### Warning Signs

Many businesses are faced with the challenge of controlling waste being illegally dumped after regular business hours. This issue can be attributed to a lack of public understanding about the local environment and how pollution impacts the health of Sheridan Creek Watershed. Drainage features, such as swales, may appear as a convenient location to dispose of waste far from the property owner's line of vision.

Illegal dumping on site

Educating with warning signs is a simple solution to discourage illegal dumping. Signs educate everyone about the direct connection between Bernardi Building Supply's property with Sheridan Creek, Rattray Marsh and Lake Ontario. Signs also inform potential offenders dumping is an illegal activity subject to fines under Mississauga's Storm Sewer By-Law 259-05 (with fines up to $100,000).


Example of the signage to be installed

## Spill Containment Sump

Bernardi Building Supply has an outdoor fuel station to fill its vehicles, a common feature for many businesses in Mississauga. The outdoor fuel station is constructed on a concrete pad as required by municipal bylaws, however, open fuel stations can be a threat to surface water quality if a spill takes place. Depending on the

size of the spill, fuel could wash into storm sewers and impact water quality in Sheridan Creek, Rattray Marsh and Lake Ontario. The impact of a spill may not be fully understood due to a lack of information, or where to seek out information.

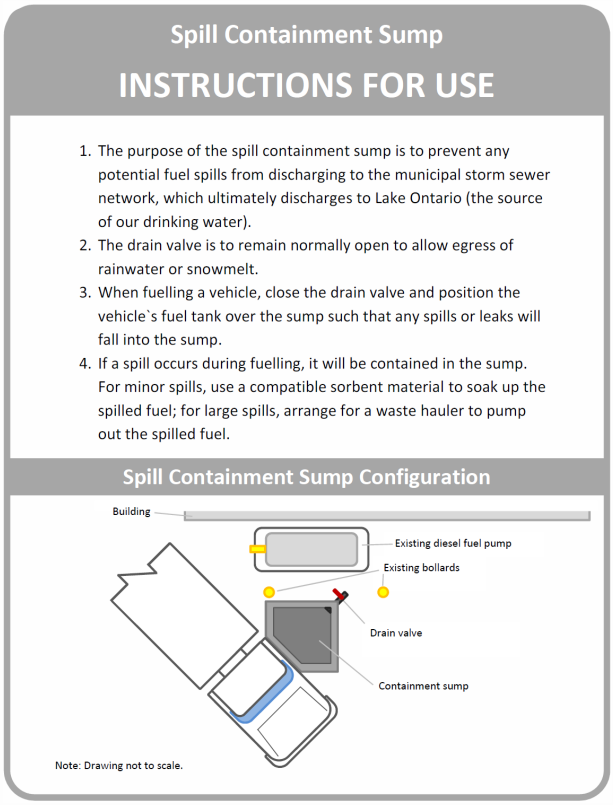
Fuel station

Protecting surface water quality by preventing pollutants from coming into contact with rainwater and snow melt runoff initially is considered a first line of defence.

Constructing a spill containment sump will capture any spills that may take place when service vehicles are being fuelled. The pad is equipped with a shut-off valve that can be closed during fuelling and opened again once fuelling is complete to drain rainwater or snowmelt. When fuelling a vehicle, the drain valve is closed and the vehicle's fuel tank is positioned over the sump so any spills or leaks will fall into the sump. If a spill occurs during fuelling, it will be contained within the sump.


Spill containment sump installed

Instructions have been developed to provide direction on operating the spill containment sump. Instructions cover using the sump and what to do if a spill occurs.




Spill containment sump instructions

## Treatment

A second line of defense incorporates features into the site to filter and treat rainwater and snow melt before it reaches Sheridan Creek, Rattray Marsh and Lake Ontario.

### Swale Enhancement

Existing drainage swales were enhanced to improve their ability to filter and treat rainwater runoff before entering Sheridan Creek.

Swale enhancements include the following components:

- Removing invasive species
- Re-grading existing swales
- Creating clear water buffer strips
- Creating sediment traps
- Planting native plant species
- Buffer protection - demarcation

## Removing Invasive Species

Invasive plant species out-compete local native species by growing aggressively and reproducing rapidly without any natural predators to keep their numbers in check. After direct habitat loss, invasive plants are the next primary threat to native biodiversity. Invasives, such as Reed grass, European buckthorn and Manitoba maple, were well established throughout the site and were a seed source to downstream areas, especially Rattray Marsh, which is a provincially significant wetland.

Invasive species on the east side of the property prior to removal

Overgrown reeds created a thick wall of vegetation and impaired how the existing swale drained. These features also made ideal locations for illegal dumping.

Invasive species on the west side of the property prior to removal

Removing reeds and other invasive species (Manitoba maple, European buckthorn and Purple loosestrife) established a clear view of the swales and buffers, creating a visible link to the swale's condition. A visible buffer also deterred people from dumping in swales and let the property owner and staff quickly recognize when illegal dumping had occurred. The dense stand of reeds impaired the swale's ability to treat rainwater and snow melt and also created maintenance issues.


Invasive species removed

Invasive species were sprayed with an herbicide. The remaining plants were physically removed.

Invasive species removed

## Clear Water Buffer Strips

Where space permitted clear water buffer strips were enhanced or created to help filter rainwater runoff and snow melt before reaching swales and catch basins that drain to Sheridan Creek. Buffer strips were prepared by excavating and disposing 300 mm of compacted soil and replacing it with 300 mm of clean topsoil. Lab tests were performed on approved topsoil to ensure it had the desired characteristics.

Buffer strip and soil amendments

## Re-grading Existing Swales

Where space permitted, swales were re-graded to optimize water quality treatment performance for a 25 mm storm event. Swales were re-graded to meet the following criteria:

- Bottom width - 0.75 m
- Side slopes - 2.5:1 to 3:1
- Flow – less than 0.15 $m^3$/s for 25 mm storm
- Velocity – less than 0.5 m/s for 25 mm storm
- Flow depth – less than 100 mm for 25 mm storm
- Longitudinal slope – 0.5 per cent to 2.0 per cent
- 300 mm topsoil depth in swale cross section

Swale enhancement on the west side of the property

Design calculations included provisions for a channel roughness typical of high vegetation growth (75 mm) to enhance filtration of suspended solids.

## Creation of Sediment Traps

Sediment that manages to pass through vegetated buffer strips will hit a third barrier – sediment traps.

To reduce sediment, sediment traps were constructed within drainage swales. Sediment traps act as a settling area for suspended solids and can remove a large percentage of sediment entering and flowing within the drainage swale.

Sediment trap on the west side of the property

Creating sediment traps provides time needed for sediment to separate and sink to the bottom. By filtering sediment from rainwater runoff and melt water, the trap prevents sediment from being transported downstream, reducing clogging in drainage swales, flooding issues and future maintenance needs.

Sediment traps were also designed to treat spring snow melt runoff by placing the traps downstream of snow storage areas. Sediment traps were designed to promote discrete settling and require maintenance once 25 mm of accumulation has occurred.

Sediment traps in front of curb cuts

### Plant Local Species

Once invasive species are cleared, local plant species will be planted and seeded on the site. The following are some species of plants introduced to swales and buffers:

- Eastern white cedar
- Red osier dogwood
- Nannyberry
- Serviceberry
- Grasses/sedges/wetland species

Local species planted (Nannyberry)

Once local vegetation is established it becomes difficult for invasive species to re-colonize the site.

### Buffer Protection

Demarcating swales indicates where the buffer starts with established posts and stones. It provides a physical barrier to snow being dumped or pushed into the swale. Swales also prevent encroachments into the buffer and discourage illegal dumping.

Demarcation by cedar posts

## Summary

Table 1 below provides a summary of all restoration opportunities for Bernardi Construction Company. Following the table is a diagram that shows how all of the design features work together (Figure 1).

| Summary of Strategies Implemented at Bernardi Building Supply | | |
|---|---|---|
| **Opportunity** | **Prevention** | **Treatment** |
| **Fact Sheets** | ✓ | |
| **Prevention of Illegal Dumping** | ✓ | |
| **Fuel Station Spill Prevention** | ✓ | |
| **Signage** | ✓ | |
| **Buffer Protection** | ✓ | |
| **Removing Invasive Species** | | ✓ |
| **Clear Water Buffer Strips** | | ✓ |
| **Re-Grading Existing Swales** | | ✓ |
| **Plant Local Species** | | ✓ |
| **Creation of Sediment Traps** | | ✓ |

**Table 1:** Summary of Strategies Implemented at Bernardi Building Supply

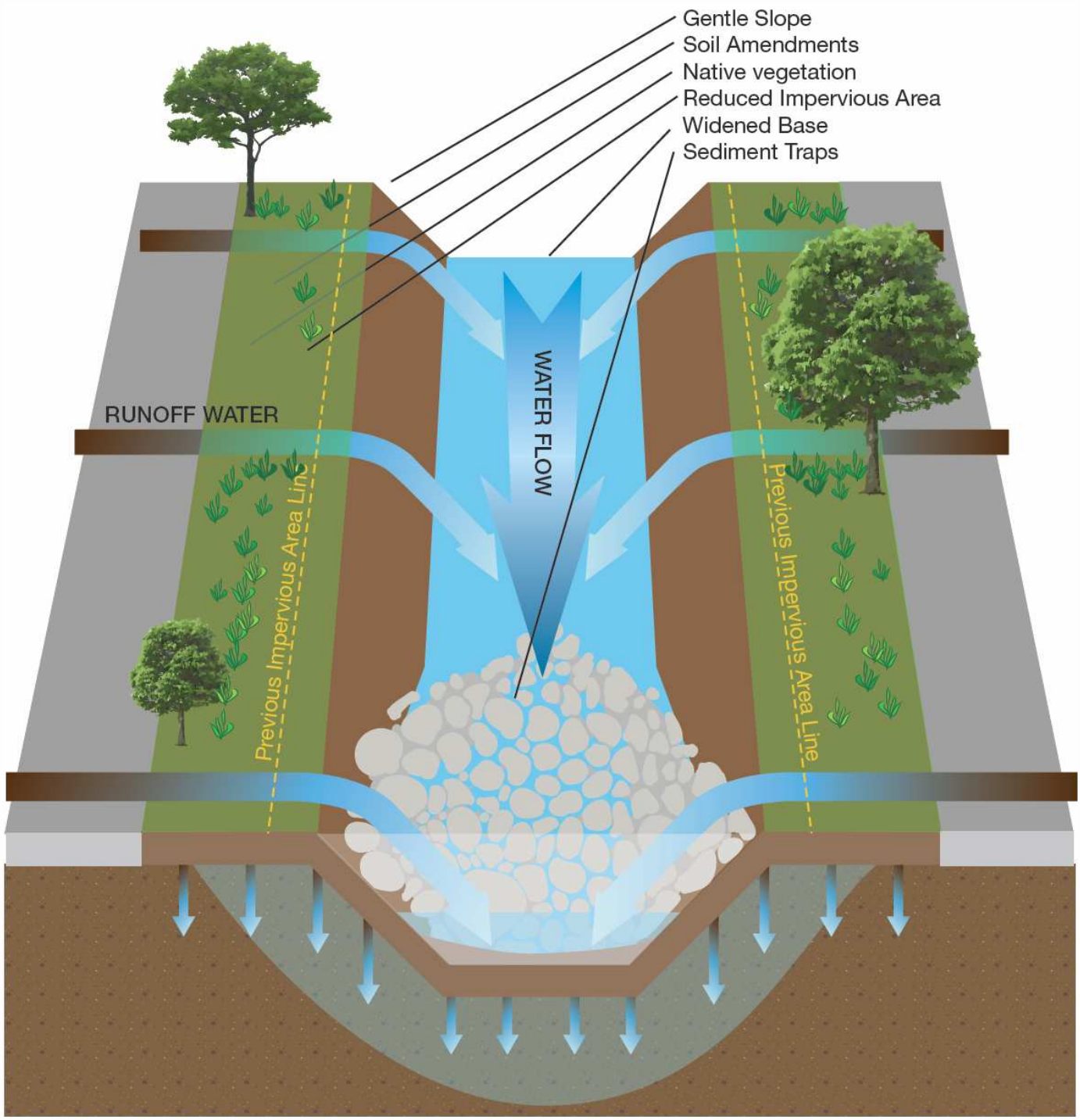



**Figure 1:** Runoff water from Bernardi Building Supply is filtered as it flows laterally through newly constructed clear water buffers, soil amendments, and native vegetation (local species). Runoff then flows to enhanced swales and sediment traps, allowing particulates to settle before draining to the catch basin.

## Lessons Learned

Reflecting on original objectives of the project, the following are some lessons learned:

- Empower stakeholders to take action and protect municipal drinking water supplies through implementing projects.

- Successful implementation of in-the-ground projects requires full-time construction inspection to ensure project success. Often times the contractor has questions regarding project design and intent of the project. Having an inspector on site to help answer questions helps the construction process move smoothly and the contractor can verify questions or concerns directly on site. This also provides a much smaller potential for errors since the contractor will not be using assumptions.

- Maintaining constant dialogue between the landowner and contractor also ensured questions and/or concerns could be addressed promptly. Unexpected issues can arise that require adjustments to the design to ensure project success. There were a number of instances when the landowner was able to shed light on activities that took place on site that could impact the project. Minor modifications were made to the design to ensure project success.

- Through the construction process, modifications were made to facilitate future maintenance issues. For example, higher densities of invasive species were present on some of the sites. Seed mixtures were replaced with mulch to suppress re-colonization of invasive species. Additional native vegetation was planted to form dense thickets to help invasive species from re-invading the site.

- Landowner cooperation was an integral part of the success of this project. Bernardi Building Supply assisted by preparing the site for construction by removing all equipment and obstacles to ensure the contractor could complete work without interruption.

- Provide operation and maintenance instructions for landowners and tenants.

- Increase public and community awareness of the importance of pollution prevention and make a connection between storm water drainage and municipal drinking water supplies.

- Based on feedback from participating landowners, interpretive signs were modified to incorporate more images and less text.

- Once you have captured public attention, offer additional education materials such as fact sheets and case studies to provide more detailed information.

- Landowners were consulted on how to name and market future workshops to encourage a broad variety of stakeholders. Choosing appropriate words is important to ensure education events are appealing to a broad audience.

- For additional tips to landowners and property managers interested in pursuing a clear water project, please see CVC's "Recommendations for Future Clear Water Projects". Details can be found on: Management Agreements, Tenders, Maintenance, Constructing to Specification, and Permits

### Benefits of Partnership

This partnership will help to:

- support MOE with source water protection initiatives and guidelines since this site drains to Lake Ontario – Mississauga's drinking water supply;
- support the City of Mississauga with pollution prevention efforts, storm sewer bylaws, Mississauga Storm Water Quality Strategy Update, and Green Development Strategy, among others;
- support Region of Peel's sanitary sewer bylaw;
- support and complement low impact development initiatives;
- support the municipality, region and MOE when dealing with spill response and preparedness.

This partnership also supports the vision, goals and objectives of Mississauga's Strategic Plan "Our Future Mississauga" by ensuring healthy and attractive communities, natural environments and drinking water supply. These features would benefit even more by using pollution prevention strategies. This is also consistent with the vision of "Our Future Mississauga". As an environmentally responsible community, the City of Mississauga is committed to environmental protection, conducting its corporate operations in an environmentally responsible manner and promoting awareness of environmental policies, issues and initiatives.

## More Information

For more information on this demonstration site or general information on clear water projects and source water protection please visit the following websites:

**Ministry of the Environment (MOE)**

- Sewer Use Best Management Practices (BMP) Documents http://www.ene.gov.on.ca/en/publications/forms/index.php#bmp
- Snow Disposal and De-icing Operations in Ontario (1994) http://www.ene.gov.on.ca/envision/gp/0412e.pdf
- Guidelines for Snow Disposal and De-icing Operations in Ontario (1975) http://www.ene.gov.on.ca/envision/gp/B4-1.pdf
- Ontario Stewardship Drinking Water Program http://www.ene.gov.on.ca/en/water/cleanwater/index.php

**Region of Peel**

- Sanitary Sewer Use Bylaw http://www.peelregion.ca/pw/water/sewage-trtmt/seweruse-bylaw.htm

**Credit Valley Conservation**

- Strategies for Sustainability http://www.creditvalleyca.ca/sustainability/

**City of Mississauga**

- Storm Sewer Use Bylaw http://www.mississauga.ca/file/COM/Storm_Sewers.pdf
- Protect Our Water http://www.mississauga.ca/file/COM/Protect_Our_Water_brochure.pdf

**The Bloom Centre for Sustainability (Formerly OCETA)**

- http://www.bloomcentre.com

**Canadian Centre for Pollution Prevention (C2P2)**

- http://www.c2p2online.com/
- http://www.c2p2online.com/main.php3?session=&section=39&heading=84

**Landowners and property managers** interested in pursuing a clear water project, please see helpful tips in CVC's Recommendations for Future Pollution Prevention Projects:

- http://www.creditvalleyca.ca/sustainability/pollutionprevention/index.html

# Clear Water Projects in Cooksville Creek Watershed

## Armstrong Manufacturing Inc.

### What is a Watershed?

No matter where you are, you are in a watershed. A watershed is the area of land that catches rain and snow which travels over land or through soil into a marsh, stream, or lake. Another way to understand a watershed is to think of an area of land that drains to a low point such as a stream, marsh, creek or lake.

### Cooksville Creek Watershed

Cooksville Creek starts south of Britannia Road and flows for 12 kilometres parallel to Highway 10 through the heart of Mississauga and into Lake Ontario. Cooksville Creek Watershed has many unique natural features and important water resources. Nestled within the heart of the city, Cooksville Creek Watershed faces many challenges as a result of urbanization.

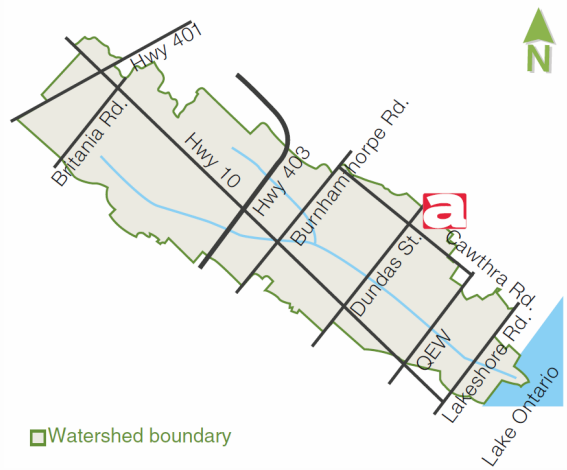
Cooksville Creek at Lake Ontario

Cooksville Creek

To protect Cooksville Creek and Lake Ontario, it is important to have clean water. One threat to clean water is rain water that washes across lawns, parking lots and roads carrying with it sediment, lawn fertilizers, pesticides, metals and pollution such as road salt. Pollutants are then washed into Sheridan Creek impacting environmental health and Lake Ontario, the source Mississauga's drinking water.

### Leading the Charge

The good news for restoration is that leaders like **Armstrong Manufacturing** (in partnership with City of Mississauga and Ministry of the Environment) are implementing projects on their property to help protect the health of Cooksville Creek and Lake Ontario – Mississauga's drinking water supply.




Armstrong Manufacturing Inc. is located at 2485 Haines Rd, Mississauga within Cooksville Creek Watershed.

## Implementation Planning

### Funding

Armstrong Manufacturing, in partnership with CVC and City of Mississauga received funding from the Ministry of the Environment to implement in-the-ground projects to protect the supply of surface water for small and medium sized businesses.[1]

Through development of demonstration sites, the goals were to:

- remove and reduce threats to surface water and municipal drinking water supplies;
- empower stakeholders to take action and protect municipal drinking water supplies by implementing in-the-ground projects;
- increase public and community awareness of the importance of pollution prevention and making a connection between stormwater drainage and municipal drinking water supplies;
- gain knowledge and experience to apply to future watershed studies as they relate to innovative pollution prevention and protecting surface water municipal drinking sources.

### Demonstration Site Selection

Demonstration sites were selected based on building a community where a number of properties could showcase pollution prevention practices. Each landowner could be an expert on pollution prevention measures implemented on their own property and be a resource to other property owners within their community.

## Strategy

The following sections describe potential sources of pollutants that may wash into storm sewers and strategies for keeping water clean.

**Prevention** is stopping or avoiding pollutants and waste from coming into contact with water in the first place. CVC's initiatives take a multi-faceted approach to prevent negative water quality impacts.

### Education

Education is a preventative measure that raises awareness and understanding of how certain activities affect the environment. Education helps increase environmental awareness, change attitudes and behaviours and provides knowledge for making change.

### Fact Sheets

Fact sheets are an educational tool to provide technical information on how to change a particular behaviour or practice. Fact sheets have been developed to provide businesses with actions they can take to improve operations and protect watershed health. This includes:

- Outdoor material storage
- Parking lot maintenance
- Building maintenance

Fact sheets are accessible online at www.creditvalleyca.ca/sustainability/.


