Identifying Municipal Barriers Preventing the Adoption of Green Infrastructure
Stormwater Management in Ontario, Canada

by

Andrew Ferguson

A Thesis
presented to
The University of Guelph

In partial fulfilment of requirements
for the degree of
Master of Landscape Architecture

Guelph, Ontario, Canada

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ABSTRACT

IDENTIFYING MUNICIPAL BARRIERS PREVENTING THE ADOPTION OF GREEN INFRASTRUCTURE STORMWATER MANAGEMENT IN ONTARIO, CANADA

Ferguson, Andrew
University of Guelph

Advisory Committee:
Nathan H. Perkins
John Fitzgibbon
Sean Kelly

Green infrastructure (GI) has emerged as a strategic landscape approach to aid in creating more sustainable communities that benefit both people and wildlife. Despite the well-known social, economic and environmental benefits of GI in managing stormwater, many municipalities have been slow to adopt GI. To understand some of the factors impeding GI adoption this study conducted a comparative case-study analysis between two municipalities and two Conservation Authorities in southern Ontario with a focus on stormwater management (SWM). Interviews were conducted with four key informants and were analyzed using coding and theming. Results indicate a number of significant barriers including: a lack of experience by contractors in constructing GI projects, maintenance costs and complexities of GI, and the need for a cultural modernization within municipalities. The knowledge revealed through this study can benefit municipalities in overcoming barriers similarly experienced in municipalities in southern Ontario.

Keywords: Green infrastructure, stormwater management, planning, cultural modernization.
ACKNOWLEDGMENTS

I would like to acknowledge the many individuals who helped make my research aspirations a reality.

Firstly, I would like to express my gratitude and appreciation to my thesis advisor, Dr. Nathan Perkins, for his unwavering patience, encouragement and understanding along the way. I am grateful for his expertise, wisdom and generous guidance, which helped make the thesis process enjoyable from inception to completion. His constant support and assistance was paramount in defining the structure of my thesis and keeping me focused throughout the entire process.

Secondly, I would like to thank my committee member, John Fitzgibbon for his additional guidance and educational offerings he provided throughout the process. John’s knowledge, experience and unique insight allowed me to step outside the box and think of the bigger picture.

Furthermore, I would like to thank the key informants who participated in the early stages of this thesis and provided invaluable insider information to develop my data collection and provide me with a basis for my research. Rachel Prudhomme, Steve Auger, Shannon Carto, and Samantha Paquette were patient and kind enough to offer me their time and answer all of my questions knowledgeably and thoroughly. I couldn’t have completed this thesis without each of you.

Additionally, I would like to thank my mother Ann Ferguson for her unconditional support and encouragement. She created a positive and productive work environment, was patient with me and gave me up-lifting words when I was stressed and helped me stay focused and driven to complete my research goals.
Lastly, I would like to thank my partner Meaghan for her help, patience, love and countless hours of
listening to conversations about stormwater management. Through the ups and downs, she stood fixed by
my side and helped me stay focused on completing this journey. Without you it wouldn’t have been fully
possible.
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CHAPTER 1
INTRODUCTION

Overview

This chapter will briefly introduce the topic of green infrastructure and why it is an important topic deserving of study. This is followed by presenting the research question, the research problem, the goal and objectives of this study.

Formation of the Research Question

This research begun with the author’s professional experience working as a construction inspector and as part of a municipal team assembled to coordinate the construction of a low impact development (LID) demonstration project recently constructed (c. 2016) in Newmarket, Ontario, Canada. This project, the “Forest Glen LID Demonstration Project” involved creating a LID bioswale demonstration project to evaluate and advance our understanding of how LID’s benefit the environment. Since the project completion in the fall of 2016, I was naturally drawn to the field of green infrastructure (GI) and stormwater management (SWM). After some thought, the question behind this thesis was formulated and that is, “If GI is so beneficial for a number of perceived reasons why hasn’t it been implemented on a larger province wide scale?”

GI SWM technology has existed for a number of years but has yet to be meaningfully implemented in municipal watershed planning in Ontario as an alternative to conventional ‘gray’ infrastructure. Cities such as Portland, Oregon, which is ranked the most sustainable city in the United States out of the fifty largest cities, has successfully implemented GI as a strategic approach to better manage urban stormwater runoff (Netusil, Levin, Shandas, & Hart, 2014). “In 2007 the Portland City Council approved a green street resolution, report, and policy to promote and incorporate the use of green street facilities in public and
private development (NRDC Case Study, n.d., p. 2). Also, in “2008, the city launched a new strategy, the $55 million “Gray to Green” program to control stormwater runoff” (Netusil, Levin, Shandas, & Hart, 2014, p. 15). This program involved large-scale tree planting, procured natural greenspace to preserve ecosystem services, and encouraged green roofs as well as constructed 920 green street facilities, also referred to as bioswales (Netusil, Levin, Shandas, & Hart, 2014). That being said, Portland, Oregon is very much perceived as further ahead than the majority of municipalities in Ontario in respect to their rate of adoption of GI.

In Ontario, there is more of a need than ever for the widely believed benefits of adopting a Green Infrastructure strategy at the municipal scale, yet progress remains slow. The purpose of this thesis is thus to understand what might be the barriers in implementing GI with the stated assumption that GI is a positive approach to addressing SWM for both municipalities and conservation authorities (CAs).

Research Problem
Although GI SWM offers many benefits, the rate of adoption in Ontario municipalities has been slow and the barriers to adoption are not well known.

Research Goal
The goal of this research is to identify barriers that may inhibit medium-sized municipalities located in southern Ontario from adopting GI SWM practices and policies. The primary goal behind this study is not only to identify these barriers, but also identify potential ways of overcoming them.
Research Objectives

1. Describe the history of GI practices for SWM by exploring the literature.
2. Evaluate results of identified barriers and identify potential solutions for similar barriers.
3. Determine best management practices for municipalities wishing to address stormwater management issues by combining identified progressive approaches and the knowledge of professionals with practices demonstrated to produce results.

Summary

This chapter introduced the research question, goal, objectives and provides a brief rationale for the need to better understand barriers to GI implementation. The following chapters of this thesis are organized to expand on this premise through an introduction to GI and what is known in the literature review. The literature review is followed by the methods employed in this study, the results obtained and a discussion of the results. Finally, conclusions are offered and placed in a context of the extant literature.
Overview

The following literature review is organized into multiple themes. Firstly, this review describes how gray infrastructure works followed by a general description of the hydrological cycle before examining the development of conservation planning. Following this, the history behind the term ‘Green Infrastructure’ is presented before examining the evolution of stormwater management in Ontario. Once the history of stormwater management has been established, current stormwater management practices and strategies are discussed.

Conventional ‘Gray’ Infrastructure

Before GI can be discussed in-depth, gray infrastructure must first be examined. According to the Webster’s New World Dictionary (2010) “infrastructure” is defined as the “substructure or underlying foundation, especially the basic installations and facilities on which the continuance and growth of a community depends.” When people hear the word “infrastructure” they often think of the built environment including: roads, bridges, sidewalks, storm and sanitary sewers, watermains and utility lines, (Benedict & McMahon, 2001 p. 5). Infrastructure represents the basic foundation on which all civilized life has been constructed. It encompasses a majority of elements that can be easily observed such as: roads and bridges; and also elements that are unseen such as: utilities and sanitary sewers, which reside mostly underground.

The built environment is often characterized by the use of hard or impermeable surfaces, which drastically
alter natural hydrological functioning and cause distinct changes to urban microclimates, hydrology, and soil properties relative to natural ecosystems (Lundholm, 2015). Urban environments are known to discharge greater volumes of contaminated waters into natural hydrologic systems when compared with rural environments with far lesser degrees of impermeable surfaces as illustrated by figure 1.

Gray infrastructure, such roads, curbs, catch basins, and storm sewers, all work cohesively together to transport stormwater from source to sink. However, transporting stormwater through underground infrastructure systems can contribute to reduced water quality, increased water volumes in streams and rivers, and increased flooding and stream bank erosion. Conventionally designed SWM systems are no longer reflective of modern day SWM issues. Today’s climate is known to be changing, which in turn affects rainfall frequency and storm severity. Results from a recent study performed on precipitation and climate change in Ontario demonstrate an increase in precipitation intensity, duration and frequency from 1960 to 2010 (Soulis, Sarhadi, Tinel & Suthar, 2016). According to Soulis, et al. (2010) “If current trends continue, existing infrastructure programs and standards will require updates” (p. 4099). It has become clear that Ontario’s climate has undergone some degree of change, which has negatively

Figure 1: Flood Hydrographs for Urbanized and Natural Drainage Basins (Ministry of Environment, 2003)
affected the ability of current conventional infrastructure networks to manage larger volumes of stormwater than they were originally designed to manage. Conventional infrastructure, unlike GI SWM systems, are not designed to remove contaminants from the water before it is discharged back into the natural hydrological cycle (Jia, Tang, Luo, Li & Zhou, 2016). The need for SWM systems that reflect current stormwater management issues, such as reducing water quantity by controlling peak flows and allowing for infiltration as well as improving water quality by providing water filtration, is evident.

The Hydrological Cycle in Natural and Built Environments

![The Hydrological Cycle in Natural and Built Environments](Credit Valley Conservation Authority, Toronto Region Conservation Authority, 2010)

When any area is altered from naturally permeable surfaces to built impermeable surfaces that given area is no longer able to catch, convey and infiltrate surface runoff as it previously did. Figure 2 illustrates how
infiltration, evapotranspiration and stormwater runoff are affected as vegetation is removed and replaced with impermeable surfaces. For example, the picture in the bottom right corner in figure 2 depicts surface runoff in an urban area. Areas that are characterized by 75-100 percent impermeable surfaces generally only allow for 10 percent shallow infiltration and 5 percent deep infiltration. Conversely, areas that are natural and are covered in only vegetation, such as trees and grass, allow for 25 percent shallow infiltration and 25 percent deep infiltration. Natural hydrology is fundamentally altered when an area transitions from natural to urban or semi-urban. Greater quantities of impermeable surfaces used in urban environments reduce natural space for infiltration thereby increasing stormwater discharge. Conventional infrastructure is merely meant to help capture and channel water through an underground infrastructure piping system, which eventually transports it into streams, rivers and lakes. Added volumes of stormwater in these various water bodies can contribute to stream bank erosion and reduced water quality hence a greater need for a more sustainable SWM system.

The Development of Conservation Planning

The principle roots of modern day conservation and GI planning can be traced back to some of the well-known and highly recognizable works of the founder of Landscape Architecture, Frederick Law Olmsted (Eisenman, 2013). Conservation planning can be defined as the “process of locating, configuring, implementing and maintaining areas that are managed to promote the persistence of biodiversity and other natural values” (Pressey, Cabeza, Watts, Cowling & Wilson, 2007, p. 583). The primary goal in conservation planning is to identify essential flora and fauna habitat and to protect and enhance that habitat in order to preserve biodiversity. Areas that tend to harbor higher levels of biodiversity and include significant habitat tend to be identified as more essential areas to be protected.
The role of GI planning, although similar to conservation planning, does include some significant and fundamental differences. Firstly, GI planning places a large emphasis on conserving greenspaces, especially within the fabric of urban environments, to help identify, design and conserve local land networks in order to maintain healthy ecological functioning (Firehock, 2015).

Secondly, GI planning seeks to protect areas, which offer invaluable ecosystem services as well as other various types of environmental resources (Czechowski, Hauck, & Hausladen, 2015). The concept of GI planning places an emphasis on viewing natural resources such as wetlands or woodlands as vital infrastructure (Grant, 2012). A wetland is characterized by permanently or seasonally flooded areas and includes aquatic vegetation (Grant, 2012). Wetlands are a vital natural resource because they provide essential natural services such as flood control, water purification and infiltration, act as a carbon sink and provide habitat to both plants and animals (Czechowski, Hauck, & Hausladen, 2015). Woodlands on the other hand are also viewed as essential GI because they generally include trees, which help provide clean water and fresh air to people through the process of photosynthesis (Andersson, Barthel, Borgstrom, Colding, Elmqvisy, Folke & Gren, 2016). Trees naturally act as a carbon sink and absorb stormwater runoff, two processes which are particularly important for regulating climate and reducing water quality and quantity issues, especially within urban environments. “Tree canopy breaks the energy of rain drops, while the duff layer of the forest floor acts like a sponge, soaking up water, reducing the velocity of overland runoff and breaking down pollutants” (Firehock, 2015, p. 6). Although people sometimes forget about the important services both trees and wetlands provide, they are nonetheless essential natural components, which contribute to maintaining healthy communities.

Lastly, GI planning comprehensively focuses on the interconnected nature of greenspaces. GI planning
provides a framework, which outlines the importance of maintaining connected greenspaces through the use of planned links and hubs as shown in figure 3. It seeks to identify landscapes essential for maintaining healthy communities and endeavours to protect, enhance and connect greenspace as a whole at city or region scales. GI takes greenspace planning beyond the preservation of a few selected sites or a minimum quantum of recreational space” (Grant, 2012, p. 60). Modern day GI planning is more comprehensive than conservation planning because it takes into account: “existing landforms, biodiversity, flood management, water conservation, maintenance of microclimates and climate change adaption” (Grant, 2012, p. 60). GI planning aims not only preserve valuable greenspaces, which can incorporate significant landscapes and biodiversity, but to provide urban inhabitants with greater access to greenspace.
Historic GI: The Emerald Necklace

The first example of GI planning can be examined by looking at Boston’s Emerald Necklace – a system of interconnected parks and linked greenways. The Emerald Necklace, which was completed in the late 1890’s, remains one of Boston’s most unique and well-known environmental features (Eisenman, 2013). The necklace is composed of a number of parks, which are linked to each other through stream and land corridors. “This network of corridors and open spaces of over 1,000 acres was the first municipal-scale open-space planning project in the U.S.” (Austin, 2014, p. 6). Although Olmsted was involved in the design and construction of New York’s most renowned greenspace – Central Park – he believed that no single park, no matter how large, could ever provide people with the beneficial influences of nature (Benedict and McMahon, 2012). The creation of the parkway system was originally pursued to link Franklin Park in 1878 to a number of other existing parks and greenspaces within Boston (Little, 1995).

Figure 4: Map of the Emerald Necklace in Boston, MA, U.S.A. (Emerald Necklace Conservatory, 2017)
The Emerald Necklace, which is illustrated in figure 4, includes: the Boston Public Garden, the Boston Common, Commonwealth Avenue, the Back Bay Fens, the Riverway, Jamaica Park, Olmsted Park, Arnold Arboretum, and Franklin Park (Benedict and McMahon, 2012).

The growth of industry in the United States during the nineteenth century consequently facilitated an influx of people in large cities in the American Northeast and Midwest (Sinnett, Smith & Burgess, 2015). Following the growth of urban populations and industry during the industrial revolution, cities were beginning to experience declining ecological conditions and urban health issues. According to Sinnett, Smith & Burgess (2015) “this unprecedented urbanization led to a deterioration in the quality of life and physical infrastructure of cities, with poor living conditions, poor sewage systems, contaminated water, pollution and the ready spread of communicable diseases” (p. 12). Boston at this time was no different from any other growing American city. Urban expansion led to fragmented natural landscapes consequently disconnecting larger landscapes into smaller and more isolated patches (Austin, 2014). “In 1987 the Presidents commission on Americas Outdoors in the USA advocated green networks to provide people with access to open spaces close to where they live, and link together the rural and urban spaces in the American landscape threading through cities and countryside’s like a giant circulation systems” (Austin, 2014, p. 11). The end product produced by the commission advocated for a national network of corridors, which could connect residential districts to natural landscapes (Beckner, 2012).

The design of the Emerald Necklace also originated from proposed ecological improvements to restore and enhance the Back Bay Fens and Muddy River and also to mitigate flooding of the Roxbury lowlands (Eisenman, 2013). During this time, the Muddy River and Back Bay Fens had become extremely degraded ecosystems due to an over abundance of raw sewage accumulation. Raw sewage at this time was naturally
draining into the Muddy River and eventually into the Charles River through the Back Fens from several different sources including; Roxbury, Dorchester and Brookline (Eisenman, 2013). The accumulation of raw sewage eventually became permanently deposited in the basin of the Back Bay in the form of a residue that persisted in the mud flats. This residue inevitably killed what remained of the estuary’s original salt march ecology (Zaitzevsky, 1992). “When the Boston Park Commission surveyed the area in 1877, animal life could no longer survive in the waters of the Back Bay” (Eisenman, 2013 p. 293). Boston at this time also experienced regular flooding in the Roxbury lowlands every ten years following heavy rains when stormwater runoff coincided with high tides (Eisenman, 2013).

Olmsted sought to solve both the sanitary issues created in the Back Bay Fens and the Muddy River while mitigating flooding in the Roxbury lowlands by transforming the Back Bay fens into a public park through the creation of a tidal marsh, which is illustrated in figure 5 above.

In order for the restoration work that Olmsted proposed to be approved, he was required to convince municipal leaders to adopt a significant expansion of the project scope (Eisenman, 2013). “The rationale
behind the plan was very far from what was commonly understood as a park” (Zaitzevsky, 1992, p. 55). In doing so, Olmsted’s concept to restore the riparian systems essential to maintaining human health within the city while simultaneously mitigating flooding issues and connecting a plethora of urban parks within Boston to each other, was realized. An imagine of the Muddy River following construction in 1920 can be observed in figure 6.

