HALIFAX
REGIONAL MUNICIPALITY

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Halifax Watershed Advisory Board
May 16, 2012

TO: Chair and Members of the Halifax Watershed Advisory Board

SUBMITTED BY: Peter Stickings, Acting Director, Planning & Infrastructure, 490-7129

DATE: April 10, 2012

SUBJECT: **Community Priorities for Green Infrastructure**

INFORMATION REPORT

ORIGIN

October 6, 2011: Save our Lakes Actions

BACKGROUND

In October 2011, Environment and Sustainability Standing Committee provided a number of Recommendations related to the consolidation of water quality policy work called "Save our Lakes". Included in those actions:

> *"Direct staff to identify possible opportunities and best management practices for inclusion of Green Infrastructure in the Red Book and for municipal internal practices";*

This report responds to that recommendation.

DISCUSSION

This consolidated consultation deliverable has been provided to staff involved with:

- Infrastructure Planning and Engineering;
- Regional and Community Planning;
- Development Engineering; and
- Facility Development.

Policy work is fertile ground, currently. With Regional Plan Review underway, CentrePlan, Water Policy Reviews, the Storm Water Management Functional Plan and Infrastructure planning to meet the challenges of extreme weather events, there are multiple opportunities for the municipality to consider adoption of green infrastructure solutions in both new and existing development.

BUDGET IMPLICATIONS

There are no impacts to the 2012/2013 Operating or Project Budgets as a result of this work.

FINANCIAL MANAGEMENT POLICIES / BUSINESS PLAN

This report complies with the Municipality's Multi-Year Financial Strategy, the approved Operating, Project and Reserve budgets, policies and procedures regarding withdrawals from the utilization of Project and Operating reserves, as well as any relevant legislation.

COMMUNITY ENGAGEMENT

This exercise reached out to community stakeholders that have demonstrated interest in lake matters, including residents, Watershed Advisory Board members and Environmental NGO's.

ATTACHMENTS

Deliverable: Community Priorities for Green Infrastructure

A copy of this report can be obtained online at http://www.halifax.ca/commcoun/cc.html then choose the appropriate Community Council and meeting date, or by contacting the Office of the Municipal Clerk at 490-4210, or Fax 490-4208.

Report Prepared by: Richard MacLellan, Manager, Energy and Environment, 490-6056

Attachment

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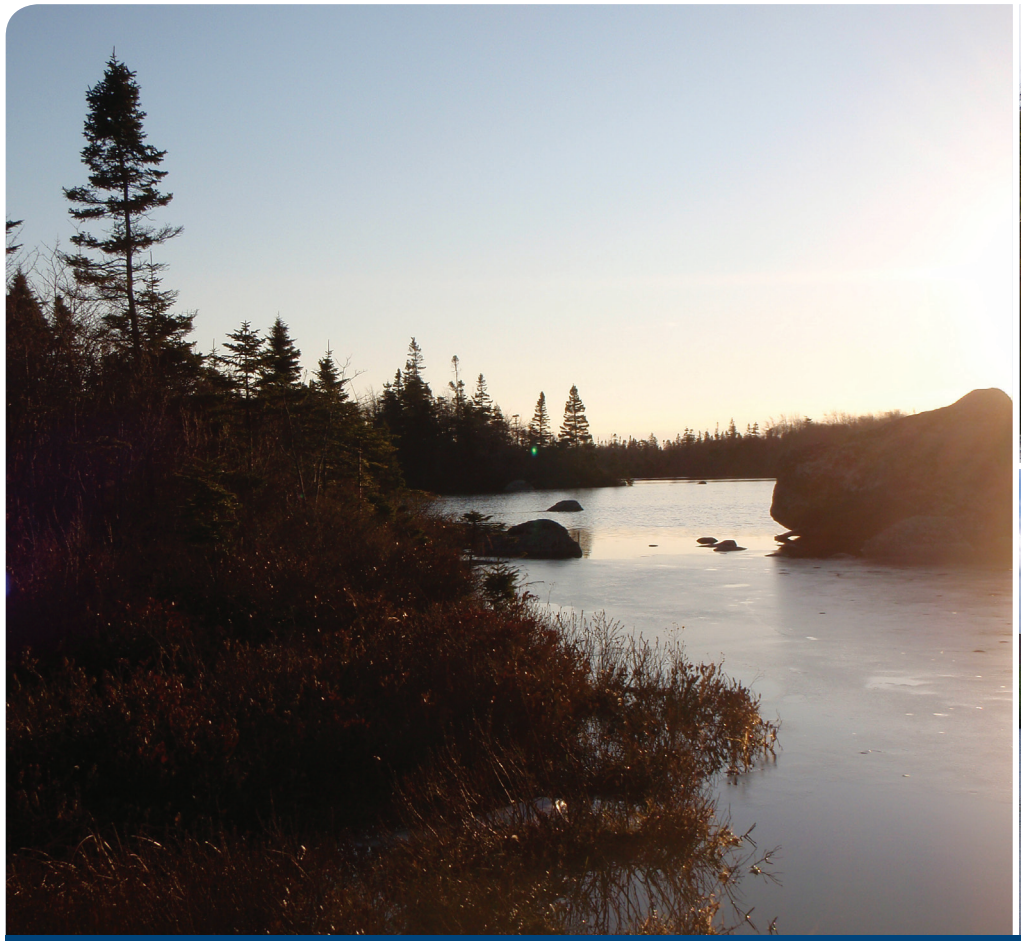

HRM PROTECT OUR LAKES WORKSHOP II JANUARY 19, 2012

Consultation and Facilitation Support

File #121510719
March 2012

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1.0 INTRODUCTION

Halifax Regional Municipality (HRM) Sustainable Environment Management Office (SEMO; now Energy and Environment) was directed to respond to a motion of the HRM Environment and Sustainability Committee that 'staff provide a report outlying the short term policy opportunities for HRM lakes.' On May 19, 2011, SEMO gathered together interested and knowledgeable parties in water resource management to discuss the protection of lake ecosystems within HRM. This first phase of consultation was designed as a Workshop and was called 'Protect Our Lakes'. The initiative was responding to three key concepts:

- Development and encroachment on water resources increases stress to our freshwater ecosystems, in particular our lakes.
- Recent Water Quality Monitoring Data demonstrates the declining health of our lakes.
- Well-designed policies have the potential to mitigate or eliminate negative ecological impacts. We are fortunate to have many knowledgeable, passionate, and committed residents wishing to protect our water resources.

