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Greening Stormwater Management in Ontario



An Analysis of Challenges and Opportunities

Greening Stormwater Management in Ontario: An Analysis of Challenges and Opportunities

by Matt Binstock

Canadian Institute for Environmental Law and Policy

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Table of Contents

Executive Summary.....	i
1.0 Why Use Green Infrastructure in Ontario?.....	1
1.1 Current Status of Green Infrastructure in Ontario	4
1.2 Policy and Legislative Tools to Promote Green Infrastructure in Ontario: Opportunities and Challenges.....	5
1.2.1 <i>Ontario Water Resources Act</i> and Tools for Stormwater Management.....	5
1.2.2 Lake Simcoe Protection Plan.....	7
1.2.3 Source Water Protection Planning and the <i>Clean Water Act</i>	9
1.2.4 Canada-Ontario Agreement Respecting the Great Lakes Basin Ecosystem	9
1.2.5 Planning Act	9
1.2.6 Provincial Policy Statement	10
1.2.7 Oak Ridges Moraine Conservation Plan.....	11
1.2.8 Water Opportunities and Water Conservation Act	12
1.2.9 Building Code	12
1.2.10 Ontario's Growth Plan for the Greater Golden Horseshoe Region	12
1.3 Infrastructure Funding.....	13
1.3.1 The Federal Gas Tax Fund	13
1.3.2 Federation of Canadian Municipalities Green Municipal Fund	13
Discussion	13
2.0 Use of Green Infrastructure in Other Jurisdictions.....	15
2.1 United States	15
2.2 Illinois.....	16
2.3 Washington.....	20
2.4 Maryland.....	22
2.5 United Kingdom	24
3.0 Analysis and Discussion.....	27
4.0 Recommendations for Ontario	29

Executive Summary

This report assesses the current state of green infrastructure use for stormwater management in Ontario and makes recommendations for how the use of green infrastructure could be increased. In recent years, there has been a growing interest in the use of green infrastructure as an alternative to relying mainly on traditional approaches that focus on the conveyance of stormwater, through pipes, to stormwater ponds and outfalls that discharge into water bodies. Green infrastructure may also help to reduce the severity of combined sewer overflows, which are a significant source of water pollution in the province. In addition, green infrastructure, where carefully planned and regularly maintained, may provide a “no-regrets” solution to climate change adaptation that could both help manage stormwater and provide other benefits such as reducing the urban heat island effect. This report focuses on ways in which green infrastructure could be promoted at the provincial and federal levels through policy, legislation or financial assistance.

While a number of Ontario municipalities have experimented with green infrastructure, there is still significant room to make further use of this technology in the province. In the Lake Simcoe Watershed, where green infrastructure is receiving serious consideration as a way to reduce phosphorus loading to Lake Simcoe, a number of barriers to using green infrastructure have been identified. Key barriers include a lack of familiarity with green infrastructure, uncertainties surrounding its performance and apprehension arising from maintenance issues.

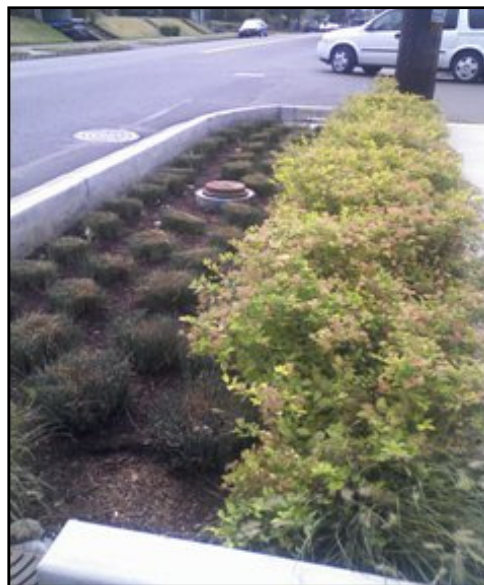
It is likely that these concerns will remain a barrier to more widespread use of green infrastructure in the province until a substantial database is available that can provide assurances of expected performance from different forms of green infrastructure across a wide variety of regions. Such a database should also provide instruction on which technologies are best suited to the region based on topography, soil characteristics and other environmental factors.

Based on the jurisdictional review conducted for this study, an effective approach to overcoming initial barriers to green infrastructure use would be to remove some of the risk for municipalities by funding pilot projects across the province that would in turn generate regionally specific performance data to encourage additional projects. Illinois’ experience with promoting green infrastructure suggests that providing grants to municipalities can be an effective means of getting past initial hesitation to experiment with new technologies. In both Washington and Maryland, substantial amounts of funding are being distributed by the state to aid municipalities in implementing green infrastructure for stormwater management. Funding for new projects plays an important role in reducing stigma and generating localized, specific performance data to convince municipalities and approval authorities that green infrastructure is viable.

Over time though, the experiences of other jurisdictions suggest that more stringent requirements may be necessary to ensure that green infrastructure is implemented on a large scale across the province. In 3 of the 4 jurisdictions studied, a shift toward legislative requirements for green infrastructure is currently underway or has been recently completed.

1.0 Why Use Green Infrastructure in Ontario?

In recent years there has been a growing interest in using green infrastructure as an alternative to the existing stormwater management approach, in which stormwater is captured in storm sewers, conveyed through pipes and eventually discharged into receiving water bodies. Green infrastructure, for the purpose of this report, is defined as “ecological processes or structures, whether natural or engineered, that process, capture and direct water, stormwater and wastewater in a similar manner to grey infrastructure, yet have multiple ancillary societal benefits.”¹ Different jurisdictions use various terms to describe green infrastructure, such as Low Impact Development, Sustainable Urban Drainage Systems, or Environmental Site Design. In this report, these various terms are used interchangeably throughout.



Curb extension with bioswale – photo courtesy of Greg Raisman

Green infrastructure can include engineered solutions such as green roofs and green walls, permeable pavement, rain barrels, cisterns and constructed wetlands. In a broader local or regional context, green infrastructure may also refer to existing natural features, such as wetlands, urban forests or parklands, that perform some degree of stormwater retention and filtration.

While none of the technologies currently being described as green infrastructure are new (some of them have been experimented with since the 1970s and 1980s), green infrastructure has increasingly been seen as a way of addressing urgent concerns in Ontario in recent years, including climate change and the need for new infrastructure investment.

Green infrastructure is being discussed as a means to reduce the impact of potential flooding that may result from more intense storm and rainfall events anticipated in a changing global climate. Two major storm events that occurred during the past decade in Peterborough, Ontario in 2004 and North Toronto in 2005 have raised awareness of how such impacts of climate change could impact infrastructure. Both events resulted in substantial financial costs related to infrastructure repair and individual property damage.

Additional pressure on sewer systems will result in increased water pollution for municipalities that rely on combined sewers, through which storm drains connect to sanitary sewer lines and discharge into water bodies when line capacity is exceeded. Ontario has as many as 107 combined sewer systems located in 89 municipalities across the province. An investigative report published in 2009 revealed more than 1,000 instances of partially treated or raw sewage from combined sewers being discharged

¹ Canadian Environmental Law Association and Ecojustice “Submission to the Standing Committee on General Government: Recommendations Regarding Bill 72” (October 12, 2010).

into receiving waters in both 2006 and 2007. The authors noted that there may be even more instances of combined sewer overflows for which there are no records.²

In a 2009 report entitled *Adapting to Climate Change in Ontario*, the Ontario Expert Panel on Climate Change Adaptation recommended that Ontario complete a comprehensive review of stormwater management practices throughout the province by the end of 2011. The panel recommended that the Ministry of Environment (MOE) ensure provisions for climate change adaptation are implemented into the provincial stormwater management framework. Furthermore, the panel recommended that the MOE update its 2003 *Stormwater Management Planning and Design Manual* in order to provide better support for innovative, multi-barrier approaches to stormwater management.³ Green infrastructure is an ideal candidate for inclusion in a multi-barrier approach to stormwater management, particularly in light of the impacts of a changing global climate. Green infrastructure has the potential to capture larger amounts of rainfall before it enters a storm drain, reducing the frequency and intensity of combined sewer overflows.⁴ While green infrastructure will not replace traditional stormwater management facilities and may not capture the largest storm events, its role as a potential complementary measure is gradually gaining recognition in the province.

Because green infrastructure can capture, retain and treat stormwater before it enters traditional storm sewer infrastructure, it can reduce the burden on these sewer systems and lessen the need for investment in traditional infrastructure. This is particularly relevant, given the alarming infrastructure deficit still being faced by Ontario municipalities. *Watertight*, a 2005 report assessing future water and wastewater needs for the province, estimated that approximately \$30 to \$40 billion will be required to invest in water and wastewater infrastructure over the next 15 years.⁵ By reducing stormwater flows and retaining stormwater on site where it can infiltrate into the ground, green infrastructure may have some potential to reduce the infrastructure deficit by making smaller investments in traditional infrastructure a possibility.

Given these urgent concerns and the growing interest in the use of green infrastructure for stormwater management, there is a need to better understand how existing policy and legislation could be leveraged to encourage greater use of green infrastructure as part of the province's stormwater management protocol. Once opportunities within current law and policy have been identified, an analysis of new tools to promote more widespread and coordinated use of green infrastructure will also be required.

The purpose of this report is twofold. First, it is intended to establish a baseline of relevant policies and legislation in Ontario that may impact stormwater regulation, including opportunities to promote green infrastructure. Second, the report reviews the experiences of other jurisdictions that are currently trying to implement green infrastructure for stormwater management on a wide scale.

² MacDonald, Elaine, and Liat Podolsky. *Flushing Out The Truth: Sewage Dumping in Ontario*. Ecojustice, 2009, pg. 7.

³ Ontario Expert Panel on Climate Change. *Adapting to Climate Change in Ontario*. Toronto: Queens Printer for Ontario, 2009, pg. 42

⁴ Podolski, Liat, and Elaine MacDonald. *Green Cities, Great Lakes: Using Green Infrastructure to Reduce Combined Sewer Overflows*. Ecojustice, 2008, pg. 6.

⁵ Ontario Ministry of Infrastructure. *Watertight: The Case for Change in Ontario's Water and Wastewater Sector*. Toronto: Queen's Printer for Ontario, 2005, pg. 7.



Green roof - photo courtesy of Arlington County, Virginia

In Canada, the use of green infrastructure as a climate change adaptation measure is supported at the federal level.