To this day, the Emerald Necklace remains one of the most beautiful, recognizable and pioneering greenway systems in North America.

The History Behind the Term ‘Green Infrastructure’

The underpinning principles of GI are derived from multiple disciplines including landscape architecture and conservation planning, among many others. The term ‘green infrastructure’ was first used in a Florida report to the governor regarding land conservation strategies in 1994 (Firehock, 2015). The inclusion of the word ‘infrastructure’ emphasizes a connection to conventional infrastructure practices while the word ‘green’ implies a new and more sustainable way of thinking (Benedict, McMahon, 2001). According to
Firehock (2015), “combining the words ‘green’ and ‘infrastructure’ was intended to reflect the notion that natural systems are equally, if not more, important components of our ‘infrastructure’ and should be included in the planning process” (p. 10). Planning for roads, buildings and other various types of infrastructure is essential for the city planning process and to ensure smart growth. However, viewing greenspace, ecosystem services and natural capital as essential infrastructure components throughout the city planning process is another step towards sustainability.

It wasn’t until 12 years after the term ‘green infrastructure’ first appeared that the Environmental Protection Agency (EPA) in the United States begun to apply site scale GI for the purposes of managing stormwater more sustainably. In 2007, Low Impact Development (LID) emerged as part of the GI umbrella (Firehock, 2015). LID’s are a set of GI principles that seek to reduce the impact of development at the site-scale. “These approaches attempt to reproduce the predevelopment hydrologic regime through innovative site design and distributed engineering techniques aimed at infiltrating, filtering, evaporating, harvesting and detaining runoff, as well as preventing pollution” (Credit Valley Conservation Authority, Toronto Region Conservation, 2010, p. 74). For example, when a parking lot is constructed on an area that was once covered in natural vegetation, that area is no longer able to catch and infiltrate stormwater as it once did. The construction of a parking lot, and utilization of frequently used impermeable construction materials, impacts the ability of water to infiltrate on site naturally. LID stormwater solutions such as: bioswales, rain gardens, green roofs, infiltration trenches and other bio-filter technologies help manage stormwater on site rather than discharge it elsewhere throughout a watershed.

Furthermore, LID’s can also be designed to remove contaminates from stormwater through engineered biomedia materials. “Effective management of stormwater is critical to the continued health of streams,
rivers, lakes, fisheries and terrestrial habitats” (Credit Valley Conservation Authority, Toronto Region Conservation, 2010, p. 13). In all, LID’s help improve water quality, reduce water quantity discharge and reduce the impact of stream bank erosion by managing stormwater runoff on site, ultimately reducing the volume and intensity of stormwater flows.

The Evolution of Stormwater Management in Ontario

Over the last four decades, SWM policies and practices have evolved from basic conveyance controls to incorporate modern LID practices that reflect more sustainable solutions in response to growing water quality and quantity issues. During the mid 1970’s, the first attempts were made to control runoff flow rates (Credit Valley Conservation Authority, Toronto Region Conservation, 2010). “By the late 1980’s, water quality became an additional focus and in the late 1990’s, approaches to mitigate accelerated stream channel erosion were introduced” (Credit Valley Conservation Authority, Toronto Region Conservation, 2010, p. 15). This included the addition of erosion and sediment controls as well as flood control practices. After the year 2000, fluvial geomorphology, monitoring, groundwater infiltration and the effect of water temperature on aquatic habits became additional areas of focus. Fluvial geomorphology refers to the study of the form and function of streams and the interaction between riparian systems and the surrounding landscape (Credit Valley Conservation Authority, Toronto Region Conservation, 2010). More recent additions to the evolution of SWM in Ontario include the understanding of the impact of climate change, water balancing and budgeting as well as a focus on LID initiatives.

It is evident that present SWM practices didn’t evolve over night, but over a period of roughly 40 years. The approach to managing stormwater in the mid 1970’s was simpler than todays layered and multifaceted approach. As SWM practices have continued to develop, so too has the complexity in which they function.
Municipalities are required to work in conformance with conservation authority watershed management plans, which often address a multitude of concerns (Credit Valley Conservation Authority, Toronto Region Conservation, 2010). Despite the fact that SWM controls, facilities and policies have grown more stringent as new knowledge and new issues arise, both the Credit Valley and Toronto Region Conservation Authorities have reported “that the environmental health of their watersheds along with others in southern Ontario continue to decline as urbanization increases (Credit Valley Conservation Authority, Toronto Region Conservation, 2010). “Conventional stormwater management, which focuses on controlling peak flow rate and the concentration of suspended solids, has failed to address the widespread and cumulative hydrologic modifications in watersheds that increase the volume of stormwater, increase the runoff rate, and cause excessive erosion and degradation of stream channels” (Credit Valley Conservation Authority, Toronto Region Conservation, 2010, p. 16-17). Conventional SWM systems also fail to remove or treat contaminants such as nutrients, chemicals, metals or salts. In southern Ontario in particular, an over abundance of phosphorus is causing extensive water quality issues in streams, rivers and more importantly, lakes. For example, Lake Simcoe, which is encompassed in the Lake Simcoe Watershed along with the Town of Newmarket, has been experiencing declining water quality issues related with high levels of phosphorus found in the water. With heavy rains runoff often carries with it excess nutrients into storm sewer systems. Eventually, runoff water contaminated with nutrients finds its way into lakes as well as other groundwater sources. This is a growing concern in managing stormwater more effectively in order to improve water quality.

Stormwater Management Today

Conventional stormwater systems today were originally designed to manage stormwater by intercepting it from various surfaces and discharging what was believed to be mostly unpolluted waters downstream into
creeks, rivers, lakes and often groundwater sources (Jia et al, 2016). Due to a changing climate, which encompasses storm events with increasing severity and frequency, has also contributed to increased stress on conventional SWM systems. In recent years, watershed monitoring in southern Ontario has reported decreasing water quality in many watersheds. Results from a recent study, which is illustrated, in figure 7, project storm events to increase in number and severity over the next 25 years. Combined with increasing numbers of people living in urban environments and the expansion of impermeable surfaces in cities will only exacerbate SWM problems.

From the year 2014, to 2050, the global population is expected to grow from 7 to 9.1 billion people (Austin, 2014). It is clear that with a changing environment, more frequent and severe storm events and declining water quality that the time to take advantage of alternative SWM technologies is now. GI, such as biofiltration technologies, have

Figure 7: Predicted Change in Precipitation Trends in Ontario from 2010-2060 (Soulis et al, 2016)
the ability to intercept, store and infiltrate stormwater on site while also removing pollutants and increasing the volume of infiltrated water while simultaneously decreasing stormwater discharge.

Green Infrastructure

The definition of GI is constantly evolving in meaning and differs greatly depending on the context in which it is being applied (Austin, 2014). According to Eisenman,

“…green infrastructure encompasses both natural and engineered greenspace across spatial scales, resulting in an interconnected network of natural areas and other open spaces that conserves natural ecosystem values and functions, sustains clean air and water, and provides a wide array of benefits to people and wildlife”. (2014, p. 287)

GI also encompasses bio-filtration facilities such as rain gardens, green roofs, vegetation strips, infiltration trenches and bioswales as well as trees, and wetlands as they all contribute to SWM.

Rain Gardens

As their name would suggest, rain gardens are a type of garden that collect rainwater runoff. Rain gardens typically are located in the center of a depression at the lowest elevated point so that they are able to intercept surface runoff. Similar to conventional gardens, rain gardens utilize plants to absorb water and often allow for temporary water storage as infiltration occurs. Typically, rain gardens, which manage stormwater from roads and parking lots, are often designed to absorb and eventually infiltrate the first 12.5mm of rainfall (Credit Valley Conservation Authority, Toronto Region Conservation, 2010).

Generally, any volume of rain exceeding the first 12.5mm ends up in conventional SWM systems. They can also be engineered to remove pollutants (chemicals, fertilizers, metals and salts) from surface runoff, which is an added benefit when considering water quality contributions. Rain gardens often vary in size and shape and can be employed in a variety of areas to help manage stormwater on site while reducing
runoff discharge. They can be utilized in parks, parking lots, residential properties, commercial, industrial or institutional areas as well as roads to provide improved natural aesthetics while allowing for functional stormwater benefits.

Green Roofs

Similar to rain gardens, green roofs come in a plethora of shapes and sizes. Green roofs typically come in two types: extensive and intensive. “The extensive green roof has a soil depth of less than three inches (150mm) and is entirely vegetated with herbaceous and other low-growing plants” (Austin, 2014, p. 173). Conversely, intensive green roofs incorporate paved surfaces with planting areas, often more than three inches deep, which are used mostly as an amenity space (Austin, 2014). Typically, the structural demand on a given building is greater with intensive green roofs. Extensive green roofs, due to their low growing profile, can primarily function as a stormwater management system, which has added aesthetic benefits as
Green roofs are typically located on the roof of a building in order to intercept, absorb, treat and retain rainwater while preventing it from entering into the conventional stormwater system. According to Austin (2014), “rainfall captured by vegetation and soil on a green roof is evaporated and transpired after the storm ends” (p. 179). Green roofs typically provide added benefits to buildings in the form of a 15-25 percent saving in heating, cooling and energy costs (Austin, 2014). Additionally, green roofs provide habitat for flora and fauna, reduce air pollution and provide carbon sequestration.

Vegetation Filter Strips

Vegetated filter strips are another type of small scale GI that convey and treat stormwater runoff in small drainage areas (Ministry of Environment, 2003). “Generally, a vegetated filter strip consists of a level spreader and planted vegetation” (Ministry of Environment, 2003, p. 120). The goal of the spreader is to...
ensure uniform flow over the vegetation, which filters stormwater runoff and promotes infiltration of the runoff (Ministry of Environment, 2003). Typically, vegetated filter strips come in two types: grass filter strips and planted filter strips.

Infiltration Trenches

Infiltration trenches, similarly to vegetated filter strips, are often utilized for small-scale SWM. Infiltration trenches can be designed to intercept stormwater runoff and allow for subsurface storage of that runoff while rainwater is infiltrated into the ground. According to the Ministry of Environment (2003) “infiltration trenches can be implemented at the ground surface to intercept overland flows, or underground as part of a storm sewer system” (p. 102). Although for the most part, infiltration trenches all provide the same services, they can differ from one another aesthetically. Characteristically, infiltration trenches come in

![Infiltration Trench](image)

**INfiltration Trench**

Figure 10: Infiltration Trench Detail (Eulie, 2015).
varying depths, widths and sizes depending on their volume of water they are designed to capture and hold. Typically they do not incorporate plants into their aesthetic structure.

**Bioswales**

Bioswales which are sometimes referred to as bioretention swales, is a term often associated with LID SWM practices. Typically, bioswales are landscape elements designed to manage stormwater while also removing silt and pollution from surface runoff (Austin, 2014). Bioswales are characterized by gently sloping sides, on either side of the swale and are often filled with vegetation (Austin, 2014). Similar to rain gardens, bioswales come in a variety of sizes depending on their design intent. Bioswales can be designed to be both linear and curvilinear in shape depending on site-specific conditions.

**The Need for Green Infrastructure**

As can be seen in the literature review, the various types of GI in managing stormwater are well developed and understood. Municipalities in the U.S. and Canada have to some degree implemented GI initiatives and there are case studies that demonstrate the effectiveness and economics of varied systems in geographical locations with different climate and urban form. What has not been as extensively studied is the slow implementation of GI, even in circumstances that would lead one to believe that GI is the most appropriate strategy. Climate change and rapid urbanization have resulted in traditional SWM systems being inadequate and yet decision-makers, be they planners, engineers, landscape architects or policy makers seem to be reluctant to embrace GI in any systematic way. So while conditions appear to be forcing a ‘new’ way of approaching infrastructure challenges, GI remains woefully underutilized. Thus, the question still remains, why is GI taking so long to catch on, specifically in Ontario municipalities that are facing significant challenges in stormwater management?
This leads to the core rationale of the present study and that is to identify possible barriers to GI implementation. Because GI has been utilized in many geographical contexts and has been shown to be beneficial in SWM systems, the right time to study the ‘lack of adoption’ in Ontario seems appropriate.

Summary

This literature review discussed seven themes. The first and second themes examined the function of gray infrastructure and discussed the natural hydrological cycle. Next, the history of GI was examined by looking at the development of conservation planning as well as the formation of the Emerald Necklace in Boston Massachusetts, in the United States, as the first example of GI planning. Next, the term ‘Green Infrastructure’ was examined before moving onto the evolution of stormwater management in Ontario. Finally, current stormwater practices were reviewed. The next chapter will discuss the methods of this study.
CHAPTER 3

METHODS

Overview

This chapter will present the methods used in this study. Firstly, this chapter discusses how cases for study were selected, how the data collection method was designed followed by how the data was collected using key stakeholder interviews. Finally, the data analysis strategy is presented.

Selection of Cases

This study employed an exploratory multiple comparative case-study analysis between two medium-sized municipalities located in southern Ontario and two Conservation Authorities, also located in southern Ontario. The Towns of Caledon and Newmarket were selected for study based on convenience (i.e., geographical access by the investigator), familiarity with GI initiatives and a perceived difference in the rate of GI adoption based on anecdotal reports. The Town of Caledon is perceived to be on the forefront of municipal environmental policy because of their green initiatives and environmental oriented policies. In particular, the Town of Caledon has developed a Climate Change Action Plan, which seeks to reduce greenhouse gas emissions and mitigate climate change, develop responsibly, reduce energy use town wide and become more sustainable at the community scale.

The two Conservation Authorities selected for study were the Credit Valley Conservation (CVC) Authority and the Lake Simcoe Region (LSRCA) Conservation Authority. These CA’s were selected to supplement the information given by respondents #1 and #2 with the Towns of Newmarket and Caledon, and help clarify the structure in which both towns operate along with the local CAs’ in relation to watershed management planning.
Figure 11: Map of the Greater Toronto Area Within Southern Ontario (Anonymous, 2017). The Towns of Caledon and Newmarket are both emphasized on this map in order to indicate their geographical locations within the context of southern Ontario.

Below are brief descriptions of the four cases. These are discussed in the Methods as the characteristics of each case informed the key informant selection process to be discussed later.
Town of Newmarket

The Town of Newmarket is located roughly 54 Kilometers north of Toronto within the heart of the Region of York and is within the Greater Golden Horseshoe region of southern Ontario. The population of Newmarket in 2016 was estimated to be 85,000 residents (Town of Newmarket, 2016). Geographically, the town measures 38.33 squared kilometers in size (Statistics Canada, 2016). The Town of Newmarket was selected for this study due to the fact that it is a medium sized urban municipality in transition in regards to the adoption of GI for SWM. Although they have begun to integrate LID principles into many of their more recent capital projects, they have yet to adopt guidelines or policies that support the use of GI technologies town-wide. LID principles fall under the umbrella of GI.

Town of Caledon

The Town of Caledon is located roughly 52 kilometers west-northwest of Toronto in the Regional Municipality of Peel and is also within the Greater Golden Horseshoe region of southern Ontario. According to Statistics Canada (2016), the Town of Caledon is 688.15 square kilometers in area and has a resident population of 59,460 persons. It is worth noting that the Town of Caledon is 18 times larger in area than the Town of Newmarket. Caledon was selected for this study because it is progressive in environmental policy including: climate change, land planning and stewardship, watershed management and sustainable development. In 2003, the Town of Caledon was awarded “The Greenest Town in Ontario” by TVO (an Ontario educational television network) in recognition of its environmental leadership (Town of Caledon, n.d.). The Town of Caledon falls under the Places to Grow Plan, Niagara Escarpment Plan, Greenbelt Plan and the Oak Ridges Moraine Conservation Plan. Caledon is uniquely situated in a geographic location that requires the town to have higher imposed development regulations and policies than most municipalities’ (Town of Caledon, n.d.).
The Town of Caledon is more of a rural based township comprised of an amalgamation of villages, urban areas and hamlets. Caledon, unlike the Town of Newmarket, is less urban in nature and emphasizes growth that is more compact and less dense. In other words, Newmarket is a smaller, urban and highly developed whereas Caledon is larger, less dense and far less developed.

Lake Simcoe Region Conservation Authority (LSRCA)

The Lake Simcoe Watershed “sweeps across 3,400 square kilometres and 20 municipal boarders, from the Oak Ridges Moraine in the south to the Oro Moraine in the north, through York and Durham regions, Simcoe County and the cities of Kawartha Lakes, Barrie and Orillia (Lake Simcoe Conservation Authority, n.d.). A total of 400,000 residents call the Lake Simcoe Watershed “home”, including a total of 20 total municipalities boarders, 18 major river systems, 4,222 kilometers of riparian ecosystems and is home to 75 species of fish (Lake Simcoe Conservation Authority, n.d.). The LSRCA has collaborated with Newmarket on a number of select LID projects constructed within the Newmarket trails systems, parks, parking lots, and road right of ways. The LSRCA was selected to participate in this study due to their involvement with GI initiatives within the Town of Newmarket.