The Protect Our Lakes Workshop was designed to help establish priority short term actions that would focus HRM's efforts to improve protection of lakes.

Following the workshop a summary report was prepared and provided to workshop participants, HRM staff and the HRM Environment and Sustainability Committee. The HRM Environment and Sustainability Committee met on September 23, 2011 to review the report and discuss future actions. During this meeting it was determined a second workshop would be held to further one of the ideas that resulted from the first workshop – exploring priorities for green infrastructure. This report is a result of this second workshop, and provides a summation of the consultation and resulting community recommendations, providing guidance for the sustainable development of the HRM in consideration of some our most valuable environmental assets – our lakes.

"Green infrastructure is a comprehensive approach to water quality protection defined by a range of natural and built systems that can occur at the regional, community and site scales. Linkages between sites and between practices within one site ensure that stormwater is slowed, infiltrated where possible and managed with consideration for natural hydrologic processes."

~US Environmental Protection Agency 2010

Stakeholders participating in Workshop II

2.0 WORKSHOP DESIGN

On the evening of January 19th 2012, HRM's 'Protect Our Lakes' second workshop session was held at the Alderney Gate Public Library, Helen Creighton Room, at 192 Prince Albert Road. (Note: The meeting was originally schedule for November 23rd 2011, but was cancelled because of a snow storm). A copy of the Workshop Invitation can be found in **Appendix A**.

In preparation for the meeting the agenda listed reading material workshop participants could review. This list included the following documents:

- HRM 'Red Book' Municipal Service System Guidelines
- HRM 'White Book' Halifax Water Design & Construction Specifications
- HRM Stormwater Management Guidelines
- US Environmental Protection Agency (EPA) Managing Wet Weather Green Infrastructure
- Toronto and Region Conservation Authority & Credit Valley Conservation Authority Low Impact Development Stormwater Management Planning and Design Guide
- Ecojustice Green Cities, Great Lakes-Using Green Infrastructure to Reduce Combined Sewer Overflows
- The Partnership for Water Sustainability in BC Website
- Ecology Action Centre Stormwater Blog
- The Green Civil Engineer Blog

The evening began with a presentation reviewing the purpose of the meeting followed by introductions of all attendees. A full list of attendees can be found in **Appendix B**. Following this key outcomes and priorities for the workshop were established. Finally, the presentation outlined the key principles of engagement and discussion for the evening using the World Café Format. A copy of the presentation can be found in **Appendix C**.

The **purpose** of the workshop was identified as:

To bring together interested and knowledgeable parties to provide an opportunity to voice recommendations on short term steps to **enhance management and protect lake ecosystems within HRM.**

Key meeting **outcomes** were identified as:

- To generate a summation of Community Recommendations.
- To use the ideas generated by this group to inform other lake related policy work being undertaken in HRM.

A key **priority** of the workshop was identified as:

- Identify **green infrastructure** that will help in the **protection of our lakes.** (*What are the types of green infrastructure we can develop standards for that will deliver benefits?)*

As a first exercise in the workshop participants discussed the meaning of the term 'green infrastructure'. An initial definition was presented:

The US Environmental Protection Agency defines Green Infrastructure and Low Impact Development in the following way:

> *An adaptable term used to describe an array of products, technologies, and practices that use natural systems – or engineered systems that mimic natural processes – to enhance overall environmental quality and provide utility services. As a general principal, Green Infrastructure techniques use soils and vegetation to infiltrate, evapotranspirate, and/or recycle stormwater runoff.*

The group agreed generally with the definition and added the following concepts to create a working definition:

- Instead of using the term 'stormwater' we should be using the term rainwater because need to consider how to manage water prior to it becoming stormwater. We need to think about the natural state and conditions.
- We need to think about the whole system – not just the lakes, but the rivers and watersheds too.
- Also need to think about the idea of slowing water.

Using this framework as a guiding foundation, meeting participants were led through a series of questions. A detailed outline of the workshop format is presented in **Appendix D**. The task of the exercise was to answer the following questions about management and protection of lake ecosystems in HRM:

- What are the types of green infrastructure you think we should have in HRM?
- Of these which are:
    - Critical opportunities for new development?
    - Critical opportunities for existing development?
    - Complex and require a great deal of know-how?
    - Easy to implement?
    - Costly and expensive?
    - Require significant regulatory change to implement?
- What are the top priorities?

After working groups identified different types of green infrastructure, the group quickly worked through these ideas in plenary, resulting in a core list of different types of green infrastructure desired in HRM. Then the group added further characteristics to each type of green infrastructure, identifying which were best for new development or existing development, and whether or not their implementation was easy, complex, costly, or required significant regulatory change. Finally, after further discussion in plenary, the group identified their top priorities for green infrastructure. Full results of the exercise can be found in **Appendix E**.

2.1 Workshop Results

The input gathered from the meeting held on January 19th 2012 can be found in its original format in **Appendix E.** These results were further modified (**Appendix F**) and organized to develop a final summary table (**Table 3.1**). The input gathered from the workshop was further analyzed, interpreted and organized revealing priorities for future green infrastructure, as shown in **Table 3.2**.