Environment Canada's *Canadian Communities Guidebook for Adaptation to Climate Change* promotes adaptation measures that will generate co-benefits that contribute to climate change mitigation. Creation of new green infrastructure and protection of existing green infrastructure are identified as potential adaptation actions in the guidebook.⁶ Similarly, *Adapting to Climate Change: An Introduction for Canadian Municipalities* advocates the use of "no-regrets" climate adaptation measures. A no-regrets climate change adaptation measure will provide benefits to a

community even if the anticipated climate change impact it was intended to address does not occur.⁷ For example, the use of green roofs may provide a range of benefits, such as runoff retention, urban heat island effect reduction and aesthetic enhancement, even if climate change patterns do not unfold precisely as they have been anticipated.



Other benefits of green infrastructure in the context of climate change adaptation include: providing places to store water for reuse; allowing water to infiltrate into the ground to sustain aquifers and river flows while capturing sediment; removing pollutants from the water; and reducing or slowing down peak flows, which can reduce flooding.⁸

In addition to stormwater runoff management, green infrastructure has the potential to provide a number of environmental, social and economic co-benefits.⁹ Constructed wetlands can provide habitat for waterfowl or other species.¹⁰ As

Example of Permeable Paving

⁶ Bizikova, Livia, Tina Neale, and Ian Burton. *Canadian Communities Guidebook for Adaptation to Climate Change - Including an Approach to Generate Mitigation Co-Benefits in the Context of Sustainable Development. (First Edition)*. Environment Canada and University of British Columbia, 2008, pg. 50.

⁷ Mehdi, Bano, Charles Mrena, and Al Douglas. *Adapting to Climate Change: An Introduction for Canadian Municipalities*. Canadian Climate Change Impacts and Adaptation Research, 2006, pg. 6.

⁸ Jaffe, Martin, et al. *Using Green Infrastructure to Manage Urban Stormwater Quality: A Draft Report to the Illinois Environmental Protection Agency*. Illinois Environmental Protection Agency, 2010, pg. 5.

⁹ *Ibid.*

¹⁰ United States Environmental Protection Agency. "Constructed Wetlands for Wastewater Treatment and Wildlife Habitat – 17 Case Studies" 1993.
http://water.epa.gov/type/wetlands/upload/2004_10_25_wetlands_ConstructedWetlands-Complete.pdf.

most forms of green infrastructure rely on vegetation, they can also improve air quality.¹¹ One study has suggested that green infrastructure can benefit the urban poor by enhancing property values, drawing more people to the streets, thereby improving community safety and creating green infrastructure construction and maintenance job opportunities for low-income individuals.¹²

Regardless of whether climate change occurs exactly as anticipated in Ontario, implementing green infrastructure will provide benefits.

1.1 Current Status of Green Infrastructure in Ontario

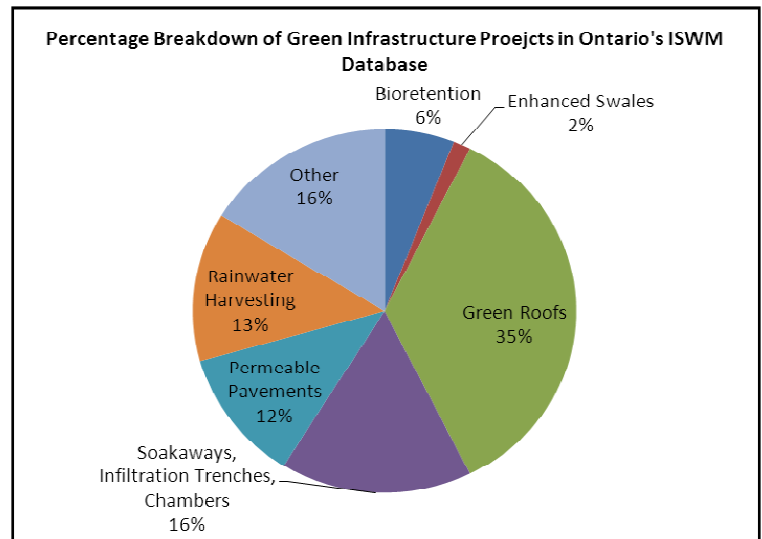


Location of green infrastructure projects registered in the ISWM database. Image courtesy of www.iswm.ca

While there is no comprehensive inventory of green infrastructure projects that have been implemented in Ontario to date, an Innovative Stormwater Management Practices (ISWMP) database is maintained by the Toronto and Region Conservation Authority. Although this database may not be comprehensive, it does provide some insights into the current status of green infrastructure in Ontario. Based solely on the projects registered in the ISWMP database, many existing green infrastructure projects are located in Southern Ontario, with most occurring in the GTA and surrounding area.

Green infrastructure projects can also be identified by category in the ISWMP database. Currently, the majority of registered green infrastructure projects are green roofs (35%) followed by soakaways, infiltration trenches and chambers (16%), rainwater harvesting (13%) and permeable pavements (12%).

The use of green infrastructure is also promoted in various parts of Ontario's current land use planning and water management frameworks. These are outlined in the following section.



¹¹ Jaffe, Martin, et al. Using Green Infrastructure to Manage Urban Stormwater Quality: A Draft Report to the Illinois Environmental Protection Agency. Illinois Environmental Protection Agency, 2010, pg. 39

¹² Dapolito Dunn, Alexandra. "Siting of Green Infrastructure: Legal and Policy Solutions to Alleviate Urban Poverty and Promote Healthy Communities." *Environmental Affairs*, 2010: 41-66.

1.2 Policy and Legislative Tools to Promote Green Infrastructure in Ontario: Opportunities and Challenges

1.2.1 Ontario Water Resources Act and Tools for Stormwater Management

The *Ontario Water Resources Act*¹³ (OWRA) and its Certificate of Approval process currently govern stormwater in Ontario. The OWRA contains provisions for regulating municipal wastewater effluent and prevents the discharge of other harmful pollutants into any waters within provincial boundaries. Section 53 of the OWRA requires new municipal sewage works, as well as expansions and alterations to existing facilities, to obtain a Certificate of Approval in order to operate. The OWRA includes stormwater facilities in its definition of sewage works, and requires that stormwater infrastructure projects obtain a Certificate of Approval if stormwater is discharged to surface water bodies, onto the surface of the ground, or into groundwater.

Through MOE, the Ontario government has produced a *Stormwater Pollution Prevention Handbook* (2001)¹⁴ and a *Stormwater Management Planning and Design Manual* (2003).¹⁵ Additional design guidelines for stormwater management systems are contained in the *Design Guidelines for Sewage Works* (2008). These tools are intended to assist municipalities in obtaining a Certificate of Approval for stormwater management systems. Certificates of Approval for stormwater management systems are considered by MOE on a site-specific basis.

In 2007, a request was submitted under the *Environmental Bill of Rights* (EBR) to review stormwater management policy and legislation in Ontario in the context of climate change adaptation.¹⁶ In undertaking the review, MOE took the lead in forming an inter-ministerial working group that included the Ministry of Natural Resources (MNR), Ministry of Municipal Affairs and Housing (MMAH), Ministry of Energy and Infrastructure (MEI) and the Ministry of Transportation (MTO). Federal agencies were also involved in the process, including Environment Canada, the Department of Fisheries and Oceans, and Infrastructure Canada. Municipal representatives included the Municipal Engineers Association and the Association of Municipalities of Ontario, as well as Conservation Authorities. The review focused on policies, acts, regulations and non-regulatory best management practices (BMPs) within MOE jurisdiction.

The review concluded that the OWRA and the *Environmental Protection Act* are sufficient to address the potential impacts of climate change on stormwater in the province. MOE indicated that climate change adaptation measures can be implemented through issuance of approvals, prohibitions and penalties, or through the creation of regulations.¹⁷ However, MOE concluded that a new policy framework is required

¹³ R.S.O. 1990 c.O.40.

¹⁴ Ontario Ministry of the Environment and Toronto and Region Conservation Authority. *Stormwater Pollution Prevention Handbook*. Toronto: Queen's Printer for Ontario, 2001.

¹⁵ Ontario Ministry of the Environment. *Stormwater Management Planning and Design Manual*. Toronto: Queen's Printer for Ontario, 2003.

¹⁶ Ontario Ministry of Environment. "Environmental Bill of Rights (EBR) Application for Review Decision Summary MOE File Number 07EBR008.R," 2010, pg. 9.

¹⁷ *Ibid.*

to support the implementation of municipal stormwater management systems that are sufficient to address climate change.¹⁸

The MOE review identified other key findings, including the need for:

- Data gathering and management to monitor the state and performance of stormwater management systems in the province and inform adaptive infrastructure renewal decisions. Currently, no province-wide inventory is available for municipal stormwater systems to gauge the size of the problem or measure how much progress has been made with regards to a system's condition or vulnerability to climate change;
- Pilot projects and incentives that will encourage the adoption of climate-resilient stormwater management systems. In particular, the MOE identified the importance of implementing source control measures; and
- Continued collaboration between MNR, MEI, MTO, MMAH, conservation authorities and municipalities in the development of stormwater management solutions to address climate change adaptation.¹⁹

MOE's review also acknowledges that the current *Stormwater Management Planning and Design Manual* is based on work that was completed in the 1990s, and an update is required to reflect the new realities presented by climate change.²⁰ The review notes that in a majority of cases, municipal stormwater facilities are modeled on design guidance provided in the manual; however, the current focus of the manual is on conveyance and end-of-pipe aspects of stormwater management.²¹ An earlier review of the manual in 2004 also noted a lack of emphasis on preventative measures, such as on-site stormwater retention and infiltration.²²

As part of the EBR review process, MOE also articulated its vision for a climate-resilient stormwater management policy that would:

- Address both source control and conventional stormwater management;
- Reduce stormwater runoff by building communities that preserve the natural water cycle;
- Recognize stormwater as a resource for such tasks as flushing toilets, landscape watering, etc.;
- Recycle stormwater back into the natural water cycle while protecting water quality and quantity; and
- Include data collection and a vulnerability assessment for existing conventional stormwater management systems to assist in climate adaptation decisions by municipalities.²³

¹⁸ *Ibid*, pg.1.

¹⁹ *Ibid*, pg.1-2.

²⁰ *Ibid*, pg. 6.

²¹ *Ibid*, pg. 4.

²² Bradford, Andrea, and Bahram Gharabaghi. "Evolution of Ontario's Stormwater Management Planning and Design Guidance." *Water Quality Research Journal of Canada*, 2004, pg. 349.

²³ Ontario Ministry of Environment. "Environmental Bill of Rights (EBR) Application for Review Decision Summary MOE File Number 07EBR008.R", 2010, pg. 8.