Credit Valley Conservation

POLLUTION PREVENTION • FACT SHEET #7

Outdoor Storage

IN INDUSTRIAL & COMMERCIAL DISTRICTS

Many businesses store materials or products outdoors. The risk of stormwater pollution is greatest for operations that store large quantities of liquids or bulk materials at sites that are connected to the storm drain system.

Protecting outdoor storage areas is a simple and effective pollution prevention practice. The underlying concept is to prevent runoff contamination by avoiding contact between outdoor materials and rainfall (or runoff). Unprotected outdoor storage areas can generate a wide range of stormwater pollutants, such as sediment, nutrients, toxic materials, and oil and grease.

Materials can be protected by installing covers, secondary containment, and other structures to prevent accidental release. Outdoor storage areas can be protected on a temporary basis (tarps or plastic sheeting) or permanently through structural containment measures (such as roofs, buildings, or concrete berms).

Pollution prevention opportunities include:

- Emphasize employee education regarding storage area maintenance.
- Keep an up-to-date inventory of materials stored outdoors, and try to minimize them.
- Store liquids in designated areas on an impervious surface with secondary containment.
- Inspect outdoor storage containers regularly to ensure that they are in good condition.
- Minimize stormwater run-on by enclosing storage areas or building a berm around them.
- Slope containment areas to a drain with a positive control (lock, valve, or plug) that leads to the sanitary sewer (if permitted) or to a holding tank.
- Schedule regular pumping of holding tanks containing stormwater collected from secondary containment areas.
- Ensure all containers are properly sealed or covered, such as lids on drums and small containers.
- If you use a service provider, add language to protect water quality in the maintenance contract.

Outdoor storage areas that drain into the storm drains.

The intent of this factsheet is to provide guidance only and if there is any discrepancy between the factsheet and current versions of applicable Federal and Provincial Acts and Regulations and/or Municipal By-laws, the Acts, Regulations and/or By-laws take precedence. Since this document is only meant to be a guidance document, site specific analysis of each facility is required to identify the most effective pollution prevention measures. CVC accepts no responsibility for any loss, damage, or injury whatsoever to any person or property using the factsheet.

www.creditvalleyca.ca

Example of the fact sheets available on CVC's website

[1] **This project has received funding support from the Government of Ontario. Such support does not indicate endorsement by the Government of Ontario of the contents of this material.**

## Signs

Different signs have been created to reach the greatest audience. This was done in three tiers, with a large sign to notify passersby there is a clear water project on site. The next type of sign was posted either in front or inside the business to provide more information about the type of technology implemented. The third type, a cautionary sign, alerts people on site of the project to discourage illegal activities.

### Informational Signs

Signs provide facts about the site and connections to local watershed including:

- Who the project partners are
- Connection to Cooksville Creek Watershed
- Site map
- Projects implemented
- Where to get more information

### Warning Signs

Many businesses are faced with the challenge of controlling waste being illegally dumped after regular business hours. This issue can be attributed to a lack of understanding about the environment and how pollution can impact the health of Cooksville Creek Watershed. Drainage features, such as swales, may appear as a convenient location to dispose of waste far from the property owner's line of vision.

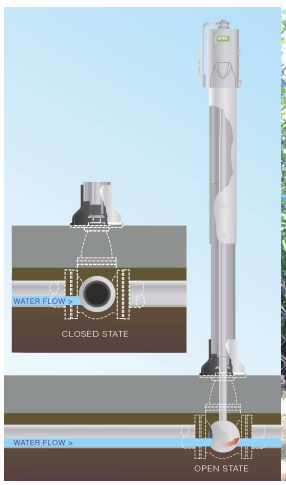
Example of the signage installed

## Spill Diversion - Post Indicator Valve

Liquids are stored near the loading dock, which contains a catch basin that drains to a swale. Trucks load and unload materials in this location, so any spill would drain directly into the catch basin which then empties into Cooksville Creek and Lake Ontario, Mississauga's drinking water source.

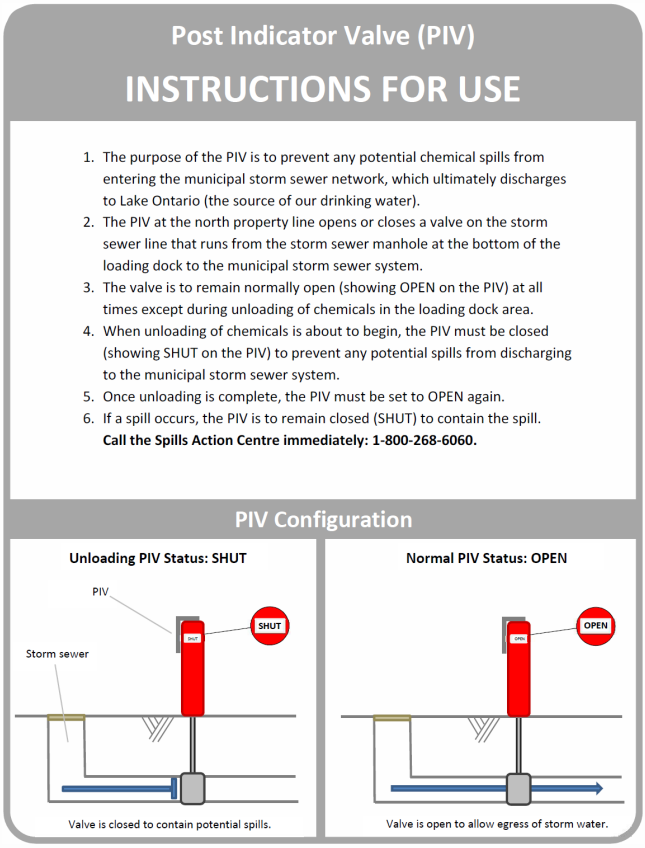

Catch basin in close proximity to loading dock

A post indicator valve (PIV) was installed in the storm sewer pipe between the catch basin and loading dock. As part of loading procedures, the valve will be shut when the loading dock is in use. If a spill happened, it would be contained between the PIV and catch basin, preventing it from reaching Cooksville Creek.



PIV design

PIV installed

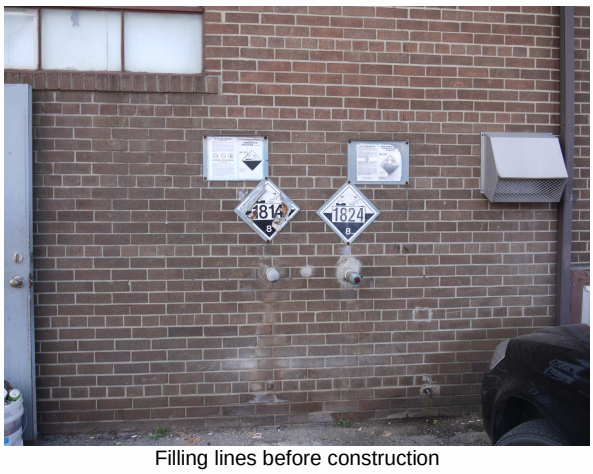



**PIV instructions**

Instructions were developed to provide direction on operating various on-site prevention measures, including the PIV.

## Spill Containment Sump

The bulk filling station had no barriers or spill containment. Because the station is outside, spills would be washed away by rain and drained into the catch basin. Employees or customers would not fully understand the impact because of a lack of information.




Filling lines before construction

The spill containment sump captures any material spilled from the delivery area located beneath the filling lines. Two bollards (posts) were constructed to prevent cars or service vehicles from coming into contact with valves and people parking in the area.

Filling lines after construction of spill containment sumps and bollards

## Lessons Learned

Reflecting on original objectives of the project, the following are some of the lessons learned:

- Empower stakeholders to take action and protect municipal drinking water supplies through implementation of in-the-ground projects.
- Successful implementation of in-the-ground projects requires full time construction inspection to ensure project success. The contractor will often have questions regarding project design and intent. Having an inspector on site to answer questions helps the construction process move smoothly because the contractor can verify questions or concerns. This also provides a smaller potential for error since the contractor will not be building based on assumptions.
- Maintaining constant dialogue between the landowner and contractor also ensures questions and/or concerns can be addressed promptly. Unexpected issues can arise that require adjusting the design to ensure project success. There were a number of instances when the landowner was able to shed light on activities that could impact the project. Minor modifications were made to the design to ensure project success.

- Landowner cooperation was an integral part to the success of this project. Armstrong Manufacturing assisted by preparing the site for construction by removing all equipment and obstacles so the contractor could complete work without interruption.

- Provide operation and maintenance instructions for landowners and tenants.

- Increase public and community awareness about why it is important to prevent pollution and show people the connection between storm water drainage and municipal drinking water supplies.

- Based on feedback from participating landowners, interpretive signage was modified to incorporate more visual images and less text.

- Once you have captured public attention, offer additional educational materials such as fact sheets and case studies to provide more information.

- Landowners were consulted on how to name and market future workshops to encourage a broad variety of stakeholders. Choosing appropriate words is important to ensure educational events are appealing to a broad audience.

- For additional tips to landowners and property managers interested in pursuing a clear water project, please see CVC's "Recommendations for Future Clear Water Projects". Details can be found on: Management Agreements, Tenders, Maintenance, Constructing to Specification, and Permits

## Benefits of Partnership

This partnership will help to:

- support MOE with source water protection initiatives and guidelines since this site drains to Lake Ontario – Mississauga's drinking water supply;
- support City of Mississauga with pollution prevention, storm sewer bylaws, Mississauga's Storm Water Quality Strategy Update and Green Development Strategy;
- support Region of Peel's Sanitary Sewer Bylaw;
- support and complement low impact development initiatives;
- support the municipality, region and MOE when dealing with spill response and preparedness.

This partnership also supports the vision, goals and objectives of Mississauga's Strategic Plan "Our Future Mississauga" by ensuring healthy and attractive communities, natural environments and drinking water supply. These features would benefit even more by using pollution prevention strategies. This is also consistent with the vision of "Our Future Mississauga". As an environmentally responsible community, the City of Mississauga is committed to environmental protection, conducting its corporate operations in an environmentally responsible manner and promoting awareness of environmental policies, issues and initiatives.

## More Information

For more information on this demonstration site or general information on clear water projects and source water protection please the following websites:

**Ministry of the Environment (MOE)**

- Sewer Use Best Management Practices (BMP) Documents http://www.ene.gov.on.ca/en/publications/forms/index.php#bmp
- Snow Disposal and De-icing Operations in Ontario (1994) http://www.ene.gov.on.ca/envision/gp/0412e.pdf
- Guidelines for Snow Disposal and De-icing Operations in Ontario (1975) http://www.ene.gov.on.ca/envision/gp/B4-1.pdf
- Ontario Stewardship Drinking Water Program http://www.ene.gov.on.ca/en/water/cleanwater/index.php

**Region of Peel**

- Sanitary Sewer Use Bylaw http://www.peelregion.ca/pw/water/sewage-trtmt/seweruse-bylaw.htm

**Credit Valley Conservation**

- Strategies for Sustainability http://www.creditvalleyca.ca/sustainability/

**City of Mississauga**

- Storm Sewer Use Bylaw http://www.mississauga.ca/file/COM/Storm_Sewers.pdf
- Protect Our Water http://www.mississauga.ca/file/COM/Protect_Our_Water_brochure.pdf

**The Bloom Centre for Sustainability (Formerly OCETA)**

- http://www.bloomcentre.com

**Canadian Centre for Pollution Prevention (C2P2)**

- http://www.c2p2online.com/
- http://www.c2p2online.com/main.php3?session=&section=39&heading=84

**Landowners and property managers** interested in pursuing a clear water project, please see helpful tips in CVC's Recommendations for Future Pollution Prevention Projects:

- http://www.creditvalleyca.ca/sustainability/pollutionprevention/index.html

For more information specific to the demonstration sites or general information on clear water projects and source water protection, refer to the following websites:

**Ministry of the Environment (MOE):**
Sewer Use Best Management Practices (BMP) Documents
http://www.ene.gov.on.ca/en/publications/forms/index.php#bmp

Snow Disposal and De-icing Operations in Ontario (1994)
http://www.ene.gov.on.ca/envision/gp/0412e.pdf

Guidelines for Snow Disposal and De-icing Operations in Ontario (1975)
http://www.ene.gov.on.ca/envision/gp/B4-1.pdf

Ontario Stewardship Drinking Water Program
http://www.ene.gov.on.ca/en/water/cleanwater/index.php

**Region of Peel:**
Sanitary Sewer Use Bylaw
http://www.peelregion.ca/pw/water/sewagetrtmt/seweruse-bylaw.htm

**City of Mississauga**
Storm Sewer Use Bylaw
http://www.mississauga.ca/file/COM/Storm_Sewers.pdf

Protect Our Water
http://www.mississauga.ca/file/COM/Protect_Our_Water_brochure.pdf

**Credit Valley Conservation**
Strategies for Sustainability
http://www.creditvalleyca.ca/sustainability/

**The Bloom Centre for Sustainability (Formerly OCETA)**
http://www.bloomcentre.com

**Canadian Centre for Pollution Prevention (C2P2)**
http://www.c2p2online.com/
http://www.c2p2online.com/main.php3?session=&section=39&heading=84

### 4.3.2 COMMERCIAL DEMONSTRATION PROJECT

This section presents the highlights from a demonstration project that took place in the commercial sector. Recognizing the opportunity available to build low impact development techniques into the design of a property rather than retrofit a property afterwards, Smart Centre sought out a brownfield development project.

In east Mississauga, Dundas Street East and Dixie Road, there is a brownfield development underway at a site that was formerly used for two purposes: as an industrial property; and, a small portion of the property was used as a golf driving range. The investors desired to develop the site into a Smart Centre. TRCA and the City of Mississauga's objective of being

involved in the redevelopment was to improve stormwater management onsite, reduce pollution runoff, and promote water balance onsite by retaining 10.m of runoff through attenuation, infiltration and evaporation across the site.

Figure 4.3 presents the site development plan, which was developed through a joint-venture with Azuria Group, Fieldgate Commercial and Retrocom Mid-Market Reit.


**Figure 4.3 Site development plan developed through a joint-venture with Azuria Group, Fieldgate Commercial and Retrocom Mid-Market Reit.**

Initiatives being pursued at this demonstration project include:

- Significant restoration to Little Etobicoke Creek (which borders the property)
- Extensive application of LID techniques, including bioswales, permeable pavement, infiltration galleries, perforated storm sewers, interpretation pavilion, rainwater fountain;
- Enhanced sustainability of buildings through energy conservation and water diversion;
- Reduced urban heat-island effect through reflective roofing, shade over parking area and planting over 300 trees;
- Provision of multi-modal transportation support through bicycle racks, carpool parking spaces and public transit connection.

Figure 4.4 presents some of the specific LID techniques being implemented onsite.

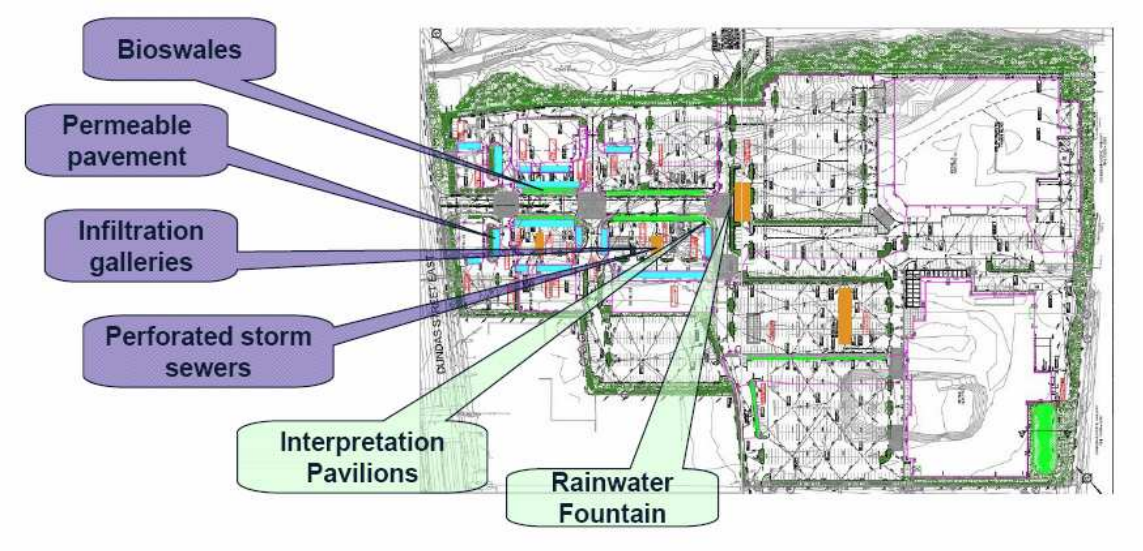



**Figure 4.4 Low impact development techniques being implemented on-site**

## 4.4 LESSONS LEARNED FROM DEMONSTRATION PROJECTS

With the implementation of CVC's low impact development and pollution prevention pilot sites on industrial properties, CVC has learned many lessons and identified specific areas in which attention to detail is important. These lessons learned are described in this sub-section.

### 4.4.1 HAVE A MANAGEMENT AGREEMENT

The purpose of the management agreement is to ensure that all parties know their responsibilities as it allows for the pollution prevention infrastructure to be installed as efficiently as possible and avoid conflict and/or liability issues. It is highly recommended that a detailed management agreement be signed with all involved parties. The agreement used for CVC's industrial demonstration projects outlined that CVC would conduct site visits with the landowner as well as use the site for demonstration purposes to showcase pollution prevention and storm water best management practices for source water protection on small business properties. CVC and the landowner agreed that the public would have access to the landowner's property for at least two mutually agreed upon field trip workshops to see the demonstration project (with a minimum of 7 days' notice). In addition, the agreement included the landowner participation in at least one public workshop to showcase the success of the project, organized by CVC, that would be open to all interested stakeholders within Cooksville and Sheridan Creek Watersheds.

### 4.4.2 TENDER SPECIFICS ARE IMPORTANT:

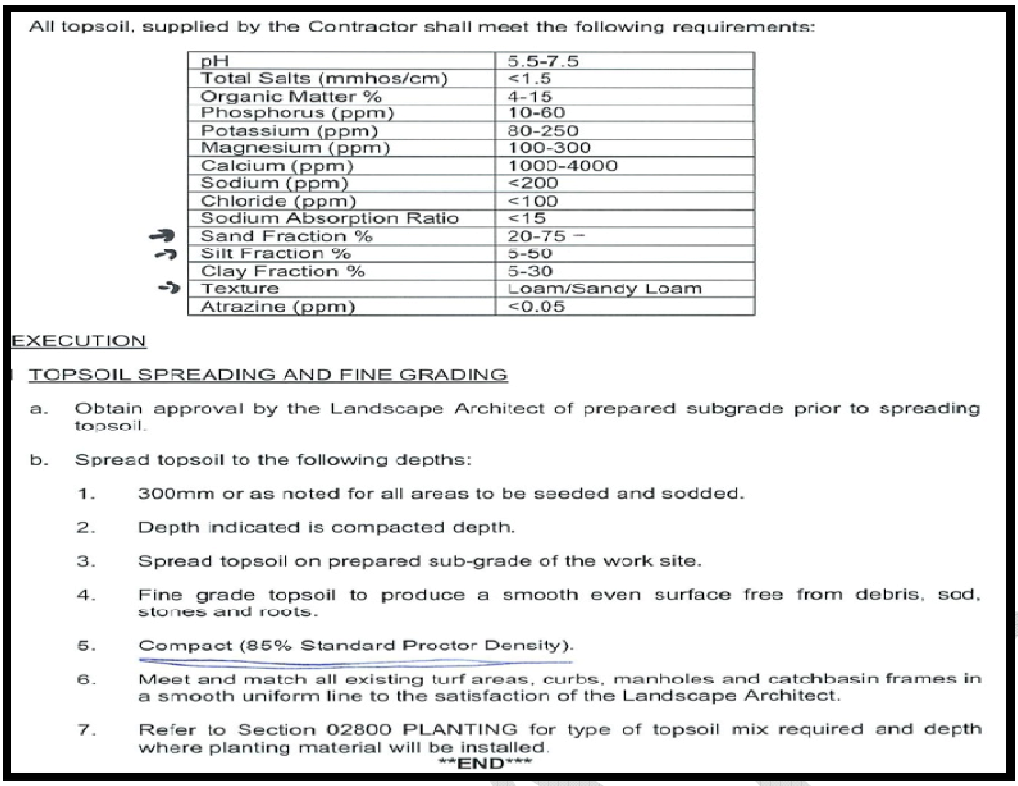
The tender (i.e. terms of reference for a contract for landscape contractor's activities) should be divided into sections regarding general requirements, site preparation, topsoil spreading and fine grading, planting, and seeding.