(United States Environmental Protection Agency, 2012)

Table 2.1 Green Infrastructure Priorities

Type of Mechanism/ Control	Type of Green Infrastructure	Existing Development	New Development	Expensive	Complex	Easy	Regulatory Change	Critical Future Green Infrastructure
New Development								
Natural Systems	Retain/Plant Vegetation – Maintain Wooded Areas	3	8			14	9	12
	Natural Wetlands		2	1		6		5
Source	Development Grading		3		1	2	9	9
	Permeable Pavement / Porous Hard Surfaces	3	9	7			3	5
	Green Roofs	1	3	1	3		2	5
	Purple Pipes (Greywater)		7	8	9		8	3
Conveyance	Rough Surface Piping		1			3	1	1
End of Pipe	Engineered Wetlands		4	8	6	1	1	4
	Development Pond (New ⇨ larger particles + Wetland ⇨ <20μm)		7	2		1	1	1
Existing Development								
Source (Site)	Cisterns/Rain barrel – Source Use of Rainwater (on site storage)	12				11		7
	Rain Gardens	5			1	9		5
	Disconnect Downspouts	2				3	1	1
	Source Infiltration	2	2	1			1	1
	Retain well vegetated Greenbelts on Streams and Around Lakes	4	1			1	3	4
Source (Region)	Daylighting	2		9	7	2	1	7
	River Gauging	2				1	1	2
Conveyance (Site)	Bio Swales	6					1	1
Conveyance (Region)	Removal of Stream Obstructions – culverts	1			2		1	2
	Baffles for Slowing Ditches Flow and Allowing Silt to Settle	1	1		6		1	1
End of Pipe (Site)	Oil Grit Separators	4	2	1		2	3	4
End of Pipe (Region)	Stop C.S.O. Sewer into Lakes/Harbour	1	1	16	12		6	5
	Filtration (membrane) Development Sites – not just settling ponds (Bio filtration)	5	3	5	10		4	2
Legend:								
Number of Votes	1-4 (Low)		5-8 (Moderate)			9 – 16 (High)		

Table 2.2 Top Priorities for Green Infrastructure

Type	Priority Green Infrastructure*	Characteristics				Possible Actions *(See Section 3 for detail)*
		Expensive	Complex	Easy	Regulatory Change	
New Development						
Natural Systems	**Retain/Plant Vegetation/ Wooded Areas**			✓	✓	**Regional Plan Review, Stormwater Management Functional Plan, Lot Grading Bylaw Review**
	Natural Wetlands	✓		✓		**Regional Plan Review, Stormwater Management Functional Plan, Lot Grading Bylaw Review**
Source Controls	**Development Grading**		✓	✓	✓	**Lot Grading Bylaw Review**
	Permeable Pavement / Porous Hard Surfaces	✓			✓	**Policies, programs and incentives**
	Green Roofs	✓	✓		✓	**Policies, programs and incentives**
Existing Development						
Source Controls *Site*	**Cisterns/Rain barrel – Source Use of Rainwater (on site storage)**			✓		**Policies, programs and incentives**
	Rain Gardens		✓	✓		**Policies, programs and incentives**
Source Controls *Region*	**Daylighting**	✓	✓	✓	✓	**Used as strategic solution in management approach**
End of Pipe Controls *Region*	**Stop C.S.O. Sewer into Lakes/Harbour**	✓	✓		✓	**Comprehensive view of green and gray systems**

* *Between 5-16 participants identified as a priority for green infrastructure*

3.0 COMMUNITY PRIORITIES FOR GREEN INFRASTRUCTURE

The following sections provide information concerning the specific types of infrastructure shown in Table 2.2 - the priority outcomes of Workshop II. During the workshop the group emphasized the importance of couching any green infrastructure practices within a broader context of water resource management. Prior to implementation it is important to consider their strategic application within the context of the site, community, watershed and region.

New Development

1.1 Retain Existing Natural Areas (& Natural Wetlands)

There was general consensus within the group that retaining the existing natural landscape is critical to maintaining water quality. This was identified by the group as one of the top priorities and one of the **easiest** ways to improve the quality of new development. It was also noted that **regulatory change** is required in order to change current land development practices.

By preserving the natural landscape we can retain important hydrologic functions such as retention, detention, infiltration and the filtering of stormwater. Examples include highly permeable soils, pocket wetlands, riparian buffers, undisturbed natural vegetation and tree clusters. (Toronto and Regional Conservation Authority and Credit Valley Conservation Authority, 2010).

Under the Regional Plan, HRM has taken steps to change the form of development by implementing Open Space Subdivision requirements for new development. These policies apply to development on new roads within the suburban (Rural Commuter) and developed rural (Rural Resource) areas of the municipality.

While the Open Space policies are an important first step in changing the form of residential development in suburban areas, the policy does not apply to development occurring on existing roads and development occurring within the urban core (Urban Settlement). The Open Space policies do not account for other land use forms such as institutional and commercial.

There are still many opportunities for HRM to take a lead role in refocusing construction and development standards so that more land is retained in its natural state, and for HRM to consider low impact design to improve retention and infiltration of rainwater.

HRM's 5 year Regional Plan Review is an opportunity for HRM to review the existing planning framework to determine if policy and supporting regulations can be furthered to minimize impacts to the natural landscape.

Other documents such as the Lot Grading Bylaw (presently under review) and Stormwater Management Functional Plan (presently under development) also play a key role in **establishing protection and consideration of the natural landscape and hydrologic functions as a fundamental design principle and first step in site planning and development.**

1.2 Development Grading

There was general consensus within the group that development grading significantly impacts water quality and stormwater runoff. The group acknowledged that **regulatory change** is necessary in order to implement changes enabling low impact design.

Development grading and soil and erosion control can have a significant impact on water quality. Construction practices such as clearing, topsoil removal and stockpiling, site grading and compaction can significantly impact and alter the natural landscape (United States Environmental Protection Agency, 2005).

The present review of the HRM Lot Grading Bylaw is a key opportunity **to review existing site-scale regulations and consider alternatives to standard practices that could improve water quality management on-site close to the source.**

3.1 Permeable Pavement/Porous Hard Surfaces

During the workshop, participants identified permeable pavement or porous hard surfaces as another top priority in the development of green infrastructure in HRM. One of the key characteristics associated with this form of green infrastructure **was cost**.