MOE concluded that policies, guidance, public education and incentives would be more desirable than the use of mandatory regulations or legislation.²⁴

In his most recent annual report, the Environmental Commissioner of Ontario (ECO) supported MOE's vision for resiliency as described in the EBR review, but raised concerns over the lack of a timeline for implementing next steps.²⁵ The ECO noted that while the use of incentives for innovative source control are ideal for use during a transition period between traditional and modernized practices, mandating green infrastructure would create a more level playing field for developers and municipalities. The ECO also suggested that mandating green infrastructure may help to foster innovation and generally speed up progress on implementing climate change adaptation measures.²⁶

1.2.2 Lake Simcoe Protection Plan

The Lake Simcoe Protection Plan (LSPP), given authority by the *Lake Simcoe Protection Act, 2008*,²⁷ came into force in 2009. The LSPP was designed to address the growing problem of phosphorus loading to Lake Simcoe, in part the result of increased urban runoff and wastewater effluent caused by the substantial growth pressures Simcoe County has experienced in recent years.

Under the LSPP, municipalities in the Lake Simcoe Watershed are required to develop comprehensive stormwater master plans by 2014.²⁸ Stormwater master plans will require an evaluation of cumulative impacts of stormwater runoff from both existing and planned development. Stormwater master plans also require an evaluation of the effectiveness of current stormwater management facilities and an assessment of opportunities to perform retrofits.²⁹

A majority of phosphorus loading to Lake Simcoe is the result of urban and agricultural runoff, with urban runoff being the single largest contributor at 31% of total annual loading.³⁰ The Lake Simcoe Phosphorus Reduction Strategy was finalized in 2010 to support the phosphorus loading reduction objective of the LSPP. The Strategy encourages the use of green infrastructure to reduce phosphorus loading and estimates that 2.7 tonnes per year of phosphorus from urban runoff could be prevented from entering Lake Simcoe by using green infrastructure practices.³¹

Environment Canada will administer a \$30 million Lake Simcoe Cleanup Fund. Money from the Fund will cover up to two thirds of total project costs and can be used to support innovative methods to control urban stormwater runoff.³²

²⁴ *Ibid.*

²⁵ Environmental Commissioner of Ontario. *Redefining Conservation*. Toronto: Queens Printer for Ontario, 2010, pg. 163.

²⁶ *Ibid*, pg. 164.

²⁷ S.O. 2008, c. 23.

²⁸ Ontario Ministry of the Environment. *Lake Simcoe Protection Plan*. Toronto: Queens Printer for Ontario, 2009, pg. 28.

²⁹ *Ibid.*

³⁰ Ontario Ministry of the Environment. *Lake Simcoe Phosphorus Reduction Strategy*. Toronto: Queens Printer for Ontario, 2010, pg. 26.

³¹ *Ibid*, pg. 29.

³² Environment Canada. "Lake Simcoe Clean-up Fund" website. <http://www.ec.gc.ca/eau-water/default.asp?lang=En&n=85C54DAE-1>.

Additional studies and workshops have been taking place to foster a better understanding of how to implement green infrastructure in the Lake Simcoe Watershed. A number of barriers were identified by local practitioners during these discussions. Key barriers include the following:

- Modeling the potential benefits of green infrastructure is considered a relatively new field and is more complex than modeling a sewer shed for stormwater management based largely on pipes and conveyance of stormwater from the site.³³
- Green infrastructure has the potential to change drastically over time and, as a result, may be transformed to other land uses aside from the stormwater management role it was established to perform.³⁴ Maintenance can also be a barrier, especially in cases where green infrastructure must be installed on private properties.³⁵
- Green roofs may require irrigation and may be vulnerable to invasive species.³⁶
- Use of green infrastructure could result in increased municipal staff costs for maintenance, e.g., enforcement through by-law officers.³⁷
- Green infrastructure may be easier to implement and maintain in public settings. Schools and parks were identified as potential candidates for green infrastructure; however, gaining access to the land required may be difficult.³⁸
- Currently there is a lack of Ontario-specific and regionally specific data available on the performance of green infrastructure that would assure municipalities and developers that technologies will perform as expected. There is a need for municipalities to take risks and implement pilot projects in order to gather Ontario-specific performance data to fill this gap.³⁹
- A lack of data on the overall costs and long-term benefits of implementing green infrastructure was also identified as a barrier. While initial costs of installation are relatively well known, there is less data on anticipated maintenance costs and long-term maintenance timelines.⁴⁰
- Green infrastructure may be covered by snow during the winter, preventing infiltration of water into the soil for long periods of time.⁴¹
- A lack of an overarching vision for how green infrastructure should be implemented was also identified as a barrier. Currently, a number of noteworthy green infrastructure approaches are being implemented as pilot projects, but there is little broad coordination.⁴²

³³ Oglivie, Oglivie and Company. "Phase 1 Workshop: Stormwater Management Strategies for Uncontrolled Urban Areas in the Lake Simcoe Watershed." King City, September 28, 2009, pg.10.

³⁴ *Ibid*, pg.35.

³⁵ *Ibid*, pg.34.

³⁶ *Ibid*, pg. 49.

³⁷ *Ibid*, pg. 34.

³⁸ *Ibid*, pg. 35.

³⁹ *Ibid*, pg. 55.

⁴⁰ *Ibid*, pg. 51.

⁴¹ *Ibid*, pg. 54.

⁴² *Ibid*, pg. 25.

1.2.3 Source Water Protection Planning and the *Clean Water Act*

The 2006 *Clean Water Act* is the most recent piece of legislation enacted by the Ontario government to implement the recommendations of the Walkerton Inquiry. The *Clean Water Act* recognizes stormwater that is discharged to land or surface waters as a threat to drinking water quality. Source Water Protection Committees established under the *Clean Water Act* will eventually craft policies that ensure adequate management of stormwater in vulnerable areas. Future assessments of drinking water threats are expected to require the consideration of climate change impacts. Inclusion of climate change adaptation measures in source water protection policy will also be required.⁴³

1.2.4 Canada-Ontario Agreement Respecting the Great Lakes Basin Ecosystem

The Canada-Ontario Agreement Respecting the Great Lakes Basin Ecosystem (COA) is an agreement between the federal government and the Ontario government that outlines how the two will collaborate to protect the Great Lakes Basin ecosystem. An objective of the COA is to reduce contaminant loading from urban stormwater runoff and combined sewer overflows in Great Lakes Basin communities.⁴⁴ Changes to stormwater management that could reflect an increased role for green infrastructure have been discussed in regards to the (COA).⁴⁵

“A massive contributor [to green infrastructure adoption] would be a municipality with political influence, driving this and saying, ‘OK, we have land here that we own, we are going to develop this as a pilot project... and we are going to do all these things green and see how it goes. We are going to act as the developer and the main stakeholder in the whole thing.’ It is certainly risky, but it also could be a huge contributor to getting a body of knowledge together to say this works, this does not.” -Lake Simcoe LID Workshop Participant

Participants in stakeholder discussions on the feasibility of green infrastructure for cities in the Great Lakes Basin have identified some barriers to implementation, including a lack of funding and implementation guidance. Provincial funding is needed to stimulate green infrastructure industries, and municipalities need assistance in developing or updating their stormwater plans.⁴⁶

1.2.5 Planning Act

The *Planning Act* establishes the fundamental “ground rules” for land use planning in Ontario. The Act provides municipalities with the powers to establish municipal official plans, zoning by-laws and other land use planning tools, such as the ability to place conditions on development approvals. MMAH identifies the following sections of the *Planning Act* as having relevance for encouraging a green infrastructure-based approach to stormwater management and climate change adaptation efforts:

⁴³ Ontario Ministry of Environment. “Environmental Bill of Rights (EBR) Application for Review Decision Summary MOE File Number 07EBR008.R,” 2010, pg. 10

⁴⁴ Environment Canada and the Ontario Ministry of Environment. “Canada-Ontario Agreement Respecting the Great Lakes Basin Ecosystem” 2007.

⁴⁵ Great Lakes and St. Lawrence Cities Initiative. “Canada-Ontario Agreement Memorandum of Cooperation Municipal Great Lakes Working Group Meeting #4 Theme: Stormwater/Wastewater and Climate Change .” March 4, 2009.

⁴⁶ *Ibid*

Planning Act Section	Relevance to Promoting Green Infrastructure
Official Plans – Section 16–27	MMAH notes that municipalities may incorporate climate change adaptation measures in their official plans. Official plan policies can complement municipal initiatives, such as green building, water conservation, tree planting, etc.
Protection of Settlement Area Boundaries Sections 22, 34	Municipal council refusals or non-decisions on expansions of the settlement area boundary cannot be appealed to the Ontario Municipal Board. Building compact communities can promote the preservation of naturally occurring green infrastructure beyond the settlement area border in countryside areas.
Complete Application Requirements Subsections 22(5), 34(10.2), 51(18), 53(3)	Municipalities can define what types of supporting studies are required for Official Plan Amendments, Zoning By-law Amendments, Subdivisions and Consents. Municipalities could require developers to produce supporting studies that demonstrate how climate change is addressed, e.g. through stormwater management plans, with an increased focus on on-site retention through green infrastructure.
Community Improvement Plans (CIPs) Section 28	Section 28 of the <i>Planning Act</i> enables municipalities to acquire, hold, clear, lease or sell land within a designated area, as well as provide grants and loans to property owners to undertake certain activities. This power could be used to address climate change adaptation issues, such as building retrofits.
Zoning By-laws – Section 34	Zoning by-laws enable municipalities to prohibit development in areas that contain environmentally sensitive features or in flood-prone areas. They can be used to protect areas that provide natural stormwater retention, groundwater recharge and other ecological services.
Height and Density Bonusing – Section 37	Section 37 of the <i>Planning Act</i> enables municipalities to enter into agreements with developers wherein they will provide facilities or services in exchange for increased building height and density. This provision could be used by municipalities to require developers to construct green infrastructure.
Site Plan Control – Subsection 41(4)	Subsection 41(4) of the <i>Planning Act</i> enables municipalities to require certain external design elements in a project site plan. This provision could be used to secure various types of on-site green infrastructure.
Parkland Dedication – Subsection 42 (6.2)	In situations where parklands cannot be created on site, Subsection 42 (6.2) of the <i>Planning Act</i> enables municipalities to allow a reduction in cash-in-lieu requirements in exchange for design features that address climate change, such as green roofs, permeable surfaces, etc.
Plan of Subdivision – Section 51	Municipal approval authorities could review Plans of Subdivision for how they address climate change adaptation in their design and layout. Examples could include conditions on the approval that require easements or land dedicated to green spaces and natural features.
Development Permit System (DPS) – Section 70.2 and O. Reg. 608/06	The development permit system combines zoning, site plan control and minor variance approvals. Climate change adaptation could be considered in the development permit system by specifying conditions to protect green spaces, water management and conservation measures, exterior building features such as green roofs, or by expanding on matters partially addressed through the site plan control process, such as the removal, restoring or preservation of certain natural features.