Credit Valley Conservation Authority (CVC)

The Credit Valley Watershed stretches through two total regions including Peel and Halton and is comprised of nine municipalities including: “the City of Brampton, City of Mississauga, Town of Caledon, Town of Erin, Town of Halton Hills, Town of Mono, Town of Oakville, Town of Orangeville, Township of Amaranth and Township of East Garafraxa (Credit Valley Conservation Authority, n.d.). The watershed is one of the more urban and ecologically diverse watersheds in southern Ontario (Credit Valley Conservation Authority, n.d.). The CVC was selected for this study based on its collaborative working relationship with
the Town of Caledon implementing watershed improvements as well as GI based projects.

Figure 12: **Municipal and Conservation Authority Government Structure.** This figure illustrates the structure in which the Towns of Newmarket and Caledon function together in relation to the LSRCA and CVC.
Data Collection

Two types of data were collected during this research study. An in-depth literature review, much of it presented in the preceding chapter, was utilized to identify: 1) possible GI SWM barriers, 2) municipal and CA decision-making structures and, 3) the most appropriate means for obtaining qualitative data from decision-makers in key roles. The second primary method of selecting data was in-depth interviews with a key-stakeholder from each of the cases.

Key Informant Interviews

The primary method used to collect information for the purposes of this study was achieved through conducting semi-structured interviews with key informants (Zeisel, 2006). This method was selected to accomplish three main objectives: 1) to determine whether the selected municipalities have undertaken GI projects or discussed developing GI policies; 2) to identify barriers inhibiting GI projects or policies; and 3) to determine potential or perceived solutions for overcoming barriers to GI projects and policies. All questions asked were done so in the context of each respondent’s professional experience with GI and SWM.

Identifying Key Informants

Key informants were identified in a variety of ways including; an established professional relationship, through my advisor, and through networking. Rachel Prudhomme, the Director of Engineering Services with the Town of Newmarket and Steve Auger, the Stormwater Management Specialist with the LSRCA, were both identified through previous professional relationships. Shannon Carto, the Climate Change Specialist with the Town of Caledon, was contacted through a former student colleague of my advisor, Dr. Nate Perkins. Furthermore, Samantha Paquette who works in the Watershed Management department at
the Credit Valley Conservation (CVC) as a Water Resource Specialist, was contacted via networking. Steve Auger assisted me in contacting Christine Zimmer, a Senior Manager of Water Protection and Restoration at the CVC who helped facilitate an interview with Samantha Paquette.

Contact with Key Informants
Key informants were contacted via email about participating in the research study. Once the key informants agreed to take part in the study, the location, date and time of the interview was determined. Prior to the interview, key informants were given more details about the purpose of the study.

Semi-Structured Interviews
In total, four separate in-person key-informant interviews were conducted during this study and were digitally recorded using Apple iPad Mini. Prior to the interview process, an Apple Computer Inc. Application called “Voice Recorder” was downloaded onto the Apple iPad Mini to allow for the interviews to be recorded and later transcribed into a Microsoft Word 2010 document.

Semi-structured in-depth interviewing, which combines predefined questions typically used in structured interviews with open-ended exploration similar to unstructured interviews, was chosen as the primary data gathering method to collect information from individuals about their professional opinions and experiences (Wilson, 2014). A total of four predetermined descriptive questions were asked during each interview. Descriptive questions “ask people to describe things and may provide insight or suggest areas for query that the researcher might not have considered” (Bradley & Harrell, 2009, p. 35). Each separate interview included a plethora of follow-up questions, also called “probes” in order to keep the interview flowing and to clarify answers given by the respondents (Zeisel, 2006). “Interviewers should also probe when they
think that the respondent has not told them everything they can; the answer provided is a “non-answer”, in that it does not answer the question; if the interviewer thinks the respondent has not understood the question; or if the respondent says “I don’t know” (Bradley & Harrell, 2009, p. 44).

During the interview process it was imperative that the researcher not lead any of the answers or offer any biased thoughts or opinions. “Interviewers must also stay neutral; this includes being neutral in probes, and also in verbal and nonverbal cues” (Bradley & Harrell, 2009, p. 68). When interviewers do not maintain a neutral discussion during an interview, they may influence or bias the data by affecting how respondents either interpret a question or respond to that question (Bradley & Harrell, 2009).

Interview Guideline for Municipal Key Informants

a. Can you describe what you know about Green Infrastructure?

b. Has your municipality/organization discussed GI policies or projects?

c. Do you think there are barriers to implementing GI policy or projects?

d. How did/could you overcome each one of these barriers?

Data Analysis

The data obtained for the purposes of this study was qualitatively analyzed through the use of coding and theming key-informant interview responses. Coding and theming is the process of sorting and organizing data, which enables it to be systematically analyzed (Bernard, Wutich, Ryan, 2017).

Upon completion of key-informant interviews, the recorded interview data was transcribed into text and analyzed using line-by-line analysis to identify themes. The goal of the analysis was to develop a list of
recurring themes, ultimately allowing conclusions to be made and municipal barriers to the adoption of GI for SWM to be identified. Technical, political and financial barriers were identified as well as potential or perceived solutions to help resolve the identified barriers.

Summary
This chapter presented the methods used in this research. It discussed what the research objectives were, how the data collection method was determined, and how the collected data was obtained and analyzed. The next chapter will discuss the results of the research.
Overview

This chapter will examine the results obtained through the semi-structured interviews and discuss the implications. As discussed in the preceding chapter, the aim of the semi-structured interviews with key-informants was to elicit what were considered to be barriers to the adoption and implementation of GI. This information was expected to be broad in scope and possibly include political, financial, and technical barriers to the adoption of GI at the municipal level in southern Ontario. A plethora of potential solutions to the barriers discussed are also given.

The following tables present the results obtained from interviews after coding and theming the transcripts. The results represent a comprehensive list of barriers identified by respondents #1 through #4. Although more than one respondent may have spoken of the same barrier to GI, no barrier was listed more than once regardless of how many times it was brought up. Due to the small sample size of data collected through this study, it made more sense to simply list each barrier once, than it did to reference how many times each respondent identified a single barrier. Comparing barriers based on the number of times mentioned could have potentially placed a larger emphasis on that barrier, even though more significant barriers may have only been mentioned once.

The barriers and potential solutions listed below have all been interpreted and summarized from the transcribed interview data. The data gathered from respondents #1 and #2 from the Town of Newmarket and the Town of Caledon were generally more comprehensive in nature whereas the data gathered from respondents #3 and #4 from the LSRCA and the CVC, were more technical in nature.
Figure 13: Green Infrastructure Barriers Summarized. This figure illustrates the three major themes and encompasses the individual barriers identified by respondents #1 through #4 as well potential solutions to the identified barriers.

### Interview Responses Coded into Two Major Themes: Barriers and Potential Solutions

#### Table 1 – Barriers To Implementing Green Infrastructure

**Technical Barriers**

- **Maintenance Complexities**
  - In order for Green Infrastructure to function optimally it must be maintained properly.
  - Operational maintenance staff can often be reluctant to maintain GI if they are unfamiliar with it or are not properly trained in maintenance procedures and practices.
  - There are such a wide variety of different types of GI with varying maintenance levels between each of them effectively making GI maintenance more unique and specialized work.

- **Lack of Educated and Experienced Contractos in Constructing GI Projects**

- **Lack of Properly Trained Municipal Staff**

- **Misconceptions of GI Project Costs**
  - Space Constraints
Operational maintenance can often be a complex issue because sometimes multiple departments can be responsible for maintaining different portions of a single GI feature (Parks, Forestry, Horticulture, Roads).

In some cases, property owners can be responsible for yearly maintenance in maintaining, a bioswale or rain garden for example. Property owners may resist becoming responsible for GI maintenance near or on their property due to the yearly time commitments and effort the upkeep takes. Often, people over estimate or misconceive how much yearly maintenance is required.

Property owners responsible for the upkeep of GI features should be, but are not always educated how to properly maintain GI.

Lack of Properly Trained Municipal Staff

A generational divide is evident. Within Municipalities, senior managers, project coordinators, and municipal decision makers may be reluctant to want to design, coordinate and implement GI projects because of a lack of familiarity, knowledge and experience.

Within municipalities, some staff have worked in one position or one area/department for an extended period of time and are more familiar with managing, coordinating and/or administrating conventional “gray” infrastructure projects making it easier for them to stick with what they know rather than with what they don’t know ("what’s wrong with the way we’ve always done it”?).

Municipalities come in all different shapes and sizes and all have varying organizational structures and staffing hierarchies. Not all municipalities have stormwater specialists who specialize in stormwater management with expertise in GI.

Lack of Educated and Experienced Contractors Constructing GI Projects

Currently, due to the limited utilization of GI in southern Ontario, a majority of contractors have little experience in constructing GI projects.

Generally, GI projects require great attention to detail, knowledge and understanding to construct correctly. Overlooking or not fully comprehending small details in the construction of GI can result in limited functionality.

Often, contractors with little or no GI construction experience will bid on publically available GI construction contracts because they are hungry for work.

Contractors bidding on GI projects generally have a limited understanding of the products and materials involved which can inhibit their ability to provide a fair and competitive price.

There is also a lack of training opportunities for contractors to become familiar with GI construction materials, products, construction techniques and practices. This lack of training and experience in building GI projects puts more pressure on contract administrators, inspectors, project coordinators and consultants to ensure proper construction is obtained.

Space Constraints

Space constraints are commonplace among municipal projects.

Existing underground utilities such as water mains, sanitary sewers, gas lines,
fiber optics, and telephone and cable lines often make optimizing the design and
construction of GI a complex process.

- Sometimes with GI projects there is also a lack of depth to construct GI features
  such as a bioswales. A high underground water table for example can also
  negatively influence infiltration capacity often making it difficult to construct and
  function optimally.

Misconception of GI Project Costs

- One of the issues currently inhibiting GI projects is the misconception about the
  costs. GI projects often don’t cost substantially more than the alternative gray
  infrastructure project.

Political Barriers

Changing the Cultural Mindset (“Going Green”)

- In order for GI to become a standardized construction staple in southern Ontario,
  a culture modernization in operational thinking will have to occur.
- We have to break out of the “gray” infrastructure only mold and push the
  envelope further to incorporate more sustainable solutions.
- No more excuses. Just because we’ve always done things a certain way doesn’t
  mean we have to keep doing it.
- For a cultural modernization to occur, municipalities will have to take a more
  progressive and sustainable approach from top to bottom within the organization.

Needing The Necessary Political Drive

- Within municipalities, council members may lack support or the political dive
  necessary for supporting GI projects or initiatives. Within some municipalities,
  council members often have an enormous impact on projects and the development
  of new policies. Having a strong and open municipal council that supports green
  initiatives such as exploring GI alternatives to manage stormwater can make all
  the difference in the world.

Financial Barriers

- In order to implement GI projects and policies, municipalities need to have
  adequate financial capitol.
- GI projects can cost more than gray infrastructure projects but they don’t have to.
- There is a misconception that the cost of GI projects is greater than conventional
  infrastructure projects.
- Sometimes implementing GI is actually cheaper than gray infrastructure
  depending on the scope and type of the project
- Retrofitting is generally more expensive than constructing GI on a new
  development site.
- People don’t always realize the intrinsic value of GI.
- GI projects often require more maintenance than conventional infrastructure
  projects. Budging for higher yearly maintenance costs can be a deterrent.
- Budgeting for more frequent maintenance can be difficult not only from a
  planning perspective but from a financial viewpoint.
Due to the fact that only a limited number of contractors have experience with pricing GI projects as well as building them, it can make obtaining a fair price for both the contractor and the client difficult.

### Table 2 – Potential Solutions For Implementing Green Infrastructure

#### The Power of Education

- Achieving a shift in culture is never simple. In order for municipalities to start implementing more GI projects and policies, people in general must become more aware and educated about GI procedures, practices, benefits and opportunities.
- Engineers, planners, policy makers, senior decision makers, designers, landscape architects, project coordinators and project administrators all need to become more educated in the field of GI.
- The public needs to also be educated about what GI is, why it’s important and about what environmental benefits it has to offer.
- Pilot GI demonstration projects help educate and inform the public by demonstrating how GI works.
- Public workshops about GI can be very informative, educational and engaging sessions that teach people about the need for the change.
- Community support for GI can positively influence municipal decisions and help encourage the willingness to become more sustainable.

#### Educating Contractors

- Educating contractors in order to teach them about GI construction materials, products and practices are just as important as educating the public or professional realms about green technologies and the benefits they offer.
- Providing contractors with the opportunity to visit partially constructed mock GI construction sites would allow them to become more familiar with the nuances and materials, with the conditions, utility constraints and all the potential conflicts that can arise during the construction process.
- It’s essential that information learned through the construction of GI projects and the development of GI policies is properly disseminated to the right sources so that the construction techniques and practices continue to progress forward.
- Learning from mistakes made during design or construction needs to be fed back into the information system in order to produce better designed and better built GI projects.

#### Provincial Support for GI

- Ultimately, the more support municipalities receive from the Provincial Government in the form of policies, regulations, guidelines, and government grants and funding, the easier it is for municipalities to implement GI projects.
- The Ministry of Environment and Climate Change is currently working on a supplement to the 2003 Stormwater Management Planning and Design Guide which will promote better GI design and increase the frequency of GI technology use in managing stormwater.
By providing an update to the supplemental guidelines for Stormwater Management Planning and Design, the provincial government is providing a language that can be adopted as a requirement at the municipal government level. Once updated regulations are approved and delivered by the Provincial Government of Ontario, municipalities’ will be able to start to undergo an organizational modernization that allows them to integrate more GI projects and GI focused policies.

Incorporating GI Maintenance into Everyday Maintenance Practices is Important
- Offering educational training sessions that teach maintenance professionals how to maintain GI are quintessential.
- GI projects often vary greatly from project to project. The professionals maintaining GI need to be informed about the nuances of the upkeep and know how to properly maintain each and every one.
- Incorporating GI maintenance into daily, monthly or yearly maintenance procedures is important and can ensure adequate maintenance is performed.
- Prior to municipal construction of GI projects, all known maintenance procedures by all necessary departments must be discussed and agreed upon to prevent any potential for confusion or cross-departmental struggle.

Developing and Enhancing Municipal Stormwater Master Plans
- Developing or enhancing stormwater master plans is an essential step towards managing watershed runoff effectively and efficiently.
- Developing a stormwater master plan allows for a watersheds to be managed holistically and for GI projects to be coordinated together rather than just on a project to project basis.
- There is a need to develop a stormwater management plan in conjunction with municipal Water and Wastewater departments because stormwater makes a big impact on Water and Wastewater functions.
- GI projects by themselves can be very beneficial for a local site but the key to managing stormwater effectively lies in the ability of GI projects to be incorporated into watershed management as a whole.
- Stormwater master plans can allow for problematic stormwater areas to be identified and made a priority for potential GI projects.
- Having a stormwater specialist or stormwater department within a municipal workforce is an important step towards managing stormwater and coordinating GI projects. Having the right staff in place can help ensure the success of GI projects as a whole.
Discussion of the Results

Despite the fact that GI has existed for some time now, municipalities have been quite slow to adopt and implement the range of GI projects possible. Most of the information contained in the literature review section helped to frame the history of GI as well as associated benefits. While there is substantial information available to municipal decision-makers very little information was found that identifies the barriers in developing and implementing GI at the municipal level (Benedict and McMahon, 2012). The sections below compare and contrast the results in the context of the literature.

Comparing and Contrasting

In order to illustrate the different perspectives from each respondent, this section will be divided into three categories based on the barriers, which as previously mentioned are as followed: Technical Barriers,
Political Barriers, and Financial Barriers. Each category will contain a simplified figure summarizing the known barriers discussed throughout the interviews with all four respondents.

Technical Barriers

A technical barrier can be considered an obstacle that needs to be overcome in terms of education, physical and maintenance operation, time, support and training among other things. This barrier is significant as it encompasses the actual creation of a GI system and without understanding these technical difficulties municipalities will not be able to overcome them in order to proceed with the process.

Table 3 – Technical Barriers

<table>
<thead>
<tr>
<th>Municipality</th>
<th>Technical Barriers</th>
</tr>
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<tbody>
<tr>
<td>Respondent #1 (Newmarket)</td>
<td>• Lack of interest in operational maintenance</td>
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<tr>
<td></td>
<td>• Misconceptions of time spent on maintenance</td>
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<tr>
<td></td>
<td>• Lack of public support and awareness of GI</td>
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<td></td>
<td>• Lack of education about stormwater, where it goes or how large volumes can reduce water quality and affect the environment</td>
</tr>
<tr>
<td>Respondent #2 (Caledon)</td>
<td>• A lack of trained staff that know how to maintain and incorporate GI into the urban landscape</td>
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<tr>
<td></td>
<td>• Budgeting for the maintenance of LID’s post construction</td>
</tr>
<tr>
<td>Respondent #3 (Lake Simcoe Region Conservation Authority)</td>
<td>• Lack of education and experience for contractors in GI SWM projects</td>
</tr>
<tr>
<td>Respondent #4 (Credit Valley Conservation Authority)</td>
<td>• Lack of staff training on operational maintenance</td>
</tr>
<tr>
<td></td>
<td>• Space constraints</td>
</tr>
<tr>
<td></td>
<td>• Utilities</td>
</tr>
</tbody>
</table>
Comparison

The respondents from the Towns of Newmarket and Caledon provided a wide array of technical barriers inhibiting the adoption of GI projects and policies. Both respondents touched on the importance of education in relation to having adequately trained staff members that have the necessary skills to design and implement GI projects as well as having properly trained operational maintenance staff. Respondents #3 & #4 with the LSRCA and the CVC also brought up this same point, and it is a significantly important barrier among all respondents. GI systems are far more complex and multifaceted than most conventional stormwater systems; however, they also provide many more significant benefits to people and the environment through more sustainable stormwater functioning (Firehock, 2015). In order for GI systems to function optimally, they need to be designed appropriately, constructed correctly and maintained properly. If errors, oversights, under sights or any unexpected issues arise during design, construction or post construction, and are not mitigated appropriately, optimal functioning of GI stormwater systems potentially can become reduced (Credit Valley Conservation Authority, Toronto Region Conservation, 2010).