Recent studies show that new approaches to stormwater management using low impact design can result in a reduction in overall site development costs (United States Environmental Protection Agency, 2007). There are many existing research reports available, for example, the US Environmental Protection Agency has collected a number of studies from various sources listed here:

http://water.epa.gov/infrastructure/greeninfrastructure/gi_costbenefits.cfm

Benefits of Green Infrastructure	
Environment	• Improve air quality • Flood protection • Drinking water source protection • Replenish groundwater • Improve watershed health • Protect or restore wildlife habitat • Reduce sewer overflow events • Restore impaired waters • Meet regulatory requirements for receiving waters
Social	• Establish urban greenways • Provide pedestrian and bicycle access • Create attractive streetscapes and rooftops that enhance livability and urban green space • Educate the public about their role in stormwater management • Urban heat island mitigation • Additional recreational space • Improve human health
Economic	• Efficient land use • Reduce hard infrastructure construction costs • Maintain aging infrastructure • Increase land values • Encourage economic development • Reduce energy consumption and costs • Increase life cycle cost savings

(United States Environmental Protection Agency , 2010)

Some cities, such as Chicago, are proactively replacing existing impervious surface with permeable surfaces. Chicago's Green Alley Program was originally a pilot study that has resulted in the resurfacing approximately 20 alleys per year. It also encourages private property owners to do the same. (Low Impact Development Center, 2008) (United States Environmental Protection Agency , 2010) The US EPA also notes that once this program was instituted, costs for porous concrete dropped significantly (United States Environmental Protection Agency, 2009).

The City of Toronto has produced 'Design Guidelines for Greening Surface Parking Lots' (Toronto City Planning , 2007).This provides direction for site development and identifies, along with a number of other deign options, different types of surface treatment that could be used to create more impervious surface in a parking lot.

(Ecojustice , 2008)

Principles of Low Impact Development

(Toronto and Regional Conservation Authority and Credit Valley Conservation Authority, 2010)

1. **Use existing natural systems as the integrated framework for planning.**
   - Consider regional and watershed scale contexts, objectives and targets
   - Look for stormwater management opportunities and constraints at the watershed/subwatershed and neighbourhood scales
   - Identify and protection environmentally sensitive resources
   - Employ a landscape-based approach to stormwater management and design
2. **Focus on runoff prevention.**
   - Minimize impervious cover through innovative site design strategies and the application of permeable pavement
   - Incorporate green roofs and rainwater harvesting systems in building designs
   - Drain roofs to pervious areas with amended topsoil or stormwater infiltration practices
   - Preserve existing trees and design landscaping to create urban tree **canopies.**
3. **Treat stomwater as close to the source area as possible.**
   - Utilize decentralized lot level and conveyance stormwater management practices as part of the treatment train approach
   - Lengthen overland flow paths and maximize sheet flow
   - Maintain natural flow paths by utilizing open drainage
4. **Create multifunctional landscapes.**
   - Integrate stormwater management facilities into other elements of the development to conserve developable land
   - Utilize facilities that provide filtration, peak flow attenuation, infiltration and water conservation benefits
   - Design landscaping to reduce runoff and enhance site aesthetics
5. **Educate and maintain.**
   - Provide adequate training to monitor and maintain lot level and conveyance stormwater management techniques on public property
   - Teach property owners, managers and their consultants how to monitor and maintain lot level stormwater management practices on private property

Some of the major sources of impervious cover are our transportation systems, such as roads, sidewalks, driveways and parking lots. These can be the greatest contributor to total imperviousness in a given community (Center for Watershed Protection).

In redeveloping existing sites, there are opportunities to improve the quality of water management on the site and within the context of the overall stormwater management system. Creative site and landscape design can convert an existing site; green infrastructure practices such as increasing permeable surfaces could result in a redevelopment project that may ameliorate watershed conditions by reducing existing impervious cover.

To better understand and potentially remove cost barriers, further research, generating a more detailed understanding of local development costs may assist in further implementation of permeable surfaces. HRM could also develop incentive programs or require the use of permeable surfaces publically funded infrastructure projects. Other projects could include education and outreach programming to encourage residents to use permeable surface on driveways. In developed areas where there are stormwater management issues such as flooding, HRM may want to consider a case study employing a suite of green infrastructure solutions such as permeable surface treatment.

With the multitude of paved surfaces in the urban environment, there are a seemingly unlimited number of opportunities to improve new development or retrofit as redevelopment occurs, whether this on private property or publically owned property. HRM could consider **a range of alternatives to standard practices that could incentivize use of permeable surfaces and help to remove any potential cost barriers.**

3.2 Green Roofs

During the workshop, participants identified green roofs as another top green infrastructure priority. One of the key barriers identified was **cost**. Although green roof construction costs can be higher than a traditional roof structure, the additional benefits and potential cost savings generated through the use of green roofs should also be considered.

These benefits may include stormwater flow reduction including impact on combined sewer overflow (CSO), improvement in air quality, reduction in direct energy use, and creation of amenity space (Ryerson University, 2005) (Liu & Baskaran, 2003).

(United States Environmental Protection Agency, 2012)

The Ecology Action Centre has developed a Nova Scotia Green Roof Manual which outlines potential incentives and regulatory actions that could be put in place to help offset the additional costs associated with the development of green roofs (Ecology Action Centre, 2009).

The City of Toronto is one of the most well cited examples of a green roof subsidy program. Their Eco-Roof Incentive Program is designed to promote the use of green roofs on Toronto's existing commercial, industrial and institutional buildings. Eligible green roof projects will receive $50 / square metre up to a maximum of $100,000. (City of Toronto , 2012).

The Toronto program evolved from a 2005 Study that evaluated the costs and benefits associated with green roofs. The study showed that if 5,000 hectares

Scale of Green Infrastructure

(United States Environmental Protection Agency , 2010)

Regional Scale: At the larger regional or watershed scale, green infrastructure is the interconnected network of preserved or restored natural lands and waters that provide essential environmental functions. Large-scale green infrastructure may include habitat corridors and water resource protection.