Adapted From: Ontario Ministry of Municipal Affairs and Housing “Planning for Climate Change”
<http://www.mah.gov.on.ca/AssetFactory.aspx?did=7234>

1.2.6 Provincial Policy Statement

The Provincial Policy Statement (PPS) provides a substantial opportunity to further the promotion of green infrastructure across the province. The PPS is given authority by the *Planning Act*, and provides guidance on how to address land use matters that have been declared as provincial interests, such as the protection of provincially significant natural heritage, agricultural lands and natural resources. All single-tier and regional level municipal official plans, as well as individual development approvals, must

be consistent with the objectives identified in the PPS. Currently, Section 2.2.1 of the 2005 PPS requires planning authorities to ensure that stormwater management practices “minimize stormwater volumes and contaminant loads, and maintain or increase the extent of vegetative and pervious surfaces,”⁴⁷ but does not explicitly define, or call for use of green infrastructure in stormwater management.

The PPS is reviewed every five years, and this review process is currently underway. MOE is a partner in the current PPS review, which could include an opportunity to enhance existing stormwater and water conservation measures.⁴⁸ Several groups have called for more explicit language to promote green infrastructure in the next edition of the PPS.⁴⁹ Also, the Ontario Expert Panel on Climate Change Adaptation has recommended that the idea of planning to enhance resilience in the presence of climate change pressures should be embodied in the “Vision for Ontario’s Land Use Planning System” section of the PPS.⁵⁰

1.2.7 Oak Ridges Moraine Conservation Plan

The Oak Ridges Moraine Conservation Plan (ORMCP) was introduced in 2002, under the authority of the *Oak Ridges Moraine Conservation Act*. The ORMCP protects a 190,000-hectare tract of land in Southern Ontario, stretching from Caledon in the west to Trent Hills in the east, from urban development pressures and aggregate pits and quarries.

Section 45 of the ORMCP requires proponents of major development projects to prepare a stormwater management plan that promotes lot-level control of stormwater. A number of potential green infrastructure options that can be included in a stormwater management plan are outlined in the technical supporting documentation for the ORMCP.⁵¹ The ORMCP also establishes limits on the area of impervious surfaces that can be constructed in development projects.

However, the limits on impervious surfaces only apply to areas where there are already significant restrictions on new development in the Countryside, Natural Linkage and Natural Core areas of the ORMCP.⁵² These limits do not apply within the urban Settlement Areas, where most of the development pressures and subsequent risks to surface and groundwater exist.

⁴⁷ Ontario Ministry of Municipal Affairs and Housing. *Provincial Policy Statement*. Toronto: Queen's Printer for Ontario, 2005, pg. 16.

⁴⁸ Ontario Ministry of Environment “Environmental Bill of Rights (EBR) Application for Review Decision Summary (MOE File Number 07EBR008.R)” 2010, pg. 11.

⁴⁹ The first round of comments on the PPS have now been submitted, and a PPS Review Collaborative has called for recognition of green infrastructure in the updated PPS in combination with a “fix-it-first” approach to infrastructure development that would maximize use of existing infrastructure before allowing additional expansion. The PPS Review Collaborative recommended in Part IV of the updated PPS that land use planning must be explicitly linked with integrated watershed management, stipulating that the assessment of cumulative impacts and responses to changing natural hazards (and climate change) focus on the protection of green infrastructure, with engineered solutions being chosen as a final resort.

⁵⁰ Ontario Expert Panel on Climate Change. *Adapting to Climate Change in Ontario*. Toronto: Queens Printer for Ontario, 2009, pg. 62.

⁵¹ Ontario Ministry of Municipal Affairs and Housing. *Oak Ridges Moraine Technical Paper Series # 17 – Stormwater Management Plans*. Toronto: Queens Printer for Ontario.

⁵² Ontario Ministry of Municipal Affairs and Housing. *Oak Ridges Moraine Conservation Plan*. Toronto: Queen’s Printer for Ontario, 2002, pg. 36.

1.2.8 Water Opportunities and Water Conservation Act

In November 2010, the *Water Opportunities Act, 2010*⁵³ (WOA) was enacted as a schedule of the *Water Opportunities and Water Conservation Act, 2010*⁵⁴ (WOWCA), which also amended other legislation. The WOWCA calls for an integrated approach to drinking water provision, stormwater and wastewater management, and the possible use of municipal water conservation targets.⁵⁵ The WOA represents a key opportunity for green infrastructure to be implemented at the municipal level with provincial guidance. The Act allows MOE to establish province-wide targets for water conservation, as well as additional targets that may vary by jurisdiction. In addition, the WOA provides the authority to create regulations that will require the eventual creation of Municipal Water Sustainability Plans.⁵⁶

The WOA describes the proposed framework for Municipal Water Sustainability Plans as requiring an integrated approach to the provision and management of drinking water and the management of stormwater and wastewater.⁵⁷ The Minister of the Environment may also develop targets or performance standards as a component of the Water Sustainability Plans, which could include targets for the use of green infrastructure to manage stormwater. A large interest group comprised of municipal, non-profit and private sector stakeholders is calling for supporting regulations under the WOA that encourage or require the use of green infrastructure by municipalities.

1.2.9 Building Code

MOE is a partner with MMAH on the next scheduled edition of the *Ontario Building Code*, expected for release in 2011. The *Ontario Building Code* provides another opportunity to enhance existing stormwater and water conservation measures. Some potential changes to the Code proposed in the first round of consultations could be geared toward climate change adaptation, such as enhancing the resilience of buildings to extreme weather events.⁵⁸

1.2.10 Ontario's Growth Plan for the Greater Golden Horseshoe Region

The 2006 Growth Plan for the Greater Golden Horseshoe (Growth Plan) is a comprehensive land use planning policy for the Greater Golden Horseshoe Region of Southern Ontario. The Growth Plan requires municipalities to accommodate new growth through intensification and redevelopment along major roads and transportation corridors within existing settlement areas and establishes commercial and residential intensification targets for urban and greenfield development.

The Growth Plan encourages municipalities that share an inland water source to coordinate stormwater plans, as well as plans for potable water and wastewater, to ensure that quality and quantity is maintained and improved. Municipalities are also encouraged to implement and support innovative approaches to stormwater management as part of redevelopment and intensification.⁵⁹ A current

⁵³ S.O. 2010, c. 19, Sched. 1.

⁵⁴ S.O. 2010, c. 19.

⁵⁵ S.O. 2010, c. 19, Sched. 1, s. 45.

⁵⁶ *Ibid.*

⁵⁷ *Ibid.*

⁵⁸ Ontario Ministry of Municipal Affairs and Housing. *Potential Changes for the Next Edition of the Building Code*. Toronto: Queen's Printer for Ontario, 2010, pg. 7

⁵⁹ Ontario Ministry of Public Infrastructure Renewal. *Places to Grow: A Growth Plan for the Greater Golden Horseshoe*. Toronto: Queen's Printer for Ontario, 2006, pg. 27.

information gap may be the extent to which innovative approaches to stormwater management have been undertaken as part of redevelopment and intensification projects.

The Ontario Expert Panel on Climate Change Adaptation has noted that there could be opportunities to coordinate regionally integrated stormwater management plans that make use of green infrastructure through the Growth Plan and has recommended the development of guidelines to support this goal.⁶⁰

1.3 Infrastructure Funding

The construction of municipal water and wastewater infrastructure in Ontario is supported by both provincial and federal financial contributions. If a greater portion of stormwater runoff in Ontario were to be controlled through the use of green infrastructure, it is likely that some degree of support from both the federal and provincial government would be required. Below are some of the key infrastructure funding programs that have been used to finance water and wastewater infrastructure in Ontario and could be used for future green infrastructure initiatives.

1.3.1 The Federal Gas Tax Fund

A component of the Building Canada Fund, the federal Gas Tax Fund (GTF) provides an ongoing source of funding for municipal infrastructure. Canadian municipalities are entitled to an annual percentage of the GTF based on a per capita formula. Infrastructure funding derived from the gas tax can be used toward water and wastewater infrastructure projects.⁶¹

1.3.2 Federation of Canadian Municipalities Green Municipal Fund

Although it is not supported by federal or provincial money, the Federation of Canadian Municipalities' Green Municipal Fund finances a range of municipal projects with a "triple-bottom-line" approach aimed at improving the natural environment as well as the local economy and standard of living.⁶² Innovative stormwater and wastewater management projects have been supported through the Green Municipal Fund in the past.

Discussion

A survey of current policy and legislation in Ontario reveals that there are numerous opportunities for the advancement of green infrastructure on either a provincial or regional basis. In particular, the *Planning Act* contains multiple provisions that could in theory be used to advance green infrastructure across the province. In spite of these opportunities, the overall uptake of green infrastructure in Ontario has been relatively sporadic and slow. Over time, the use of green infrastructure by municipalities may increase as a result of newer initiatives such as: the proposed policy framework for stormwater to be developed by MOE; the LSPP and Lake Simcoe Phosphorus Reduction Strategy; supporting regulations for the WOA; and amendments to the *Ontario Building Code*; and PPS.

An ongoing examination of efforts to promote green infrastructure on a large scale in other jurisdictions will help to both inform initiatives such as the WOA and the stormwater policy framework as they

⁶⁰ Ontario Expert Panel on Climate Change. *Adapting to Climate Change in Ontario*. Toronto: Queens Printer for Ontario, 2009, pg. 62.

⁶¹ Infrastructure Canada - Gas Tax Fund: <http://www.infc.gc.ca/ip-pi/gtf-fte/gtf-fte-eng.html>.

⁶² Federation of Canadian Municipalities Green Municipal Fund: <http://www.sustainablecommunities.fcm.ca/GMF/>.

develop and identify potential gaps that current initiatives in Ontario do not address. The following sections of this report review the experiences of jurisdictions in the United States and the UK in their attempts to increase the use of green infrastructure.