The Town of Newmarket has only recently adopted GI. For example, according to Respondent #1, there “was an education process with staff as well so that they started feeling more comfortable looking at LID’s right away and not just adding it in to make it look like we tried, but really making it work”. The Town of Newmarket, although relatively new to the world of GI has started to utilize GI technology and practices on various capital projects (parks and trails) as well as with development planning. Whenever new developers come to Newmarket, the Town deliberately attempts to get them to examine the possibility of incorporating LID features into their site if feasible before falling back to conventional SWM systems.

Similarly, Respondent #2 with Caledon also touched on this same topic of looking at the potential for
implementing LID’s wherever possible. Respondent #2 however, provided a situational example of an issue that can occur when proceeding forward with GI. Respondent #2 discussed how consultants could design an LID for a particular area even though the design or the area that the GI is being proposed for may not make complete sense. In other words, consultants are generally willing to produce a deliverable design in order to get paid even though a given proposal may not make comprehensive sense because they are often hungry for work. According to Respondent #2 “we did one project where we did permeable pavement. I don’t know if they (the consultants) knew how sensitive that is to the environment. They put it in a place where there wasn’t a lot of protection in terms of the surrounding area. As soon as the rains would come it literally was like pushing all the water into this area, which they thought was great because you get lots of infiltration but it also carried with it all the silt and sand that was coming from the uplands and they really didn’t think about it and it clogged”. Respondent #2 went on further after making this point to discuss how such an issue can be an inhibiter for future GI projects alike. Executing GI projects just to implement them isn’t the most effective way to approach the adoption of such systems at the municipal level. In order for municipalities to continue to design, implement and construct GI projects, the projects themselves need to make sense and need to function as they are intended to function, otherwise, it can inhibit municipalities from continuing down this road to a more sustainable SWM practice.

Contrasting

While both Respondent #1 and #2 did discuss the operational maintenance related with GI and LID sites, they both approached it from different perspectives. Respondent #1 talked about the misconceptions of time spent on maintaining for example, an LID garden or bioswale. According to Respondent #1, people are not often favourable to having such systems located near or on their property because of the associated garden maintenance that comes with it. According to the information provided by Respondent #1, most
small to medium sized gardens only often require a couple of hours of maintenance per season which is far less than most people tend to think. Although GI systems generally require more frequent maintenance than conventional infrastructure systems, the benefits of GI often outweigh the disadvantages (Benedict and McMahon, 2012).

Respondent #2 also touched on the subject of misconceptions related to GI maintenance; however, they examined the difficulty of budgeting for operational maintenance and identified it as a barrier toward implementing GI projects and potentially, policies. If homeowners who live near a GI feature and aren’t responsible for maintaining it, the municipal entity in which the GI falls is usually responsible for maintaining it. GI projects are far more complex and variable than conventional systems; therefore, the maintenance of such features can be a deterrent toward implementing them (Benedict and McMahon, 2012). According to Respondent #2 “from my understanding with LID, the maintenance is the hardest part. That’s where the money comes in and some of our engineers are aware of that so they don’t want to take them on”.

Technical Barriers Identified By Conservation Authority Respondents

As previously mentioned, both respondents #3 & #4 discussed the difficulties in implementing GI projects due to a general lack of education and experience in constructing and maintaining GI. In particular, respondent #3 with the LSRCA explained the lack of experience currently observed in contractors responsible for constructing GI projects. According to respondents #3 “there’s the challenge right now in implementing these projects because contractors are only so experienced with green infrastructure”.

Similarly, respondent #4 discussed the difficulties observed in providing adequate maintenance to GI
features as operational maintenance staff responsible for maintaining GI features often receive a lack of training. According to respondent #4 “there is such a wide variety of different types of green infrastructure with varying maintenance levels between each of them” which is one of the reasons why GI maintenance is so challenging. In order to provide adequate maintenance to GI features, operational staff responsible for maintaining different types of GI will have to be trained separately on the various types. Respondent #4 also discussed the difficulties of designing GI within utility constraints such as watermains and gas-lines.

Outcome/Solution

Respondent #1 and #2 also briefly discussed the importance of educating the general public through GI initiatives as well as constructing demonstration sites to bring positive attention to the many benefits of GI. When speaking about the importance of educating the public, Respondent #1 said, “we need to communicate it. We need to almost shame people into not wanting to do it the wrong way anymore”.

Similarly, Respondent #2 also examined the importance of seeing the intrinsic value in GI projects. According to Firehock, (2015), “many scientific studies demonstrate that restoring ‘natural infrastructure’ can reduce significantly the damage from storm surges”(p. 1). Understanding the true value of GI, although difficult, is quintessential towards understanding how it can be environmentally and financially beneficial. Although respondent #2 did not approach it from the same angle as respondent #1, they did have this to say: “yeah. I think people aren’t realizing the value. People assume that it’s not going to fix a problem. It’s just a nice thing to have”. Both of these points reinforce the fact that education is paramount in gathering financial, political and technical support in order to continue to allocate, time, money and other various resources into developing GI projects as opposed to conventional SWM Systems.

Communicating the many benefits of GI can be achieved in a number of ways. In order for employees to
feel more comfortable in implementing and maintaining GI technology, they must first be adequately trained. A plethora of courses and educational modules are available in classroom format, or online, which offer information about GI including the principles and maintenance of GI features (Credit Valley Conservation Authority, Toronto Region Conservation, 2010). Even in situations where traditional engineers, planners or project coordinators lack knowledge and experience in relation to GI, it is possible to educate them. That being said, municipalities have to be willing and able to want to educate their employees. Not only does this process often cost money, but it takes time as well. Smaller municipalities like Caledon, appear to be in a position where they must first catch up with departmental projects and operations before they really dive further into adopting GI projects and policies. Conversely, larger municipalities such as Newmarket appear to have more resources to help fund GI projects.

Educating the public and making them aware of the benefits of GI is also an essential part of the process. Towns like Newmarket and Caledon are both still at a point where they are implementing and constructing what are called ‘LID Demonstration Projects’. The goal of these projects is to bring awareness to the benefits of GI by constructing GI projects in public areas where people not only see them being constructed, but see them functioning (Credit Valley Conservation Authority, Toronto Region Conservation, 2010). Once GI has been firmly established within municipal practice, municipalities will be able to move further away from just piece meal GI projects such as LID demonstration projects and start looking at GI as a whole in regards to water balances and the management of entire watersheds.

Political Barriers

A political barrier can be considered any politically based obstacle that inhibits any municipalities from adopting GI projects and policies. This can include council support, adequate resources, cultural mind-set
and being able to pass policies at the municipal level in order to proceed with the implementation.

<table>
<thead>
<tr>
<th>Municipality</th>
<th>Political Barriers</th>
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| Respondent #1 (Newmarket)                        | • Culture change for the public  
• Council support or lack of support for undertaking GI initiatives                     |
| Respondent #2 (Caledon)                          | • Staff interest and drive to implement GI projects  
• Having adequate resources to pursue GI projects  
• Changing the cultural mind-set and shifting the mentality of the public  
• Seeing the intrinsic value in GI to help increase water quality and reduce water quantity  
• N/A                                                                                   |
| Respondent #3 (Lake Simcoe Region Conservation Authority) |  
• Potential cross departmental struggle with a lack of stormwater management departments |
| Respondent #4 (Credit Valley Conservation Authority) |  
• N/A                                                                                   |

Comparison

One of the more significant barriers which was identified by both respondent #1 and #2 is the need for a cultural change or cultural modernization in relation to using GI first before looking at conventional systems. Both respondents touched on the fact that it is difficult to change the way municipalities think and operate. For example, when looking at the data given by respondent #1 it brings new light on the political difficulties of undergoing such a change. According to respondent #1 “some people see us as a little fanatic about it because we’re really pushing this but really we wish we could reach more people and educate them and change the culture. It takes a long time to change the culture”. Creating a cultural change or cultural modernization in the way municipalities operate although difficult, is no doubt achievable with time (Norwine, 2016).
Similarly, respondent #2 had this to say: “I think one is a lack of trained staff. In our case we have people who have been at the town for a very long time”. As professionals move through their careers it becomes harder to learn new things or new ways of operating after working for so many years. Not only is it difficult for people to learn about new procedures and practices but also it is difficult for municipalities to force professionals into managing and administering projects they know very little about which is one of the many reasons why cultural changes happen at such a slow rate (Norwine, 2016).

Both respondents from the Town of Newmarket and Town of Caledon examined the important influence that an elected municipal official or group of officials can have towards the implementation of GI projects and policies. Neither respondent #1 nor #2 discussed council members acting as a barrier toward GI but mentioned that there is potential for such an issue within any municipality. It is apparent that some municipalities located within southern Ontario may be susceptible to a lack of political support for GI. Both respondents elaborated on how the Newmarket and Caledon council members have been supportive and influential of GI projects. When talking about Caledon’s council, respondent #2 had this to say: “we have a strong council. I’ve worked with a couple of council members on projects that are a bit more green and they’re always supportive of it”. Similarly, respondent #1 reiterated the importance of a strong and supportive council toward GI initiatives by saying: “we’re fortunate here in Newmarket because our council is very open to being more environmentally friendly and they’re ready to accept change in that direction”. Having political support for GI initiatives, projects and policies is quintessential in having the ability to adopt GI at the municipal level (Firehock, 2015).
Contrasting

Respondent #2 did talk about a few barrier related issues that were different from respondent #1. For example, respondent #2 discussed the importance of seeing the intrinsic value of GI in relation to how wetlands function (Firehock, 2015). “I think with municipalities’ there’s a lack of having a business case for green infrastructure – showing the payback, the economic cost versus the paybacks that you see”.

Respondent #2 stressed the importance of seeing the intrinsic value in order to place a high return value in using GI over conventional infrastructure for SWM. This is a barrier because it is very difficult to assess the actual value of a GI feature, such as a bioswale or a rain garden, over implementing conventional stormwater infrastructure. GI functions similar to the way certain ecosystem services function such as a wetland (Austin, 2014). Wetlands provide water storage and water filtration, which provide enormous cost savings in relation to water and wastewater treatment plants. As wetlands disappear, water treatment plants must be expanded to maintain the same level of service provided by a wetland (Firehock, 2015).

Water that enters a GI feature is often captured, retained and stored on site while the water is allowed to infiltrate (Credit Valley Conservation Authority, Toronto Region Conservation, 2010). Conversely, conventional systems help capture and discharge stormwater often downstream, which generally creates higher peak volumes, which in turn negatively impacts water quality and water quantity (Credit Valley Conservation Authority, Toronto Region Conservation, 2010). Respondent #2 referred to the fact that assessing the ability of GI to mirror ecosystem services is difficult to put a price on.

As the need for GI continues to increase, municipalities may begin to take more advantage of GI alternatives to conventional systems in order to reduce stormwater quantities entering aquatic systems as well as improve water quality in streams, rivers, lakes and groundwater sources.
Political Barriers Identified By Conservation Authority Respondents

Both respondents #3 and #4 with the LSRCA and CVC didn’t have a whole lot to say on the political side of implementing GI. That being said, respondent #4 explained the potential for cross-departmental struggles when discussing operational maintenance barriers. It is apparent that often multiple departments, such as parks, forestry, horticulture, and roads, can be responsible for performing maintenance in and around a particular GI feature such as a bioswale located with the right of way. According to respondent #4 “there’s also a struggle between who does what because when you have a bioswale, you’ll have trees, shrubs and perennials potentially but you’ll also have the underground infrastructure so you might have four different departments maintaining a single feature”.

Outcome/Solution

As employees currently working in municipalities move on to bigger and better opportunities, prospective hires for GI or stormwater specialists arise. Outside of the jobs that become available as another professional moves on to a new opportunity, stormwater management is likely to become more of a permanent fixture in municipal engineering departments. In doing so, Towns like Caledon and Newmarket are afforded new chances to hire workers with knowledge and experience in implementing GI projects and policies. Having in house staff that understand the benefits of GI and possess the technical knowledge related to GI is quintessential in order to adopt GI at the municipal level (Austin, 2014).

It’s easy to see how assigning a numeric value to GI can be difficult. What’s important to understand here is that water runoff has to go somewhere. More wetlands usually lead to less treatment plants, which have enormous cost saving implications (Firehock, 2015). Similarly, GI features help store water and reduce
large quantities of runoff from entering into streams, rivers, lakes and especially water treatment facilities (Credit Valley Conservation Authority, Toronto Region Conservation, 2010). Moving forward, this value may become clearer and better understood which would only further support the stormwater benefits of GI. As municipal decision makers, council members and even the public begin to understand the hidden value that GI has to offer, the level of opposition or resistance to GI projects may begin to decline.

As sustainability continues to become a topic of focus for municipalities alike, political support from council members will likely only increase as the momentum for GI continues to build. As more municipalities located in southern Ontario or even around the world successfully implement GI projects and policies on a much larger scale than currently observed, political support for GI will likely grow.

Providing training opportunities to educate both contractors responsible for constructing GI as well as maintenance staff responsible for maintaining GI will be essential to the expansion of GI at the municipal level. Right now, the LSRCA is in the process of bridging the barrier between contractor and GI by providing mock construction sites for contractors to learn from, enabling them to be better equipped to construct GI projects properly. According to respondent #3 “the instructors and the contractors can get in there and talk about the nuances with the materials, with the conditions, with the utility constraints, with all the different curve balls that come at them and work through that”. This represents an effective way to work alongside the contractors responsible for constructing GI projects and to educate them about the construction process in order to reduce issues experienced during construction or post construction of GI.

Discussing how the upkeep of a particular GI feature will be carried out prior to construction can reduce the struggles of cross-departmental maintenance. By establishing, identifying and separating maintenance
staff roles before GI construction commences it will allow for a reduction in these struggles.

Financial Barriers

A financial barrier is any obstacle involving budget, resources, funding opportunities, and general finances within a municipality.

### Table 5 – Financial Barriers

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<thead>
<tr>
<th>Municipality</th>
<th>Financial Barriers</th>
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| **Respondent #1 (Newmarket)**                    | • Perception of costs to implement policies and projects  
|                                                  | • Having adequate finances to implement GI projects/policies for educational programs we need but also for retrofits which is more expensive than starting from the ground up |
| **Respondent #2 (Caledon)**                      | • The misconception that the cost of GI projects are generally greater than conventional infrastructure projects |
| **Respondent #3 (Lake Simcoe Region Conservation Authority)** | • Getting GI projects priced accordingly                                                                  |
| **Respondent #4 (Credit Valley Conservation Authority)** | • Maintaining budget                                                                                   |

**Comparison**

Respondents #1 and #2 both discussed the financial difficulties of implementing GI projects. They both brought up the point that GI is quite often perceived as a much more expensive alternative to conventional stormwater systems; however, according to both respondents from the Towns of Newmarket and Caledon, GI is actually a cheaper and more effective option than conventional stormwater systems. Understanding the economic implications of SWM decisions is an important step toward seeing the value in utilizing GI and preserving significant environmental areas that contribute to the generation of clean drinking water.
For example, New York City spent 1.5 billion dollars to procure 80,000 acres of land within their watershed to restrict development and protect water quality. According to Firehock, (2015) “while this was a large sum of money, it was far less than the $8 billion required to build an adequate filtration plant and an additional $300 million annually for its operating costs” (p. 8). Although this is a different example than the ones provided by respondents #1 & #2, it nonetheless frames the importance of understanding the economic value in using nature to manage stormwater.

Respondent #1 discussed the importance of having adequate financial support in order to afford to train internal staff as well as the general public. According to respondent #1 “we tend to forget to mention it because we think everyone knows that the number one problem is having enough money to be able to have the educational programs we need, but also do the work and do our changes because retrofitting is very expensive”. Respondent #2 approached the same topic of having adequate financial support by looking specifically at the comparisons in cost between GI versus gray infrastructure in the same situation. Respondent #2 had this to say: “I think the misconception is that it’s really expensive to do it the green way. Unless we can show a quick turn around on that investment there’s usually push back on it”. In light of the information given by respondent #2 there appears to be a small window of success for municipalities like Caledon who start out before many others in their adoption of GI. Municipalities that are just beginning to experiment with GI for the management of stormwater runoff are likely to encounter far more resistance and opposition. It is apparent that when someone or something tries something new for the first time that errors are likely to occur along the way. Well this is the case with GI just like anything else. Multiple iterations are often observed before the final solution to making GI work more efficiently and can be effectively understood.
Contrasting

Overall, there were not a lot of significant contrasting differences in the discussion centred on the financial aspect of developing GI between respondents #1 and #2. At the end of the day, having adequate resources to finance GI initiatives and GI projects is a common issue between both the Town of Newmarket and the Town of Caledon.