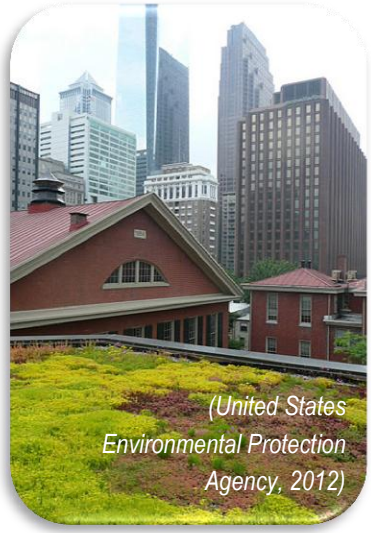
Community Scale: At the community and neighborhood scale, green infrastructure incorporates planning and design approaches such as compact, mixed-use development, parking reduction strategies and urban forestry that reduces impervious surfaces and creates walkable, attractive communities

Site Scale : At the site scale, green infrastructure mimics natural systems by absorbing stormwater back into the ground (infiltration), using trees and other natural vegetation to convert it to water vapor (evapotranspiration) and using rain barrels or cisterns to capture and reuse stormwater. These natural processes manage stormwater runoff in a way that maintains or restores the site's natural hydrology. Site-level green infrastructure is also referred to as low-impact development or LID, and can include rain gardens, porous pavements, green roofs, infiltration planters, trees and tree boxes and rainwater harvesting for non-potable uses such as toilet flushing and landscape irrigation.

or 50 million square metres of available roof space were landscaped, it would result in an estimated savings of $313.1 million in new infrastructure costs for storm-water management, heating and cooling of buildings, along with $37.1 million in annual cost savings (Chu, 2007) (Ryerson University, 2005).

Portland, Oregon is another well cited example. They have an ecoroof incentive program that funds up to $5 per square foot of an ecoroof project. Installation costs for ecoroofs in Portland range from $5 to $20 per square foot (City of Portland, 2012) .

The City of Toronto has since implemented a bylaw which requires the use of green roofs on new buildings of a certain scale (City of Toronto, 2009). Since January 31 2010, green roofs have been required on new commercial, institutional and residential development with a minimum Gross Floor Area of 2,000m2. Starting April 30, 2012, the Bylaw will require compliance with the Bylaw for new industrial development (City of Toronto, 2012).



(United States Environmental Protection Agency, 2012)

The City of Vancouver has a 'how to' green build design series that includes information on green roofing for residential homes (City of Vancouver, 2010).

To help increase the use of green roofs in HRM, more supporting information could be provided to help developers understand the costs associated with local green roof development, and the potential return on investment. HRM could develop a subsidy, incentive or educational programs. HRM could consider **a range of programs that could incentivize use of green roofs and help to remove any potential cost barriers.**

Existing Development

1.3 Cisterns/Rain Barrels

There are many examples of municipal programs encouraging or subsidizing the use of rain barrels. In Vancouver, the City subsidizes the rain barrel cost by 50% - the City website notes over 3000 rain barrels have been sold since program inception. (City of Vancouver, 2011). The City of Guelph also has a rain barrel program and sells rain barrels to residents for $45 (City of Guelph, 2012). In 2011, the City of Ottawa offered a Rain Barrel Rebate Program (Jackson, Emma, 2011).

(United States Environmental Protection Agency, 2012)

It is generally agreed that when used appropriately, rain barrels may contribute to reductions in direct stormwater runoff and may be used as an integral part of stormwater management plans. This is dependent on the quality of installation, ongoing maintenance, and the degree of take up (or numbers of installations) in any given area.

The Insurance Bureau of Canada recently completed a study examining the effectiveness of rain barrels. The study was called the Wingham Rain Barrel Study and was conducted in the Township of North Huron, Ontario, from 2009 to 2011. Free rain barrels were distributed to every resident in the community and the usefulness of rain barrels were observed. Results of the study showed a favorable impact on stormwater:

> *"In the process of installing barrels, 70% of the community's downspouts were disconnected from the sewer system, which meant less rainwater flowing into that system. As a result, there was a 5% reduction in the ratio of rainwater to volume of water pumped at the sewer treatment plant between 2009 and 2010."* (Insurance Bureau of Canada, 2011)

In addition to potentially providing benefits in assisting with reducing stormwater runoff and improving retention close to the source, rain barrels are also useful in education for water conversation and rainwater management.

HRM could consider developing an educational program to encourage citizens to use of rain barrels. HRM could also consider the development of a case study or subsidized program in localized areas which have stormwater management or water quality issues. HRM could consider **a range of programs that could incentivize use of rain barrels and help to improve knowledge and understanding of water conservation and rainwater management.**

1.4 Rain Gardens

Rain Gardens, or bioretention areas are typically promoted in residential areas, but can also be used to improve retention in surface parking lots or along street networks. They are generally considered to be a simple, cost-effective stormwater management practice. Similarly to rain barrels, rain gardens can also act as educational tools in helping citizens to understand hydrological functions, stormwater management and water conservation practices.

Rain Gardens are very similar to flower gardens, however they are usually dug below grade and are designed for temporary storage of stormwater. There are many resources available to aid in the design of rain gardens. CMHC offers a free detailed guide for residential home owners who wish to develop a rain

(Milwaukee Metropolitan Sewerage District, 2009)

garden on their property (Canada Mortgage and Housing Corporation, 2011). The Low Impact Development Centre also provides a free, detailed, rain garden design template website (Low Impact Development Center , 2007).

Because they can be relatively small in size, bioretention areas are viewed as one of the most useful tools in retrofitting existing areas to improve stormwater management, particularly at the site or neighbourhood level.

In some communities wide-scale rain garden development is being explored. In the Seattle and Puget Sound Region, Washington State University and partners are undertaking a stewardship campaign to install 12,000 rain gardens by the year 2016 (Washington State University , 2012). This program is aimed at reducing pollution entering into major waterways.

The City of Vancouver also has a well-known program called 'Green Streets'. In some instances, such as Crown Street, these gardens act as a first level control before water is discharged into the stormwater collection system (City of Vancouver, 2011) (United States Environmental Protection Agency, 2007) .

The City has also concluded that "installing naturalized street designs in new developments will be less expensive than installing conventional drainage systems" (United States Environmental Protection Agency, 2007).

Similar to Rain Barrel programming, could consider developing an educational program to encourage citizens to use of rain gardens. HRM could also consider the development of a case study or subsidized program in localized areas which have stormwater management or water quality issues. HRM could consider **a range of programs that could incentivize use of rain gardens and help to improve knowledge and understanding of water conservation and rainwater management.**

1.5 Daylighting

During the workshop daylighting of streams was identified as a top priority for developed areas of HRM. In 2006 HRM developed a policy for daylighting of streams in the Municipality.