General Requirements of a Tender: CVC recommends including general guidelines within the tender to inform all parties of the scope of work that will be done. Under these general guidelines the following was included: the contractor must report to CVC in writing of any conditions or defects encountered on the site during or before construction which may adversely affect its performance; final inspections for all work will be at the end of the maintenance period established by CVC; prior to commencement of work on site, the contractor is to verify existing sub-grade site conditions and report in writing immediately to CVC any discrepancies and conditions which are at variance with drawings and specifications.

Site Preparation Requirements: Site preparation information is important to include in a tender because it informs the contractor about the preparation practices required and/or preferred. Examples from the tender include: protecting excavations from freezing and keeping excavations free of water at all times by providing and operating all necessary pumping equipment; requiring topsoil to be re-used for landscape work unless specified otherwise; fill material to be clean, free of topsoil and organic matter and debris; fill material proposed for use to be approved by the landscape architect before placing; and, on site excavated material may be used for filling when approved by the landscape architect.

Topsoil Spreading and Fine Grading: It is recommended that the tender include provisions for requiring a basic aggregate test topsoil report for stockpiled topsoil and a basic aggregate test topsoil report concerning atrizine for imported topsoil. The contractor should be responsible for the cost of these reports and should submit the reports to the landscape architect for approval before commencing work. Lastly, all excavated material must be removed from planting pits and beds and the material disposed offsite. In addition, it is important to include a protocol for testing on site excavated material by the landscape architect in order to approve the soil for backfilling. Also important to include in the contract is a statement of who is responsible for soil replacement and associated costs if the installed soil differs from the specified soil. Omitting these specific requirements could cause significant delays and increases overall costs (e.g. cost to excavate, cost for labour, shipping cost, disposal cost, and cost incurred from potential damage to live goods and site).

Figure 4.5 presents an example of the topsoil requirements that were included in the CVC contract for these industrial demonstration projects. However, CVC has learned that there were some omissions from this list and these are noted in these lessons learned described above.



All topsoil, supplied by the Contractor shall meet the following requirements:

| | |
|---|---|
| pH | 5.5-7.5 |
| Total Salts (mmhos/cm) | <1.5 |
| Organic Matter % | 4-15 |
| Phosphorus (ppm) | 10-60 |
| Potassium (ppm) | 80-250 |
| Magnesium (ppm) | 100-300 |
| Calcium (ppm) | 1000-4000 |
| Sodium (ppm) | <200 |
| Chloride (ppm) | <100 |
| Sodium Absorption Ratio | <15 |
| Sand Fraction % | 20-75 – |
| Silt Fraction % | 5-50 |
| Clay Fraction % | 5-30 |
| Texture | Loam/Sandy Loam |
| Atrazine (ppm) | <0.05 |

EXECUTION

TOPSOIL SPREADING AND FINE GRADING

a. Obtain approval by the Landscape Architect of prepared subgrade prior to spreading topsoil.

b. Spread topsoil to the following depths:

1. 300mm or as noted for all areas to be seeded and sodded.
2. Depth indicated is compacted depth.
3. Spread topsoil on prepared sub-grade of the work site.
4. Fine grade topsoil to produce a smooth even surface free from debris, sod, stones and roots.
5. Compact (85% Standard Proctor Density).
6. Meet and match all existing turf areas, curbs, manholes and catchbasin frames in a smooth uniform line to the satisfaction of the Landscape Architect.
7. Refer to Section 02800 PLANTING for type of topsoil mix required and depth where planting material will be installed.

**END***

**Figure 4.5 Excerpt of topsoil requirements from CVC contract**

Planting Requirements*:* To increase the chances of plant survival, it is recommended that the tender include requirements specifying that all planting materials should be available for inspection at the source of supply or advise the landscape architect 72 hours in advance of delivery to site. However, the landscape architect should still have the right to inspect plants upon arrival or during the course of construction and to reject plants at that time. Plants must be watered sufficiently upon planting until acceptance of plant material at the time of substantial performance of the contract. The contractor should agree to guarantee planting for a period of one year from the date of substantial performance and should any plants need re-planting, the replaced plants are re-guaranteed for an additional year from the date of replacement.

Seeding Requirements*:* Recommendations for seeding are that the provisions require the contractor to make immediate repairs or replace materials at no extra cost to CVC in the event of damage or rejection. Immediately after seeding, snowfencing must be erected to protect seeded areas from traffic until grass is established.

### 4.4.3 MAINTENANCE

There are maintenance requirements for both property owners and contractors. These are described following.

Landowner: CVC recommends that the landowner be responsible for regular maintenance activities once plant material is accepted.. Maintenance includes but is not limited to weeding,

fertilizing as required by soil tests, cutting as required to maintain grass at a maximum height of 60mm and watering. CVC met with landowners, tenants, employees, and property maintenance contractors to tour their respective properties to explain in detail all of the maintenance requirements. In order to jump start maintenance activities, CVC also provided volunteers from CYC (Conservation Youth Corps) to show businesses how to take care of their new features.

Contractor: The contractor is responsible to monitor plant material during the guarantee period and advise the owner of any changes in the maintenance activities required to ensure plant survival. Seeded areas are to be maintained for 60 days until acceptance of seeding work. The contractor is responsible for supplying water to the site and watering seeded areas to sustain its prosperous growth and prevent deterioration. The contractor is to provide 3 applications of fertilizer in the first year of maintenance to seeded areas. The contractor is also responsible for routine maintenance and operation of the swales. This includes landscaping, weeding, sediment and debris removal. The swales should be inspected quarterly and after every major storm event to ensure that no erosion has taken place that the swale is functioning as designed and all components of the swale such as sediment traps, rock sumps are in place. Any damage to the swale should be repaired immediately and all damaged vegetation should be replaced including grass. Once the sediment exceeds the depth of 25mm, it should be cleaned out. Cleanout of the sediment traps and the rock sumps should be undertaken every 5 years by removal of rock, washing it and placing it back. In addition, equipment maintenance is required by the contractor. Required maintenance for the post-indicator valve (PIV) includes annual lubrication of the bearing area with light machine oil as well as readjustment of the targets for the 'open' and shut' labels. For the spill containment sumps, in addition to a spring and fall clean-up of any gravel or debris, a general clean-up of any wind-blown garbage should be done prior to receiving trucks at the unloading area. Potential consequences of poor maintenance include plant failure, excessive weeds, return of invasive species, and designed features not working as intended.

### 4.4.4 DESIGN

CVC recommends that the original design be adaptable with respect to unforeseen circumstances such as budget constraints, unanticipated difficulty obtaining permits, and landowner's practical suggestions as the project progresses. For example, cedar posts were part of the original design throughout the entire site. However, the landowner knew that one of his tenants operated heavy machinery and suggested a larger barrier to deter the vehicles from entering the buffer. As a result, landscaping stones were used in the section where the heavy machinery was parked. Also, at Armstrong Manufacturing, concrete bollards were used at the spill containment sumps to prevent cars and trucks from accidentally damaging the sumps.

### 4.4.5 PERMITS

For any future stormwater water project, CVC recommends that applications for permits begin as soon as possible. Proposed features may be eliminated as work required to receive permits may require significant cost and time which budget constraints do not allow. For example, at the Armstrong Manufacturing site, the City had several concerns: the first was that the proposed rain cover over the containment sump on the north side of the building would require a permit, and the close proximity to the property line would require a variance adjustment to get permission to install a rain cover which would take several months to obtain. A second concern was the potential for trucks to hit the canopy structure; the City suggested that as a mitigation measure, the work be done in phases. They indicated that CVC would need approval from the drainage department as the roof structure would divert water into a concentrated flow which may require eaves troughs. Their recommendation was to build the containment sump first, which did not require a permit, and then determine whether there is a need to build a roof structure later.

Regarding the post indicator valve at the back of the property, the City was not sure whether they could support this as there may be liability issues. One of the liability issues posed by the City was if the landowner were to forget to re-open the valve and if flooding were to occur in the loading dock, the landowner may be able to make a claim against the City for any damages. To address issues of liability, CVC created an agreement that has cross indemnification clauses. The approval took several months and required the completion of numerous application forms.

### 4.4.6 SUMMARY OF RECOMMENDATIONS

In summary, with respect to the industrial demonstration projects completed by CVC, the key recommendations, based on lessons learned are as follows:

- Have a detailed management agreement that clearly outlines roles, responsibilities, and expectations of each party involved;
- The tender should include detailed instructions on how the features should be installed; the tender should assign responsibility for incorrect installations and materials;
- Include thorough yet simple maintenance instructions for all aspects of the project;
- Have an adaptable design that can be modified if landowners recommend features that may work better than originally proposed design considering the landowner is most familiar with the property; and
- Begin the permitting process as soon as possible.

## 4.5 OVERVIEW DESCRIPTION OF POLLUTION PREVENTION MEASURES RELEVANT TO BOTH INDUSTRIAL AND COMMERCIAL PROPERTIES

There are many things industrial and commercial land owners can do around their property to help ensure that only clean water is entering the storm drainage system. Applying the principles of pollution prevention, "the use of processes, practices, materials, products, substances or energy that avoid or mnimize the creation of pollutants and waste, and reduce the overall risk to the environment and human health" (Canadian Environmental Protection Act, 1999), can help to ensure that businesses are in compliance with storm sewer bylaws, protecting local environmental health and protecting Peel's drinking water supply. The two key pollution prevention measures for industrial and commercial enterprises to be aware of are spills management, and the City of Brampton's municipal stormsewer bylaw. Further details on these two measures are presented following.

### 4.5.1 SPILLS MANAGEMENT

Spills are one of the sources of water pollution in the Credit River Watershed. Between 1988 and 2008, there were 2643 spills recorded in the CVC jurisdiction and adjoining buffer area. The spills that occur in the Credit River Watershed have the potential to adversely affect water quality which could further impact water intakes, aquatic species, ecological health and Lake Ontario.

Urbanized subwatersheds within the Credit River watershed are more prone to spills (Spills Characterization for the Credit River Watershed, 2010). Within Fletchers Creek, there have been 78 spills on record between 1988-2008. For instance, while conducting a restoration assessment on the stream corridor, CVC staff observed a spill of a hydrocarbon (i.e. oil) product entering the stream from an outfall located at the southeast corner of Bovaird Drive West (Hwy 7) and Fletcher's Creek. The spill was reported to the Ontario Ministry of the Environment (MOE)'s Spills Action Center by CVC staff. City of Brampton staff quickly responded and erected a boom around the outfall. MOE and Region of Peel staff followed the spill back to its source, a company located on Regan Road. The spill was subsequently stopped. This case demonstrates several important spills management practices: firstly reporting spills to the MOE as soon as they are detected; secondly, the benefits of municipal agencies being equipped with trained spill response teams and tools (such as booms); and, the benefits of up-to-date sewer maps and trained staff that can trace spills to their source. Pictures of the spill are presented as Figure 4.6

**Figure 4.6 Pictures of spill contaminants**

### 4.5.2 STORM SEWER BYLAW

Sewer Use Bylaws are municipal tools with the potential to control spills to storm sewers as well as other sewer infrastructure (i.e. sanitary or combined sewers). The City of Brampton's current sewer bylaw was enacted in 1975 and makes no reference to storm sewers. This is a deficiency in the Sewer Use Bylaw that prevents the City of Bramption from having access to the authority, tools and compliance measures to control undesirable inputs of deleterious substances to the storm sewer system and local watercourses. In addition, the bylaw contains outdated references to agencies (Ontario Water Resources Commission) and positions (City Engineer) that no longer exist and therefore limit the credibility of the bylaw. There are no references to "spills" and any related duty to report (although a duty to report is a provincial requirement). Storm sewer bylaws in neighbouring municipalities, like the City of Mississauga, contain a number of provisions that can and should be used to address concerns associated with construction activity runoff and spills prevention.

A comparison of municipal sewer bylaws are provided in Appendix H

### 4.5.3 POLLUTION PREVENTION MEASURES FOR INDUSTRIAL AND COMMERCIAL PROPERTY OWNERS

Table 4.2 presents a description of important pollution prevention (P2) opportunities applicable to the industrial and commercial sector in this region. The table includes pollution prevention topics such as irrigation practices, de-icing activities, vehicle maintenance, dumpster management, material storage, fueling stations, spill management, and parking lot maintenance.

There have been 78 spills on record between 1988-2008 in Fletchers Creek. Elicit discharge of chemicals was observed by CVC staff during the Stream Assessment

**Table 4.2 Pollution Prevention (P2) Opportunities Applicable to the Industrial and Commercial Sectors**

| P2 Issue | Photo | Description of Issue and Recommendation |
|---|---|---|
| **Irrigation Practices** |  <br>Turf irrigation washing across parking lot (photo credit: CVC) | Issue: Non-target irrigation (irrigation that is intended for turf but lands on impervious surfaces such as roads, parking lots, sidewalks and driveways washing away pollutants into the stormsewer).<br><br>Recommendation: targeted irrigation practices (if irrigation is necessary) |
| **Winter De-icing** |  <br>Improper salt storage leading to chloride inputs to the stormsewer (photo credit: CVC) | Issue: Application of rock salt to roads, sidewalks, driveways and parking lots leads to impaired water quality, soil degradation, and vegetation loss and is toxic to aquatic life. This can result in structural damage to infrastructure like bridges and vehicles. Improper storage of rock salt leaches directly into storm sewers.<br><br>Recommendation: enclosed salt storage. |

| P2 Issue | Photo | Description of Issue and Recommendation |
|---|---|---|
| **Vehicle Maintenance** |  <br>Auto repair being performed behind a commercial strip mall (photo credit: CVC) | Issue: Vehicle repair that occurs when proper facilities are not available can result in materials being either washed or disposed illegally into the storm drain.<br><br>Recommendation: Perform car maintenance under cover within a garage, and carefully dispose of all oil, antifreeze, and other fluids at approved recycling facilities. |
| **Dumpster Management** |  <br>Dumpster in poor condition leaking fluids onto the parking lot (photo credit: CVC) | Issue: Field surveys found that dumpsters are often left uncovered, in poor condition with rusted and cracked bottoms which allow rainwater to come in contact with waste and leak fluid, or "dumpster juice".<br><br>Recommendation: Replace with enclosed dumpsters. |

| P2 Issue | Photo | Description of Issue and Recommendation |
|---|---|---|
| **Outdoor Material Storage** |  <br>Dumpster in poor condition leaking fluids onto the parking lot (photo credit: CVC). | Issue: Improper storage of materials results in a risk of accidental release of materials into the storm drain.<br><br>Recommendation: Properly storing materials under a canopy with secondary containment. |
| **Outdoor Fuelling Stations** |  <br>Outdoor fuel station with no spill prevention/preparedness measures (photo credit: CVC) | Issue: Small private fuel stations lacking covers, spill kits, and impervious pads pose a serious risk to water quality should a spill occur.<br><br>Recommendation: Installation of spill prevention measures. |
| **Vehicle Washing** |  <br>Outdoor vehicle washing station adjacent to stormsewer inlet (photo credit: CVC). | Issue: Vehicle wash water may contain sediments, phosphorus, metals, oil and grease, and other pollutants.<br><br>Recommendation: washing vehicles in an enclosed facility with property decontamination of wastewater prior to disposal. |

| P2 Issue | Photo | Description of Issue and Recommendation |
|---|---|---|
| **Parking Lot Maintenance** |  <br>Power washing parking lots with cleaning solvents to remove oils and grease (photo credit: CVC). | Issue: Activities such as power washing parking lots with cleaning solvents can result in pollutants being washed into the stormsewer system.<br><br>Recommendation: refrain from use of solvents when washing parking lots. |

# 5.0 STREAM AND DRAINAGE CORRIDOR ASSESSMENT

This Chapter presents the methodology used and results of both a stream corridor assessment and a storm sewer outfall assessment undertaken by Credit Valley Conservation (CVC) in the summer of 2010. A detailed description of the key restoration opportunities along stream and drainage corridors is also presented.

## 5.1 STREAM CORRIDOR ASSESSMENT METHODOLOGY

Staff from CVC conducted a physical stream corridor assessment along the Fletcher's Creek subwatershed in the summer of 2010. The objective of the assessment was to identify outfall locations, severely eroded streams banks, utility crossings, impacted riparian buffers, trash dumping, stream crossings, or channel modifications within the steam corridor. Potential restoration opportunities were also identified.

The primary assessment protocol used was the Unified Stream Assessment (USA), which is a comprehensive stream walk protocol developed by the Centre for Watershed Protection for evaluating the physical riparian and floodplain conditions in small urban watersheds. The USA integrates qualitative and quantitative components of various stream survey and habitat assessment methods and is used to identify locations of suspect illicit connections to storm sewers, impacted stream buffers, severe stream bank erosion, excessive trash accumulation and dumping, and impacted stream crossings. Restoration opportunities for discharge prevention, stream restoration, stormwater retrofits, and riparian reforestation are also identified.

The USA provides an overall reach assessment to document average in-stream and riparian conditions. In addition, it utilizes eight individual impact assessment forms for evaluating restoration potential for common urban stream impairments. Forms were modified to make them more applicable to the Fletcher's Creek Subwatershed and condensed down to six forms, as follows:

- Reach level assessment;
- Stormwater outfalls;
- Restoration opportunities;
- Road and utility crossings (including fish barriers);
- Severe bank erosion; and
- Religious offering locations.

Results of the stream corridor assessments are presented in Section 5.3.

## 5.2 STORM SEWER OUTFALL ASSESSMENT METHODOLOGY

During the stream assessments, all storm sewer outfalls observed draining into the Fletcher's Creek were assessed for water quality and maintenance issues.

The water quality parameters of dissolved oxygen, water temperature, pH, and specific conductivity were measured using a Hydrolab MS5 at all outfalls that had enough dry weather flow to submerge the meters probe. Each outfall was then given a water quality score of good, fair, and bad based on a weighting each parameter. Figure 5.1 shows a map of Fletcher's Creek with the water quality score for each outfall where water quality was measured. Of the 64 outfalls where water quality was measured, 20 were rated as good, 33 were rated poor and 11 were rated bad. Very high levels for conductivity were observed at most outfalls. This is likely caused by high chloride levels from winter maintenance activities (road salting). It is a concern that high levels were still detected during the summer months when the stream assessments took place.

In addition to the measurements taken with the Hydrolab meter, samples from seven outfalls were submitted to Maxxam Analytics in Mississauga for a more comprehensive water quality analysis. Samples were submitted for analysis of:

- Total Metals;
- *E.coli* Bacteria;
- Total Oil and Grease;
- Total Suspended Solids;
- Biological Oxygen Demand;
- Nutrients (Ammonia, Nitrate, Nitrite, Total Phosphorus); and
- Chloride.

A summary of the outfalls sampled can be found in Table 5.1.

**Table 5.1 Summary of outfalls where water samples were submitted for water quality analysis**

| Outfall Number | Location | Drainage Area |
|---|---|---|
| FCT-4 | Fletcher's at Hwy 401 | Hwy 401 runoff |
| OT-132 | Fletchers at Ray Lawson | South Fletcher's Rec Centre, Ray Lawson Boulevard, & low, medium and high density residential. |
| OT-248 | Fletcher's at Steels Ave | Steels Ave Runoff |
| OT-15 | Fletcher's at Harold Street | Harold Street, low density residential |
| OT-201 | Williams Parkway Tributary upstream of Williams Parkway | Low & high density residential |
| OT-88 | Fletchers @ Bovaird Drive | Large industrial area |
| FCT-73 | Large Outfall north of Sandalwood Parkway | Low density residential, schools |

Results of the storm sewer outfall assessment are presented in Section 5.3.