Financial Barriers Identified By Conservation Authority Respondents

Both respondents #3 & #4 with the LSRCA and CVC identified financial barriers. According to respondent #3, “Within reason we still want these projects to be priced appropriately and we want to get bang for the buck”. It is essential that contractors, municipalities and conservation authorities find a fair price medium for GI projects. Doing so will provide contractors with compensated work while contributing to effective financial management of GI projects for government agencies. Respondent #4 also discussed the importance of maintaining budget not only in the implementation or construction of GI projects but also concerning maintenance budgets.

Outcome/Solution

GI, like any other type of infrastructure or physical municipal asset, costs money to design, build and maintain. Finding funding opportunities to support these types of green initiatives is never easy. Right now, many municipalities such as Newmarket and Caledon are currently benefiting from the financial support offered by both the province as well as conservation authorities towards GI projects.

For example, as discussed by respondent #1, the Town of Newmarket is currently benefiting from an 18-month financial grant to support developing a stormwater management fee in the tax base. The Ministry of
Environment and Climate Change (MOECC) has provided Newmarket with a year and a half worth of financial funding to go towards educating other municipalities on how to develop a stormwater management fee in the public tax base in order to provide sustained funding for stormwater infrastructure maintenance as well as developing GI projects. The provincial grant provided by the Government of Ontario also goes towards funding stormwater positions and other various educational programs.

This is a clever and innovative solution that could potentially help municipalities develop their own internal funding initiatives for GI projects and policies. Taking advantage of various government funding opportunities is paramount at the moment to developing GI projects; however, these funding waves may not always last as long as some would hope. Therefore, it is essential that municipalities such as Newmarket and Caledon develop their own funding opportunities to further the financial support of the development of GI. If other municipalities located in southern Ontario can benefit from the educational opportunities provided by Newmarket in developing their own stormwater management fee, GI would potentially be utilized more at the municipal level.

Future Directions
At the moment the Ministry of Environment and Climate Change is currently undergoing a process to supplement their 2003 Stormwater Management Planning and Design Guide for the province of Ontario with a new update. This new guideline, which is expected to be available sometime in 2017, will provide municipalities with a new framework on how to further develop more sustainable stormwater initiatives. It will also provide a malleable outline and language, which can be utilized by municipalities to further facilitate GI projects and eventually, policies. Once this guideline is publically available to municipalities located in southern Ontario, they should ideally be able to adopt it as a by-law which will further support
the development of GI projects in both the capital and development arenas of municipal operation. This is
the next step in making GI mandatory for all new developments and would allow municipalities to not only
recommend GI technologies to residents, and developers as well as internally, but to enforce their use on
newly developed sites.

Lessons Learned

Whether it is a municipality or conservation authority the key-informants are aware that there will be
barriers with implementing GI as there are with any new costly changes to infrastructure design and
planning. As with any new practice, it seems that municipalities and CA’s are conservative and will look to
other projects that have been successful with GI in order to successfully launch their own. Risk-aversion is
a common phenomenon when assessing any new practice or product, particularly in the public realm,
where success is expected and failure can have negative political consequences. For example, if the Town
of Newmarket failed to successfully implement a GI project, resulting in numerous funds wasted, they may
lose the support of any elected official for future projects.

The barriers listed throughout this thesis are things that will constantly need to be improved and new
approaches will need to be created in order to satisfy and educate the public as well as the staff members
and contractors. The solutions provided from both respondent #1 & #2 are solutions that enabled them to
overcome the feats they have so far in implementing their own projects and should be used a baseline for
any new municipality or CA undertaking or hoping to undertake GI in the future in order to avoid or lessen
the risk of those barriers. Being that this thesis is based on a small sample size, it is important to note that
there are probably far more barriers than those that are listed throughout this paper. One barrier that may
exist but was not mentioned by respondents #1 through #4 is the approval process for implementing GI

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projects. It is very likely that current infrastructure or site plan approvals can pose issues towards implementing GI. It is also important to note that the barriers these respondents have overcome thus far are common barriers you will see for any new and innovative project and should be anticipated from the start.

Limitations
There were a number of limitations that the researcher experienced during this study. Firstly, during the interview process, it is likely that the researchers ability to conduct a thorough interview improved as the researcher gained experience and confidence in interviewing professionals. Therefore, it is probable that the final interview, which was conducted with Samantha Paquette with the Credit Valley Conservation Authority, was more thorough than the first interview, which was conducted with Rachel Prudhomme with the Town of Newmarket.

Finally, the research data collected in this study was only limited to two medium-sized municipalities located on southern Ontario. Both municipalities represent a small sample size of the much larger municipal population in Ontario, let alone the remainder of North America or the World. This research was conducted to identify why municipalities in southern Ontario have been slow to adopt this modern technology. Additionally, interviewing a larger number of professionals from a greater number of municipalities in southern Ontario would have likely produced results, which are more comprehensive and replicable.

Implications for Landscape Architecture
The implications for expanding the use of GI at the municipal level are enormous. At the moment, professionally certified engineers typically carry out conventional infrastructure design and
implementation. That being said, implementing more green and less gray infrastructure projects opens the door for Landscape Architects, along with other professionals, to become more involved in the design process. GI projects often require a multitude of professionals to collaborate on a given project to ensure complete success. Engineers, planners, water resource and stormwater management specialists as well as landscape architects are often required to collaborate on GI projects since they often involve many different layers and necessitate the coming together of a variety of professionals. Bringing landscape architects into the fold of GI generates wider opportunities for streetscaping, beautifying and enhancing stormwater management functioning.

Gray infrastructure projects generally involve the construction of underground systems, which can be designed and implemented solely by engineers, depending on the project scope. Conversely, GI projects which are much more complex and multifaceted, require detailed design that reflects the many components which encompass GI. Expanding the use of GI at the municipal level not only can create further opportunities for landscape architects and other various professionals to find work, but it allows for aesthetic and functional improvements to the environment. GI projects combine aesthetic improvements to the environment through the use of bioswales and rain gardens while simultaneously enabling improved stormwater functioning. Not only would this create more work opportunities for landscape architects but also it would certainly help create more beautiful and functional landscapes that lessen the impact of water quality issues on the natural environment.

Stormwater related positions are becoming more of a permanent fixture in municipal environments. As GI continues to be a point of focus for municipalities like Newmarket and Caledon, the opportunity for designers and stormwater specialist will only grow.
Ultimately, adopting and implementing GI at the municipal level has many benefits for the environment as well as people and communities who live near them. GI not only has the ability to help improve aesthetic elements of communities and cities but it also facilitates improved stormwater functioning.

Suggestions for Future Research

Although the research conducted in this paper was able to help construct a set of perceived barriers that municipalities in southern Ontario face in implementing GI projects, much more can be done to help expose and improve this problem as a whole. This same study could potentially be expanded to include a much larger sample of municipalities and Conservation Authorities possibly producing results that are persuasive enough to tip present practices toward a GI systems approach.

There is also potential for future research results to be codified and placed in a provincial repository of project information easily accessible to municipalities and decision-makers. An accessible bank of GI best practices information might help overcome some of the barriers that have been identified and discussed in this paper. GI has been shown to be cost effective in the long-term and is a viable alternative in SWM systems. Moving toward implementation of GI systems however does require a shift in traditional approaches to infrastructure planning and design. Any shift in the public realm, particularly those involving millions of dollars involves risk and it may be that research on the organizational capacity for risk in municipalities and CAs is a future area of study.
Finally, as this study demonstrates, while the benefits of GI designs are known, simply ‘championing’ GI without an understanding of the barriers will create a risk of failure when implementing this innovative infrastructure and will inhibit the future for all Ontarians.
REFERENCES


Interview with Respondent 1
Employer: Town of Newmarket
Position: Director of Engineering
Date: December 6, 2016
Time: 2:30

Interviewer: I know you know me but let me first begin by introducing myself. My name is Andrew Ferguson and I am a 3rd year MLA student at the University of Guelph. I am currently conducting research related to municipal green infrastructure and stormwater management in southern Ontario, Canada. Let me take a few minutes to briefly explain the process of this semi-structured interview. Semi-structured means it’s sort of where ever you take it, based on your answers. You are asked the same group of questions I am going to be asking other people but your responses can be different. I will be asking you a total of four questions concerning green infrastructure and stormwater management with several follow up questions per question in order to stimulate conversation and maintain clarity of responses. The interview process should range between thirty and sixty minutes. Is it was okay if I record this interview for data transcription purposes?

Respondent: Yes.

Interviewer: Okay. So the first question I have for you is; can you describe what you know about green infrastructure?

Respondent: That’s a big question.

Interviewer: It is.

Respondent: Well the first thing that comes to mind of course is LID because of our line of work – low impact development – and how we can move forward towards the future with new ways to manage stormwater.

Interviewer: Okay. Now when you say green infrastructure you’re talking about a lot more than just stormwater right?

Respondent: That’s correct.

Interviewer: Yeah so in terms of green infrastructure I mean it can go from one spectrum to another like it can go to an extreme. For example a project where you’re reconstructing a whole roads for example which is all infrastructure. You have your sanitary sewer, your watermains, and your storm sewers. Then you have your granular materials that go on top of that, that are delivered by trucks.

Interviewer: Right.

Respondent: And then you have asphalt that goes on top of your granulars, and then you have concrete curbs and sidewalks and then you have the plantings and everything else.
Respondent: Now, depending on how far you want to go with that you could even have a plan where you say that if you really wanted to be green in your construction processes you could say for example “we want all materials to be sourced locally to reduce the amount of greenhouse gasses that are emitted from the transportation processes that bring these products to the site.

Interviewer: Right.

Respondent: Or you could have a non-idling policy that is strictly enforced on site with penalties associated with contractors that idle. If their trucks are sitting there idling and the foreman doesn’t tell them to turn it off while they are sitting there waiting there could be some kind of either financial penalty or maybe a working days penalty of something, you could be creative about. That’s in an extreme case of trying to be green while your doing infrastructure.

Interviewer: Right.

Respondent: That’s in terms of the construction itself. So there’s all kinds of things we can do with the projects. Another thing is the actual processes themselves, for example, the sanitary sewer. Where it ends up is a treatment plant. Well how green is that treatment plant? So if the treatment plant is producing all kinds of emissions and is not cleaning the product to a certain standard then we have issues with the treatment plant as well. That’s also infrastructure. So there’s no limit to what you can do really and I’m not sure whether that’s answering the question the way you wanted?

Interviewer: Just whatever you can tell me about green infrastructure, it’s a very open question.

Respondent: The other thing is using the proper vegetation for restoration after the project. Were getting into plants now that soak up water a lot more than in the past. We like to use native species. Another thing that you’ve probably heard about is replacing sod on islands, for example, in the middle of a round about just as an example. So if you have a round about and your cars are going around and you’ve got this island in the middle – we used to sod them. Then we started putting in native grasses that grow up wild and soak up a lot more water so they act a little bit like a rain garden. But then you get all kinds of complaints from residents saying well it looks really like a bunch of weeds, its not maintained, and we want grass there, it looks neater and cleaner. So we need to educate the public as well about what is green infrastructure and get them to be on board with that as well and that is very difficult. So sometimes there’s a lot of resistance to green infrastructure.

Interviewer: Right.

Respondent: What else can I say about green infrastructure? The processes, the materials that we use, recycled materials on site. At one time they were crushing tires and using pieces of tires in asphalt. Or they were using glass in asphalt. We try to recycle these products and use them as much as possible in construction materials. Sometimes it doesn’t work out. I think there was an issue with glass I’m not sure, don’t quote me on this one, but I think there was an issue with reflection of light or something. They weren’t able to continue using that. But we’re testing materials to use in our infrastructure.

Interviewer: Okay. I think that’s good. The second question I have for you, and this is going to get more
focused as we go but has your municipality discussed green infrastructure policies or projects?

Respondent: Well if we talk about low impact development you probably are aware that our department has made that a very high priority.

Interviewer: Right.

Respondent: Yeah.

Respondent: So we’re very forward thinking on that and we are unique among municipalities in looking first when ever we rebuild a road – we look first at low impact development options before we go to traditional storm sewers. So if it’s not possible to put an LID in then we’ll end up with regular conventional storm sewers, which is always our last resort.

Interviewer: Okay.

Respondent: So that was an education process with staff as well so that they started feeling more comfortable looking at LID’s right away and not just adding it in to make it look like we tried but really making it work. So that’s coming along well.

Respondent: What’s the question again? I’m going off topic.

Interviewer: No that’s okay. Has you municipality discussed green infrastructure policies or projects?

Respondent: In terms of policies, yes. Jenn Slykhuis (Sr. Environmental Coordinator) has put together a site alteration by-law that we’ve been working on for years and never really got completed because when I came in I yanked it off and I said “no” we’re not going in that direction. Lets go in the direction that the LSRCA (Lake Simcoe Conservation Authority) and the MOECC want to go in – the Ministry of Environment and Climate Change right.

Interviewer: Okay, Yup.

Respondent: They’re really pushing for low impact development and new ways to do things and our by-law before was called cut and fill bylaw.

Interviewer: Right.

Respondent: So the cut and fill by-law no longer exists. It went to counsel last month and was approved and we now have a site alteration by-law that is very strong on low impact development techniques.

Interviewer: Okay.

Respondent: So first of all we have a by-law in place that was endorsed by counsel and we can now send our by-law officers out there and charge people if they are not doing things the way they are supposed to be done according to the by-law. Now, the next stage of what Jenn Slykhuis is doing is developing a policy
for low impact development so that developers who come to this town to develop, whether its through a site plan agreement for high-rise developments or whether it’s a subdivision plan where they create a whole bunch of new houses, there will be a requirement to include low impact development within that particular development. So right now Brandon Ewart (Sr. Engineering Development Coordinator) does it with a lot of the site plan applications that he reviews for storm sewers but he really doesn’t have any teeth to impose it and compel developers to use it. We can only ask and say please look at LID options for your property. Most of the time they’ll do it but if they refuse to do because they think it will cost more or they think its going to be difficult to do then we don’t really have anything that we can wave at them and say “well you know if you want to develop in Newmarket than you have to do it”. We only have that site alteration by-law right now. Once the policy is in place it’s going to be a document that forces developers to look at low impact development first and that will be included in our planning processes as well. Jenn Slykhuis has included all of the planning and building departments and a lot of other departments – public works – all kinds of other departments to comment on the policy. She’s doing very well, she should be done in January or February with that. If it’s a policy I’m not sure that it has to go to council but we’d like to let counsel know that we have that policy in place.

Interviewer: Excellent. Thank you.

Respondent: You’re welcome. And of course the projects too. Like that was the policy and the by-law but the projects, like I said before, we always look at LID first before conventional storm sewers. We have a lot of them. We just finished actually Forest Glen.

Interviewer: Right.

Respondent: It’s called an LID demonstration project. There’s no storm sewer at all. There are curbs along both sides and the curbs have depressions – curb cuts – to let the drainage go into rain gardens all along the street. We got buy in from the homeowners. We had a barbeque on the street on a Saturday with the residents and brought out all kinds of plants and different concept drawings of different types of rain gardens that they could choose. So everybody chose what rain garden they wanted in front of their house. So they could all be different or some of them could be the same. What ever they chose is what they got. We had that meeting with them and we’ve continued to have discussions with them all the way through to include them in the design of the project. So it was really a special project and the LSRCA has done a before, during and after video that’s really well done and I think it’ll be on YouTube soon. So I can give you a heads up when it’s on there.

Interviewer: Okay. Yeah I’d like to see that.

Respondent: Yeah. It’s really well done. Just to show how the construction progressed and what kind of biomedia we were using and there are all kinds of conceptual drawings, and kinds of things to explain how it works. It was really well done.

Interviewer: Great.

Respondent: Oh, the other thing, we’ve just implemented the stormwater management fee. And counsel just approved it actually last night. They approved the fee as being a separate fee that we’re going to charge residents for stormwater management.
Interviewer: And would that fee be commencing in January?

Respondent: Yeah.

Interviewer: What does that entail?

Respondent: Well what we did was we removed all the costs of stormwater management from the tax base because before it was paid through taxes, people’s taxes.

Interviewer: Stormwater maintenance costs right?

Respondent: The maintenance and the planning and design and everything else, and construction. So all the stormwater costs were removed by finance and were put in a separate account now. Sort of like the water charges. You know how you pay for water separately than you pay for your taxes?

Interviewer: Right.

Respondent: Well you will pay for water and you will also pay for stormwater in Newmarket. So there is a zero net effect this year because whatever the reduction was in the taxes is what the charge will be for the fee this year.

Interviewer: Okay, I understand.

Respondent: Yeah, so it’s a zero net effect.

Interviewer: So that means each homeowner within Newmarket will be contributing to that fee?

Respondent: They will be yes. Counsel has approved that.

Interviewer: Is that to help maintain LID projects within town limits or also to go towards the implementation of new projects?

Respondent: Everything stormwater related should be coming out of there. So for example, the maintenance of our exiting stormwater management ponds that we want to get away from. We don’t want to do ponds anymore but we’re stuck with some ponds. They function well. They do have a certain purpose that we want to maintain so we have to maintain the ponds. Occasionally we have to dredge them or we just have to look at the inlets and outlets to make sure they are functioning properly and are at the right elevation and things like that.