The policy states the following:

- *Preservation of watercourses by avoidance of enclosing or piping is the priority.*
- *HRM encourages the Nova Scotia Department of Environment & Labour not to permit piping of watercourses.*
- *HRM will encourage watercourse daylighting, as part of efforts to preserve or restore natural watercourses as a component of a stormwater management strategy.*
- *HRM is not responsible for fish habitat management.*
- *Daylighting will be considered according to the following conditions, in subsidiary order as indicated:*

Setting Green Infrastructure Retrofit Goals

(Low Impact Development Center, 2008)

1. Identify watershed goals.

Identifying the watershed goals that green infrastructure will be used to meet helps determine which practices to use and how many will need to be implemented in order to achieve the environmental goals. This ensures that the green infrastructure retrofit policy being created is focused on real environmental improvement, from the outset. Watershed goals can include obtaining a particular level of: Volume reduction, Pollutant load reduction, Reduced flooding, Groundwater recharge, and Water supply/ reduced energy demand.

2. Identify applicable green infrastructure practices.

Land use is a critical criterion for selecting appropriate practices. Some green infrastructure practices are better suited for urban application, and some are more appropriate for rural use. Also, some are better at removing certain pollutants than others, and some allow for infiltration, whereas others don't. A particular green infrastructure practice, or combination of practices, can be selected depending upon the goals and application conditions.

3. Determine the level of implementation that will meet the watershed goals.

Once the most applicable green infrastructure practices have been selected, the degree of implementation that will accomplish the environmental goals should be determined. For example, how many square feet of green roofs need to be installed to accomplish the volume reduction necessary to protect the receiving water? Or, how many square feet of bioretention practices are needed in order to maintain natural groundwater aquifer levels?

4. Measure goal attainment.

The most important measure of green infrastructure retrofit success is evidence of beneficial impacts in the environment (e.g., healthy groundwater aquifers, healthy stream habitat, or reduced pollutant levels in receiving waters). A method to measure environmental improvement should be a part of a green infrastructure retrofit effort. If a green infrastructure retrofit incentive program or regulation is not resulting in measurable environmental improvement, the program and/or regulation should be reevaluated and modified to better achieve the watershed goals. In addition, it is useful to compile the number of green infrastructure practices installed or number of square feet of functioning green infrastructure practices in order to determine the effectiveness of the retrofit incentive program or regulation at increasing the number. However, success in implementing green infrastructure practices should not be mistaken for the importance of confirming the achievement of watershed goals.

1. Where existing HRM stormwater collection infrastructure must undergo significant repair or replacement, daylighting of the watercourse involved will be considered as an option. Consideration will include the feasibility of daylighting in relation to the surrounding environment, land use and ownership, adequacy of space, drainage and potential flooding issues, safety and other practical or engineering considerations as appropriate. Legal and liability issues must also be considered. Replacement of culverts with bridges or a three-sided culvert rather than straight pipe is preferred wherever possible. Daylighting projects should be environmentally friendly and compatible with the surrounding area.

2. Where practical and legal considerations in condition 1 could permit a feasible daylighting project, HRM will consider the cost of daylighting as opposed to costs for repair or replacement of existing infrastructure. Any allocation of HRM capital resources must be considered according to the priority rating criteria established by Council for capital projects relating to wastewater and stormwater.

3. Where community interests or groups advocate daylighting of a particular enclosed watercourse, HRM will consider the project in light of conditions 1 and 2. Any funds or resources which a community group can contribute will be part of the project consideration. Should full funding for a daylighting project be provided by an outside group, HRM will cooperate with the project to the extent possible under the considerations outlined in condition 1. (Halifax Regional Municipality, 2006)

As noted in the above policy and by the group, one of the key barriers to daylighting are the costs associated with this practice. Because of the associated costs, the opportunities for daylighting may not be plentiful, however it is important when considering watershed or lake water quality rehabilitation to consider stream/river daylighting or restoration as potential tool. For example, the United States Environmental Protection Agency has created a guide which can assist decision-makers in assessing the effectiveness of restoration by couching it within the watershed /biophysical context (United States Environmental Protection Agency , 1995).

1.6 Prevent Combined Sewer Overflow

To improve existing infrastructure, many municipalities are facing significant costs. Infrastructure is aging; similarly upgrades are required in order to meet new infrastructure standards as well as keep pace with emerging development patterns. Addressing issues such as Combined Sewer Overflow can create significant costs for a municipality.

“Moreover, piped stormwater and combined sewer overflows (CSOs) may also, in some cases, have the adverse effects of upsetting the hydrological balance by moving water out of the watershed, thus bypassing local streams and ground water” (United States Environmental Protection Agency , 2010).

Green Infrastructure practices can provide a new approach to infrastructure and stormwater management. They can help to provide new, sustainable, cost-effective solutions to water related challenges such as CSO, flooding and water quality.

(Milwaukee Metropolitan Sewerage District, 2009)

Some municipalities are implementing major campaigns to improve CSO. One example comes from the Milwaukee Metropolitan Sewerage District. Their Strategy called 'Fresh Coast Green Solutions' is aimed at 'weaving their grey and green infrastructure into a sustainable future' (Milwaukee Metropolitan Sewerage District, 2009). They are taking a comprehensive look at their infrastructure to integrate grey and green infrastructure to result in zero sewer overflows.

The opportunity that Green Infrastructure presents is that is a useful framework that can assist municipalities in taking a holistic look at infrastructure and water resource management, by linking these systems back into the principles of hydrologic natural processes. **By considering green infrastructure within the larger management picture, HRM can potentially derive more sustainable, beneficial and lower-cost alternatives.**

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Appendix A

AGENDA

HRM 'Protecting Our Lakes' - Green Infrastructure Workshop
January 19, 2012
6:00 – 8:00 P.M.

The Environment and Sustainability Standing Committee (of Regional Council) has asked HRM staff to invite the original 'Protecting Our Lakes' workshop participants to two further sessions. The first of these sessions will focus on "greening" the Red Book (for Municipal Design Guidelines) and the second will review HRM Lake Water Quality Data. The corresponding actions in the consultation report delivered to the Standing Committee are ***Action 36: Initiate review of Red Book to include standards for green infrastructure design*** and ***Action 15: Develop and deliver HRM Annual Lake Report***.