***Figure 5.1a Out fall Water Quality Rating- Highway 7 to Mayfield***

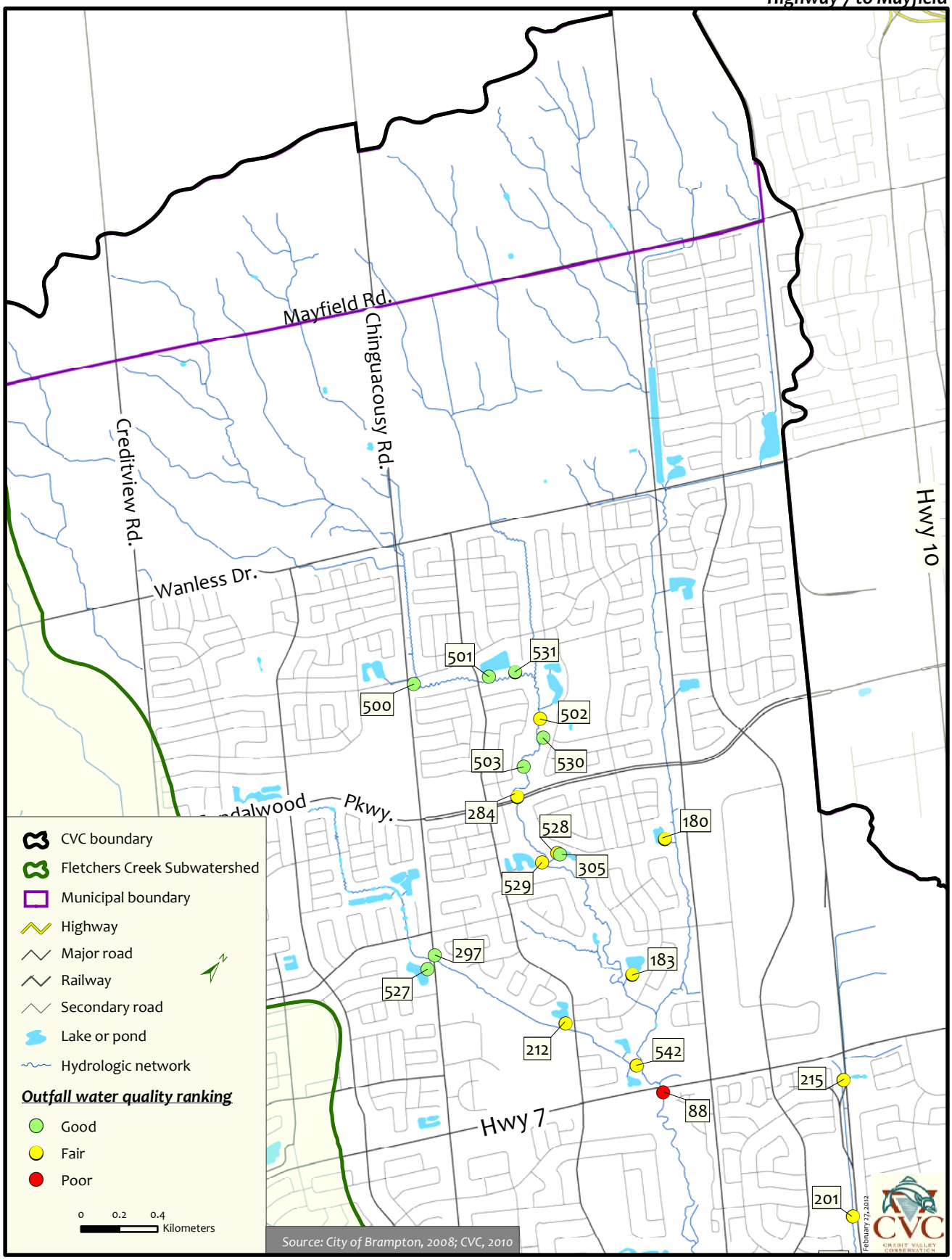


***Figure 5.1b Outfall Water Quality Rating- Steeles to Highway 7***

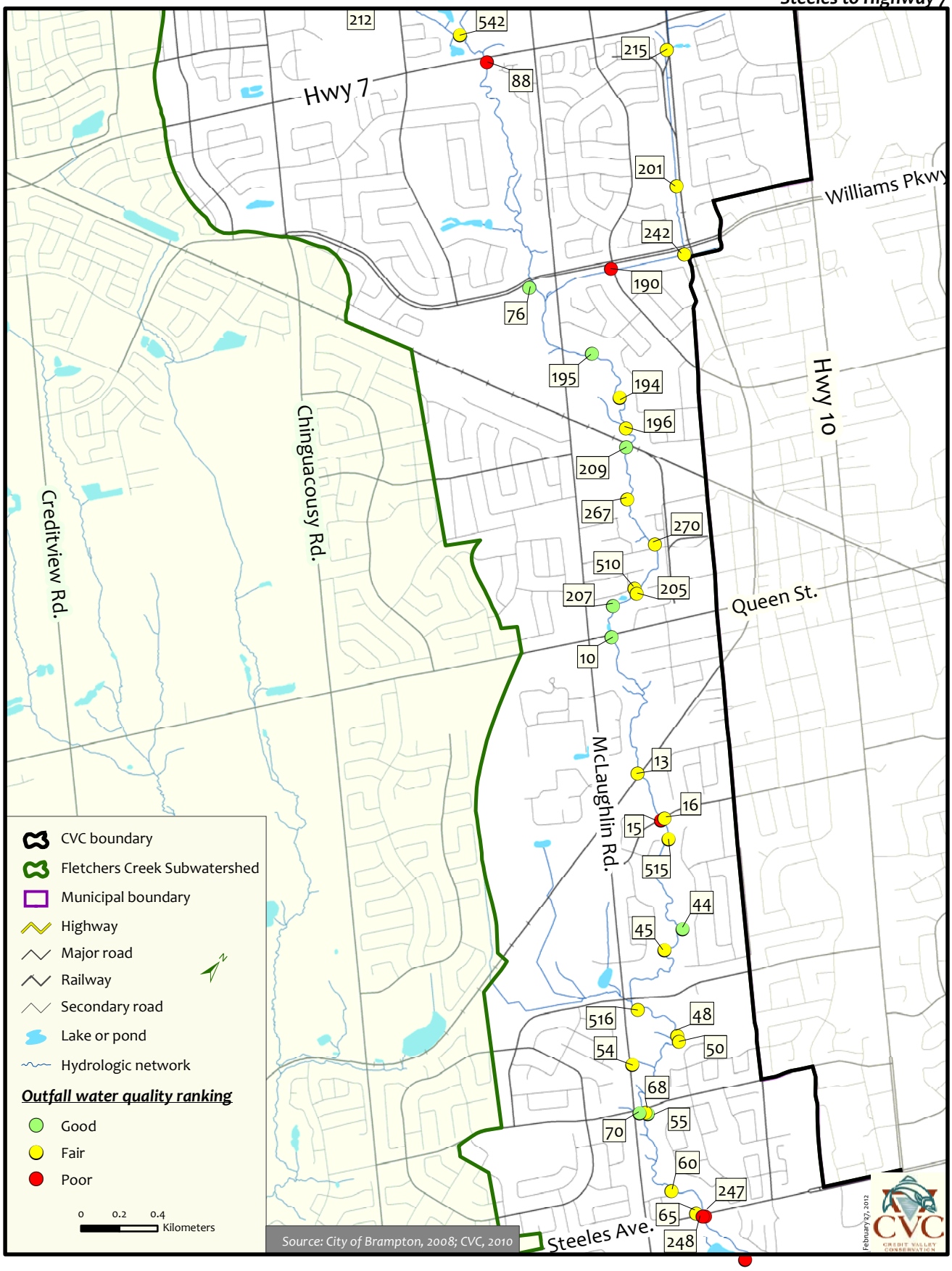
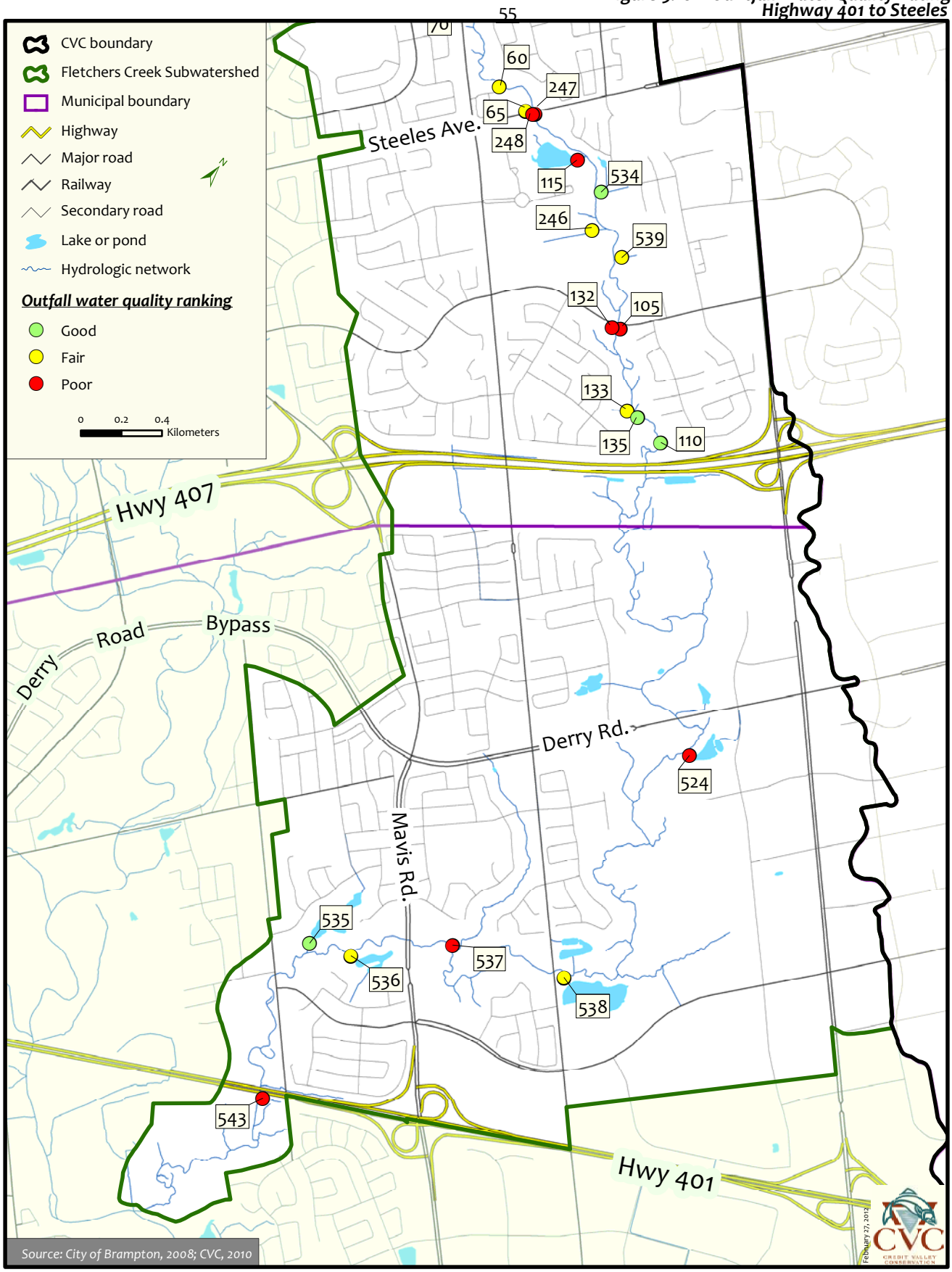


***Figure 5.1c Outfall Water Quality Rating- Highway 401 to Steeles***



## 5.3 RESULTS OF STREAM CORRIDOR AND STORM SEWER OUTFALL ASSESSMENTS

### 5.3.1 RESULTS OF STREAM CORRIDOR ASSESSMENTS

The results of the stream assessment showed that there were numerous problems identified that have potentially negative consequences for stream corridor health. These included the existence of fish barriers to prevent migration, the use of concrete lined channels where natural stream corridors used to be, evidence of stream bed lowering, and garbage located within the stream corridor.

During the stream assessments, a spill of a hydrocarbon (oil) product was observed coming from one of the stormsewer outfalls (see Chapter 4, section 4.5.1 for further detail and photographs).

### 5.3.2 RESULTS OF STORMSEWER OUTFALL ASSESSMENTS

The stormsewer outfalls encountered along Fletcher's Creek during the stream assessment were in fairly good condition. Four outfalls are in need of repair due to erosion and an exposed pipe was observed in reach FC1-20. Information about each of these outfalls can be found in Table 5.2 and pictures are presented in Figure 5.2 following the table.

**Table 5.2 Outfalls Requiring Maintenance**

| Outfall ID | Reach | Location | Issue |
|---|---|---|---|
| OT-1 | FC1-2 | Downstream of Second Line | Outfall falling into creek |
| OT-1-19-3 | FC1-19 | Downstream of Queen Street | Severe erosion around outfall |
| | FC1-20 | Upstream of Denison Avenue | Exposed and cracked pipe |
| OT-267 | FC1-21 | Upstream of Denison Avenue | large scour pool under outfall, Exposed rebar |
| OT-208 | FC1-21 | Upstream of CNR Tracks | Outfall falling into creek |

**Figure 5.2 Outfalls Requiring Maintenance.**

A summary of exceedences in the water quality results in the storm sewer outfalls is presented in Table 5.3. Chloride values from the laboratory analysis confirm that the high conductivity values measured in many of the outfalls is caused by high chloride concentrations, likely a result of winter maintenance activates. Chloride does not bind to soil, which allows it to travel easily through the soil to the closest water body. For this reason Chloride concentration are often found in high concentration throughout the year, and even in the summer when rock salt is not used for de-icing purposes.

**Table 5.3 Summary of exceedences in water quality laboratory analysis for sampled outfalls compared to Ontario Provincial Water Quality Objectives (PWQO), if PWQO values do not exist for the selected parameter then the CCME Canadian Water Quality Guidelines for the Protection of Aquatic Life are used.**

| Sample ID | | | FCT-4 | FCT-73 | OT-248 | OT-15 | OT-88* | OT-88 | OT-201 | OT-132 |
|---|---|---|---|---|---|---|---|---|---|---|
| Sampling Date | | | 15-Jun-10 | 29-Jun-10 | 13-Jul-10 | 15-Jul-10 | 20-Jul-10 | 6-Aug-10 | 6-Aug-10 | 6-Aug-10 |
| Time | Units | Guideline[1] | 12:05 PM | 9:55 AM | 10:10 AM | 11:55 AM | 1:15 PM | 2:10 PM | 1:15 PM | 3:15 PM |
| Location | | | Hwy 401 | FC1-27 | Steels | Harold | Hwy 7 | Hwy 7 | FCT-58 | Ray Lawson |
| Field pH (from Hydrolab) | pH | 6.5-8.5 | 8.96 | 8.19 | 7.04 | 7.18 | 10.66 | 7.55 | 7.71 | 8.11 |
| Field Dissolved Oxygen | mg/L | 4 | 10.32 | 6.07 | 3.97 | 4.05 | 7.73 | 6.18 | 6.11 | 13.89 |
| Inorganics | | | | | | | | | | |
| Total Phosphorus | mg/L | 0.03 | 0.082 | 0.29 | <0.002 | 0.009 | 0.4 | 0.078 | 0.043 | 0.13 |
| Total Suspended Solids | mg/L | 25 | 63 | 130 | <1 | 9 | 100 | 4 | 2 | 62 |
| Dissolved Chloride (Cl) | mg/L | 252 | 860 | 32 | 1400 | 850 | 470 | 570 | 350 | 740 |
| Petroleum Hydrocarbons | | | | | | | | | | |
| Total Oil & Grease | mg/L | ** | <0.5 | <0.5 | <0.5 | <0.5 | 23.1 | 2.6 | <0.5 | 25.2 |
| Metals | | | | | | | | | | |
| Total Aluminum (Al) | mg/L | 0.075 | 0.13 | 5.1 | 0.009 | 0.068 | 0.52 | 0.12 | 0.071 | 0.13 |
| Total Boron (B) | mg/L | 0.2 | 0.14 | 0.05 | 0.05 | 0.04 | 0.23 | 0.27 | 0.05 | 0.08 |
| Total Chromium (Cr) | mg/L | 0.001 | <0.005 | 0.007 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 |
| Total Cobalt (Co) | mg/L | 0.0009 | <0.0005 | 0.0022 | <0.0005 | <0.0005 | 0.0008 | <0.0005 | <0.0005 | <0.0005 |
| Total Copper (Cu) | mg/L | 0.005 | 0.003 | 0.013 | 0.007 | 0.002 | 0.019 | 0.011 | 0.001 | 0.010 |
| Total Iron (Fe) | mg/L | 0.3 | 17 | 5.5 | <0.1 | <0.1 | 1.4 | 0.6 | 0.2 | 0.3 |
| Total Lead (Pb) | mg/L | 0.005 | 0.0010 | 0.0035 | <0.0005 | <0.0005 | 0.015 | 0.0011 | <0.0005 | 0.0010 |
| Total Silver (Ag) | mg/L | 0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | 0.0002 | 0.0001 | <0.0001 | <0.0001 |
| Total Vanadium (V) | mg/L | 0.006 | <0.001 | 0.011 | <0.005 | <0.005 | 0.002 | <0.001 | <0.001 | <0.001 |
| Total Zinc (Zn) | mg/L | 0.02 | 0.015 | 0.033 | 0.007 | 0.020 | 0.080 | 0.018 | <0.005 | 0.021 |
| Total Zirconium (Zr) | mg/L | 0.004 | <0.001 | 0.004 | <0.001 | <0.001 | 0.002 | <0.001 | <0.001 | <0.001 |
| MICROBIOLOGY | | | | | | | | | | |
| Escherichia coli | CFU/100mL | 100 | <10 | 920 | 30 | 530 | 5400 | 160 | 610 | 2200 |

[1]Guidleline refers to the Ontario Provincial Water Quality Objectives (PWQO) if PWQO values do not exist for the selected parameter then the CCME Canadian Water Quality Guidelines for the Protection of Aquatic Life are used.
*Sample collected during spill
**Exceed PWQO if product, sheen, or odour observed
Red text = above applicable guideline

## 5.4 RESTORATION OPPORTUNITIES ALONG STREAM AND DRAINAGE CORRIDORS

The results of the stream drainage corridor assessments were used to determine potential restoration opportunities applicable to Fletcher's Creek. These opportunities are preliminary and should be considered as a foundation for future efforts. CVC and the City of Brampton can use this information to help identify site candidates for future restoration projects. Projects that are implemented will still need to go through a feasibility evaluation and design phase to determine the exact restoration approach applicable.

Figure 5.3 outlines the decision process that was followed.

Table 5.4 identifies the potential restoration opportunities for each assessed reach. Further detail on each type of restoration opportunity is described following Table 5.4.

Appendix K provides case studies of a number of stream restoration projects led by CVC. The case studies provide a range of examples and are implemented throughout the Credit River Watershed

Figure 5.3 Flow chart that outlines the decision process that was followed that provides the rational for how some of the restoration opportunities were identified.