2.0 Use of Green Infrastructure in Other Jurisdictions

2.1 United States

The 1972 *Clean Water Act*⁶³ is the primary legislation regulating the discharge of pollutants into waters in the United States. The *Clean Water Act* regulates point source pollution by requiring polluters to obtain a permit from the Environmental Protection Agency (EPA) under the National Pollutant Discharge Elimination System (NPDES).⁶⁴ The NPDES is overseen by the EPA in partnership with state environmental agencies. Industrial, municipal and other users who discharge directly to surface waters must obtain a permit to operate and are required to reduce pollutant discharges to the maximum extent practicable.⁶⁵ The NPDES is in part a “technology based” regulation, in that the pollution control methods used by permittees must reflect established standards for various categories of industry.⁶⁶

Stormwater runoff is considered to be a leading contributor to water quality problems in the United States and was first formally addressed in a series of amendments to the *Clean Water Act* in 1987.⁶⁷ The US EPA first instituted stormwater regulations under the *Clean Water Act* in 1990. The 1990 *Clean Water Act* regulations required municipalities with a population of 100,000 or more to acquire NPDES permits for all stormwater discharges from “Municipal Separate Storm Sewer Systems” (MS4s).⁶⁸ “Phase 2” permits, introduced in 1999, required smaller MS4s in both urban and rural areas to obtain NPDES stormwater permit coverage. Phase 1 MS4 permits are issued on an individual basis, while Phase 2 MS4s are covered by a general permit that is usually statewide and includes a range of general conditions. Small MS4s obtain coverage by filing a Notice of Intent application to comply with the conditions of the Phase 2 general permit.⁶⁹

All MS4 permit holders are required to develop stormwater management plans based on a set of 6 minimum measures that include: public outreach and education; public participation in the creation of the plan; detection and elimination of illicit discharges; stormwater runoff controls at construction sites; post-construction runoff control (for both new development and redevelopment); and pollution prevention/good housekeeping for municipal operations. To support the development of stormwater management plans, the US EPA maintains a National Menu of Best Management Practices (BMPs). The current National Menu of BMPs includes a section on “innovative BMPs for site plans”, where fact

⁶³ Also known as *Federal Water Pollution Control Act*, 33 U.S.C. 1251 et seq.: <http://epw.senate.gov/water.pdf>.

⁶⁴ *Ibid.*

⁶⁵ *Ibid.*

⁶⁶ Waterkeeper Alliance. "All Stormwater is Local - Chapter 3: History of Stormwater Regulation Under the Clean Water Act." 2009, p.13.

⁶⁷ United States National Research Council. *Urban Stormwater Management in the United States*. Washington D.C.: The National Academies Press, 2008, pg. vii.

⁶⁸ The federal EPA defines an MS4 as “a conveyance or system of conveyances owned by a state city or other public entity that discharges to waters of the US.” MS4’s are “systems designed or used to collect or convey stormwater including storm drains, pipes and ditches”.

⁶⁹ Waterkeeper Alliance. "All Stormwater is Local - Chapter 3: History of Stormwater Regulation Under the Clean Water Act." 2009, p.18.

sheets and case studies on green roofs, bioswales, and other types of green infrastructure can be accessed.⁷⁰

Green infrastructure [also referred to as “Low Impact Development” (LID) by the US EPA and some state level environment agencies] is gaining increasing recognition across the United States, as can be seen in both the level of research and support given to these technologies by the US EPA through factsheets, case studies and recommendations for state and municipal governments, as well as through the level of investment dedicated to various forms of green infrastructure in some states.⁷¹

Despite growing recognition by the US EPA, overall uptake of LID across the US has been described as slow.⁷² The current regulatory structure has been identified as a key barrier to broader use of LID.⁷³ While federal regulations under the *Clean Water Act* provide a minimum standard for stormwater management and a range of best management practices to choose from, the use of LID ultimately depends on state level stormwater management requirements that go beyond minimum standards, or initiatives taking place at the municipal level. A number of states have chosen to go beyond the minimum requirements for stormwater management established by the *Clean Water Act* in recent years. State level stormwater management requirements in Illinois, Washington and Maryland are reviewed in this report. The selection of states for review was primarily based on their identification as leaders in stormwater management practices in either peer reviewed, or “grey literature” publications.

2.2 Illinois

The Illinois Environmental Protection Agency (IEPA) is responsible for the state stormwater program, which is in part based on federal NPDES requirements under the *Clean Water Act*.⁷⁴ Illinois’ most recently updated permitting requirements for MS4s in 2009 state that “permittees should adopt strategies that incorporate stormwater infiltration, reuse and evapotranspiration of stormwater into the project to the maximum extent practicable.” While the word “should” does not make these strategies mandatory, the IEPA has indicated that it intends to strongly encourage municipalities to require green infrastructure in development projects.⁷⁵

The IEPA also maintains a Green Infrastructure Grant Program that provides grants for “any stormwater management technique or practice employed with the goal of preserving, mimicking, restoring or

⁷⁰ US EPA, National Menu of Stormwater Best Management Practices <http://cfpub.epa.gov/npdes/stormwater/menuofbmps/>.

⁷¹ As of early 2010, California, Illinois, Louisiana, Oregon, Pennsylvania and Wisconsin had either invested in, or were willing to invest over 100 million dollars in green infrastructure projects. These project included what has been defined by the Centre for Neighborhood Technology as ‘city green infrastructure’, or in wetland restoration projects.

⁷² Gearheart, Greg. A Review of Low Impact Development Policies: Removing Institutional Barriers to Adoption. Beltsville: Maryland Low Impact Development Center, 2007, pg. 9.

⁷³ *Ibid.*

⁷⁴ Illinois Bureau of Water – Phase 2 Stormwater: <http://www.epa.state.il.us/water/permits/storm-water/index.html>.

⁷⁵ Sprague, Hal. The New Illinois Stormwater Permit: Is Your Municipality Thinking Outside the Pipe? The Center for Neighborhood Technology, 2009. <http://www.cnt.org/repository/MS4-article.pdf>.

enhancing natural hydrology.”⁷⁶ Each year, \$5 million is made available to municipalities for green infrastructure projects through the grant program. Municipalities are required to pay project costs and perform the work, and then submit expenses and supporting documentation to the IEPA for reimbursement.⁷⁷

Also in 2009, the state of Illinois passed the *Green Infrastructure for Clean Water Act* into law. The Act formally recognizes the environmental, social and economic benefits of using green infrastructure to manage stormwater runoff and requires Illinois to assess and evaluate the potential for further use of green infrastructure to manage stormwater.⁷⁸

The Act was accompanied by an extensive report that includes supporting information outlining the benefits of green infrastructure, a review of experiences with the use of stormwater requirements that go beyond the basic federal requirements in other states, and recommendations to support the widespread use of green infrastructure approaches throughout Illinois.

Key recommendations from the addendum report for the *Green Infrastructure for Clean Water Act* include:

- **Development of performance standards or volume control requirements that can be adapted on a site-specific basis**

The authors note that performance standards have now become commonplace throughout the United States, and recommend a flow-reduction requirement, such as retaining the first inch of runoff on site by using green infrastructure practices. The report suggests that use of a single performance standard also requires less training for agencies and landowners and enables them to use a mix of green infrastructure approaches based on site-specific needs, so long as the general standard is met.^{79 80}

- **A gradual phase-in of green infrastructure requirements over time**

A gradual phase-in of requirements is proposed to allow communities to develop the necessary training and expertise needed to use and maintain green infrastructure. Planning and preparation is expected to occur more quickly if communities are required to establish goals for gradually increasing the amount of surface area that meets the established green infrastructure standard. The authors recommend the use of a portfolio standard that would include a percentage mix of green infrastructure in the overall stormwater management portfolio. The suggested approach is a long term percentage target for green infrastructure that could be met incrementally through the use of realistic annual goals.⁸¹

⁷⁶ Illinois Environmental Protection Agency. *ABC's and 123's of Navigating the Requests for Proposals*. <http://www.epa.state.il.us/water/financial-assistance/publications/nps509C.pdf>

⁷⁷ Illinois Green Infrastructure Grant Program for Stormwater Management <http://www.epa.state.il.us/water/financial-assistance/igig.html>.

⁷⁸ Illinois Green Infrastructure for Clean Water Act <http://www.ilga.gov/legislation/publicacts/fulltext.asp?Name=096-0026>.

⁷⁹ Jaffe, Martin, et al. *Using Green Infrastructure to Manage Urban Stormwater Quality: A Draft Report to the Illinois Environmental Protection Agency*. Illinois Environmental Protection Agency, 2010, pg. 14.

⁸⁰ A “one-size-fits-all approach” is discouraged because of differences between the hydrological characteristics in different areas, such as soil type and infiltration rates, surficial geology, proximity to waterways, slopes or other factors.

⁸¹ Jaffe, Martin, et al. *Using Green Infrastructure to Manage Urban Stormwater Quality: A Draft Report to the Illinois Environmental Protection Agency*. Illinois Environmental Protection Agency, 2010, pg. 16-17.

- **Disbursement of funding for staff and other resources to mainstream green infrastructure in communities and a watershed level approach to implementation**

In the Illinois context, the county governments are the local authorities closest to operating on a watershed scale. The authors recommend that state resources should be provided to help county governments fulfill new responsibilities related to green infrastructure, or counties should be given authority to charge fees that will cover program costs. The authors recommend that other local technical expertise, such as that already available in drainage districts,⁸² could be drawn upon by county governments for knowledge transfer. It is also recommended that more funding should be directed to these agencies through stormwater fees or grants to support the additional workload.⁸³

- **Enforcement of stormwater retention standards that are applicable to NPDES permits**

The authors suggest that the on-site stormwater retention standard should be applicable to all projects currently requiring an NPDES permit. This would include MS4s, construction projects and industrial sites. The authors also recommend that a long-term goal should be the inclusion of more urban and suburbanizing areas based on the total amount of impervious surface rather than on population size.⁸⁴

- **Use of a variety of funding methods to support green infrastructure projects**

The authors suggest that the IEPA should require private developers to use the stormwater retention performance standard. Developers should pay the costs of creating stormwater infrastructure on site, and occupants should pay the costs of maintaining stormwater infrastructure and other associated costs after the project is completed. Simultaneously, the use of green infrastructure should provide credits that provide a financial incentive for adoption.⁸⁵

- **Use of restrictive covenants to ensure long-term maintenance of green infrastructure**

The report authors call for perpetual agreements which would ensure that maintenance of green infrastructure is continued when properties change ownership. It is also recommended that monitoring and compliance reporting should be undertaken at a minimum of three- to five-year intervals, during which time penalties would be laid against property owners who fail to maintain green infrastructure. Municipalities should also retain the right to enter a property to perform maintenance when owners fail to do so, and then bill property owners for the costs incurred.⁸⁶

⁸² According to the Illinois Association of Drainage Districts, a Drainage District is “A small unit of local government formed by landowners. This special district may be formed to construct, maintain, or repair drains or levees or to engage in other drainage or levee work for agricultural, sanitary, or mining purposes. Drainage Districts are created by petition or referendum and court approved. Each district is governed by three drainage commissioners.”

⁸³ Jaffe, Martin, et al. Using Green Infrastructure to Manage Urban Stormwater Quality: A Draft Report to the Illinois Environmental Protection Agency. Illinois Environmental Protection Agency, 2010, pg. 17.

⁸⁴ *Ibid*, pg. 18.

⁸⁵ Jaffe, Martin, et al. Using Green Infrastructure to Manage Urban Stormwater Quality: A Draft Report to the Illinois Environmental Protection Agency. Illinois Environmental Protection Agency, 2010, pg. 19.