This meeting on January 19th will be used to identify community ideas for green infrastructure and improving municipal standards such as the 'Red Book'. In preparation for this meeting an Agenda is provided and a list of sample resources, including a link to the 'Red Book'. Please direct any questions or comments to Cameron Deacoff deacofc@halifax.ca or Kate Greene kate.greene@stantec.com .

Time	Item	Method
6:00-6:10pm	Welcome (Purpose, Outcomes, Priorities)	Plenary
6:10-6:20	Meaning of term 'Green Infrastructure'	Plenary
6:20-6:35	Desired Types of Green Infrastructure/Standards	Group
6:35-7:15	Identifying Critical Opportunities	Plenary
7:15-7:30	Identifying Barriers to Change/ Reality Check	Plenary
7:30-7:50	Top Three Ideas for Change	Group/Plenary
8:00 pm	Close Out	Plenary

List of Sample Resources	
Resource	**Link**
'Red Book' // Municipal Service System Guidelines	http://www.halifax.ca/designcon/design/munservices.html
'White Book' // Halifax Water Design & Construction Specifications	http://www.halifax.ca/hrwc/HRWCDesignandConstructionSpecifications.html
EAC Stormwater Blog	http://managingstormwater.blogspot.com/
Halifax Regional Municipality Stormwater Management Guidelines 2006	http://www.halifax.ca/environment/documents/HRMStormwaterManagementGuidelines2006.pdf
Toronto and Region Conservation Authority // Credit Valley Conservation Authority Low Impact Development Stormwater Management Planning and Design Guide	http://www.sustainabletechnologies.ca/Portals/_Rainbow/Documents/LID%20SWM%20Guide%20-%20v1.0_2010_1_no%20appendices.pdf
The Partnership for Water Sustainability in BC	http://www.waterbucket.ca/
Green Cities, Great Lakes-Using Green Infrastructure to Reduce Combined Sewer Overflows	http://www.ecojustice.ca/publications/reports/the-green-infrastructure-report/attachment
US EPA Managing Wet Weather Green Infrastructure	http://cfpub.epa.gov/npdes/greeninfrastructure/technology.cfm
The Green Civil Engineer Blog	http://www.thegreencivilengineer.com/

Appendix B

MEETING SIGN-IN SHEET	
Project: HRM Protect Our Lakes/Green Infrastructure	**Meeting Date:** January 19, 2012
Facilitator: Kate Greene	**Place/Room:** Alderney Library, Helen Creighton Room

Name (Organization)	**E-Mail Address**
Cameron Deacoff (HRM)	Cameron.Deacoff@halifax.ca
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Peter Lund	Peter.lund@halifax.ca
Kevin Gray (Halifax Water)	
Roger Wells (HRM)	
Shalom Mandaville (SWCSMH)	
Pierre Clement (DLAB)	
David Lombardi (Seaforth Engineering)	

Appendix C

‘Protecting Our Lakes’

Stantec

Our Purpose

To bring together interested and knowledgeable parties to provide an opportunity to voice recommendations on short term steps to **enhance management and protect lake ecosystems within HRM.**

Introductions

- **Name**
- **Organization**

Our Outcomes

- Generate a summation of Community Recommendations.
- To use the ideas generated by this group to inform other lake related policy work being undertaken in HRM.

Our Priority Today

Identify **green infrastructure** that will help in the **protection of our lakes.**

What are the types of green infrastructure we can develop standards for that will deliver benefits?

What is Green Infrastructure?

The USEPA defines Green Infrastructure and Low Impact Development in the following way:

Green Infrastructure:

An adaptable term used to describe an array of products, technologies, and practices that use natural systems – or engineered systems that mimic natural processes – to enhance overall environmental quality and provide utility services.

As a general principal, Green Infrastructure techniques use soils and vegetation to infiltrate, evapotranspirate, and/or recycle stormwater runoff.

Identification:

- List the types of green infrastructure you think we should have in HRM. (one per sticky note)

Round 1:

- What are the critical opportunities for new development?
- What are the critical opportunities for existing development?

Round 2:

- Which are complex and require a great deal of know-how?
- Which are easy to implment?
- Which are really expensive?
- Which require significant regulatory change to implement?

Round 3:

- What are the top priorities?

Implementation:

- If you were to guide HRM in developing an action plan for developing more Green Infrastructure, what do you think the key three steps would be?

Appendix D

Time	What	Notes
6:10-6:15	**Our Purpose** To bring together interested and knowledgeable parties to provide an opportunity to voice recommendations on short term steps to **enhance management and protect lake ecosystems within HRM.** **Introductions** **Our Outcomes** • Generate a summation of Community Recommendations. • To use the ideas generated by this group to inform other lake related policy work being undertaken in HRM. **Our Priority Today** • Action to take place in the near term. • *What are the things we can do now or begin now that will deliver benefits?* • *FOCUS AREA:* Green Infrastructure	**Quickly review, the same as the last time. Introductions will be quick.**
6:15-6:25	**Plenary:** (Group Discussion) What do we mean by Green Infrastructure? Show definition and discuss.	**To identify the boundaries of the discussion**
6:25 -6:40	**Break Out Groups:** (World Café) List the types of Green Infrastructure you think we should have in HRM. One per sticky note.	**Buffer Time Added Here**
6:40-6:50	**Plenary:** (Dotmocracy) Round 1: What's Important What are the critical opportunities for **new development**? (5-10 dots) What are the critical opportunities for **existing development**? (5-10 dots)	**What's Important**
6:50-7:00	**Plenary: (**Group Discussion)	**Buffer Time Added**