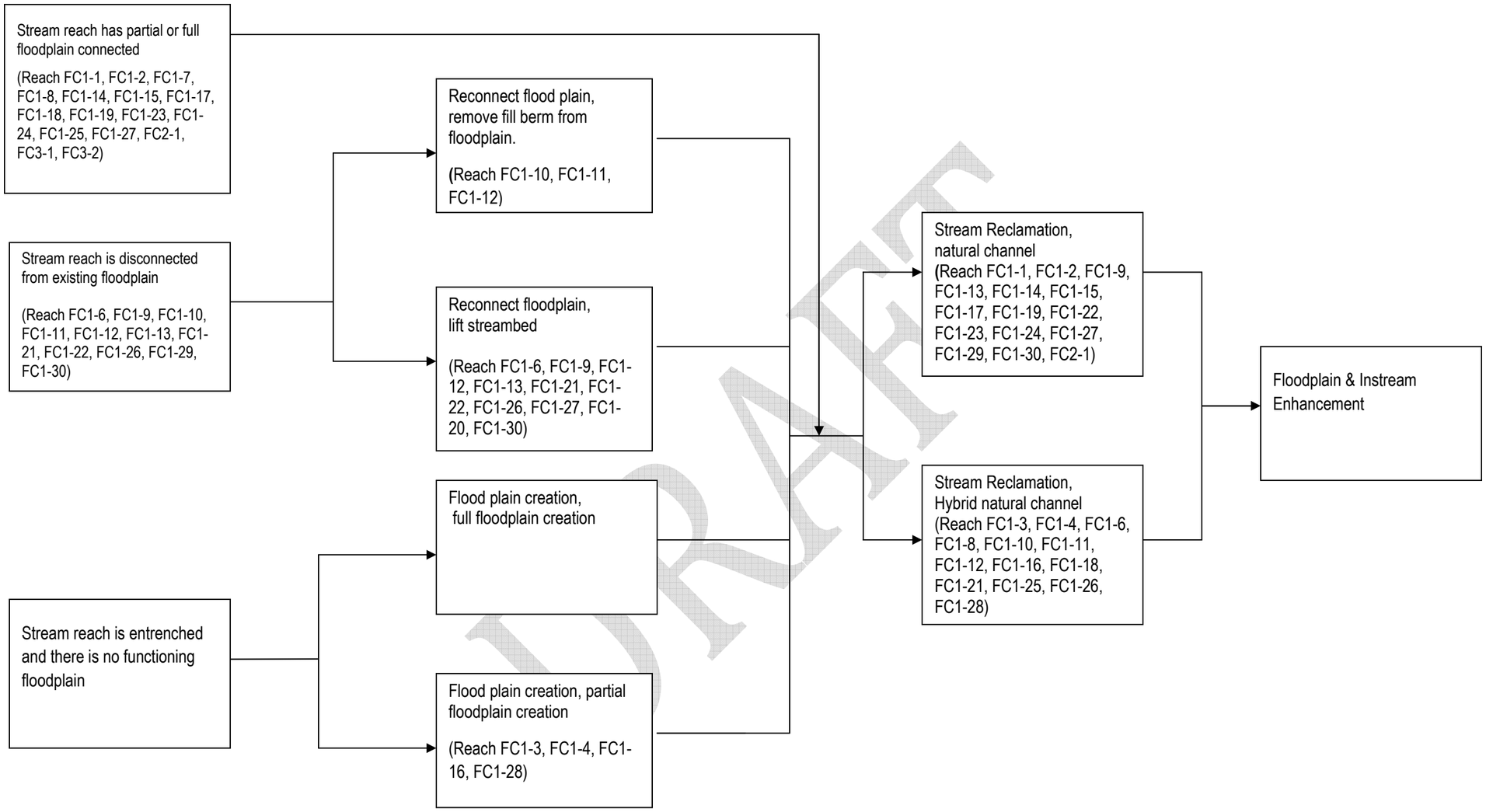


**Table 5.4 Stream and Drainage Corridor Restoration Opportunities along Fletcher's Creek**

| Stream Reach | Restoration Opportunity | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Floodplain Enhancement | | Naturalization | | | Stream Reclamation | | |
| | Bank Stabilization | Habitat Improvement | Fish Barrier Removal | Floodplain Creation or Enhancement | Floodplain Terracing | Buffer Enhancement | Invasive Species Management | Trash Cleanup | Fix Erosion Problems | Remove Fill/Berm | Remove Armouring |
| FC1-1 | X | | | X | | X | | | | | |
| FC1-2 | X | | | X | | | | | | | |
| FC1-3 | X | X | | | X | X | X | | | | |
| FC1-4 | X | | | | X | | | | | | |
| FC1-5 | X | | | | | X | X | | | | |
| FC1-6 | X | | | | | X | X | | | | |
| FC1-7 | | | | | | | | | | | |
| FC1-8 | | X | | | | X | | | X | | |
| FC1-9 | | X | | X | | X | X | | X | | |
| FC1-10 | X | X | X | | X | X | X | X | X | X | |
| FC1-11 | | X | X | | X | X | X | X | | X | |
| FC1-12 | | X | | | X | X | X | X | X | X | X |
| FC1-13 | | X | X | X | | X | X | X | | | X |
| FC1-14 | | X | | X | | X | X | | X | | |
| FC1-15 | X | X | X | X | | | X | | X | | |
| FC1-16 | | X | | | X | X | X | X | X | | |
| FC1-17 | X | X | | X | | | | X | X | | X |
| FC1-18 | | X | | | X | X | | X | X | | X |
| FC1-19 | | X | | | | X | | X | X | | |
| FC1-20 | X | X | | | | X | X | X | X | | X |
| FC1-21 | X | X | | | X | X | X | X | X | | X |
| FC1-22 | | X | | X | | X | X | X | X | | |
| FC1-23 | X | X | | X | | X | X | X | X | | |
| FC1-24 | X | X | X | X | | X | X | X | X | | |
| FC1-25 | | X | | | | X | | X | | | |
| FC1-26 | | X | | X | | X | | X | | | |
| FC1-27 | | | | X | | | X | | X | | |
| FC1-28 | | X | | | X | X | X | X | X | | |
| FC1-29 | | X | | | X | X | X | X | X | | |
| FC1-30 | | X | | | X | X | X | | X | | |
| FC2-1 | | X | X | X | | X | | X | X | | |
| FC2-2 | | X | | | | X | | | | | |
| FC3-1 | X | | X | | | | X | X | X | | |
| FC3-2 | | X | | | | | | | | | |
| FC3-3 | | X | | | | X | | | | | |
| FC3-4 | | X | | | | X | | | | | |
| FCT-56 | | X | X | | | X | X | X | | | X |
| FCT-58 | | X | | | | X | | X | | | X |

There are a diverse range of restoration opportunities identified within the stream corridor ranging from riparian plantings, invasive species removal, stream de-channelization, day-lighting, fish barrier removal, wetland creation and floodplain terracing. Figure 5.4 below highlights some of the restoration opportunities that were identified during the stream assessments.

**Figure 5.4 Examples of restoration opportunities identified in the Fletcher's Creek subwatershed**

| Management Technique | Photo | Restoration Opportunity |
|---|---|---|
| **Infrastructure** | | |
| Outfall Inspections |  <br>Illicit discharges from stormsewer outfalls (photo credit: CVC) | o Identify stormsewer outfalls that may be discharging suspect materials, have strong odours, or have evidence of staining;<br>o Investigate the contributing drainage area for potential pollution sources. |
| Fish Barrier Removal |  <br>Fish barrier preventing fish migration to the upper reaches of the watershed (photo credit: CVC) | o Identify grade control structures, utility crossings and road crossings that can act as barriers to fish movement.<br>o Identify potential mitigation measures such as fish baffles, ladders, step pools and relocating utilities or lowering culvert inverts |
| Grade Control |  <br>Knick point indicating stream bed lowering | o Identify stream reaches with soft shale bedrock susceptible to chemical and physical weathering.<br>o Identify reaches where the stream bed is lowering and backcuttting through evidence of knick points<br>o Consider protecting the |

| Management Technique | Photo | Restoration Opportunity |
|---|---|---|
| | (photo credit: CVC) | stream bed from further downcutting and prevent knick points from migrating upstream |
| Trash Clean-up |  <br>Removal of trash in stream corridor from help of volunteers (photo credit: CVC) | o Identify reaches with excessive trash and debris |
| ***Floodplain Enhancement*** | | |
| Habitat Improvement |  <br>Creation of vernal pool within floodplain (photo credit: CVC) | o Identify stream reaches that have been heavily impacted and opportunities to improve habitat diversity both in stream and within the floodplain.<br>o Look for opportunities to introduce woody structures, rocks, boulders, vegetation, floodplain wetlands, pools and riffles. |
| Floodplain Creation |  <br>Removal of flood control berm to restore floodplain access (photo credit: CVC) | o Identify stream reaches where there is potential to restore the interaction between the creek and its floodplain.<br>o Identify flood control structures that prevent frequent storms from entering the floodplain<br>o Identify reaches where adequate space exists to create floodplain |

| Management Technique | Photo | Restoration Opportunity |
|---|---|---|
| Stream Restoration |  <br>Concrete line channel with potential for de-channelization (photo credit: CVC) | o Identify reaches that have been channelized<br>o Identify space and utility constraints and assess whether restoration techniques may apply |

Details on each type of restoration opportunity described above are presented following.

### 5.4.1 BANK STABILIZATION

In areas with localized bank erosion where conditions preclude larger scale reclamation and the bed of the stream is relatively stable, bank stabilization is a restoration opportunity. In such situations, the bank erosion should not be an extensive feature along the entire reach; if it is then a stream reclamation project could be more appropriate. There are three basic types of bank stabilization:

- *Bank Grading and Planting*: Bank grading and planting is for situations where width in the stream corridor is available to grade the bank to a more stable slope. It is preferable to other methods of bank stabilization since it is often less expensive and provides the benefits of a natural stream bank.

- *Soil Bioengineering*: Soil bioengineering utilizes live plant material along with erosion control matting to provide extra stabilization for steeper slopes while avoiding riprap or gabion baskets/mattresses. Soil bioengineering helps control water runoff, filters the soil from runoff, moderates ground and water temperature, and improves the canopy cover over harder methods of stream bank stabilization. Soil bioengineering should be considered if corridor width is not available to grade back the bank without extra stabilization.

- *Structural Stabilization*: Structural stabilization is for areas where the slope is too steep for either soil bioengineering or bank grading. Boulder banks and crib walls are examples of options to consider when approaching a site that falls under this category. These structural stabilization methods still can help improve stream function and provide some habitat value.

See Figure 5.5 for examples of bank stabilization. The top diagram demonstrates how re-grading is the most appropriate technique for situations with enough room to allow a stable bank slope without bioengineering or additional structures. The bottom diagrams show live branch layering using either logs or rocks for stabilizing the toe of slope; this technique is more appropriate for more constrained situations that still have room for grading but at a slope that needs reinforced with bioengineering. Structural stabilization for the most constrained sites is not shown.

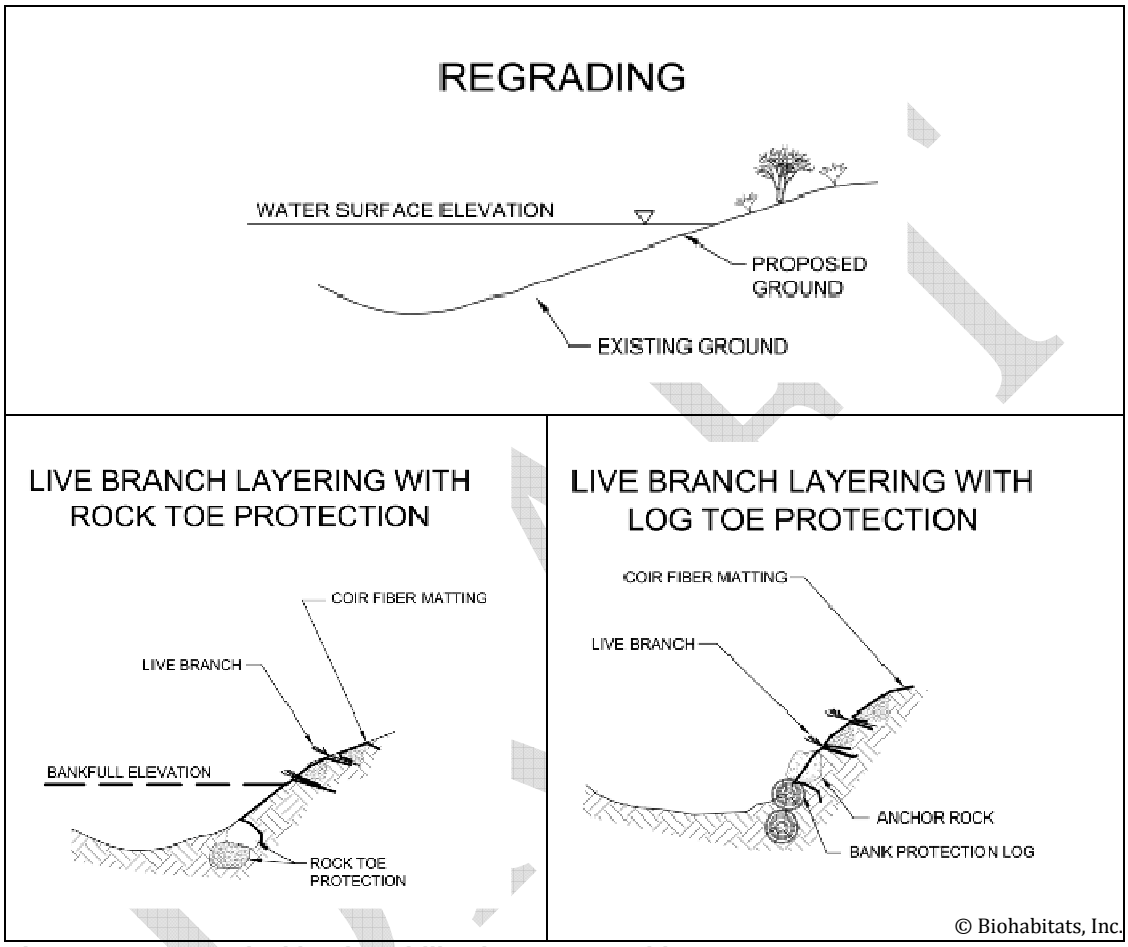



**Figure 5.5 Typical bank stabilization opportunities.**

### 5.4.2 AQUATIC HABITAT IMPROVEMENT STRUCTURES

Many sections of Fletcher's Creek lack a diversity of channel features that are necessary for a healthy aquatic ecosystem. In addition, some are in situations too constrained to allow for stream reclamation. In these cases, the opportunity exits to provide habitat structures that diversify the features in the stream channel. Habitat structures need to be carefully located so that they do not wash out or become unstable due to stream erosion.

Examples of aquatic habitat improvement structures include woody debris that adds cover for fish and macroinvertebrates, log or rock structures that diversify the stream channel bed, and constructed riffles that add habitat for macroinvertebrates and spawning areas for fish. Stream

restoration structures can have dual benefits of stabilizing the channel while also providing aquatic habitat. See figures 5.7 and5.8 for examples of aquatic habitat improvement structures.

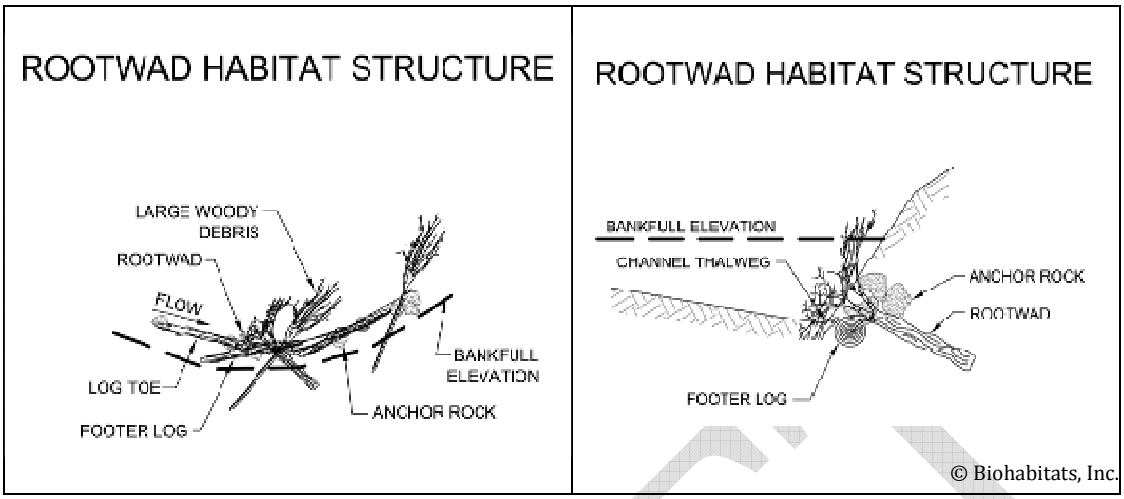



**Figure 5.6 Design details of an aquatic habitat improvement structure.**

The figure on the left shows a plan view of a rootwad habitat structure with large woody debris bundles. The figure on the right shows a profile of a rootwad habitat structure.

**Figure 5.7 Photographs of actual habitat improvement structures.**

The top photograph shows a constructed riffle with log structures in the background almost one year after construction. The figure on the lower right shows a log vane; the overhanging branches of the shrub left of the log vane also provide critical aquatic habitat. The figure on the left shows rootwads with large woody debris bundles.

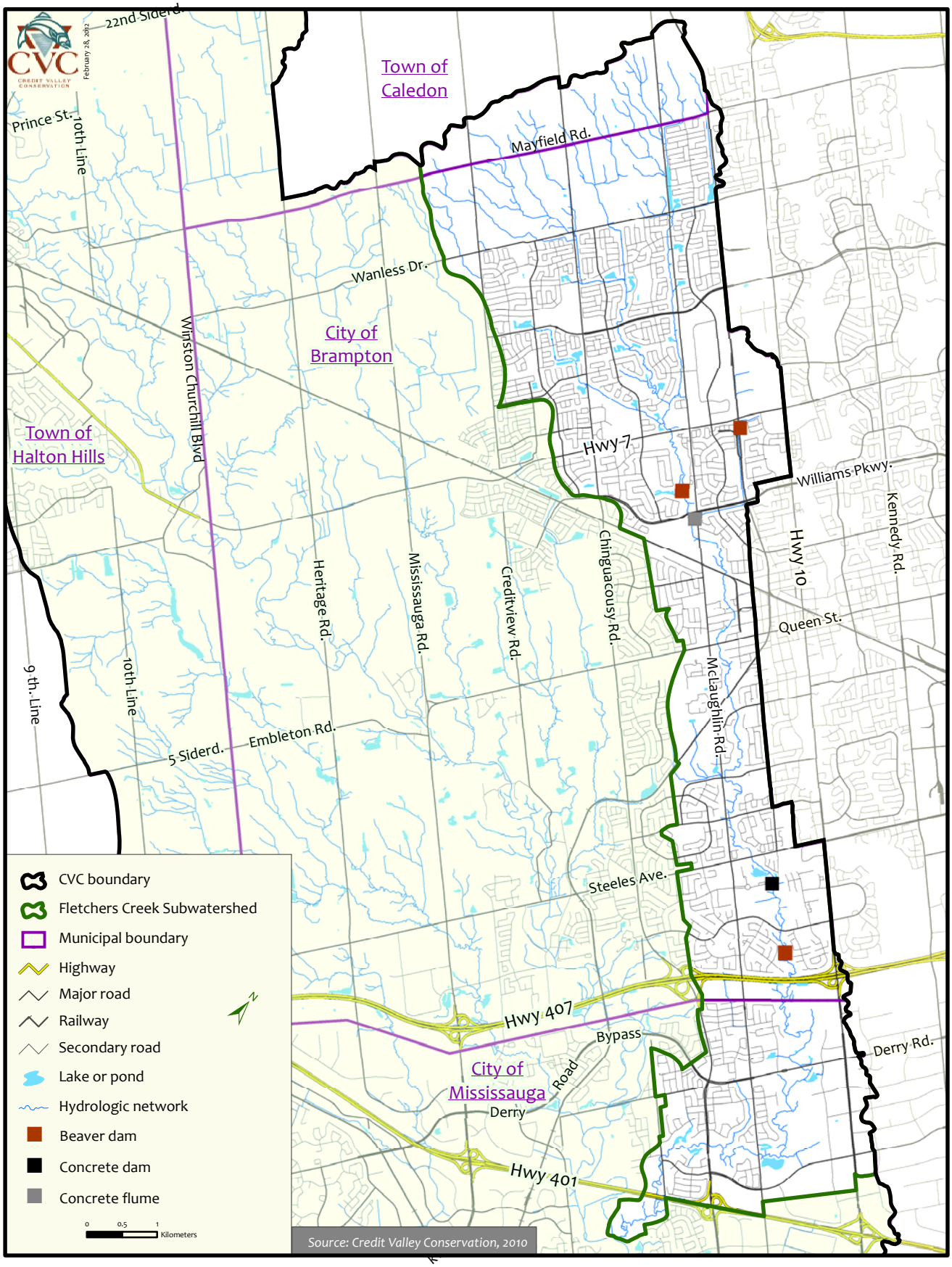
### 5.4.3 FISH BARRIER REMOVAL

Fletcher's Creek contains some drops in elevation greater than 12 cm. Such conditions prevent fish from swimming upstream and act as barriers to their movement. Fish need to be able to move as part of a healthy life cycle. Artificial infrastructure such as road and utility crossings and attempts at grade control as well as more natural geological features uncovered due to stream incision all act as fish barriers, as shown in the photographs in Figure 5.8 (overleaf). Figure 5.9 provides a map of the Fletcher's Creek subwatershed and locations of in stream fish barriers.

To improve fish movement, drops in elevation should to be shortened to no more than 12 cm, and resting areas for fish, such as pools, should be added above and below drops and culverts. Concrete-lined channels or road crossings should have a more natural bed with riffle/pool or, in steeper channels, step/pool cascade sequences. For utility crossings, relocation should be pursued. If relocation is not possible, then side channels or fish ladders should be considered. Examples are presented in Figure 5.10.

**Figure 5.8 Examples of existing fish barriers in Fletcher's Creek**
Starting from the top left photograph and moving right then down: riprap grade control riffle, concrete grade control dam, concrete channel grade control flume, beaver dam, old farm field access bridge, debris jam, natural nick point, crossing undermined (creek flowing under concrete pad), narrow culvert.