⁸⁶ *Ibid*.

- **Creation of stormwater utilities separate from drinking water and wastewater utilities by local governments**

The authors suggest the use of a stormwater fee system to fund the provision and ongoing maintenance of stormwater facilities instead of using general tax revenues. In addition, a system should be established where the use of green infrastructure would make users eligible for a reduced stormwater fee. Ongoing eligibility for the reduced fee would be dependent on passing periodic performance reviews to ensure the technology was being maintained.⁸⁷

- **Enforcement of regular, standardized reporting on green infrastructure performance**

The authors stress that regular reporting in a consistent format would help decision makers determine which green infrastructure approaches are best for particular projects.⁸⁸

While it is too early to tell whether these recommendations will be included in future revisions of the *Green Infrastructure for Clean Water Act* or what impact they may have, some assessment of progress toward implementing green infrastructure in Illinois to date using existing tools is possible. Chicago has been described by the IEPA as the state leader in terms of green infrastructure implementation, with the rest of the state lagging behind significantly.⁸⁹ However, some modest success has been achieved in gaining wider buy-in for green infrastructure from municipal and regional approval authorities throughout the state. This success has resulted from the ability of the IEPA to point to specific successful projects and have monitoring data in place to back up their claims. In addition, the IEPA has made an effort to reach out to communities to familiarize them with the technology and its capabilities.⁹⁰

“Making the change from grey to green infrastructure is a huge hurdle: it’s easy for municipal officials to understand piping stormwater” - Amy Walkenbach, Watershed Management Section, Illinois EPA

The use of the Green Infrastructure Grant Program to support projects at the municipal level has also been more helpful to date in achieving buy-in compared to encouraging MS4 permit holders to adopt green infrastructure technologies, which had only resulted in change within a few proactive municipalities. The grant program has been described as a key factor in encouraging municipalities to experiment with new approaches to stormwater management. Overall, the transition to greater use of green infrastructure has been described as a slow process, mostly due to a lack of familiarity with new technologies in comparison with traditional stormwater piping methods.⁹¹ Similar to other jurisdictions, fear of liability in the event of a technology failure was cited as another barrier to more widespread use of green infrastructure.⁹²

Responsibility for the maintenance of green infrastructure is also a detractor for municipalities, although notably, IEPA-funded projects show no evidence of maintenance obligations being neglected. When a municipality receives IEPA funding to implement a green infrastructure project, that municipality is

⁸⁷ *Ibid.*

⁸⁸ *Ibid*, pg. 20.

⁸⁹ Personal Communication, Illinois EPA, 2011.

⁹⁰ *Ibid.*

⁹¹ *Ibid.*

⁹² *Ibid.*

required to sign a contract for a 10-year operation and maintenance plan. In the event that maintenance is not performed by the municipality, the IEPA can request that grant money be paid back, which has never happened in practice.⁹³

IEPA staff also expressed support for the implementation of green infrastructure on a wider scale, such as at the watershed level. Projects in which multiple technologies work together as parts of a system were seen as being more effective, although more challenging to coordinate across different municipalities than individual technologies acting alone. These could include situations in which green roofs and rain barrels capture initial flows, or where excess overflow is diverted into swales and/or constructed wetlands before finally entering streams or other watercourses.⁹⁴

2.3 Washington

Some assessment of Washington's stormwater management framework in comparison to Ontario's has already taken place in previous studies. A 2004 study compared Ontario's *Stormwater Management Planning and Design Manual* to Washington's state level stormwater guidance. This study found that, in contrast to Ontario, Washington's stormwater guidance included "a stated objective to apply all known, reasonable and available source control BMPs to all projects."⁹⁵

In addition to establishing goals for the use of LID in stormwater design guidance, Washington recently made the use of LID measures in stormwater management a mandatory component of state MS4 permits. Under the new system, permittees will be required to make use of LID to the maximum extent practicable. The move to mandatory use of LID was the result of a 2008 decision by the Washington Pollution Control Hearings Board.⁹⁶ Prior to the Board's decision, MS4 permits that were issued in 2007 required Phase 1 and Phase 2 cities and counties in Western Washington to allow, but not require, the use of LID in new development and redevelopment.⁹⁷

After a successful appeal by municipalities, environmental groups and other stakeholders, the permits were remanded to the Department of Ecology by the Pollution Control Hearings Board, with the direction to require local governments covered by the permits to enforce LID *wherever feasible* in new development and redevelopment projects. The Board based this decision on a review of available LID guidance, design standards and other documentation that demonstrated that LID is currently a proven and effective technology at site, lot and subdivision levels. As a result, the Board determined that use of LID wherever feasible was required in order to reduce pollutant discharges in stormwater runoff to the

⁹³ *Ibid.*

⁹⁴ *Ibid.*

⁹⁵ Bradford, Andrea, and Bahram Gharabaghi. "Evolution of Ontario's Stormwater Management Planning and Design Guidance." *Water Quality Research Journal of Canada*, 2004, pg. 350.

⁹⁶ The Washington Pollution Control Hearings Board is a component of the Washington Environmental Hearings Office (EHO). The mandate of the Washington EHO is described as "Conduct fair and impartial hearings and issue clear and well-reasoned decisions; Provide expeditious and efficient resolution of environmental appeals through hearings and alternative dispute resolution processes; Foster a consistent statewide interpretation of Washington's environmental laws in agency decision making and appeals and; Assist parties in understanding the hearing process to ensure meaningful and enhanced access to justice.

⁹⁷ Personal Communication, Washington Department of Ecology, 2011.

maximum extent practicable.⁹⁸ The Board did not recognize LID as a proven technology at the watershed level as part of the decision, but requested that the Department of Ecology begin preparing to require LID at the watershed level in the future.⁹⁹

Following the Board decision, the Department of Ecology developed draft language for a new stormwater permit and also undertook an advisory process, receiving comments from a wide range of stakeholders. The current draft language for incorporating LID into development codes proposes a range of measures that include both stormwater management measures and land use planning measures aimed at reducing runoff.

Land use planning measures intended to reduce stormwater runoff include: clustering and impervious surface limits through zoning and subdivision code changes; reduced road width; retention of native vegetation during new development; and reduced lot setbacks. In addition to these measures, when developers propose a project that will significantly increase densities or expand the designated urban growth area, the local government will be required to undertake an analysis of the impacts on upstream and downstream water quality and hydrology and demonstrate the benefits of the project from a social, economic and environmental perspective.¹⁰⁰

This analysis would lead to the creation of sub-watershed targets intended to mitigate or prevent water-related development impacts. The trigger for requiring the municipality to undertake the analysis would be a proposed development of 80 acres, or one that would increase the existing urban growth area by more than 5%, depending on which is smaller.¹⁰¹ The same requirements would apply to urban intensification projects.

Mitigation measures for development that meet these criteria may include establishing maximum limits on the amount of impervious area and a minimum amount of native vegetation to be maintained on site.

In addition to the requirements described above, the developer may also be subjected to a graduated menu of required stormwater treatment technologies that will change with the amount of impervious surface area proposed for the project. The smallest proposals (less than 2,000 square feet of impervious surface) may require no additional LID measures, whereas larger proposals that include greater amounts of impervious surface would be subject to a mandatory list of LID measures that could include rain gardens, permeable pavement, green roofs or a traditional roof with runoff routed below the parking lot. Developers would be able to choose from a list of mandatory practices to meet a performance standard based on maintaining on-site pre-development runoff characteristics.¹⁰²

⁹⁸ Locklear, Henrietta H.P. "Washington State Decision Makes LID Mandatory." *Stormwater: The Journal for Surface Water Quality Professionals*, 2009. <http://www.stormh2o.com/july-august-2009/washington-state-decision-2.aspx>.

⁹⁹ *Ibid.*

¹⁰⁰ Washington Department of Ecology. "Proposed Requirements and Timelines to Update Development Codes to Incorporate LID" (August 2010) pg. 2.

¹⁰¹ *Ibid* pg. 1.

¹⁰² *Ibid.*

Comments received so far on the proposed mandatory LID framework have been mixed. Building industry representatives and some municipalities have expressed concern that mandatory LID requirements, especially for smaller developments, may deter developers from investing in the area and preclude community buy-in.¹⁰³ ¹⁰⁴ These stakeholders also argued that the requirement for a basin-scale analysis of hydrological impacts and justification of an urban growth area expansion or increase in density on social, environmental and economic grounds goes beyond the intended purpose of the NPDES stormwater permit system.¹⁰⁵ At the same time, other critics, such as the US EPA felt that the proposed mandatory LID framework does not go far enough, and should include more detailed requirements for analyzing the impacts of new development at the basin scale.¹⁰⁶

Currently, the Washington Department of Ecology has reviewed stakeholder comments and is developing preliminary draft permit language for LID in preparation for reissuance of the final Phase 1 and Phase 2 permits in June 2012.

To assist in funding the implementation of current LID projects, the Washington Department of Ecology has made \$23.4 million in grants available, which can be used for either retrofits of existing stormwater facilities or new stormwater management projects. Over 2010, an additional 23.5 million in state funding was distributed to municipalities for stormwater projects.¹⁰⁷ Some municipalities are also making use of stormwater fees calculated on the basis of impervious surface coverage as a means of reducing runoff and covering the maintenance cost of stormwater conveyance systems.¹⁰⁸

2.4 Maryland

Stormwater management guidance in Maryland has also been contrasted with Ontario's current guidance in a 2004 study, which found that Maryland has taken a more progressive approach to stormwater guidance in several respects. Ontario's stormwater manual provides information on how to calculate reductions in the amount of runoff that needs to be treated with end-of-pipe methods if on-site retention and infiltration, or other methods to slow runoff, are used. However, Maryland's guidance manual establishes a credit system for the use of these approaches.¹⁰⁹ Credits in the Maryland stormwater manual are available for conserving existing natural areas, downspout disconnection and other low impact development approaches.¹¹⁰ Until recently, the use of LID options outlined in Maryland's stormwater guidance manual were optional.

¹⁰³ LID Comments from Jodi Slavik, Building Industry Association of Washington.
<http://www.ecy.wa.gov/programs/wq/stormwater/municipal/LID/LIDcomments/BIAWcommentsLID.pdf>

¹⁰⁴ Clark County General and Specific Comments on the August Ecology Proposal.
<http://www.ecy.wa.gov/programs/wq/stormwater/municipal/LID/LIDcomments/ClarkCoLIDcomments081210.pdf>

¹⁰⁵ *Ibid.*

¹⁰⁶ United States Environmental Protection Agency (Region 10) Comments on Ecology's August 2010 LID Proposal.
<http://www.ecy.wa.gov/programs/wq/stormwater/municipal/LID/LIDcomments/EPACommentsLID083010.pdf>

¹⁰⁷ Washington Department of Ecology. *News Release - Cities, counties getting \$23.4 million for stormwater-control projects*. January 20, 2011. <http://www.ecy.wa.gov/news/2011/020.html>.