Interviewer: Right.

Respondent: We have consultants that do work for us in stormwater management. That’s going to come out of the fee. When public works puts in new catch basins, that’s a stormwater project that will also come out of the fee. The intention is that every single thing related to stormwater will be paid from the stormwater fee.
Interviewer: Okay.

Respondent: We’re even thinking of putting partial or complete salaries in there too. So for example, if we do end up with a permanent LID coordinator or a climate change coordinator that looks after stormwater 100% of the time, that could come out of there eventually.

Interviewer: Very exciting!

Respondent: Yeah, It is. I almost forgot about that one.

Interviewer: I think you’ve answered that question thoroughly.

Respondent: Yeah, I think I got that one better.

Interviewer: Okay. My third question is, do you think that there are barriers to implementing green infrastructure policies or projects?

Respondent: Yeah absolutely. And Jenn Slykhuis would probably have a lot more than me but first is perception. Perception for the cost associated with it. A lot of people who don’t really have the figures in front of them might think that it’s a lot more expensive to do that, its a lot more complicated, but it isn’t.

Interviewer: To implement policies or projects?

Respondent: To implement projects. Yeah.

Respondent: Like for example, developers. For them to put in an LID instead of a conventional storm sewer they have to make sure first of all that their consultant who’s doing the design for them – and we can’t dictate who they use, they chose their own consultant – but they have to make sure their consultant is comfortable with that sort of stuff. So developers have to know what they’re doing. Another barrier to policies too is the personnel that maintain our infrastructure doesn’t like to have new infrastructure to maintain that they’re not used to and they’re not aware of how much maintenance is required. People tend to think that if you put in some rain gardens that it’s going to require a lot of maintenance like a park or a flower garden, which is not necessarily the case because we’re told be experts that it (the rain gardens on Forest Glen Road) requires weeding twice a year and that’s about it. Maybe every 8-10 years it has to be checked to make sure it’s still draining properly.

Interviewer: That’s it?

Respondent: Yeah. That’s what we’re told. I mean were just getting into it so we don’t really know yet but that unknown is something that can be a barrier to creating the policies, especially in fiscal restraints when we don’t want to increase the amount of resources we have – the number of people, the amount of money that we get to do maintenance. It’s difficult for us to always be doing more with the same amount of resources. As we grow as a municipality there’s additional work that needs to be done to maintain a certain level of service.
Interviewer: Right.

Respondent: Either you have to put more money in so that you can retain the same service on a wider level or we have to reduce the service level to be able to do it with the same about of people and money. So that’s a fine balance that’s very difficult in the public sector.

Interviewer: Right. Okay. So that’s mostly looking at perception of it through the public eye and their support for these types of projects?

Respondent: Internally too, right now I’m just dealing with the public works people who have to maintain them. Then there’s the general public out there that requires a certain amount of education. There are people who know all about rain gardens and want them and apply for funding at the LSRCA. They’ll give you 50% funding up to a maximum of $7500 is you do a rain garden on your property.

Interviewer: That’s great.

Respondent: Yeah. And some people apply for that and get it and some people don’t know about it and do rain gardens and some people don’t want to know to know anything about rain gardens and don’t want to do them at all because they don’t understand how helpful they are for the environment or they don’t care, one of the two. It’s hard to make people care.

Interviewer: It is yes.

Respondent: Cause you know you see tree huggers and you see people that sit in trees because they don’t want the trees to be cut down or lay down in front of a piece of equipment because they don’t want the rain forest to be destroyed or anything like that. You think that they’re crazy sometimes but really for them this is a very personal cause and its something very important to them. Well we have the LID bug now and we didn’t have it before. Some people see us as a little fanatic about it because we’re really pushing this but really we wish we could reach more people and educate them and change the culture. It takes a long time to change the culture.

Interviewer: It does. It’s a very slow process.

Respondent: Right. And this is definitely a culture change. Because we’re used to you know, you flush the toilet, it goes to the sanitary sewer. You don’t care about the pipes under ground, you just do it. Stormwater, it always comes down the gutter and where ever it goes it goes and people don’t know. But now Jenn Slykhuis is going to special events in town and she’ll put up a map that says, “my stormwater goes here”. She asks people to point where they think their stormwater goes. So they’ll look for the rivers and things and say “I think its going there”. A lot of times they’re wrong. She’ll show them where their stormwater goes when they put something down the drain.

Interviewer: Right.

Respondent: If you wash your car and you’ve got some detergent that’s going into the storm sewer, people don’t know where it goes. They don’t realize it goes into a river and ends up in Lake Simcoe – all the phosphorus that’s in Lake Simcoe right now. Its another part of green infrastructure too that I forgot if I go
back to the first question – the amount of phosphorus that we produce in terms of sewage treatment plants, and how now we’re getting into phosphorus reduction programs. Trying to balance phosphorus and trying to find ways to reduce the amount of phosphorus that goes to for example, Lake Simcoe, to have a zero net effect.

Interviewer: Right.

Respondent: So they are looking to create another sanitary sewer treatment plant that would go into Lake Simcoe. And the water that comes out would be fine but it would have phosphorus in it so we’re looking for phosphorus offsets in other places.

Interviewer: Okay. Sorry, just let me bring you back to the question here, it’s easy to get off topic. We’re just talking about the barriers to either policies or projects and you were identifying what it’s like to have support for these types of projects and sort of the realm of perception. Would these be the only barriers that come to mind?

Respondent: Well in some municipalities even the counsel could be a barrier if they don’t want to support that kind of change. However, we’re fortunate here in Newmarket because our counsel is very open to being more environmentally friendly and they’re ready to accept change in that direction. So at the political level there could be some resistance as well.

Interviewer: So political, perception, are there any other potential barriers?

Respondent: Well, money. Always money. We tend to forget to mention it because we think everyone knows that that’s the number one problem is having enough money to be able to have the educational programs we need but also do the work and do our changes because retrofitting is very expensive. If you have a street that has a storm sewers and you want to retrofit it and put in all rain gardens it’s very expensive.

Interviewer: Such as the Forest Glen demonstration project?


Interviewer: Yes, Okay. Where it’s a little more financially sustainable to build from the ground up like within a new development for example?

Respondent: Yup.

Interviewer: Okay. That’s three questions so my last question is, and you sort of touched on this a little bit but, how could you overcome some of these barriers?

Respondent: Well, public education, money. I think a lot of communication is needed and that’s part of the education program too right. We need to communicate it. We need to almost shame people into not wanting to do it the wrong way anymore.

Interviewer: Right. So, hypothetically speaking if you have more community support or support from
within an organization as well as within the public you could find it easier to overcome some of those barriers and then implement more projects in the end?

Respondent: Yup. And the upper levels of government too like the provincial government and federal government talks a lot about climate change and about how to implement LID and things like that. When they put money into it, it’s for infrastructure renewal. Its not necessarily geared towards what we need to do, its geared towards their political objectives. They might look at pipelines right now and say, “that’s an environmental project” because it reduces the amount of trucking or the number of trains we have going around with these products. And the pipelines are better but for us, at the municipal level, that’s not really helpful.

Interviewer: So there’s a little bit of a disconnect or sort of a difference in operational thinking. They are looking at a situation from a provincial level where as in a municipal area you’re looking at different features to that?

Respondent: Right. So if we had for example the federal government is looking at these pipelines. If they were looking at LID and stormwater management the same way they are looking at oil pipelines we could have a lot more support for this culture change that were trying to achieve.

Interviewer: Right.

Respondent: They’re not even asking us for input.

Interviewer: Right.

Respondent: They’ve got they’re mandate and that’s it.

Interviewer: And they stick to it.

Respondent: Yes, right.

Interviewer: So essentially getting the provincial government on board as well as the public is important?

Respondent: Yeah, I think the provincial government is on board right now. The Ministry of Environment just came out with a statement about LID I actually think I have it right here. I think it would be useful. This is an interpretation bulletin from the MOECC. “Going forward the ministry expects that stormwater management plans will employ LID in order to maintain the natural hydrologic cycle to the greatest extent possible”. And that’s a direction that comes directly from the Ministry of the Environment and Climate Change.

Interviewer: Okay.

Respondent: Also, right now I’m working on getting a huge grant from MOECC to help us to educate other municipalities as to how we were able to implement our stormwater management fee.

Interviewer: Excellent.
Respondent: So it’s a special project that will last about 18 months, being funded 100% by the MOECC. So I can’t say that the provincial government is not engaged you know because they really are leaders but they weren’t on board as quickly as for example the conservation authorities and the municipalities were but now they’re really pushing it. So they are on board now. Now we have to get it from the federal government too.

Interviewer: Okay well I think you have pretty much answered my questions very thoroughly.

Respondent: Yeah? That didn’t take to long.

Interviewer: Let me just say thank you for taking the time to participate in the interview.
Interview with Respondent 2  
Employer: Town of Caledon  
Position: Climate Change Specialist  
Date: December 20, 2016  
Time: 2pm

Interviewer: Let me first begin by introducing myself. My name is Andrew Ferguson and I am a 3rd year MLA student at the University of Guelph. I am currently conducting research related to municipal green infrastructure and stormwater management in southern Ontario, Canada. Let me take a few minutes to briefly explain the process of this semi-structured interview. I will be asking you a total of four questions concerning green infrastructure and stormwater management with several follow up questions per question in order to stimulate conversation and maintain clarity of responses. The interview process should range between thirty and sixty minutes. Is it okay if I record this interview for data transcription purposes?

Respondent: Yes.

Interviewer: So my first question, it’s a very large one: Can you please describe what you know about green infrastructure?

Respondent: Okay. In a municipal context?

Interviewer: Yes, please.

Respondent: Okay. I know in terms of what we use in development. I mostly apply it with stormwater management plans. Looking at different LID technologies depending on the environment and the type of building that we’re going to be applying it to. So usually conducting a study on the best practice for that.

Interviewer: What do you mean by how much do I know?

Respondent: Okay. I don’t know if I can recite the principles but in terms of what it’s really used for is stormwater management I think, and flooding and also helping with water conservation efficiency. I think it’s a way that people are going towards with climate change adaptation.

Interviewer: Right.

Respondent: I guess there are different forms of it. For the most part I’m most familiar with LID’s.

Interviewer: Which is low impact development?

Respondent: Yes.
Respondent: Beyond that I’m not sure what I can pull out.

Interviewer: It’s a very general question. You’re speaking to what your used to working with?

Respondent: Yes.

Interviewer: What are the principles of LID?

Respondent: Like how it works?

Interviewer: Yeah.

Respondent: Okay. I guess one of the principles are mimicking nature almost through hard infrastructure in some way but avoiding the use of the usual hard infrastructure – gray infrastructure. Using the environment around you to collect and convey water.

Interviewer: You can describe anything about green infrastructure; for example, I know trees are considered green infrastructure. It’s a very general question to establish what you know about the topic.

Respondent: So you’re talking about incorporating renewable energies?

Interviewer: Yup. It’s just a very general question to get things going. So anything you might know about any types of green infrastructure would be excellent.

Respondent: I think from my understanding the definition of green infrastructure – I do think it encompasses renewable energy technology – from my perspective so. I would include installing solar panels, geothermal units, progeneration units. I was looking at the building envelope so building green buildings in terms of thinking about energy and water efficiency to the building materials to the equipment that’s used – that’s energy efficient.

Interviewer: When you talk about LID are you talking about LID as in stormwater management for example with a street or are you talking LID for buildings?

Respondent: Both. Like even residential, commercial buildings, parks. Those are the applications that I think I’m most familiar with and use. And they vary obviously depending on the environment that you install those in. From bioswales to rain barrels to permeable pavement. We’ve done a number of projects here with permeable pavement.

Interviewer: Okay.

Respondent: Not always successful, I think it’s a tricky art. We’ve done a couple of those. A bunch of bioswales. That’s my perspective of green infrastructure including all those different areas of focus.

Interviewer: Okay great. My second question is has your municipality or organization discussed green infrastructure policies or projects?
Respondent: I think it comes up. I think our approach is to follow along with provincial mandates and guidelines. I don’t think we’ve done anything out of the box or anything too innovative here yet. For the most part we follow the ministries stormwater guidelines.

Interviewer: Right.

Respondent: Right now in terms of the energy efficiency and the green energy act, all of that, building codes, we don’t really go beyond that. But like I said we’ve done a couple of LID projects in our community centers. In residential developments we’ve got a number of stormwater ponds that we use and make use of in the residential developments in our settlement areas.

Interviewer: When you say it’s sort of been a subject of discussion what do you mean? Do you mean you’ve discussed developing these policies based on guidelines or guidelines that may come out in the future?

Respondent: I’ve brought it up a couple of times, especially with our engineering team and there’s interest but a lack of resources and money. I think the misconception is that it’s really expensive to do it the green way. Unless we can show a quick turn around on that investment there’s usually push back on it. We have green development standards for example so, that requires any building built after 2010 that’s over 10,000 square feet that has to be lead certified.

Interviewer: Okay so gold, silver, platinum, something like that?

Respondent: Yeah. So we do have that in place.

Interviewer: That’s just a commercial building right?

Respondent: Yes. Commercial, industrial, institutional, any of our facilities, Town Hall. We are expanding our Town Hall so it’s going to be over 10,000 square feet so the new edition will be lead. I think we require a minimum of lead silver.

Interviewer: Okay. That’s pretty high. That’s a good standard.

Respondent: Yeah. So we’ve got a couple of buildings that we’ve already built that way. Sorry what was the question again?

Interviewer: Has your municipality/organization discussed green infrastructure policies or projects?

Respondent: I think the closest that we have are green development standards. Other than that I mean we don’t have anything else in place.

Interviewer: Are the green development standards based off of the provincial standards and guidelines?

Respondent: Basically we provide them with options that are available. They have to follow the lead guide right. So there are only so many options but we allow them to pick out of a sweep of different options including water efficiency and building materials.
Interviewer: So they can focused on one more than the other as long as they meet the minimum requirements for lead silver and up?

Respondent: Yeah. We did kind of knew with one of our new developments – Mayfield West – Base two, which is just coming online, which is an extension of our most recent residential development area. We were able to have the builders enter into an agreement where they would actually exceed the building code with water energy efficiency. So basically they have a number of options of things they can do outside and inside. They have to choose two from outside and two from inside for every house and that’s including the building code in terms of water and energy efficiency.

Interviewer: Okay.

Respondent: It includes equipment to plumbing to how the houses are constructed – the materials that go into them, the use of rain barrels – some of them are low hanging fruit.

Interviewer: I know even some of those certifications are where did the material come from right? How long was it travelling? So if you get some sort of local material you get higher points based on the system correct?

Respondent: Yeah. There are options they can choose from - two from each. Right now we’re working in a development that has long-standing issues of flooding. Basically it was built without really considering how much water would be collecting in that area so we’re working with TRCA and with a consultant team to identify LID options for addressing those issues. As our team was going forward they were only going to put hard infrastructure in. So I worked with the TRCA and brought them on board so we’re working to find options to put LID in the developments to try and reroute some of that water rather than put in hard infrastructure.

Interviewer: Very interesting!

Respondent: We also have a stormwater management plan and they (consultants) had LID recommendations in there. So they looked at all of our stormwater sewer systems basically, everything, and gave them a rating. They identified where the issues were and helped us prioritize projects. Whatever possible they recommended.

Interviewer: Is this the consultant or the TRCA?

Respondent: This is the consultant for our stormwater master plan which kind of looked at Caledon overall.

Interviewer: Right. So you identified the areas that most need some sort of LID retrofit?

Respondent: Yup. So we’ll be doing that there.

Interviewer: Very cool.

Respondent: That’s about it. We have our official plan, which has a sustainability and climate change section in it. It’s not a stick but it’s a recommended approach. From that we construct the by-laws, which
are enforceable. We don’t have many by-laws that enforce a lot of climate change considerations but it’s in the official plan that these things have to be considered.

Interviewer: Right. It’s a starting point.

Respondent: Yeah. After doing a scan we found most municipalities didn’t have such a strong climate change and sustainability section in it. So we’re trying to keep ahead of the times.


Interviewer: My third question, this is when it starts getting fun, is, do you think that there are barriers to implementing green infrastructure policies or projects?

Respondent: I think one is a lack of trained staff. In our case just because we have people who have been at the town for a very long time.

Interviewer: So you mean staff that say understand LID’s?

Respondent: Or green infrastructure in general or how to incorporate it into the urban landscape. I think we’re slowly building that in our planning department. Our urban planning department didn’t really have a lot of people who had green infrastructure training but we do now. So that’s sort of shifting

Interviewer: Do you mean like the engineer coordinators or who ever may be coordinating these types of projects?

Respondent: Actual planners.

Interviewer: Oh okay.

Respondent: We didn’t really have any. Now we have at least three who have that background. I would just say that they are green people, they like to try to use green infrastructure approaches if possible, we work with them and they’ll ask for our opinion so we’ll put in our recommendations and they’ll accept them for the most part.

Interviewer: Oh okay. Very interesting.

Respondent: So I feel like we’re turning a corner there. Our stormwater management – we have like an older crew there so I think they’re used to doing things how they’ve always done things.