***Figure 5.9 Fish Barriers and Beaver Dams***



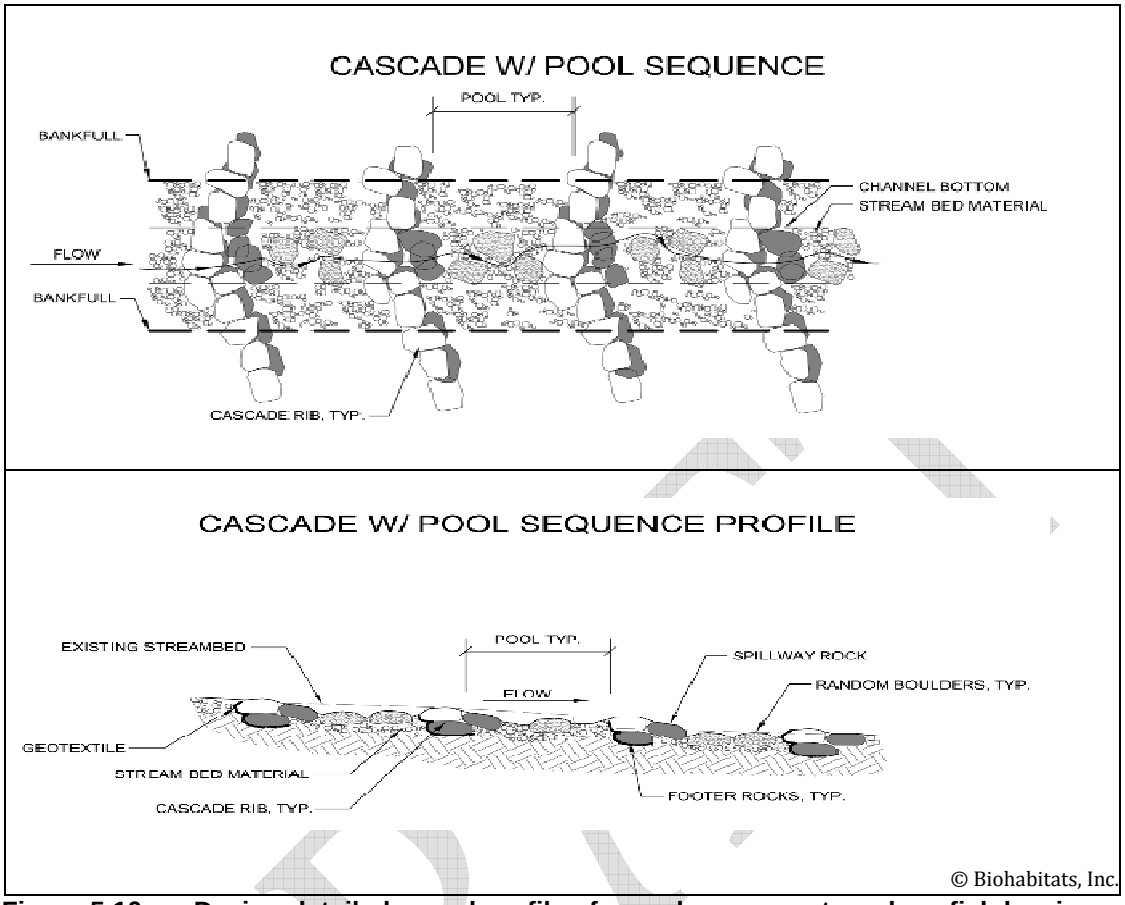



**Figure 5.10 Design detail plan and profile of a pool sequence to reduce fish barriers such as drops due to utility crossings or steep concrete-lined channel sections**

### 5.4.4 GRADE CONTROL

As a stream adapts to changes within its system, it can develop knickpoints or headcuts, which form a sharp change in elevation over a short distance. These knickpoints gradually work their way upstream, causing the stream channel to downcut and become unstable. Fletcher's Creek has the potential for headcut formation and migration particularly in the areas north of Bovaird Drive where development has occurred more recently. Grade control structures, such as cross vanes, can help to stabilize the creek bed. See Figure 5.11 for an example of a grade control structure.

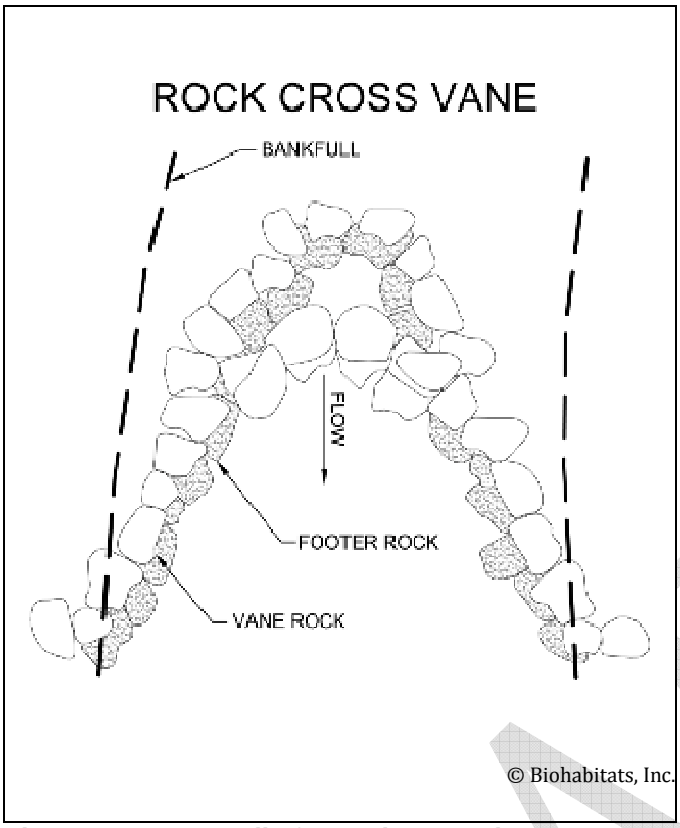



**Figure 5.11 Detail of a grade control structure.**

### 5.4.5 FLOODPLAIN RESTORATION

The floodplain is a vital part of a stream corridor. Flooding is a natural and necessary occurrence in streams, and the floodplain is the morphological feature that allows flooding to happen while maintaining the stream's dynamic equilibrium. Peak flows are attenuated by spreading over the larger floodplain, dissipating stream energy, and lowing water levels. In addition, fine sediment and other items such as woody debris and seeds deposit on the floodplains, making them more productive. Vegetated floodplains provide important habitat and water quality benefits though a system of wetlands and depressions that store floodwater, promote infiltration, and provide refuge for different life stages of aquatic species.

When this width in a floodplain is lost, more shear stress is focused in the channel, causing erosion and instability. The construction of berms and levees result in the destabilization of the flood cycle and the disconnection of the Creek from its floodplain. In many areas along Fletcher's Creek, the floodplain has been narrowed or totally lost, with the stream channel now confined to a small linear corridor. The resulting instability shows itself by bank failure and downcutting as it tries to adjust to the higher water levels and shear stress. Traditional floodplain management practices have often changed the stream environment through modifying flow and sediment characteristics. Floodplains have been developed for a variety of human uses, which often leads to the construction of dams and levees to control the flooding

that naturally occurs. The cumulative confinement and alteration of Fletcher's Creek over time has resulted in loss of flood storage and has had a detrimental effect on the health of the creek.

Floodplain restoration results in a gaining back of hydraulic and ecological function through restoring the interactions between the creek and its floodplain. The potential benefits for the Fletcher's Creek subwatershed include reducing flood levels; improving stream stability; creating ecosystem improvements for fish, amphibians, reptiles, and birds; and improving water quality. An important part of restoring Fletcher's Creek is protecting and improving the floodplain in areas where it still exists.

### 5.4.6 FLOODPLAIN CREATION

Floodplain Creation is appropriate where the channel has lowered and become entrenched, turning the old floodplain into a terrace that is too elevated to flood except during extremely high flows. This loss of more frequent hydraulic connectivity between the stream and floodplain destroys many of the benefits that are possible in a more connected system. In Fletcher's Creek, channel entrenchment can be both intentional and accidental. Some parts of the stream have purposefully been lowered to accommodate drainage from the storm sewer system; in other situations, the channel has downcut in response to increased flow resulting from land use changes in the upstream watershed. Open space along an entrenched segment of stream presents an opportunity to create a new floodplain at a lower elevation than the old one, allowing floodwaters to spill out of the stream channel into the newly created area. Floodplain creation projects can be further enhanced by creating riparian wetlands in the new floodplain. See Figure 5.12 for an example of floodplain creation.

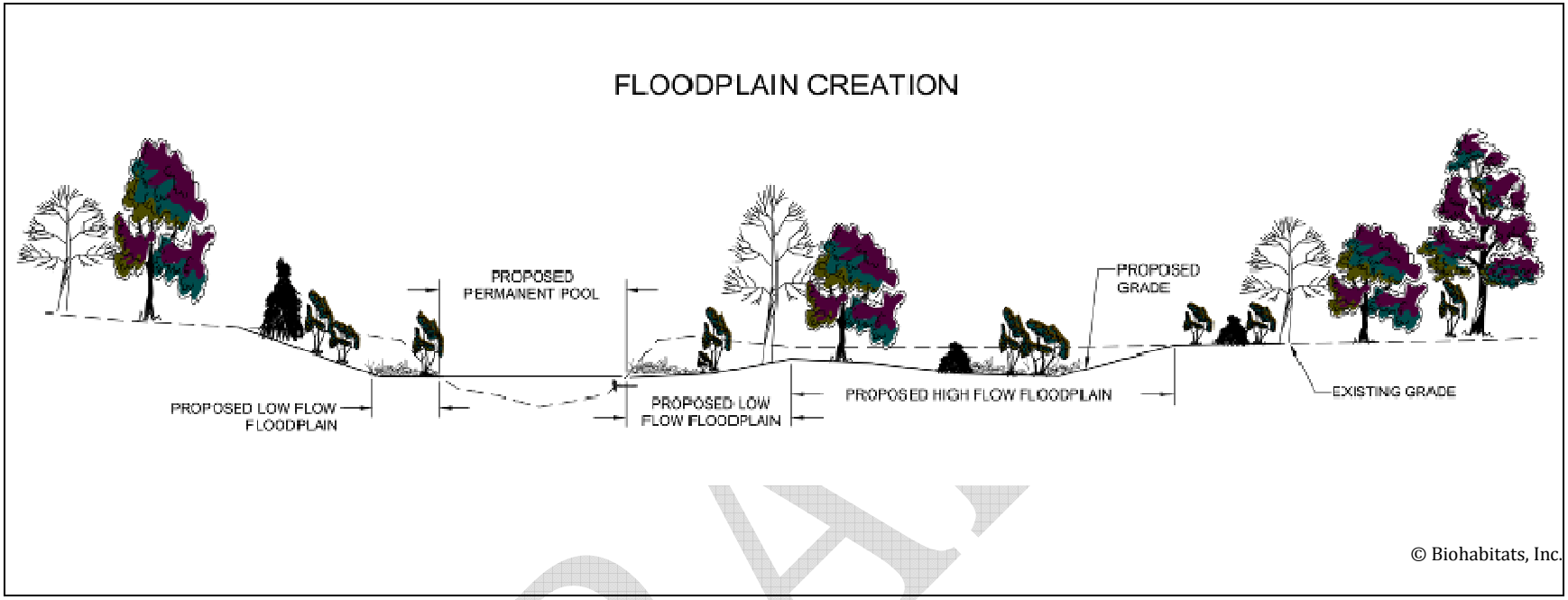



**Figure 5.12 Conceptual cross section of floodplain creation.**

The existing grade (dashed line) is lowered along the channel and different levels of floodplain are created, providing opportunities for different hydrologic regimes and resulting vegetative communities.

In more confined areas without room for floodplain creation, there may be an opportunity for floodplain terracing (or benching) that creates a multistage channel, or a channel within a channel. This method allows larger storms to have a small floodplain, which helps dissipate stream energy and provides some habitat benefits and floodplain connectedness. See Figure 5.13 for an example of benching.

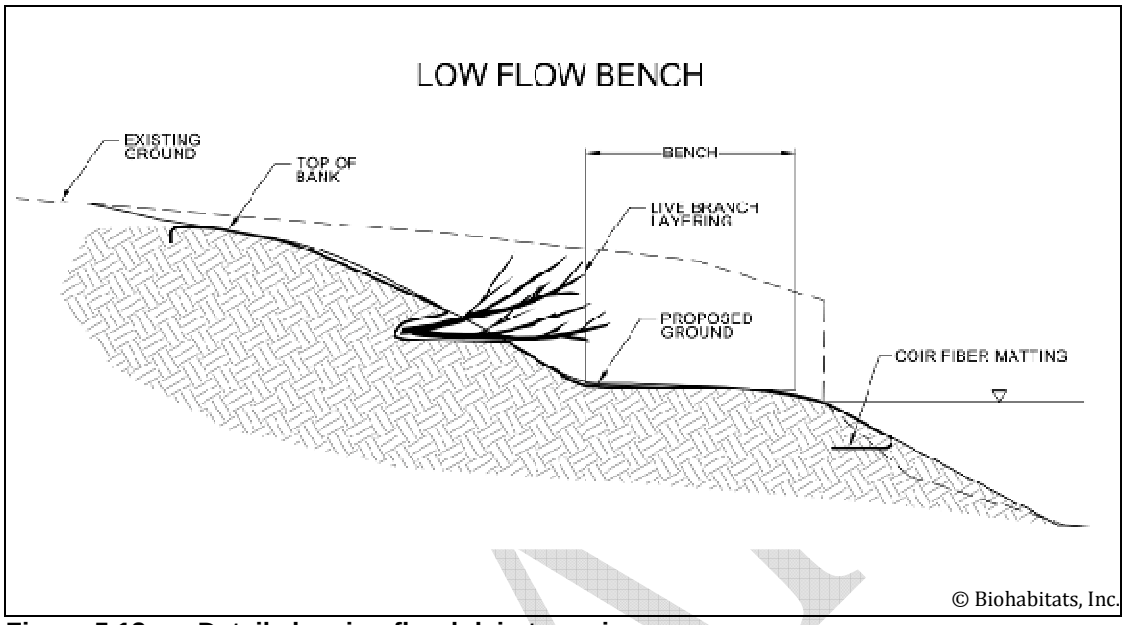



**Figure 5.13 Detail showing floodplain terracing**

In locations without enough room for full floodplain creation, terraces (or benches) can be excavated to provide some of the benefits of a floodplain.

### 5.4.7 FLOOD PLAIN RECONNECTION

In some areas along Fletcher's Creek, floodplains exist that have been disconnected from the stream by berms. The locations that also have a land use compatible with occasional flooding present the opportunity to remove the berm and restore connectivity with the stream. This reconnection opportunity would help restore the natural structure, function, and dynamic processes to Fletcher's Creek. As with floodplain creation, the creation of new riparian wetlands can also be part of a floodplain reconnection project.

### 5.4.8 RIPARIAN WETLAND ENHANCEMENT

Important parts of floodplains are riparian wetlands. These shallow seeps and depressions help drive the benefits from floodplains, providing water storage, water quality improvement, and valuable habit for biodiversity. In some parts of Fletcher's Creek, these features still exist, and in areas considered for floodplain restoration, the opportunity exists to restore and create them. Additional features made out of woody material can further improve the habitat. See Figure 5.14 for an example.

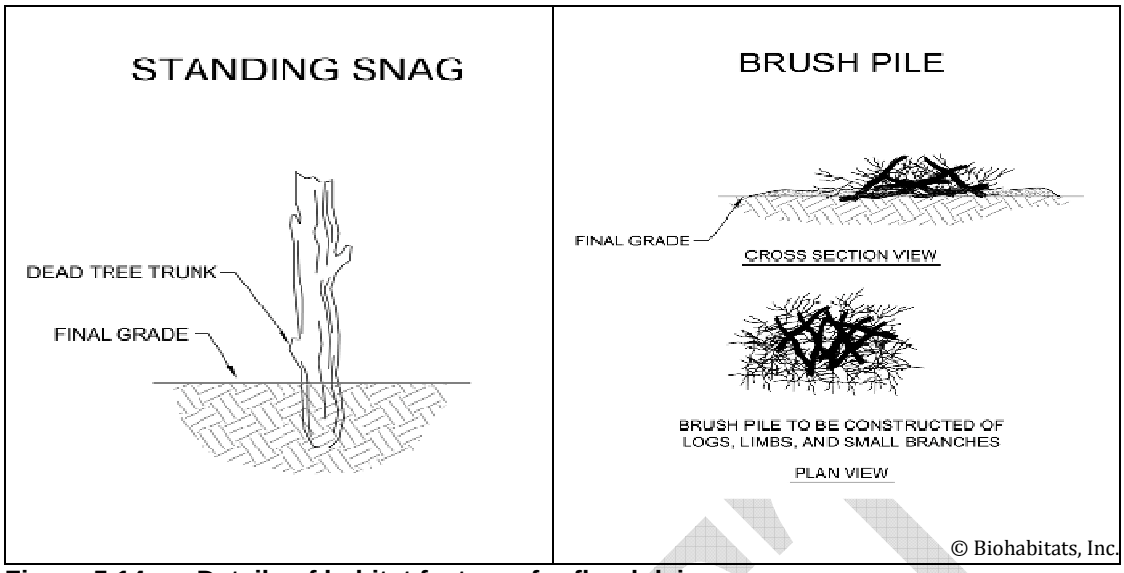



**Figure 5.14 Details of habitat features for floodplains.**

Standing snags and brush piles provide important refugia for many species and provide an immediate benefit to restoration projects.

### 5.4.9 RIPARIAN CORRIDOR NATURALIZATION

Naturalization is the process of allowing the stream to recover on its own, with only minimal assistance. In some situations, the constraints on the stream corridor such as existing development or infrastructure, may not allow grading and use of heavy equipment necessary to achieve a more complete floodplain or stream restoration. In this case, naturalization is a method that maximizes ecological improvement while working with the existing site constraints.

Some corridors along Fletcher's Creek have little or no vegetated buffer along the stream. Often the vegetated riparian buffer is narrow and full of exotic species, or maintained as a pastoral park setting with mown grass and widely spaced landscaped trees. This lack of a native vegetated buffer denies important habitat and ecological connectivity for plants and animals. Any width of a forested native riparian buffer is better than none at all; however, wider buffers provide more benefits. Stream corridors should have a minimum buffer between the surrounding land and the stream of at least 50 meters. If the distance of 50 meters cannot be achieved, then as much distance as possible should be planted as a buffer.

An important component of the naturalization of riparian corridors is invasive species management. For centuries, people have moved organisms, including plants, around the world. A small percentage of these cause serious problems in their new environments and are known as invasive species. In the Fletcher's Creek subwatershed, invasive plant species have become established, overwhelming the native populations and taking over areas of land that have been disturbed. Besides affecting the native vegetative species, these species can also have an impact on the stream function, water quality, and terrestrial species that depend on the native vegetation species for food and shelter. Through the eradication of these

species and proper vegetative management, the native habitat can be given a chance to return and will improve the overall quality of the ecosystem. Invasive species removal is also an opportunity to involve volunteers in the restoration of Fletcher's Creek.

An additional part of naturalization is trash removal. Just as runoff from storm events travels down a watershed and combines in stream channels, trash typical of developed areas tends to make its way into stream corridors. Fletcher's Creek has many areas along the stream corridor that contain trash, See Figure5.15 for an example. Besides being unsightly, larger pieces such as manmade wood debris, grocery carts, and car parts, can divert flow patterns and act as blockages; trash can also affect the water quality of the stream. Regular trash removal will help the stream to function normally and look nicer. It is also an opportunity to involve volunteers in the stream's improvement, see Figure 5.16 for an example.

**Figure 5.15 Examples of trash found along and in Fletcher's Creek**

## 5.4.10 STREAM RECLAMATION

Stream reclamation is the action of restoring a degraded stream to a naturally functioning system that is in balance with the existing flow regime, sediment supply, and site constraints. Stream reclamation is the most holistic restoration approach of all the techniques presented

in this section and it provides numerous benefits, including stabilization and grade control, improvement of aquatic habitat, and enhancement of the floodplain. Stream reclamation should be the first option when considering restoration. Only after further feasibility assessment and identification of site constraints such as utility crossings, existing infrastructure, and property ownership, should other less extensive methods be considered. For example, perhaps an existing utility could be relocated, which would then allow a more substantial reclamation project to occur. Sewer lines along and across creeks can form significant constraints to restoration efforts; however, relocation of these lines not only helps the restoration, but can also improve the sewer line by removing it from an exposed location susceptible to erosion. Stream reclamation can adapt to the specific site conditions and will vary from site to site. Due to the drastic changes throughout its watershed and channel, reclamation for Fletcher's Creek will have to consider the site specific constraints and will most likely not include restoration to pre-settlement conditions.

Within the Stream Reclamation category, there are several subcategories of restoration opportunities depending on the amount of space and extent of constraints on either side of the stream corridor: Natural Channel Stream Reclamation, Hybrid Natural Channel Stream Reclamation, and Daylighting.

Natural Channel Stream Reclamation: Natural Channel Stream Reclamation involves restoring the entire stream: the planform, the profile, and the cross section. The planform is the shape of the channel looking down on it from above. The profile is the elevation of the streambed, water surface, and streambank height along the project reach. The cross section is the area within the channel between opposite stream banks. The full reclamation process often involves creating a new floodplain and associated off-channel wetlands. The benefits of restoring the stream to a more natural condition include long-term stability, improved habitat, and enhanced wetlands in the stream corridor. Possible constraints to full reclamation of Fletcher's Creek may include limitations to changing the general elevation of the streambed due to infrastructure and flood-capacity constraints. See Figures 5.18 and 5.19 for examples. Figure 5.20 following, presents a picture of a natural channel stream reclamation.