¹⁰⁸ District of Columbia Department of the Environment. "Changes to the District's Stormwater Fee"
<http://ddoe.dc.gov/ddoe/cwp/view,a,1209,q,498382.asp>.

¹⁰⁹ Bradford, Andrea, and Bahram Gharabaghi. "Evolution of Ontario's Stormwater Management Planning and Design Guidance." *Water Quality Research Journal of Canada*, 2004, pg. 349-350.

¹¹⁰ *Ibid.*

In 2007, Maryland passed the *Stormwater Management Act of 2007*, which states that on-site LID (also referred to in the legislation as Environmental Site Design) is the preferred approach to stormwater management.¹¹¹ Much like the proposed regulations for Washington State, developers are now required to demonstrate that they have implemented LID techniques to the maximum extent practicable before permission to use traditional stormwater management approaches is granted. Developers are also required to preserve the groundwater recharge capability of the site at pre-development levels.¹¹² The Act requires that municipalities review and update planning, zoning and public works ordinances (by-laws) in order to remove any barriers to the use of green infrastructure. The Act also provides a model ordinance to support this process.¹¹³

While there have been some calls to relax Maryland's new stormwater management requirements, which are seen by some in the development community as a deterrent to new investment, the state is also regarded as one of the more progressive US jurisdictions in terms of promoting LID.¹¹⁴ As in other US jurisdictions, the issue of long-term maintenance of LID technologies has been identified as a key challenge.¹¹⁵

To assist in funding the implementation of LID projects the US EPA, Maryland Department of Environment, and Maryland Department of Natural Resources have jointly funded the Green Streets - Green Jobs program.¹¹⁶ Recently, nine communities received money through the program to fund the design and planning work necessary to install rain gardens and permeable pavement.¹¹⁷

The Maryland Department of Environment has indicated that it supports the use of a stormwater fee to fund implementing LID to the maximum extent practicable.¹¹⁸ Some municipalities have already established stormwater utilities that charge landowners on the basis of impervious surface.¹¹⁹

¹¹¹ Gearheart, Greg. *A Review of Low Impact Development Policies: Removing Institutional Barriers to Adoption*. Beltsville: Maryland Low Impact Development Center, 2007, pg. 21.

¹¹² New Jersey, a state that has also been described as having strong stormwater management policies, also uses a performance standard that requires 100% of pre-development groundwater recharge capability to be maintained.

¹¹³ Maryland Department of Environment. "Stormwater Act of 2007 Factsheet" <http://www.mde.state.md.us/programs/Water/StormwaterManagementProgram/Documents/www.mde.state.md.us/assets/document/Stormwater%20Act%202007%20Update.pdf>.

¹¹⁴ Jaffe, Martin, et al. *Using Green Infrastructure to Manage Urban Stormwater Quality: A Draft Report to the Illinois Environmental Protection Agency*. Illinois Environmental Protection Agency, 2010, pg. 73.

¹¹⁵ *Ibid*, pg. 78.

¹¹⁶ United States Environmental Protection Agency. EPA Announces "Green Streets-Green Jobs" Pilot Grants for Anacostia. July 25, 2010. <http://yosemite.epa.gov/opa/admpress.nsf/0/257927276882191c8525778a00650be9?OpenDocument>.

¹¹⁷ Leaderman, Daniel. Nine county communities receive 'green' street grants: \$200K awarded for projects to improve water quality. May 5, 2011. http://www.gazette.net/stories/05052011/laurnew170341_32541.php.

¹¹⁸ Maryland Department of the Environment. *MDE Releases "Stormwater Management Act of 2007" Fees System Report*. <http://www.mde.state.md.us/programs/ResearchCenter/ReportsandPublications/Pages/ResearchCenter/publications/general/emde/vol3no7/stormwater.aspx>

¹¹⁹ City of Rockville. Stormwater Management Utility Fee. 2011. <http://www.rockvillemd.gov/residents/swm/>.

2.5 United Kingdom

Much like the US jurisdictions discussed here, the UK has been attempting to promote widespread use of green infrastructure, generally referred to as Sustainable Urban Drainage Systems (SuDS), for several years. Combined sewer overflows present a significant problem in the UK. In England, approximately 40% of the sewer systems use combined sewers.¹²⁰ In the summer of 2007, extensive flooding during a period of intense rainfall, which was described as the largest peacetime emergency seen by the UK, also raised the profile of stormwater management issues and resulted in further consideration of how SuDS could be implemented as a partial solution.¹²¹

Planning Policy Statements

The English planning system relies on a series of national policy statements that provide detail on how to apply the provisions of planning legislation in local-level decisions. Planning Policy Statements are not legally binding, but are the primary guidance for planning policy development and development approvals for lower levels of government.

Planning Policy Statement 25: Development and Flood Risk, 2010 (PPS25) – which replaced the 2001 Planning Policy Guidance 25: Development and Flood Risk (PPG25) – is intended to improve coordination between land use planning and flood control. PPS25 also formally introduced the concept of SuDS into the planning system.^{122 123} PPS25 states that local development approval authorities “should give priority to the use of SuDS” for stormwater management.¹²⁴

Identified Barriers to SuDS Use

Since the formal introduction of SuDS through PPS25, a number of barriers to implementing SuDS have been identified at the local level. Research into the effectiveness of PPS25 has suggested that the requirements to incorporate SuDS into developments have not been widely implemented. A 2005 assessment found that while there was high awareness of SuDS concepts among planners, less than half included the incorporation of SuDS as a condition on development approvals.¹²⁵

As has been the case in Ontario and in US jurisdictions, a lack of familiarity with new technologies considered to be SuDS has been cited as a barrier to their widespread use in development projects. A lack of experience with SuDS was found to result in planners potentially overlooking sites where SuDS

¹²⁰ UK Department of Food, Environment and Rural Affairs. "Future Water: The Government's Water Strategy for England." 2008.

¹²¹ UK Cabinet Office "The Pitt Review: Lessons Learned from the 2007 Floods" 2007
<http://webarchive.nationalarchives.gov.uk/20100807034701/http://archive.cabinetoffice.gov.uk/pittreview/the-pittreview.html>.

¹²² White, Iain, and John Rowe. "Unpacking the Barriers to Sustainable Urban Drainage Use." *Journal of Environmental Policy and Planning*, 2005: 25-41.

¹²³ Green infrastructure is also encouraged through the Planning Policy Statements, although in the UK context green infrastructure refers to open space and preservation of existing natural features. Currently a new PPS to promote green infrastructure is being developed.

¹²⁴ UK Department for Communities and Local Government. "Planning Policy Statement 25: Development and Flood Risk" 2010, pg. 5.

¹²⁵ White, Iain, and John Rowe. "Unpacking the Barriers to Sustainable Urban Drainage Use." *Journal of Environmental Policy and Planning*, 2005, pg. 39.

might have been incorporated into a development.¹²⁶ A lack of robust data on the performance of SuDS has also been a deterrent to widespread use at the local level. It has been noted that performance data from other jurisdictions such as the US has been relied on in the past to determine the effectiveness of SuDS in the absence of locally specific data.¹²⁷

Inadequate staff resources were also found to be a barrier to translating PPS25 requirements into local projects. The large workloads planners already manage have meant that they have been hesitant to advocate for inclusion of SuDS because of the increased effort required.¹²⁸

In the past there has also been a lack of coordination in how SuDS should be managed. Different authorities are responsible for land drains, water courses, curtilage drainage and highway drainage.¹²⁹ There is also a lack of clarity regarding who should check a proposed SuDS in a development application (Environment Agency or planner). As a result, an engineer may have to be hired by local planning authorities to review a proposal. By comparison, traditional stormwater drainage is well understood. In the past there has also been reluctance among the various authorities with a role in stormwater management to take responsibility for SuDS, especially when benefits of the technology are realized in downstream areas that are not part of the development site.¹³⁰

An additional barrier to widespread SuDS use has been uncertainty as to whether exclusion of SuDS is grounds to turn down a development proposal or place a condition for SuDS on an approval. Planners observed that individual developments in most cases don't contribute enough to overall runoff to justify a rejection on the basis of not using SuDS. Other concerns, such as the need to provide housing, might also override the need to reduce the impacts of flooding.¹³¹

Developers may also be hesitant to use SuDS in projects for economic reasons. If a SuDS cannot be designated as open space, the developer might lose income as a result of having to meet requirements to include both open space and SuDS in a project. Planners may choose not to place a condition to use SuDS on a development approval to avoid being challenged by developers through the appeal process.¹³²

Recent Developments

In 2008, the Department for Environment, Food and Rural Affairs (DEFRA) published *Future Water: The Government's water strategy for England*, which outlines the government's long-term water management and climate change adaptation goals. The strategy establishes a vision for the year 2030 in which more adaptable drainage systems supported by the SuDS approach will improve water quality,

¹²⁶ *Ibid*, pg. 28.

¹²⁷ Personal Communication, Paul Schaffer, CIRIA, May 2011.

¹²⁸ White, Iain, and John Rowe. "Unpacking the Barriers to Sustainable Urban Drainage Use." *Journal of Environmental Policy and Planning*, 2005, pg. 28.

¹²⁹ *Ibid*, pg. 32.

¹³⁰ White, Iain, Juliet Richards, and Jeremy Carter. "Local Planning Practice and Flood Risk Management in England: Is There a Collective Implementation Deficit?" *Urban Environment*, 2008, pg.19.

¹³¹ White, Iain, and John Rowe. "Unpacking the Barriers to Sustainable Urban Drainage Use." *Journal of Environmental Policy and Planning*, 2005, pg. 34-35.

¹³² *Ibid*, pg. 36.

reduce flood risk and runoff, reduce impacts on the sewer system and create new opportunities for water reuse.¹³³

To implement the long-term vision for stormwater management, the government's strategy proposes Surface Water Management Plans (SWMPs) as a means to bring different authorities involved in stormwater management together to promote an integrated approach that will include greater emphasis on SuDS. DEFRA has provided a guidance manual for the creation of SWMPs and has funded a series of 15 pilot projects through which SWMPs have been implemented and monitored for effectiveness. One of the objectives of the SWMP pilot projects was to ensure that SuDS implementation takes place in a coordinated manner, as opposed to a case-by-case or piecemeal approach.