Interviewer: The gray infrastructure way?

Respondent: Yeah. So I think that’s a huge challenge which maybe just for certain municipalities depending on the composition of your staff. The other one would be financing. It’s more expensive to do the green way than to do alternative.

Interviewer: Did you say that’s a misconception?
Respondent: In my opinion I would think it’s a misconception. It is expensive but I think people really don’t realize what the payback is. You’re extending the life of the infrastructure in most times. Also, some of the LID’s people think are going to cost too much are actually cheaper than hard infrastructure.

Interviewer: Do you mean just in the construction phase?

Respondent: I was actually just talking about the construction. I think the issue with a lot of LID’s is with the maintenance of it. That’s where the money comes in. So that’s hard to argue. Some of them do require a lot of maintenance. I think that’s a barrier. I think those are the two big things – the financing and just the staff that’s trained to do it.

Interviewer: So if you had more staff that knew how to sort of plan these types of infrastructures or LID projects and you had the financial support that you would be able to implement more of them?

Respondent: Yup. We have a strong council. I’ve worked with a couple of council members on projects that are a bit more green and they’re always supportive of it. But I find a lot of money to do it so that helps. It’s not like taking money from the town.

Interviewer: Right. It’s finding it in other ways.

Respondent: Yes. In order to get it done. I think the demonstration is where its key, they have to be able to see it.

Interviewer: Do you think both of those barriers apply for developing green infrastructure policy as well?

Respondent: Yes. I think when I pitched that – to do a green infrastructure policy – its those reasons that come back like who’s going to lead this? And unfortunately it’s beyond the scope of my work because I do a number of things. We have a stormwater team but the stormwater team itself can’t take it on because they are already buried by a number of projects. Were just trying to catch up here at the town.

Interviewer: Oh right. Once you catch up maybe they’ll be a little more time to get ahead?

Respondent: Yeah. Right now we’re just trying to do an inventory of our stormwater culverts. That was just done this summer. Before that we didn’t know what we had. That’s sort of like the state that we we’re in.

Interviewer: Did you hire another consultant to do that?

Respondent: Yeah. A consultant and a couple of summer students. I think about 6 or 8 for two summers. They went out and they did an inventory of all of our stormwater structure assets. So we have that now and now we’re putting it into an asset management system. One of the things I’m trying to work with at the Region of Peel is they’re doing a natural capitol assessment which is what I think is the way that most municipalities I hope are going. We’re hoping to incorporate that into the asset management system. So we look at a lot of our natural assets as something that needs to be managed just like hard infrastructure because it provides a service.
Interviewer: Right.

Respondent: Yes. I think that’s the problem of not understanding the value of a wetland. That’s not really green infrastructure but it sort of plays on that. There has to be a change in the mindset right. I think we have enough concrete to last us for quite sometime in terms of it being gray infrastructure. So shifting that mentality is at the crux of sort of moving forward, in my opinion.

Interviewer: Okay. All right. That’s great. So my last question is how did or could your municipality/organization overcome each one of these barriers? So the two barriers for example that you mentioned being the financial side of it and lack of trained staff.

Respondent: I guess what’s missing also then I guess is, another barrier is the will or the interest to see the value in it, the value in green infrastructure. A lot of people think that it’s fluffy, that it doesn’t actually have value. But I think being able to convince the people that there’s a value to this, just like paving the roads. It’s of equal importance to shift the way that we’ve been building. I think that’s also a challenge.

Interviewer: Sort of a culture shift?

Respondent: Yeah. I think people aren’t realizing the value. People assume that its not going to fix a problem. Its just a nice thing to have.

Interviewer: That’s what you mean by fluffy right? As in the way it’s perceived?

Respondent: Yes. Yeah. I don’t think there’s a strong understanding of the value of green infrastructure.

Interviewer: Right.

Respondent: So we’re working on that.

Interviewer: By that do you mean the public or municipal decision makers or kind of both?

Respondent: I’m not sure how the public feels. I can’t answer that. But I think with municipalities’ there’s a lack of having a business case for green infrastructure – showing the payback, the economic cost versus. the paybacks that you see. And then how to go about implementing these types of things. There are a number of guidelines. I think we need to have staff that trained in these kinds of concepts.

Interviewer: Right.

Respondent: I find that when municipalities have someone dedicated to it, that’s their job, then they achieve it. I think when you have staff who are hoping to solve the problem they’re not always going to go the green infrastructure way.

Interviewer: It’s easiest to just do what you know right?

Respondent: Yeah. That’s what it seems to be.
Interviewer: Right.

Respondent: For people who have been doing it a long time its like lets just do more of that now. It’s not so much more as it is lets catch up with time and shift the way we’ve been doing our different practices and operations.

Interviewer: Do you know how that type of shift could happen? I guess just sort of hiring people that have the qualifications and experience to implement these types of projects.

Respondent: I think the first part is having the political will for it. Then I think you get the staff and the money allocated for it. In order to sort of start that shift you have to have the will. In my experience the best way to do that is to share where it’s being done and where it’s being done successfully.

Interviewer: Like with case studies?

Respondent: Yes. Anything that I pitch I try and find an example of where it’s being done and if its being done in a municipality that’s similar to Caledon. There’s no point showing people what Vancouver’s doing because we’re not Vancouver. It’s hard to find a lot of rural examples. There’s a lot in B.C. but not so much out here in Ontario.

Interviewer: Right. Caledon’s unique in its own way and stormwater projects are sort of like different shoe styles.

Respondent: Yeah exactly.

Interviewer: I can imagine that being hard trying to find something that really represents what you’re trying to do here or what you could do here.

Respondent: Oh yeah, its very hard right. So we try and use like Brampton or Mississauga or Halton Hills, the surrounding municipalities. When ever they’re doing something innovative we try and share that with our senior management or town council and make a pitch for it.

Interviewer: And that sort of builds that political momentum to allow for more projects that are green infrastructure to be implemented?

Respondent: Yes. For sure. In my experience that’s what works – is the proof.

Interviewer: Right. So that all kind of comes back to having the political will and having the qualified staff to be able to do that? Before you said the financial side of it was kind of a big thing but more so in the implementation?

Respondent: From my understanding with LID the maintenance is the hardest part. That’s where the money comes in and some of our engineers are aware of that so they don’t want to take them on. I think you need the staff because I think if you go out with an RFP and say “we want to do LID” and you have a consultant that comes in and wants to get paid they’re going to do LID. We have a lot of clay in Caledon and we’ve
put in LID’s that haven’t worked but it's because it’s been put in the wrong place, not knowing the environment. I think that’s what you really need – someone that’s trained and knowledgeable in all those principles and all the concepts to be able to ensure that its successful because those are the projects that have hurt us.

Interviewer: Have some of those LID projects that have been put in the wrong place deterred more projects from being implemented, like with the ones that aren’t quite successful?

Respondent: I think so. For example, we did one project where we did permeable pavement, this was before my time, but I don’t know if they knew how sensitive that is to the environment. They put it in a place where there wasn’t a lot of protection in terms of the surrounding area. As soon as the rains would come it literally was like pushing all the water into this area, which they thought was great because you get lots of infiltration but it also carried with it all the silt and sand that was coming from the uplands and they really didn’t think about it and it clogged. It’s become like the bain of our operations existence because they have to clean it out. So that’s they’re memory of it.

Interviewer: Its just maintenance costs right?

Respondent: Yes. But had it been put in the right place it would have worked. Knowing that permeable pavement doesn’t really work that great when you have large flood waters right? In my understanding it’s better for a slower rainfall. They don’t have much of an infiltration capacity. Its not really meant to work like a stormwater pond. Having staff that would know those types of things would allow us to do it right.

Interviewer: Great. Okay. So basically just the financial and having the appropriate and qualified staff and the political will.

Respondent: Yes. Those are big things.

Interviewer: Yes. Okay great. Thank you very much. Thank you for taking the time to participate in an interview today!
Interview with Respondent 3  
Employer: Lake Simcoe Conservation Authority  
Position: Stormwater Management Specialist  
Date: December 22, 2016  
Time: 2:30

Interviewer: Let me first begin by introducing myself. My name is Andrew Ferguson and I am a 3rd year MLA student at the University of Guelph. I am currently in the process of conducting research on municipal green infrastructure and stormwater management in southern Ontario, Canada. Let me take a few minutes to briefly explain the process of this semi-structured interview today. I will be asking you a total of four questions concerning green infrastructure and stormwater management with several follow up questions per question in order to stimulate conversation and maintain clarity of responses. The interview process should range between thirty and sixty minutes. You said it was okay that I record this this interview today?

Respondent: That’s correct

Interviewer: my first question is very broad but can you please describe what you know about green infrastructure?

Respondent: All right. I started as a practitioner in 2003 after finishing my Maters of Science at the University of Guelph. That Maters of Science focused on stormwater management in the context of modeling optimization. So I went into the industry after that knowing quite a bit about models that could be used in design. Similar to yourself Andrew I interviewed a bunch of consultants for my research for my MSc about optimizing design. As I said before as we were doing our intros today, before you hit the record button, I kind of came into the industry backwards in having a lot of professional experience in teaching and a lot knowledge from undergrad and from my masters but not a lot of practice. When I entered the workforce I was working for Stantec and we were working on a lot of jobs throughout the country, there was a real push on commercial development. Certain clients that Stantec was working for at the time, I was gaining a lot of experience and coming up with solutions with stormwater management to meet certain objectives all across the country to serve these different clients. Often in at times we were hoping to bring more green infrastructure type technology into the solutions. Clients often will go so far as to what is required but not further. Sadly, I found more than half the time if not the majority of the time we weren’t implementing as many low impact development or green infrastructure solutions as I would have liked but always keen on finding the opportunity. So as years went by from 2003 to 2005 I gained that initial design experience, had a handful of green infrastructure type designs under my belt, and then I actually moved into the environmental management group at Stantec to do more focus work on environmental water quality solutions. I deviated away from stormwater management and I was working still for municipal clients but this was more in the context of assimilative capacity studies and looking at discharges from waste water treatment plants and upgrades to treatment plants and how the technology applied at the treatment plant in meeting targets there would perform within the ambient conditions in the receiving
waters. So we would model that, study that in situ, collect the background data and move that forward. So I gained a lot of experience doing that for a few years, which I still find in the broader context of green infrastructure, has still given me the right perspective coming back into this field.

Interviewer: Right.

Respondent: So in 2010 I moved on to Golder & Associates and that’s when I came back into the realm of being the project lead in Ontario for stormwater management, serving in a number of offices, predominately working with practitioners in the Greater Toronto Area and internally but serving a lot of internal clients and external clients in Ontario and still throughout North America. And through that, more green infrastructure opportunities came up again, both municipal, private industry, etcetera, from infiltration features to some limited bioswales designs. Again through that I was working through design to permitting but still not necessarily getting the implementation experience I was seeking. And some of the opportunities still presented the see through experience but sometimes clients wouldn’t pay for that because they had their own in house expertise to do that whether it was a mining company or CN for example. They didn’t always need that from a designer or a consultant.

Interviewer: Right.

Respondent: Since 2014 when this opportunity came up at the Lake Simcoe Region Conservation Authority I came into this position as the stormwater specialist and more than ever before I was able to engage all these different green infrastructure projects. Seeing through these demonstrations projects for different municipalities throughout the watershed has afforded me in the last 2 years that complete package – experience to see from inception to delivery these different green infrastructure projects.

Interviewer: Alright. Can you be more specific to describe the principles of green infrastructure or what you may know about it outside of your experiences with it?

Respondent: The term its interesting and I’ve been on several meetings this year where we’ve debated the difference and whether or not for example, with the 2010 CVC TRCA LID SWM planning and design guide that was put out or not, whether or not that guide when we update, which I’m currently serving on the update team, where we’re going to see that through in 2017 – updating all the content, bringing in new content. We were debating whether or not to call it the “Green Infrastructure Guide”. I say that in giving you more perspective on what I know because I know it doesn’t just apply to low impact development solutions, its about the landscape architectural aesthetic value more so than just what an LID would provide. It’s about parks base, looking at solutions with different plantings throughout an urban sort of context. I know it expands much further than just having a low impact development lot level or conveyance control spin on providing drainage solutions for stormwater management.

Interviewer: Right.

Respondent: I can’t pretend to know all that green infrastructure encompasses because I’ve been so focused on low impact development right. The focus has been too narrow for me and I do acknowledge still I think the synergy between water resources engineers or analysts and landscape architects and seeing through bigger green infrastructure plans is really what defines that whole scope of work.
Interviewer: Right. Okay. So my next question is, has your municipality/organization discussed green infrastructure policies or projects?

Respondent: Yes. Yes we have. When I was brought into this position at the LSRCA they had already formed a working group focused on better site design and that working groups mandate was to develop policies for the watershed that would promote better green infrastructure design.

Interviewer: Okay.

Respondent: And so it wasn’t necessarily to make it mandatory in the watershed yet but the deliverable that came out of that, the group started in late 2013, earlier 2014, they brought in different members from municipalities in the engineering departments and planning departments. They brought in ‘build’ within the GTA – that association. They brought in practitioners that were known to do quite a bit of work in the watershed and they brought in academics along with representatives from the Ministry of the Environment and Climate Change. They formed this working group and their sole purpose was to develop a model by-law and LID stormwater management guidelines for better site design. They worked through how that inception played out in Minnesota to develop something called the minimal impact design standards, which was a similar sort of idea. The overall purpose of this was to again provide this package – it could be a by-law with language that could be applied to a site alteration by-law a municipality had, it could be, within schedule A, the LID stormwater management guidelines were providing that criteria and the requirements that could be brought into a municipal technical guide for stormwater management. It was eventually brought into our own technical guidelines for stormwater management submissions that the LSRCA has out there for areas that are regulated by the authority right.

Interviewer: Okay.

Respondent: So again all of this worked towards different angles on policy at different levels of government that could be used to promote in the broader sense, better green infrastructure. One other notable about this model by-law and stormwater management guidelines is the current update or new effort by the Ministry of Environment and Climate Change to supplement their 2003 Stormwater Management Planning and Design Guide. The idea is not to duplicate the 2003 guide but to compliment it by providing more direction on low impact development criteria.

Interviewer: Right.

Respondent: Well, the criteria it’s using in a nutshell, they’re really kind of reflecting and basing a lot of the content and a lot of the discussion off of the model by-law and the LID stormwater management guidelines that were developed within the Lake Simcoe Watershed by that policy-working group. That being said, the inspiration for that goes back to the minimal impact design standards in Minnesota.

Interviewer: Right. So those plans in turn allow you to update your guidelines to allow for more low impact development in design or in development plans within the Lake Simcoe Watershed?

Respondent: Correct. In a larger development site like a new proposed subdivision for example, you’re typically dealing with some sort of regulated area whether it’s a tributary or a protected woodlot or even steep slopes. There’s some context, the authority needs to be part of that whole draft plan approval process
before the subdivision is green lighted to be built.

Interviewer: Right.

Respondent: Along with that would be the source water protection objectives and water budget objectives right and low impact development targets work their way into that conversation. Back to the whole move of criteria of the focus now for low impact development with better site design objectives they really introduced the focus on trying to get back to predevelopment hydrologic conditions. So the better site design focus and conversation starts with “what is your 90th percentile storm”. What is the representative storm? Upon kicking that around and following standard methods developed by the Environmental Protection Agency we demonstrated that with a bit of conservatism our 90th percentile storm in our watershed is approximately a target depth of 25mm. So we started there and said well for new developments that have limited constraints or no constraints that would be the target for quantity for stormwater volume reduction. You want to retain that 25mms and get it back into the ground or retain it and filter it in some way, shape or form. Now that frightened people right off the gate because they weren’t doing it before. How are you going to do that? What if you don’t have the infiltration capacity? Well there better site design practices give the options of demonstrating okay if you don’t have the infiltration, you don’t have that native soil opportunity then demonstrate that and come up with an alternate solutions that’s feasible. Maybe your getting 50% into the ground and retaining another 12.5mm and filtering that before it moves its way down stream. Maybe your just filtering right but at the very least it really is raising the bar to get designers to think more about their site plan upfront maximizing the opportunities on the site – where can you infiltrate, where do outlets make sense, how can we get the site plan to promote as much green space as possible. How could we set up different treatment train features to filter, store, retain and infiltrate stormwater as best as we can. That’s the spirit of all this momentum with the policy and its needed, its really taking shape and seeing a lot of practical application in its first few years of being finalized.

Interviewer: Which policy is this?

Respondent: This goes back to model by-law and the LID stormwater management guidelines and how that language can be used as a policy or as a requirement.

Interviewer: Are you talking about provincial stormwater guidelines or is this specific to the LSRCA?

Respondent: So again this manual that the MOECC is developing, its using that language and adapting it within the manual to become criteria and therefore the Ministry of the Environment and Climate Change will refer to the manual and say “we want you to follow this criteria for low impact development if your going to implement these features”. So it’s not a written policy right but the point I’m trying to make is this language is malleable so different tiers of government are using it both for requirement based documents like the site alteration by-law but then it can also be used as guidance in other manuals. When someone is seeking an environmental compliance approval from the MOECC they’ll say “We want you to demonstrate the design of that feature in accordance with this manual”. Whether it is a requirement in a by-law or its guidance were trying to see that that common language is transferred throughout these different drivers.