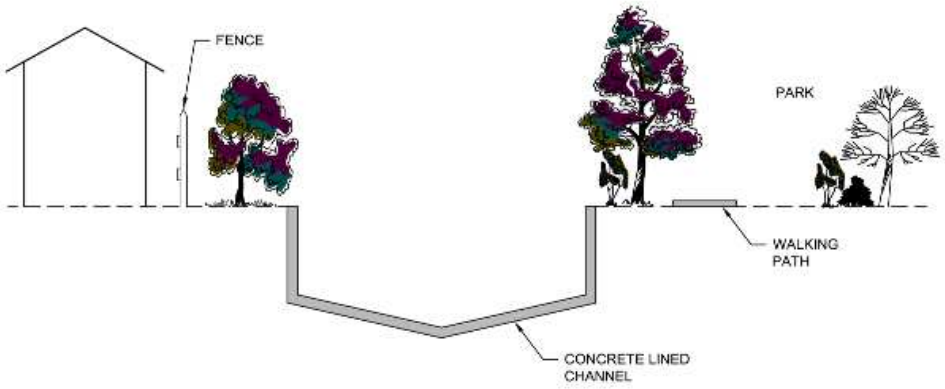



**Figure 5.17 A conceptual cross section of a typical urbanized stream**

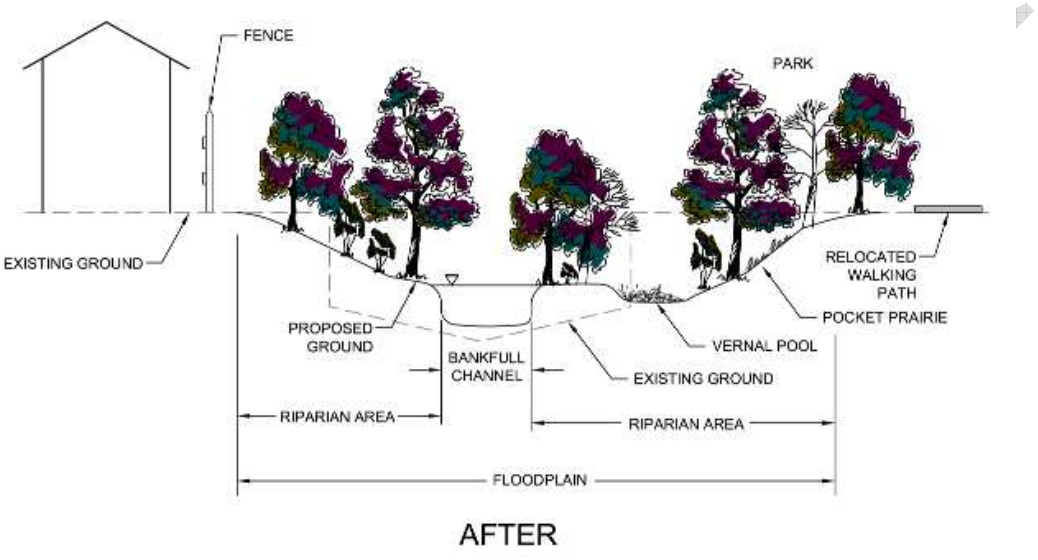



**Figure 5.18 Conceptual cross section of a natural channel reclamation**

**Figure 5.16 Examples of trash removal.**

(Creek clean sweeps are a great opportunity to involve community members of all ages and generate enthusiasm toward local streams.)

**Figure 5.19 Photographs of natural channel stream reclamation projects. In both cases, a wide floodplain was available.**

*Hybrid Natural Channel Stream Reclamation*: In areas where site constraints do not allow modifications of the channel planform, Hybrid Natural Channel Stream Reclamation can be considered. A Hybrid Natural Channel project involves a change in the stream profile and cross section. Floodplain enhancement may be limited in this type of project due to lack of space beside the stream. It will still provide ecological benefits, help stabilize the stream, and possibly reduce flooding. See Figure 5.20 for an example of a hybrid natural channel cross section. In the example, the private residences on each side of the stream limit the space available for restoration, a hybrid approach can still provide significant benefits within the existing stream footprint.

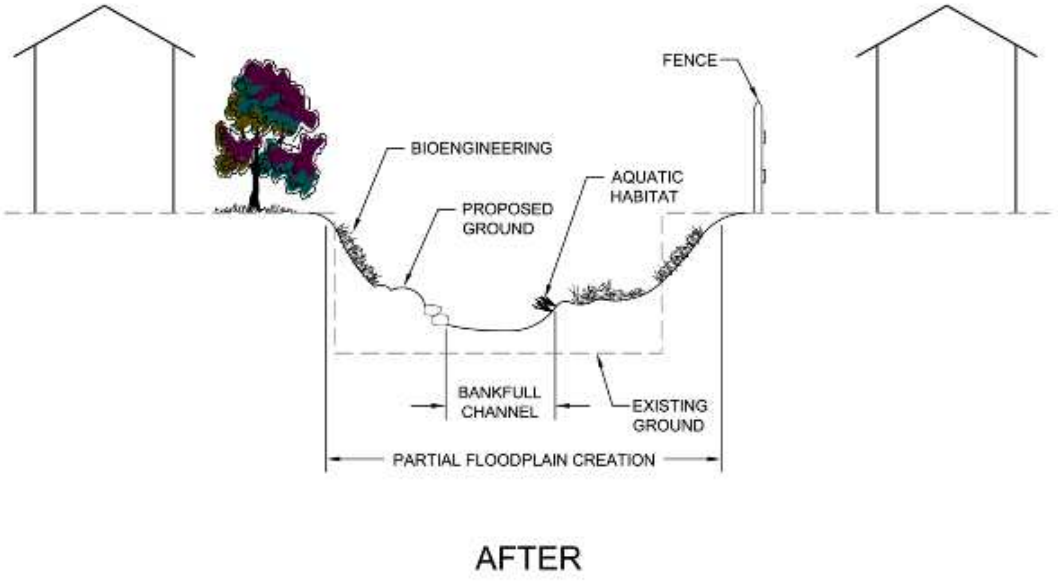



**Figure 5.20 Conceptual cross section showing hybrid natural channel reclamation.**

Figure 5.21 presents a conceptual plan of a hybrid natural channel reclamation.

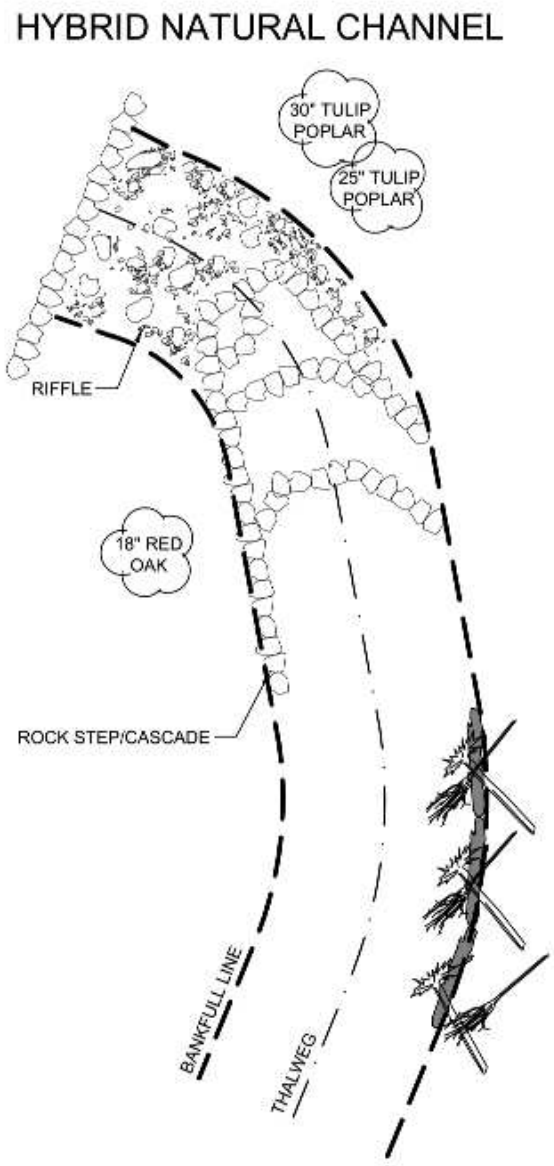



**Figure 5.21 A conceptual plan view of a hybrid channel reclamation.**

A rock step/cascade provides bank stability and grade control while also minimizing barriers to fish passage.

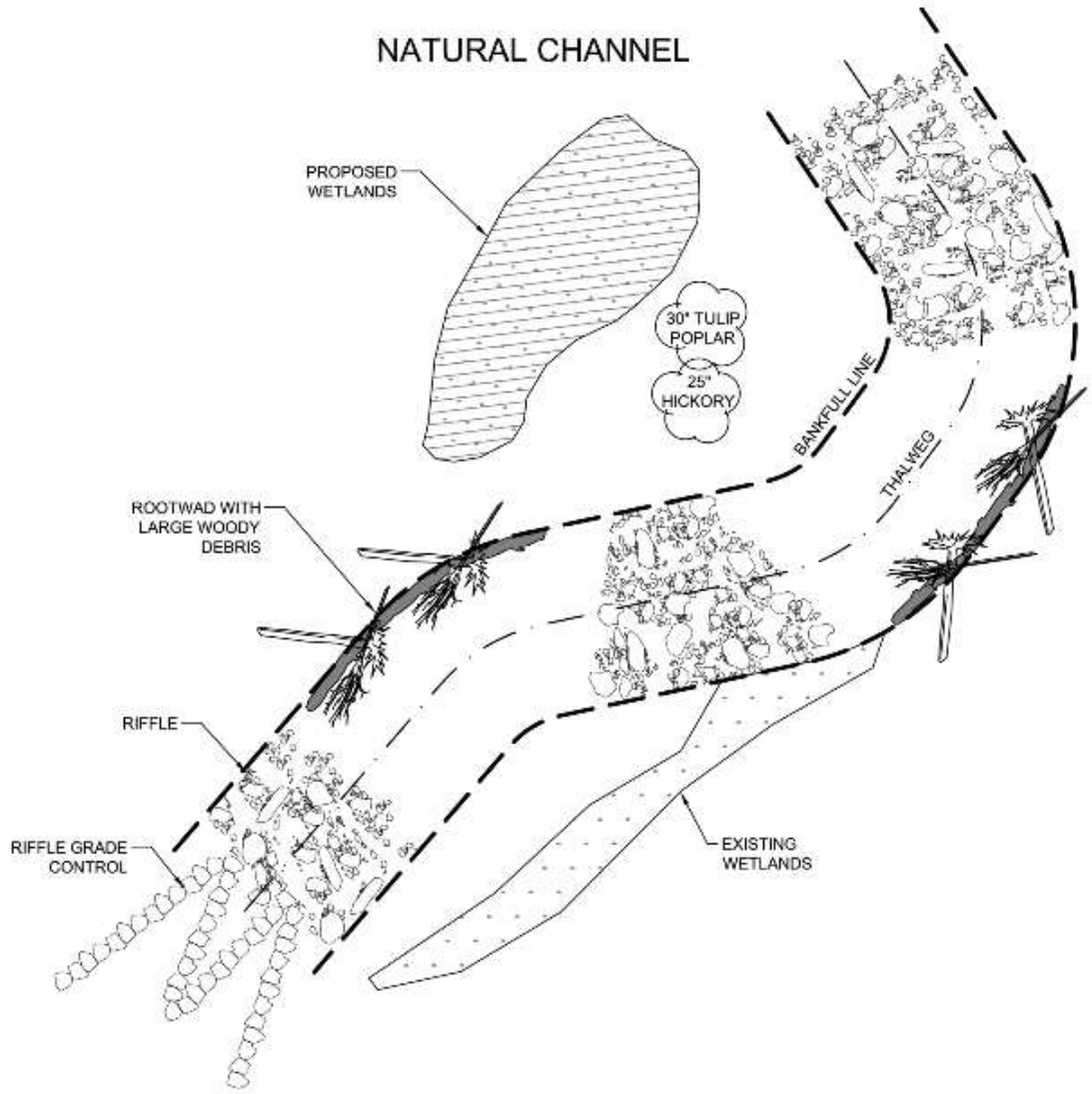



**Figure 5.22 A conceptual plan view of natural channel reclamation.**

It includes riparian wetland creation, aquatic habitat improvement with riffle and rootwad/large woody debris structures, and grade control by use of a rock vane.

Figure 5.23 presents a picture of a completed hybrid natural channel stream reclamation.

**Figure 5.23 Photograph of a hybrid natural channel stream reclamation.**

In this example, the stream corridor is constrained, so the restored section follows a similar alignment to the pre-existing stream.

*Stream Daylighting*: Many stormwater outfalls along Fletcher's Creek are located right next to the creek, with enclosed piping running under the floodplain. These outfalls could be installed at the edge of the floodplain with an open channel running to the creek. By opening up these stormwater pipes, important natural processes that provide water quality and quantity benefits could be regained. In these cases, daylighting, a term that describes projects that deliberately expose some or all of the flow of a previously covered river, creek, or stormwater drainage, is a potential restoration opportunity. Some daylighting projects recreate wetlands, ponds, and estuaries. Daylighting is a specific type of stream reclamation that can take both a full or hybrid reclamation approach. See Figure 5.24 for examples.

**Figure 5.24 An example of a stream daylighting project.**

The photograph on the left shows the pre-existing grass area on top of a buried culvert. The photograph on the right shows the new daylighted stream after construction.

# 6.0 COMMUNICATION AND STEWARDSHIP STRATEGY

## 6.1 Communication Strategy

### 6.1.1 BACKGROUND RESEARCH

Internal research allowed the identification of a short list of actions where resident behaviour change would potentially have the greatest tangible impact on water quality and biodiversity. Areas of focus were:

1. Outdoor water use
2. Fertilizer use
3. Choosing native plants.

Market research in other GTA communities provided direction on consumer motivation and messaging, making it clear that public messages should focus on aesthetics and ease-of-care, rather than environmental altruism.


**Figure 6.1 Bus shelter advertisement display**

### 6.1.2 PUBLIC OPINION/BEHAVIOUR BASELINE RESEARCH

In spring 2010, OraclePoll research conducted a telephone poll of 500 residents residing in single family homes or townhouses within selected Brampton postal areas.

The poll sought to establish behavioural benchmarks for the three areas of focus (outdoor water use, fertilizer use, and choosing native plants), plus some additional questions to probe for awareness and opinion on environmental issues.

### 6.1.3 SURVEY FINDINGS

- Top-of mind (unprompted) environmental issues included air pollution, climate change and waste; biodiversity did not register as a key issue for residents.
- Aesthetics and ease of upkeep are the most important motivators. behind landscaping choices.
- Most residents are open to using native plants in garden areas.
- 81% do not use pesticides.
- More than 75% of residents fertilize their lawn more than once a year.
- More than half of residents are not leaving grass clippings on the lawn after mowing.
- More than half of residents report that they water their lawn 'only as necessary' rather than on a regular basis.
- More than half of residents say they are 'never' inconvenienced by lawn watering restrictions.
- 27% of respondents report that their home has a downspout that connects directly into the ground.
- When prompted, environmental issues ranked by response of 'very important' were: clean drinking water (77%), water pollution (59%), air pollution (57%), waste & recycling (48%), climate change (45%), habitat loss (41%) and invasive species (29%).
- Residents get information about lawn care from a wide range of sources, including the internet (23%), garden store (13%), magazines (11%), and television (11%).
- Residents get information about lawn watering restrictions primarily from local media (40%), and outdoor signage (34%).


**Figure 6.2 Picture of CVC educational material at a bus shelter in Brampton**

### 6.1.4 COMMUNICATIONS TACTICS

CVC developed several communications products drawing on the results of the research phase, incorporating engaging visual imagery and simple, action-oriented messaging.

Tactical elements 2010:

- Designed and published fact sheet profiling public opinion survey results,

- GO Station and bus shelter advertising – messages provided a single practical action to address each of the three key behaviour areas,
- Articles on key topic areas in CVC publications: Currents (hard copy - 212,000 households) and The Source (e-newsletter),
- Dedicated web page and home page feature on CVC web site, outlining additional actions residents can take in each of the behaviour areas, as well as specific information like native plant types easily found in garden stores.

### 6.1.5 FUTURE COMMUNICATION INITIATIVES

Tactical elements recommended for spring/summer 2011 include: media releases and mat articles focusing on each behaviour area, second flight of outdoor display advertising, household mailer to Fletchers Creek pilot area (possibly wider), web features, corporate publication and social media features. Communications elements should be followed up with a repeat of the public opinion survey in fall 2011 to measure behaviour change against the 2010 baseline survey.


**Figure 6.3 Campaign artwork**

## 6.2 STEWARDSHIP AND EDUCATION

Community and stakeholder involvement is essential for the protection, restoration and enhancement of the Fletchers Creek subwatershed. There has been a steady increase in environmental awareness resulting in changing behaviours. To continue the movement in behavioural changes, CVC is committed to the continued growth and promotion of ecological management, by means of partnerships with NGO's, private landowners and other agencies, through on-the-ground projects, education and stewardship.

One of the unintended negative consequences of past urban development has been a loss of natural areas and an increasingly degraded natural environment. Specifically, our urban areas are subject to broader environmental problems, such as global climate change. Currently 63% of Fletchers Creek Subwatershed is developed with an anticipated increase in development in order to adhere to Places to Grow. For this reason, it is important to support

the development of a Green City – a city that is healthy, sustainable, and liveable with a healthy natural environment, healthy people and a thriving economy. In harmony with the objectives of the City of Brampton's Environmental Master Plan, CVC is committed to assisting in the education of the residential and business community to promote a sense of responsibility over the environment to ensure that actions and decisions are done so to keep with the principles of sustainability. CVC has three broad based programs, corporate, residential and school.

CVC has been working with Cities, the Region of Peel, community groups, NGOs, neighbouring conservation authorities, corporations and schools. In 2008, CVC stepped up its efforts in urban areas with several urban focused studies, new Urban Outreach programs, and increased urban educational programming.

### 6.2.1 CVC INITIATIVES

CVC personnel undertake joint initiatives, both inter-departmentally and with external partners. The bulk of CVC's stewardship, outreach and educational activities are coordinated and/or undertaken by the Stewardship section of the Stewardship and Restoration Department. The department's Urban Outreach Programs focus mainly on Brampton and Mississauga, and promotes ecological landscaping and restoration where possible. Related themes of Urban Outreach include Green Cities, Green Economy and general sustainability.

### 6.2.2 CORPORATE PROGRAMS

Greening Corporate Grounds (GCG): This new initiative launched by Credit Valley Conservation and Evergreen will help corporations, businesses, institutions and places of worship in Mississauga and Brampton to green their corporate and institutional lands. GCG provides a checklist of projects, site concept plans, education, design, installation and maintenance advice, and assistance with staff or volunteer planting events. CVC hasn't had the opportunity to work with a corporation within the City of Brampton but continues to look for partnership opportunities.


**Figure 6.4 Left – Greening Corporate Grounds brochure cover. Right – pictures from GCG event**

Landscape Industry/Land Managers/Developers: This is a Credit River watershed-wide educational initiative to support the landscaping industry in making the shift to ecological landscaping and green infrastructure. CVC conducts workshops, resource materials and select site advice to assist the industry in adopting best management practices.

### 6.2.3 RESIDENTIAL PROGRAMS

Your Green Yard: This is a residential program that promotes education, demonstration gardens, select site advice, and a native tree/shrub giveaway. Your Green Yard program focuses on ecological landscaping and gardening. This includes three types of activities: native plant gardening; environmental maintenance; and, green outdoor building. CVC shows residents how to make simple steps, such as planting native trees, shrubs and wildflowers, or switching to a low-maintenance lawn.


**Figure 6.5 Left – Participants of the 'Your Green Yard' program in Fletchers Creek subwatershed. Right – example of marketing material used for a 'Your Green Yard' workshop.**

Public Sites and Events: CVC coordinates plantings and other restoration/retrofit on public lands; on a more limited basis, assists with community awareness raising events

Urban Outreach works with the City to determine where best to work on public property. When selecting sites, Urban Outreach personnel also note sites that may be of interest to other CVC departments, such as potential wetlands or parking lot retrofits. In addition, Urban Outreach personnel work with the City to provide training, input into related plans and strategies, select by-law review, and other tools to aid with ecological landscaping, restoration/retrofit, green infrastructure, green cities and green economic development. Urban Outreach also provides all programs in the Credit River and other subwatersheds in Brampton.

### 6.2.4 EDUCATION PROGRAMS

Some Stewardship programs that aim at educating the public in our urban areas include:

- Conservation Youth Corps - coordinates high school student involvement in hands-on projects
- Community Outreach Volunteer Workdays - work with volunteers to aid with hands-on projects.
- Rural Outreach - attend events relevant to rural residents (eg. Brampton Fall Fair); outreach to farmers and rural landowners in headwaters

The Education programs focus on public education, multicultural outreach, and school-based programs, including working with teachers during professional development days, with the goal of promoting widespread ecological literacy. Specific programs include:

- Multicultural outreach, including "Environment and Nature Weeks" (with participation from other CVC departments)
- Public education programming on CVC lands
- School based programs, including Stream of Dreams (with Rural Outreach staff) and Save the Leopard Frog (with Water Department)
- CVC liaison with school boards and other school-based education stakeholders
- Teacher training and related resource development.

## FLETCHERS CREEK SCHOOL PROGRAM ("SAVE THE LEOPARD FROG")

The purpose of the Fletchers Creek School Program is to help create public awareness of the Fletchers Creek subwatershed by:

- Providing students with an understanding of the subwatershed within which they live;
- Creating interest in the role and importance of the Fletchers Creek subwatershed;
- Introducing natural areas in their local environment that students could explore and learn from to encourage stewardship; and
- Discouraging those activities that harm the watershed and promote those that do not.