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	What's the Pattern? Anything Missing?	**Here**
7:00-7:20	**Plenary:** (Group Discussion) Round 2: Barriers to Change Which are complex and require a great deal of know-how? (3-5 dots) Which are really expensive? (3-5 dots) Which require significant regulatory change? (3-5 dots) Which require more scientific knowledge to implement? (3-5 dots)	**Barriers to change**
7:20-7:30	**Plenary:** (Group Discussion) Now that we see all this what's the pattern, thoughts? Anything missing?(group sharing)	**Buffer Time Added Here**
7:25-7:30	**Plenary:** (Dotmocracy) Round 3: Priorities Now that you have identified all this – what do you think the priorities should be? (5-10 dots)	**Reality Check/Priorities**
7:30-7:50	**Plenary:** (Group Discussion) Identify top 3 items for implementation (existing and new)	**What now.**
8:00 pm	**Close Out**	**Close Out**

Appendix E

Ref No	Type of Green Infrastructure	Existing Development	New Development	Expensive	Complex	Easy	Regulatory Change	Critical Future Green Infrastructure
1	Stop C.S.O. Sewer into Lakes/Harbour	1	1	16	12	0	6	5
2	Lakes and Streams	0	0	0	0	1	0	0
3	Porous Structural Fill	0	0	0	1	0	0	0
4	Well Vegetated Greenbelts on Streams and Around Lakes	4	1	0	0	1	3	4
5	Stream Shading	0	1	0	0	0	0	0
6	Porous Hard Surfaces	1	1	3	0	0	0	0
7	Permeable Pavement	2	8	4	0	0	3	5
8	Cisterns/Rain barrel – Source Use of Rainwater (on site storage)	12	0	0	0	11	0	7
9	Rain Gardens	5	0	0	1	9	0	5
10	Daylighting	2	0	9	7	2	1	7
11	Purple Pipes	0	7	8	9	0	8	3
12	Green Roof	1	3	1	3	0	2	5
13	Retain/Plant Vegetation – Maintain Wooded Areas	3	8	0	0	14	9	12
14	River Gauging	2	0	0	0	1	1	2
15	Oil Grit Separators	4	2	1	0	2	3	4
16	Perforated Piping	0	0	0	0	0	0	0
17	Engineered Wetlands	0	4	8	6	1	1	4
18	Infiltration Ponds – Use of Holding Ponds when Natural Situation is Insufficient	3	1	0	0	0	0	0
19	Baffles for Slowing Ditches Flow and Allowing Silt to Settle	1	1	0	6	0	1	1
20	Development Grading	0	3	0	1	2	9	9
21	Rough Surface Piping	0	1	0	0	3	1	1
22	Narrower Road	1	1	0	1	0	0	0
23	Low Slope Ditches with Coffer Dams	0	0	0	0	0	0	0
24	Disconnect Downspouts	2	0	0	0	3	1	1
25	Removal of Stream Obstructions – culverts	1	0	0	2	0	1	2
26	Bio Swales	6	0	0	0	0	1	1
27	Curved Piping	0	0	0	0	0	0	0
28	New Development Pond ⇨ larger particles + Wetland ⇨ <20μm	0	7	2	0	1	1	1
29	Source Infiltration	2	2	1	0	0	1	1
30	Infiltration Trenches/Systems	1	1	0	0	0	0	0
31	Biofiltration	4	0	0	0	0	0	0
32	Filtration (membrane) of Runoff from Development Sites – not just settling ponds	1	2	5	10	0	4	2
33	Filtration Pond	0	1	0	0	0	0	0
34	Natural Wetlands	0	2	1	0	6	0	5

Appendix F

Ref No	Type of Green Infrastructure	Existing Development	New Development	Expensive	Complex	Easy	Regulatory Change	Critical Future Green Infrastructure
1	Stop C.S.O. Sewer into Lakes/Harbour	1	1	16	12	0	6	5
2	Lakes and Streams*	0	0	0	0	1	0	0
3	Porous Structural Fill*	0	0	0	1	0	0	0
4	Well Vegetated Greenbelts on Streams and Around Lakes	4	1	0	0	1	3	4
5	Stream Shading*	0	1	0	0	0	0	0
6	Porous Hard Surfaces*	1	1	3	0	0	0	0
7	Permeable Pavement	2	8	4	0	0	3	5
8	Cisterns/Rain barrel – Source Use of Rainwater (on site storage)	12	0	0	0	11	0	7
9	Rain Gardens	5	0	0	1	9	0	5
10	Daylighting	2	0	9	7	2	1	7
11	Purple Pipes	0	7	8	9	0	8	3
12	Green Roof	1	3	1	3	0	2	5
13	Retain/Plant Vegetation – Maintain Wooded Areas	3	8	0	0	14	9	12
14	River Gauging	2	0	0	0	1	1	2
15	Oil Grit Separators	4	2	1	0	2	3	4
16	Perforated Piping*	0	0	0	0	0	0	0
17	Engineered Wetlands	0	4	8	6	1	1	4
18	Infiltration Ponds – Use of Holding Ponds when Natural Situation is Insufficient*	3	1	0	0	0	0	0
19	Baffles for Slowing Ditches Flow and Allowing Silt to Settle	1	1	0	6	0	1	1
20	Development Grading	0	3	0	1	2	9	9
21	Rough Surface Piping	0	1	0	0	3	1	1
22	Narrower Road*	1	1	0	1	0	0	0
23	Low Slope Ditches with Coffer Dams*	0	0	0	0	0	0	0
24	Disconnect Downspouts	2	0	0	0	3	1	1
25	Removal of Stream Obstructions – culverts	1	0	0	2	0	1	2
26	Bio Swales	6	0	0	0	0	1	1
27	Curved Piping*	0	0	0	0	0	0	0
28	New Development Pond ⇨ larger particles + Wetland ⇨ <20μm	0	7	2	0	1	1	1
29	Source Infiltration	2	2	1	0	0	1	1
30	Infiltration Trenches/Systems*	1	1	0	0	0	0	0
31	Biofiltration*	4	0	0	0	0	0	0
32	Filtration (membrane) of Runoff from Development Sites – not just settling ponds	1	2	5	10	0	4	2
33	Filtration Pond*	0	1	0	0	0	0	0
34	Natural Wetlands	0	2	1	0	6	0	5
** Items Highlighted in Grey Were Removed or Combined as noted*								

Comment [KG1]: Combined with Permeable Pavement

Comment [KG2]: Added to Filtration Membrane Below

Comment [KG3]: Added to Filtration Membrane Above