Interviewer: Right.

Respondent: When we go back to a written policy again there’s these mandates in our watershed, (The
Lake Simcoe Protection Plan, the Lake Simcoe Protection Act) that language itself was promoting better stormwater management design, implementing low impact development through some of the strategic actions and development policies. So that language in its general sense has provided the impetus to get all this stuff moving forward if that makes sense?

Interviewer: Its crystal clear. Can you discuss some of the green infrastructure projects that the LSRCA has been involved with?

Respondent: For sure. So there’s one Andrew I think you know quite well which is the Forest Glen LID Pilot Project in Newmarket, the first street scaping project in the Lake Simcoe Watershed. We identified at a dead end street an opportunity during a road improvement to bring in bioswales and biofilters on either side of the right of way that would capture and filter over 1 hectare of drainage area from the local road and from the local residential properties, filter that and convey it north towards Western Creek. The creek itself and the urban catchment itself has been experiencing a number of flooding issued down stream of this project site. In bringing in this green infrastructure that slows down stormwater, retains stormwater and promotes better infiltration of stormwater is one step in helping this bigger issue and presents a solution to this bigger problem of the flooding concerns downstream. Since that project we’ve looked at other opportunities within that Western Creek sub-catchment namely at the Ray Twinny Recreation Complex implementing another LID pilot. There’s the York Region Annex Lands that’s going to be implementing some LID features. Again, it’s the same idea with bioswales and permeable pavement. Holding back water, retaining it, infiltrating it. In essence reducing the peak flows and that surge of water that gets down into Western Creek causing that flooding concern downstream. So all of these little projects and this one urban catchment example are starting to add up to present an overall solution. We are looking around the watershed and have had Environment Canada funding to have demonstrations for LID of different scales for municipalities. In East Gwillimbury we have a permeable pavement and bioswales treatment train at their Civic Centre. In Uxbridge we have a smaller bioswales rain garden feature at the Ice Arena.

Interviewer: These are mostly pilot projects right? So they are intentionally placed in areas where people can see them in action?

Respondent: Correct. We’ve tried to hit those three key criteria. The pilot project has stormwater volume reduction benefits. It is definitely going to demonstrate some water quality reduction benefits for Phosphorus, for suspended solids and that ideally its in a more public place as you framed Andrew where there’s that education value, there’s that promotional value. The idea down the road is this will be part of also our training road tour where we can take practitioners around to these different sites, explain how these projects were implemented, what the lessons learned were through each project and inspire people to continue that momentum.

Interviewer: Based on the lessons learned so to speak that you mentioned do you mean that many of these projects if not all of them are going to be monitored to understand what possibly could have been improved upon in order to feed that back into perfecting the design techniques?

Respondent: Exactly. That’s one of the key goals and objectives as the take away from the projects. Most of the municipalities have had the staff in hand to oversee the project but similar to what we were doing with Forest Glen we provided the coordination needed between consultants and the towns for example, providing technical interpretation of bridging that gap through the implementation process to make sure
things were happening properly or the QA/QC (quality assurance/quality control) was there.

Interviewer: What’s the QA/QC?

Respondent: Quality assurance/quality control

Interviewer: Okay

Respondent: Again there’s that fine balance when you’re working with your different partners that our role has been defined slightly different with each municipal demonstration depending on how they were staffed.

Interviewer: Right. Okay my third question is, do you think there are barriers to implementing green infrastructure policies or projects?

Respondent: Well we’ve talked about these barriers before right. There’s the challenge right now in implementing these projects because contractors are only so experienced with green infrastructure. They see it; they’ve seen it in different scales on different projects they’ve worked on. Some of them are better with the details than others. There’s a wide range of how well they pay attention to those details and see them through and implementation. Were finding a lot of the contractors, depending on how hungry they are will bid on these jobs but they don’t necessarily understand all the materials properly, they may not understand the objectives and they may be wanting to try to cut corners. I know your question was about policy implementation specifically right but the policy can define this trajectory but then there’s this reality of getting it in the ground and done properly. That’s why I still identify this as a big barrier. We’ve focused our attention on going into next year in 2017 where we’re developing more focus training on the contractors putting this stuff into the ground. Were going to start with a series of sessions focused on contractors that will have the training event at an active LID demonstration site where the constructions happening or wrapping up.

Interviewer: These are contractors that have or would or could bid on these types of projects?

Respondent: Exactly right. Hopefully the right ones that are keen on gaining the knowledge and learning from other case studies and what other people had to go through and carrying that forward. That will be the first step where we have that type of focus in the training. The longer game were trying to play is to develop the right funding opportunities and locations to actually have mock construction site setups to take contractors to basically show what we went through and observed at Forest Glen for example and to be able to show them a partially built bioswale for. As part of the training you go to sites where the mock setup is there and it’s kind of in the middle of being implemented. The instructors and the contractors can get in there and talk about the nuances with the materials, with the conditions, with the utility constraints, with all the different curve balls that come at them and work through that. That’s a real barrier that we have to overcome because that connects to another barrier I wanted to highlight in getting these policies implemented properly and that’s again, cost. It’s always been the concern with cost. These opportunities can come up and we can have the funding and were riding a good wave right now with green infrastructure funding in Ontario and in Canada frankly but the tide can turn again. Within reason we still want these projects to be priced appropriately right and we want to get bang for the buck. We want the development community to really see the value in doing this and the life cycle costs and the payback on having greener infrastructure in place because there are all these intangibles we know about as specialists, as landscape
architect specialists as stormwater specialists. It goes beyond water quality and quantity, its lifestyle and the effects of the human condition – more green infrastructure equals lower crime rates, better health for communities, better mental health and wellness for people. So there’s all these intangible benefits right, it’s hard to bring that into the equation of the true value of implementing them. But the challenge still right now is allowing people to have more knowledge and experience and expertise to do it and I think that’s going to help the price come down and allow it to be more affordable.

Interviewer: So when you say knowledge you mean education as well?

Respondent: Education but then the actual experience knowledge right, like just the street knowledge right. Just dealing with putting it in and knowing how the materials work. Back to the whole context within the public works and their perception of putting in a bioswales is going to be a lot more work than having a stormwater management pond downstream for example right.

Interviewer: So just to summarize the barriers, there two ones that you identified were; the reality of implementing these projects or having these construction plans but the reality that contractors may not understand how to implement a low impact development on a development site or the financial barrier of being able to do so cost effectively and efficiently based on the intangible benefits that green infrastructure can or does offer?

Respondent: Correct. That’s a good way to sum it up.

Interviewer: Okay. Well that would lead me into my next question. How did or could you overcome each one of those barriers?

Respondent: So the training piece described a little bit to you so ill just sum it up again. Were tying to move more opportunities forward for contractors to learn vicariously through others from different case studies within the GTA frankly. So we’re sharing resources and combining energies with other conservation authorities like the TRCA, like the CVC in developing. We have a broader training team that will deliver these training events not just in our watershed but also in the Credit Valley Conservation Area Watershed and the Toronto Conservation Authority Watershed right. I think that’s going to be one effort to bridge this barrier. The financial end were looking at different opportunities to change the landscape for stormwater management in the urban context in trying to find angles on not just the design approach for a site in implementing LID but looking at the urban catchment and how all the stakeholders within the urban catchment could benefit from a different catchment wide stormwater management plan that would optimize economies of scale. So instead of meeting stormwater objectives on each parcel, where are the best opportunities to put better drainage features? When its time to improve drainage in the area is there an opportunity to put it in several locations where the broader context of landowners could contribute? This is more of this gestating idea were working on as CA’s and we haven’t even really taken it to different levels of government.

Interviewer: What do you mean by CA’s?

Respondent: Conservation authorizes right. So that’s kind of one early example of us recognizing this is costly still. We have funding right now to support green infrastructure but really in helping change the landscape for how urban catchments are designed and where green infrastructure goes is one thing but
short of that really bringing in the requirements through the by-laws its helping make that happen because its going to be mandatory. If it’s a by-law it’s a requirement by a municipality well you have to do it right.

Interviewer: And this would be a requirement to implement an LID project on a portion of a development site?

Respondent: The four tiers are; you have a new build and again back to the criteria we developed in the policy-working group for the new build - trying to infiltrate 25mms, your trying to reduce phosphorus. For now we were saying a 75% reduction in total phosphorus. For a linear project because of the constraints within a road right away – the objectives was 12.5mms into the ground.

Interviewer: is that to infiltrate 12.5mms or to store and infiltrate or is there a difference?

Respondent: Well, that’s a good question so I’m leading towards that right. The initial target is infiltrate, to retain and infiltrate but again with those two types of sites – new build, retrofit would be 12.5, linear would be 12.5, but then if those three don’t apply or if the sites are more constrained then you get in to what we call the alternative site options. So you demonstrate the constrains and you work with your approval agencies to land on common ground on what are the criteria that is reasonable for the site. When we started to work on these policies it was getting the development different industries a little nervous, especially the consultants who were always trying to make water balances work and certain infiltration targets work but again they were always working with certain approaches to site plans based on clients needs and wants. Again, I think once they learned more about what this new criteria was saying, it still forwards the practitioner that road to demonstrate that we don’t have the right native soils and so on. But again a lot of this stuff was just kind of getting swept aside because it was easier for approval agencies to say “follow this manual, demonstrate we have peak flow control post to pre for all storms or what ever the criteria was for quantity, demonstrate you have erosion control on site and demonstrate you have water quality control” and how do you do that? The standard traditional was according to the Ministry of Environment and Climate Change Guide was looking at end of pipe facilities right. So the practitioners more often than not were defaulting to these standard approaches because that’s what was giving these clients what they needed in the most expedited manor. To sum up that was another barrier were bridging through presenting this language that can be adopted as a requirement right and it is right? Well, you worked for the Town of Newmarket right, well, guess what, the Town of Newmarket has modified and updated one of their bylaws that brought in the better site design concepts.

Interviewer: Great! I think that’s it Steve. Thank you very much for taking the time to interview with me today.
APPENDIX D

Interview with Respondent 4
Employer: Credit Valley Conservation Authority
Position: Water Resources Specialist
Date: January 18, 2017
Time: 11:00 am

Interviewer: Let me first begin by introducing myself. My name is Andrew Ferguson and I am a 3rd year MLA student at the University of Guelph. I am currently in the process of conducting research on municipal green infrastructure and stormwater management in southern Ontario, Canada. Let me take a few minutes to briefly explain the process of this semi-structured interview today. I will be asking you a total of four questions concerning green infrastructure and stormwater management with several follow up questions per question in order to stimulate conversation and maintain clarity of responses. The interview process should range between thirty and sixty minutes. You said it was okay that I record this this interview today?

Respondent: Yes.

Interviewer: So my first question is very general. Can you describe what you know about green infrastructure including the principles, what you know about it and what your involved with?

Respondent: Okay. So at the CVC I’m involved with many green infrastructure projects at different levels so throughout the whole design process from policy and planning to design, construction and operation and maintenance. So we have a number of demonstration sites throughout our watershed that were monitoring so we gather a lot of information from either being directly involved in the project as project managers or as providing expert advice throughout the process either to municipalities or property owners and providing support with operation maintenance once its built. We have a variety of projects that we look at from road right of ways in regional roads down to local residential roads as well as public lands like churches, parks and schools. We have a lot of green infrastructure on our own property that were monitoring so it covers a broad depth of different practices and we get down to the very detailed components as in design and constructions methods and materials all the way up to the higher level of policy planning?

Interviewer: Which municipalities are you involved with at the CVC?

Respondent: I think there are 11 municipalities in our watershed but we’re mostly working with Mississauga, Brampton, Region of Peel and Caledon.

Interviewer: Okay. That’s quite a number of municipalities.

Respondent: There are a lot of small ones up around the northern end of the watershed. There’s like Orangeville, Erin, Mono.

Interviewer: Right.

Respondent: The big ones that are mostly urbanized, those are the ones that we have a lot of partnerships
with.

Interviewer: Okay. Can you describe the basic principles of green infrastructure? What you know about it, what it offers, why we use it, that sort of thing.

Respondent: The basic principles are to treat water at its source either by filtering the water through different types of media or by infiltrating water into the ground. So using different practices to collect and store that water before it drains into the sewers, streams and lakes. So we’re trying to hold back that water, usually its about the first 25mm of any rain even that we like to capture into these practices delaying the peak before it enters into the main storm sewer system.

Interviewer: So my second question, as I mentioned, this is going to get a little more focused as we go, you might start understanding where I’m trying to go with this but; has your organization discussed green infrastructure policies or projects? I know you gave me some of the information but if you could fill in the blanks.

Respondent: For green infrastructure policies we’re working with the Region of Peel to get green infrastructure and stormwater design criteria so that when they build roads that criteria will have to be met and it will be met by green infrastructure. So volume reduction, that’s a big one that will go in there. Guidelines are coming out from the province and we’re on the review committee for that so once those requirements come in then all linear infrastructure, new development, redevelopment will have to meet those volume control requirements and that will be met by green infrastructure and low impact development.

Interviewer: As you said the CVC has completed a number of projects, is working on and has a number of projects planned for the future I’m sure but can you discuss one project in particular that stands out?

Respondent: I work out of the Region of Peel one day a week so I’m helping them with their road reconstruction projects so for the past year or two we’ve been working on Mississauga Road which is Queen Street to Williams Parkway in Brampton. They want to do a retrofit of the medians which are currently there now to bring in stormwater to irrigate the trees as well as to meet water quality control so that will treat 5.6 hectares of runoff coming from just north of the first local street all the way to Williams Parkway so that’s about a kilometer and 6 to 8 lane cross section.

Interviewer: That sounds exciting.

Respondent: Yeah. It’s a pretty large project so we’ve been involved since the very beginning and it began construction last October. They’ve stopped for the winter but it should finish up by the end of next year or the middle of next year.

Interviewer: That will be really exciting to see once its done, plus it’s in a very urban area?

Respondent: Yeah.

Interviewer: That’s great. Okay. My third question is; do you think that there are barriers to implementing green infrastructure policies or projects?
Respondent: Yeah. There are definitely barriers out there and we’ve hosted a number of workshops trying to get people together to come up with all of those barriers as well as provide solutions. So we had a workshop last March, it was called “Roads and Runoff”. I think there were about 20 tables and at each table there were about 12 people from different municipalities from the development industry so we brainstormed lists of all the different barriers. The ones that come up the most are: budget, operation maintenance, space constraints, and utilities. Utilities take up a lot of space in the road right of way so having room to fit in the green infrastructure is seen as a real barrier.

Interviewer: Right. Can you discuss more about operation maintenance? You said it was one of the barriers that comes up

Respondent: Yeah. So that’s a barrier that comes up where its new, the people doing road operation maintenance aren’t familiar with it so they don’t understand what it entails. There are such a wide variety of different types of green infrastructure with varying maintenance levels between each of them. So people have the ideas that there’s going to be so much operation maintenance but they are often thinking of highly manicured bioswales. So that’s what they kind of see but there’s many different options to kind of meet the maintenance needs. It’s a new way of doing business but at the same time we need to try to keep it inline with what they’re doing. They’re sucking out catch basins now, they’re street sweeping. Incorporating that into your LID or your green infrastructure is important because that’s the operation maintenance that they’re doing. There’s also a struggle between who does what because when you have lets say a bioswale, you’ll have trees, shrubs and perennials potentially but you’ll also have the underground infrastructure so you might have 4 different departments maintaining a single feature. You have parks and forestry, you have horticulture staff who aren’t necessarily part of forestry, you have your road operation maintenance staff and you might have different staff for looking at stormwater pipes. Being able to coordinate all these different groups and deciding where the responsibilities lie and hopefully someone will operate and maintain it because sometimes if just kind of gets left behind.

Interviewer: I can definitely sense the complexities in trying to work with several different departments while making sure each department maintains its responsibility

Respondent: Yup.

Interviewer: Do those reasons apply to both projects and policies or are there more specific barriers that apply to say developing policies?

Respondent: So the policy side you would still run into that cross-departmental struggle because municipalities may not have one department dedicated for stormwater. So stormwaters kind of in pieces. So coming up with a stormwater management master plan that covers the entire municipality that’s when you can look at it holistically and meet all your targets for your municipality instead of just doing piece meal projects everywhere. Being able to fit that into your budgeting process without having to go through each project, you’ll have a plan in place. It’s hard to get that plan in place if there’s no one dedicated to that. So I think the regulations coming out of the province, the Water Opportunities Act, the new LID requirements coming through will kind of push that along where you need to develop a stormwater management plan and do that in conjunction with Water and Wastewater because stormwater makes a big impact to Water and Wastewater functions.
Interviewer: Absolutely. Okay. So my last question, this is where it gets fun is; How could you overcome each one of those barriers for either policy or projects.

Respondent: I think what it comes down to is having the regulations in place from the province saying that this is how it needs to be done and then I think everyone will start getting on board with putting it into their policies throughout the whole organization. Like putting it into environmental assessments, putting it into their official plans, training staff throughout the whole department (capital works, construction and design) and training their inspectors. It’s a whole organizational change for municipalities where that needs to happen. I think the biggest push is going to be the regulations coming through.

Interviewer: Okay. You said “training staff”, you mean having staff that can coordinate or design or implement these projects?

Respondent: Yup. That’s right.

Interviewer: Okay. I think that’s it then.