In the spring and fall of 2009, 1800 students throughout the Fletchers Creek subwatershed participated in the Save the Leopard Frog school program. This included a class presentation and a half-day field tour of Fletchers Creek.

In 2010, the program reached 2,032 students throughout the Fletchers Creek subwatershed. The scope of the program for 2011 is to be determined in winter 2010/2011.

The Fletchers Creek School Program compliments a community-based social marketing campaign called "Save the Leopard Frog" (SLF) & CVC's Multicultural Outreach and Education Program in order to raise environmental awareness, increase CVC's public presence and change behaviours of residents in the watershed to protect and conserve water.

Fletchers Creek School Program activities consist of an interactive, authentic learning experience that enhances the grade four to six science and technology curriculum. Through an in-school and outdoor program, students discover the importance of the plants, animals, land and water in their own community and learn about ways that they can make a difference.

The Program involves two parts:

1. An Interactive In-School Presentation – a one hour interactive presentation to enhance student understanding of Fletchers Creek, the lands that surround it, and the plants, animals, and human communities that call those lands home.

2. A Fletchers Creek Field Expedition – a half day follow-up excursion to nearby natural areas, where students participate in hands-on outdoor activities to support their learning about Fletchers Creek.

**The Program meets the following Ontario Curriculum expectations:**

Grade 4 - Science & Technology: Habitats & Communities

Students should be able to:

- Identify reasons for depletion or extinction of a plant or animal species (e.g. invasive species)
- Describe structural adaptations that allow plants and animals to survive in specific habitats
- Describe ways in which humans are dependent on natural habitats and communities

Grade 5 - Science & Technology: Human Organ Systems and Conservation of Energy and Resources

Students should be able to:

- Assess the effects of social and environmental factors on human health, and propose ways, in which individuals can reduce the harmful effects of these factors and take advantage of those that are beneficial
- Identify ways in which our resources can be conserved and the benefits of resource and energy conservation on the environment and in our schools and homes

Grade 6 - Science & Technology: Biodiversity

Students should be able to:

- Identify and describe the distinguishing characteristics of different groups of plants and animals (e.g., invertebrates have no spinal column; insects have three basic body parts; flowering plants produce flowers and fruits), and use these characteristics to further classify various kinds of plants and animals (e.g., invertebrates – arthropods – insects; vertebrates – mammals – primates; seed plants – flowering plants – grasses)
- Explain how invasive species (e.g., zebra mussel, Asian longhorned beetle, Purple Loosestrife) reduce biodiversity in local environments


**Figure 6.6 Pictures of students participating in Save the Leopard Frog education program and testimonials from participants.**

### 6.2.5 MULTICULTURAL OUTREACH AND EDUCATION PROGRAM

Increasing numbers of new immigrants continue to change the demographics of the lands that surround the Fletchers Creek. This shift in demographics has prompted Credit Valley Conservation (CVC) to develop a Multicultural Outreach and Education Program that will:

1. Enhance the ecological literacy of new immigrants and individuals representing ethnically and linguistically diverse cultures,
2. Develop partnerships with local agencies that work with new immigrants and diverse cultural groups,
3. Increase the diversity of participants in local environmental initiatives.

The Program is developed, delivered and implemented in conjunction with community-based organizations such as libraries, community centres, settlement agencies, religious organizations, seniors groups, retirement homes and language instruction institutions. Programs are FREE but do not include the cost of buses (where applicable).

In 2010, the first full year of implementation, the program hosted a total 21 events attracting 957 participants. A series of programs have been developed to provide opportunities for new immigrants and other members of diverse cultural groups to experience and learn about their local environment.

- Environment and Nature Week - The "Environment and Nature Week" program offers a flexible week-long schedule of nature-based workshops, presentations, and outdoor events delivered by Credit Valley Conservation staff in partnership with a local institution or agency such as a library or community centre.
- ESL Program – The "Experience Nature" program for English as Second Language (ESL) learners provides an in-class presentation and optional outdoor experience for the students enrolled in the English as a second language programs in the Credit River Watershed.
- Seniors Program – The "Experience Nature" program for seniors provides an indoor workshop and optional outdoor experience for seniors groups in the Credit River Watershed.
- Internship Program – The "Diversity Outreach Internship" program provides Canadian work experience opportunities to new immigrants to help them launch their career in the Canadian environmental sector. This program remains in development fro 2011.


**Figure 6.7 Example of educational material distributed to educate the community about the impacts of Religious Offerings to water quality.**

### 6.2.6 CITY, REGION AND OTHER EXTERNAL INITIATIVES

The City, the Region of Peel, and community groups/NGOs also have several stewardship related initiatives underway. Known initiatives include:

City of Brampton*

- Grow Green Environmental Master Plan
- Parks Naturalization Program (with CVC, TRCA, Others)
- Clean City (focus mainly on litter with some added themes)
- Flower City Strategy/Communities in Bloom (not necessarily environmental but interested at this point)
- Museums and Libraries - aid with education
- Plan, bylaw and policy review
- Economic Plan (with Green Economy component)
- Miscellaneous public education tools

* Note that some initiatives also include the City of Mississauga (lower reaches) and the Town of Caledon (headwaters). Given that most of the creek is in Brampton, Brampton has been the key focus of Stewardship and Education activities to date.

Region of Peel

- Residential Landscape Program - focused mainly on water conservation; offers site advice, workshops, and demonstration gardens
- Water Smart Peel - water conservation program aimed at the ICI sector
- Miscellaneous public education tools

Peel Board of Education

- Eco-schools Program - focuses on in-school environmental actions and programs
- Schools - participate in programs and hands-on activities on public lands

Community Groups/NGOs

- Credit River Anglers Association - aid with plantings and other projects across the Credit River watershed
- Community Environmental Alliance of Peel (focus on Brampton and waste)
- Sierra Club - aid with plantings across the Credit River watershed
- Garden and Horticultural Clubs - will be approached to aid with demonstration gardens and education
- Board of Trade - aid with promoting green business and the GCG program
- Service Clubs - aid with fundraising and hands-on projects.

### 6.2.7 CVC ACTIVITIES IN PHASE I OF FLETCHERS CREEK PROJECT

The following CVC activities were completed or in progress throughout 2009 and 2010:

Urban Outreach (UO)

- Greening Corporate/Institutional Grounds (GCG) - added City and Brampton Board of Trade as program supporters, initial outreach to select businesses/institutions underway, and discussing partnership opportunities with TRCA
- Your Green Yard - 6 workshops/presentations,105 participants, 2 neighbourhood residential plantings (9 homes), initial planning for demonstration sites underway in cooperation Habitat for Humanity
- Public Sites and Events - CVC Stewardship liaised with Brampton staff to site selection with Brampton staff; 3 volunteer plantings on public sites - 293 plants, 45 participants; assistance with CYC site planning; provided Green Cities activity at one Env. Nature Week
- Landscape Industry/Land Managers/Developers - initial workshop planning underway
- Other partnerships - Garden/horticultural groups - initial outreach underway

- Misc support for other Brampton environmental initiatives - Environmental Master Plan, Green Economy strategy, Property Standards bylaw (latter initial discussion underway)

Other Stewardship Programs

- Conservation Youth Corps - 2 public sites, 3,000 plants, summer program - 39 Brampton high school students, spring/fall programs - 200 Brampton high school students; 1 invasives replanting project (Hickory Woods) - 157 plants, 280 elementary students
- Rural Outreach - Brampton Fall Fair; Stream of Dreams

Education

- Multicultural Outreach - Nature and Environment Weeks, seniors tour of watershed, meetings with several multicultural and/or faith groups, environmental ESL classes - total 21 events, 957 participants
- Schools programs - Save the Leopard Frog (with Water dept.), Stream of Dreams (lead by Stewardship staff) - total 63 events, 3201 students, 12 schools, 1 Stream of Dreams mural installation

Forestry

- Reforestation on private land - 1 site, 2400 seedlings
- Naturalization on private land - 1 site, 1064 sq. m, 107 plants
- Contracted plantings on public land - 2 sites, 6832 sq. m, 1710 plants

### 6.2.8 CONCLUSIONS AND RECOMMENDATIONS

CVC will continue with and further its Stewardship and Education initiatives as follows:

Urban Outreach (UO)

- Greening Corporate/Institutional Grounds (GCG*)* - further develop details of City and Brampton Board of Trade involvement; recruit Brampton businesses/institutions as participants; further develop TRCA delivery in remainder of City
- Your Green Yard - continued neighbourhood workshops, presentations and plantings; further planning of Habitat for Humanity demonstration sites; possibly public demonstration site (TBD with Brampton)
- Public Sites and Events - continue as CVC Stewardship liaison with Brampton staff; further site planning with Brampton staff; volunteer plantings on public sites; assistance with CYC site planning; coordinate and/or participate in other public events
- School Sites - assistance with select schoolyard projects
- Landscape Industry/Land Managers/Developers - workshop delivery
- Garden/Horticultural groups - on-going outreach; possible partnership projects to be determined with the groups

- On-going support for other Brampton environmental initiatives - Environmental Master Plan, Green Economy strategy, Property Standards bylaw, other as needed

Other Stewardship programs

- Conservation Youth Corps - 2 additional public sites, on-going outreach to Brampton high schools, involvement in Hickory Woods invasives replanting project
- Rural Outreach - Brampton Fall Fair, on-going outreach to farmers and rural landowners in headwaters

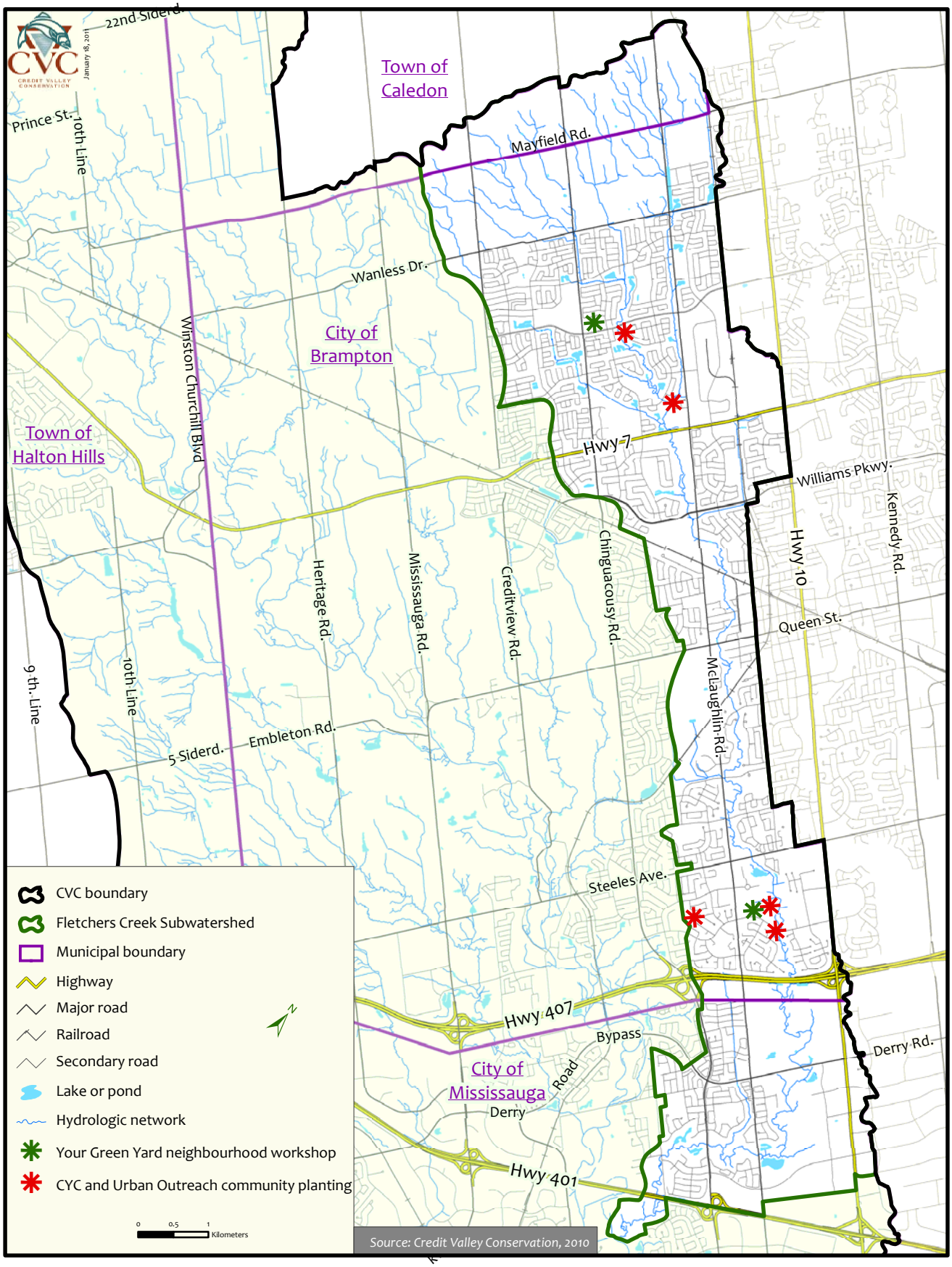
Education

- Multicultural Outreach - Nature and Environment Weeks, seniors activities, meetings with multicultural and/or faith groups, environmental ESL classes
- Schools programs - Save the Leopard Frog (with Water dept.), Stream of Dreams

Forestry

- On-going assistance with contracted sites
- On-going naturalization and reforestation projects on private lands as requested and available

***Figure 6.8 Stewardship Activities in Fletchers Creek***

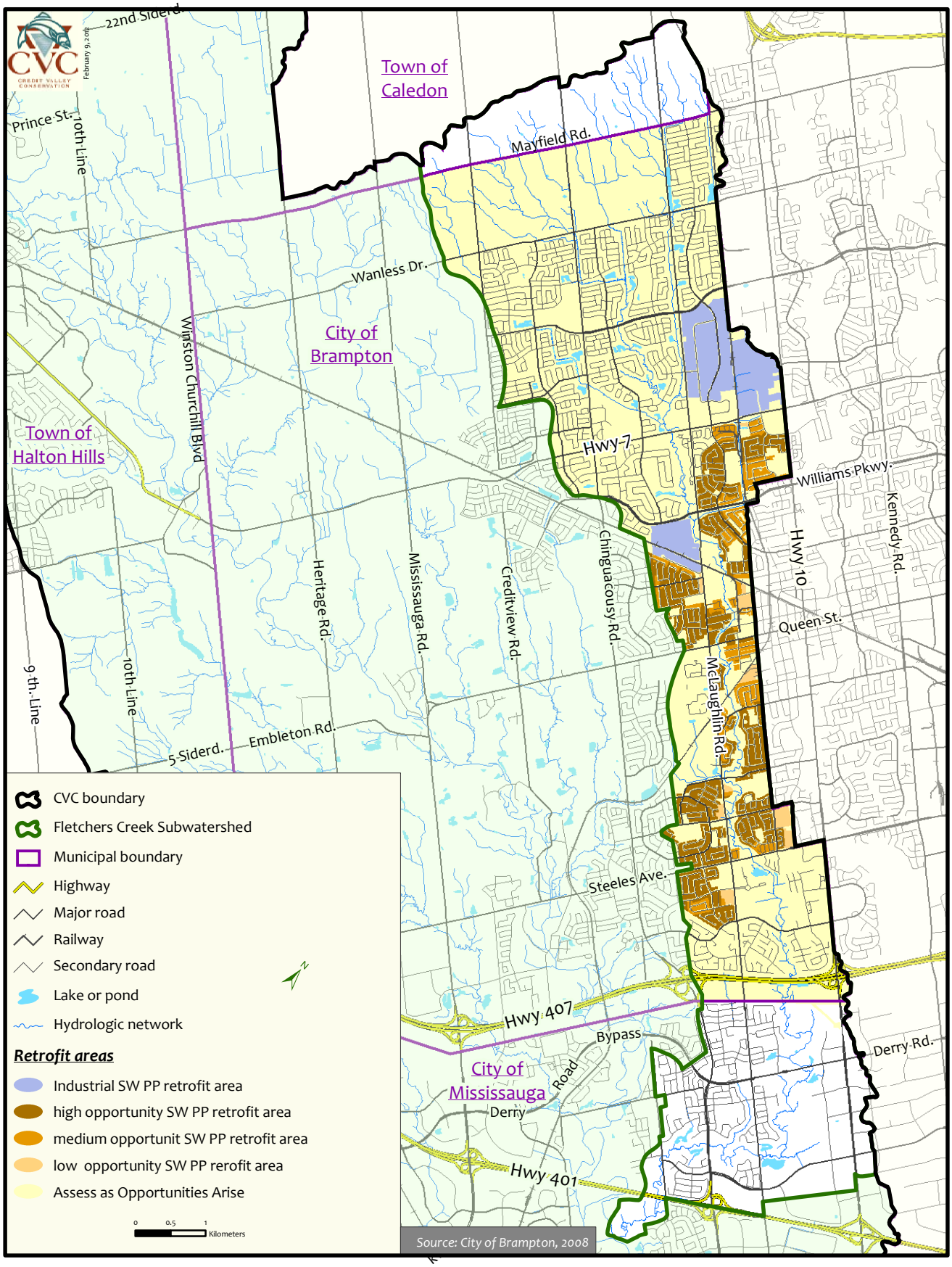


## 7.0 PRIORITY AREAS

A number of factors, including the placement of existing stormwater controls, Characterization Report results, age of development, land cover, and land use were assessed to identify opportunities for stormwater retrofit, pollution prevention, and education and outreach. Traditionally restoration is implemented as opportunities arise and has largely been successful when coupled with capital projects, like road reconstruction. For this reason, the Fletchers Creek Restoration Report provides baseline information on the land uses and land covers within the subwatershed for each of the four major land types – Residential, Public, Industrial and Commercial, and the Stream and Drainage Corridors. This method has been found to support to greatest uptake of restoration opportunities as it maximizes an often constrained municipal budget.

However, given the need to adopt a more aggressive approach to stormwater management analysis was conducted to identify priority areas to focus attention. The identification of priority retrofit areas provided in the figure below (Figure 7.1) is meant to guide efforts and assist the City of Brampton with their Stormwater Management Retrofit and Enhancement Study. Figure 1 identifies the area between Williams Pkwy and Steeles Avenues as a high priority area, and the industrial area northwest of Hwy 7 and Hwy 10. This portion of the subwatershed was mostly built before the implementation of stormwater controls and is largely characterized as low density residential with larger lot sizes and single detached homes. Monitoring results have also indicated poor water quality and increasing stream flow within this area. All other areas outside of high priority areas still provide significant opportunity and should not be discarded from consideration.

***Figure 7.1 Priority Stormwater Pollution Prevention Retrofit Areas***



## 8.0 NEXT STEPS

The City of Brampton, currently the 11th largest city in Canada, was identified by the province to be a high-growth municipality. Through significant efforts, including the development of the Environmental Master Plan and the Stormwater Management Retrofit and Enhancement Study, the City of Brampton has committed to protecting Fletcher's and Huttonville Creeks in light of growth. CVC aims to assist the City of Brampton with these endeavours through:

- Continued monitoring (including real-time flow and water quality for emergency response);
- Providing expertise and assistance as a member of the Stormwater Management Retrofit and Enhancement Study Steering Committee; and
- Providing comprehensive baseline information through the Fletchers Creek Restoration Study and Characterization Report.

Moving forward, CVC will continue to work in partnership with the City of Brampton and watershed stakeholders to implement innovative stormwater management practices and deliver pollution prevention programs. The Floating Islands project in Fletcher's Creek is a leading edge example of the City's commitment to protecting the endangered Redside Dace. This "First of its Kind" project has been a great success from a social and environmental perspective involving multiple stakeholders from the City to academic institutions, provincial agencies, local community groups within the city, consultants, manufacturers, and CVC. CVC has also partnered with the Toronto Region Conservation Authority and the Region of Peel to deliver the Partners in Project Green (PPG) to local businesses within Fletchers Creek in an effort to encourage the adoption indoor and outdoor green technologies (including tree planting, native landscaping, low impact development and pollution prevention). Through CVC's Leaders for Clean Water Program, CVC will continue to:

- Host professional development conferences;
- Conduct performance monitoring of LID sites to provide insight into sizing future stormwater systems;
- Provide assistance for LID plan review and construction of LID sites (both new and retrofit); and
- Develop retrofit tools and guidance manuals for municipalities, residents and private sectors on the design, construction, maintenance and monitoring of source and conveyance controls.

Through these initiatives CVC will continue to support the City of Brampton's efforts to implement recommendations from the Environmental Master Plan and Stormwater Management Retrofit and Enhancement Study as well as the objective to improve stormwater management with the Region of Peel's Term of Council Priorities.