During 2010 and 2011, a new National Policy Statement on Waste Water (Waste Water NPS) has been developed which recognizes SuDS as a means of runoff and flood control. While acknowledging that the use of SuDS will not replace the need for traditional stormwater and wastewater infrastructure, the Waste Water NPS establishes the goal of reducing the demand for new wastewater infrastructure capacity by diverting water from the sewer system using SuDS.¹³⁴ The government's general policy direction is to encourage use of SuDS wherever possible.

The use of SuDS is further supported by the *2010 Flood and Water Management Act (FWMA)*.¹³⁵ The FWMA amends the *Water Industry Act*¹³⁶ by removing the automatic right for new developments to connect stormwater drainage systems to the public sewer system. Instead, the FWMA requires development proposals to include plans for SuDS that will be reviewed before development approval is granted or a connection to the sewer system is permitted. The FWMA establishes an approval body for SuDS at the local or regional government level.¹³⁷ The drainage system for new developments or redevelopment must also conform with national SuDS standards to be approved.¹³⁸

Under the new system established by the FWMA, water and sewer companies act as consultee to the SuDS approval body when a traditional connection to the sewer system is proposed. The SuDS approval body is also required to assume responsibility for the maintenance of SuDS after they have been constructed, but may request financial assurance from the developer to ensure the SuDS functions as expected. While the FWMA had not been fully implemented at the time of writing, it is anticipated that this legislation will overcome most of the barriers that were previously encountered in trying to promote widespread use of SuDS.¹³⁹

¹³³ UK Department for Environment, Food and Rural Affairs. "Future Water: The Government's Water Strategy for England" 2008.

¹³⁴ UK Department for Environment, Food and Rural Affairs. "National Policy Statement for Waste Water: A Framework Document for Planning Decisions on Nationally Significant Waste Water Infrastructure" 2010, pg. 8.

¹³⁵ *The Flood and Water Management Act of 2010*
http://www.legislation.gov.uk/ukpga/2010/29/pdfs/ukpga_20100029_en.pdf.

¹³⁶ *Water Industry Act* <http://www.legislation.gov.uk/ukpga/1991/56/contents>.

¹³⁷ The SuDS approval body is the unitary authority (single-tier municipality) or county council where no unitary authority exists

¹³⁸ At the time of writing the national standards for SuDS had not yet been established.

¹³⁹ Personal Communication, Paul Schaffer, CIRIA, May 2011.

3.0 Analysis and Discussion

This investigation suggests that where green infrastructure is being contemplated to control stormwater and associated problems, there are common barriers to implementation. These barriers include a lack of familiarity with new technology and concerns arising from maintenance issues or liability in the event of technology failure. It is likely that these concerns will remain a barrier to more widespread use of green infrastructure in the province until a substantial database is available that can provide assurances of expected performance from different forms of green infrastructure implemented across a wide variety of regions, as well as instruction on which technologies are best suited to the region based on topography, soil characteristics and other environmental factors.¹⁴⁰

Currently, there are multiple provisions in Ontario's land use planning framework, particularly in the *Planning Act*, that would enable municipalities to use green infrastructure to a greater extent. However, barriers related to a lack of familiarity with green infrastructure and a lack of sufficient performance data to inspire confidence among decision makers may preclude the use of these provisions by municipalities.

Based on the jurisdictional review conducted for this study, the best means of overcoming initial barriers to green infrastructure use would be to remove some of the risk for municipalities in establishing initial pilot projects that would in turn generate regionally specific data to encourage additional projects. Illinois' experience with promoting green infrastructure suggests that providing grants to municipalities can be an effective means of getting past initial hesitation to experiment with new technologies. In both Washington and Maryland, substantial amounts of funding are being distributed by the state to aid municipalities in implementing LID for stormwater management. Funding for new projects plays an important role in reducing stigma and generating localized data to convince municipalities and approval authorities that green infrastructure is viable. Dedication of a percentage of federal and/or provincial infrastructure funding to green infrastructure projects could be a useful approach for overcoming barriers related to lack of data and municipal familiarity.

Responsibility for the maintenance of green infrastructure also appears to be a primary concern in Ontario and other jurisdictions. Concerns related to maintenance in Illinois have been addressed by creating a 10-year maintenance agreement between the municipality and the IEPA as a condition for receiving green infrastructure grants. In the United Kingdom, concerns over who is responsible for green infrastructure maintenance have been addressed recently in the 2010 *Flood and Water Management Act*, which establishes a dedicated approval and maintenance body for green infrastructure projects once they have been built. In Ontario, a similar entity could be established as part of the development of Municipal Water Sustainability Plans under the WOA, such as the creation of a dedicated stormwater utility. Stormwater utilities that typically charge landowners on the basis of impervious surface are

¹⁴⁰ The need for careful planning and attention to local conditions was recently highlighted by an experience in Seattle, Washington. In the neighborhood of Ballard, a series of local rain gardens were installed to control sewer overflows, which have since proven to be ineffective and are highly unpopular with local residents. A previously undetected underground spring and shallow groundwater where some of the rain gardens were installed has greatly reduced their drainage capability, meaning that city staff must now manually pump the gardens out to remove standing water. While the Ballard experience may not be commonplace, it does highlight the importance of understanding what technologies are most appropriate for different local conditions prior to the implementation stage.

being used in US jurisdictions to cover the costs of stormwater infrastructure. This approach to stormwater funding is already being contemplated by several Ontario municipalities.

In Ontario there is also a need for an overarching vision for green infrastructure. The PPS, and the recently enacted WOA, would be the best areas in the current law and policy framework to establish this vision. Currently, there are provisions that could be used to promote green infrastructure in the *Planning Act*, ORMCP, Lake Simcoe Protection Plan, and in other areas of Ontario's respective water and land use planning frameworks, but in practice these appear to be either too vague, or in other cases too localized, to achieve province-wide implementation of green infrastructure.

The supporting language for green infrastructure in the United Kingdom's Planning Policy Statements, and in the more recent National Policy Statements, point to the importance of having an overarching goal and vision in place. However, the challenges England has encountered in translating this vision into tangible results at the local level emphasize the important role of binding legislation in promoting unfamiliar technologies. The FWMA is expected to address some of the challenges that were identified in previous analysis of PPS25. The recent transitions in Washington and Maryland from optional use of LID to state requirements for municipalities to implement LID to the maximum extent practicable is consistent with the Environmental Commissioner of Ontario's argument for a clear green infrastructure mandate. The MOE's recent conclusion that reforms in stormwater management should be achieved through the use of incentives is not supported by the experiences in 3 of the 4 jurisdictions reviewed in this study. A combination of guidance, financial incentives and public education, with eventual implementation of more stringent requirements, may be the most effective means of promoting green infrastructure across the province.

If Ontario's current PPS were revised to define green infrastructure more explicitly and require green infrastructure-based stormwater management, municipalities would be better positioned to advocate for green infrastructure and require developers to use it in new projects. In the *Water Opportunities and Water Conservation Act*, a key opportunity to establish green infrastructure on a province-wide basis is available through the Municipal Water Sustainability Plans, which will be drafted once supporting regulations for the Act are developed. The experiences of leading US jurisdictions provide many examples that could be incorporated into Municipal Water Sustainability Plans. Recent interest in understanding how green infrastructure could be applied in a systemic manner at the watershed scale in US jurisdictions suggests that this could also be a consideration for Municipal Water Sustainability Plans.

Municipal Water Sustainability Plans should first require municipalities to complete an assessment of the potential to implement green infrastructure, as this will be different for each municipality depending on soil characteristics, population density, projected population growth and other factors. Once an assessment of the potential for green infrastructure has been completed, incremental targets based on local conditions should be established. These targets should be percentage based, similar to the proposed portfolio standard approach that has been called for in Illinois that will require a defined amount of overall stormwater management methods to be based on green infrastructure technology. If a stormwater utility were also established through the Municipal Water Sustainability Plans, funding for long-term maintenance requirements could be secured through impervious surface-based charges.

4.0 Recommendations for Ontario

Based on the analysis and discussion above, we make the following recommendations for promoting the use of green infrastructure in Ontario:

1. The Ontario government should promote green infrastructure through a combination of guidance, financial incentives and public education, with eventual implementation of legislative and regulatory requirements. Eventually, for example, Certificates of Approval for stormwater under the OWRA could require proof of green infrastructure use as a condition for continued approval. Currently, Ontario's Permit to Take Water system requires applicants to document water conservation measures they are currently practicing and plan to undertake during the lifespan of the permit. In cases where an increase in the permitted level of water taking is requested, applicants can be asked to demonstrate how increased takings could be avoided through conservation. This approach could be adapted to make green infrastructure use a condition for stormwater approvals or expansions.
2. MMAH should establish an overarching vision for green infrastructure in the PPS by revising section 2.2.1 to define and encourage green infrastructure as a means to minimize stormwater volumes and contaminant loads. The next version of the PPS should include a formal definition of green infrastructure, as well as language that calls for municipalities to require the use of green infrastructure and associated practices such as limiting impervious surface to the maximum extent practicable.
3. MOE should establish flexible targets for the study and eventual implementation of green infrastructure through Municipal Water Sustainability Plans that will be required under the *Water Opportunities and Water Conservation Act*. Municipal Water Sustainability Plans should first require municipalities to complete an assessment of the potential to implement green infrastructure. The specific requirements of Municipal Water Sustainability Plans should include:
 - a. Long-term percentage targets for the amount of green infrastructure that will be included in the overall mix of stormwater infrastructure. The long-term target should be met incrementally through small annual targets.
 - b. Where green infrastructure is required on private property, the establishment of long-term agreements with landowners to ensure that the intended function of green infrastructure will be maintained over the long term.
 - c. The creation of municipal stormwater utilities that would establish stormwater fees based on the amount of impervious surface on a property. Reduction of, or complete exemption from, the stormwater fee could be granted to landowners that establish green infrastructure on their properties. Stormwater utilities could also assist in organizing local performance data for green infrastructure projects and could potentially assume responsibility for the maintenance of green infrastructure built in public areas.
 - d. Education and training for municipal staff so that they understand how to site, implement and maintain green infrastructure.

4. A reliable source of provincial or federal funding is needed to reduce the risk for municipalities in experimenting with new technology and to generate more provincially-specific data on green infrastructure performance across specific regions of Ontario. A percentage of the federal gas tax fund could be earmarked for green infrastructure projects.
5. MMAH, MTO, MOE and MEI should honour their commitment to continue to collaborate through a permanent inter-ministerial working group for stormwater and green infrastructure and make this process open to interested stakeholders. This inter-ministerial group could also serve as a mechanism to analyze green infrastructure performance data by region. This information could be published through the Innovative Stormwater Management Practices database maintained by the Toronto and Region Conservation Authority and used to inform the technical guidance documents maintained by the provincial government.
6. The Ontario government should establish green infrastructure pilot projects across the province to generate regionally specific data to support additional future projects.