Development of a Stormwater Credits Program at Halifax Water

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Abstract

This paper examines stormwater credits as a specific area in the development of a stormwater utility. Halifax Water, as a public utility, is in the process of developing a rate structure for stormwater to provide dedicated funding for this component of its infrastructure. The principles by which utilities are guided allow for customers to opt out of receiving the service. Stormwater Credits are designed to reduce stormwater charges for customers who store stormwater on their property and thereby reduce the utility's costs. To assist Halifax Water in establishing a stormwater credits program, this study has three objectives. The first is to determine current practices with respect to stormwater credits in a sample of ten other cities in North America and recommend approaches that may be appropriate for consideration by Halifax Water. The second is to prepare a sample flow diagram for a credit application approval process. The third is to conduct cost analyses to determine Halifax Water's cost of administering a credit system and the economic feasibility for property owners to manage their own stormwater using a payback analysis for a typical commercial and residential Stormwater Management Practice (SMP) storage options. The study found that the most fair and equitable basis for credits and credit amounts may be a 'sliding scale' approach based on a percentage of area diverted from the stormwater system via approved SMPs. Another key finding is that while removing barriers to entry and working in other ways to improve the feasibility of SMP ownership may increase participation rates, it is likely that Halifax Water's cost of stormwater service will not be offset by reduced runoff until such time as water quality is regulated in Nova Scotia and is factored into the cost equation.

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1.0 Introduction

Before any discussion of stormwater credits is possible, it is first necessary to describe Halifax Water and what its mandate. Halifax Water is a public utility. James Bonbright (1961, p.4), a pioneer in the field of public utility regulation, divides public utilities into two major classes. The first class, which Halifax Water falls into, is described by Bonbright as 'those enterprises which supply, directly or indirectly, continuous or repeated services through more or less permanent physical connections between the plant of the supplier and the premises of the customer.' The second class comprises public transportation agencies. Bonbright also explains that public utilities are subject to government regulation, primarily to exercise control over the rates charged to consumers for the utility's services.

Halifax Water provides water, wastewater and stormwater services to approximately 80,000 customers in the Halifax Regional Municipality (HRM), specifically within the core boundary shown in Figure A1**,** Appendix A.

Halifax Water is regulated under the Public Utilities Act by the Nova Scotia Utility and Review Board (NSUARB). The NSUARB requires Halifax Water to directly relate the rates charged to customers to the actual cost of providing that service. Stormwater rates are currently based on metered water consumption. However, the costs associated with operating and maintaining the stormwater system are not directly related to metered water consumption but rather are more closely related to the amount of stormwater run-off from a property.

A Cost of Service Study (COSS), recently completed for Halifax Water, recommends that stormwater charges be based on the amount of impervious area (typically including roofs, driveways and sidewalks) on properties. The rationale is that the degree of impervious area, in most cases, relates to the volume and rate of run-off from properties into the stormwater system.

The COSS also recommends that a system of credits be implemented that are consistent with NSUARB guiding principles (Galardi Rothstein Group, LLC, G. A. Isenor Consulting Limited, W.H.Gates Utility Consultants Limited, 2011).

Stormwater credits are reductions in the stormwater charge for those customers that implement measures on their properties (Stormwater Management Practices or SMPs) to control run-off. Possible eligible SMPs include infiltration trenches, green roofs, storage ponds, permeable pavement and others. Credit programs are increasingly a part of a comprehensive stormwater rate structure to improve equity, provide incentives to implement or carry out an overall community stormwater management plan, or advance some other social or environmental objective.

The basic principle in developing and granting stormwater credits is that credits should be given for approved private investments or actions that reduce public cost or for those that result in a stormwater related public benefit, or to recognize that some stormwater discharges are not handled by the public system. Depending on the type of detention or retention structure, the contribution to the stormwater system may be reduced or eliminated and certain pollutants may be filtered better than others, which results in varying impacts on

the cost to serve that customer. Credits are generally based on reduction of impact or reduction of cost of service. (Galardi Rothstein Group, LLC. et. al., 2011).

As of 2009, more than 800 jurisdictions in the United States had created a stormwater[1] utility to provide dedicated funding for their stormwater programs (EPA, 2009). The Halifax Regional Water Commission (Halifax Water), with the launch of its new stormwater utility in 2013, will be among the first Canadian cities to follow this growing North American trend.

The purpose of this study is to complete three objectives in support of its proposed stormwater credit program. The first is to determine current practices with respect to stormwater credits in ten other cities in North America and recommend approaches that may be appropriate for consideration by Halifax Water. The second is to prepare a sample flow diagram for a credit application approval process. The third is to conduct cost analyses to determine Halifax Water's cost of administering a credit system and the economic feasibility for property owners to manage their own stormwater using a payback analysis for a typical commercial and residential Stormwater Management Practice (SMP) storage options.

[1] Stormwater is run-off from rain that falls onto of surfaces with varying degrees of perviousness. Run-off is typically collected in a system of curbs and gutters, catchbasins and pipes and carried to downstream water bodies (rivers and lakes or the ocean) or to a storage facility.

2.0 Literature Review

One of the most referenced books on the subject of public utility rate setting is titled ‘Principles of Public Utility Rates’ (Bonbright, 1961). The principles outlined in this book establish the benchmarks for revenue stability, fairness and equity, flexibility and understandability. The comparison of the stormwater programs for a series of sampled cities in this study uses these principles to guide which practices may be appropriate to model by Halifax Water.

Doll and Lindsey (1999) surveyed 12 utilities to determine the basis on which they grant credits and the maximum credit allowed. Their analysis also looks at various issues that utilities face when establishing credit programs as well as the economic choices that customers make when considering whether to participate or not in these programs.

Brooks (2010) developed a method to compare the relative success of stormwater credit programs using credit utilization ratios. These ratios measure participation rates in credit programs. Brooks also makes recommendations on how to maximize participation in credit programs though, for example, lowering barriers to entry.

The Minnesota Department of Transportation (2005) compiled unit construction costs for various types of SMPs. This source was used to select an approximate unit cost to construct a dry detention pond in the cost analysis part of the study.

3.0 Methodology

3.1 Meetings with Halifax Water Senior Management

Three meetings were held with senior management to develop an understanding of what work has been done to date such as consultant studies, staff research and submission to the NSUARB. Additional meetings were held as the project progressed to seek input from senior management when required. The recommendations in this paper represent the opinion of the author and not those of Halifax Water or its management. Recommendations are offered to Halifax Water for consideration only.

3.2 Review of Other Cities

Research of the stormwater rate structures of ten North American cities was completed to gather the following information:

- *General* - city, population, governance, date of utility implementation.
- *Stormwater Charges* -, basis for stormwater charge, residential and non-residential charge, exemptions from charge.
- *Stormwater Credits* – objective of credit program - quality and/or quantity, basis for granting credits, amount of single family residential credit, amount of multi-residential and non-residential credit, storage requirements (design storm) and eligible SMPs.

The primary source of information on stormwater credit programs from other North American cities is their official web sites. Numerous websites were

reviewed and, generally, those with the most well developed stormwater credit programs and availability of information were selected for comparison purposes. Specific sources of information, in addition to the pages of the websites themselves, included ‘Credit Program Manuals,’ bylaws, credit application forms, council reports and public presentation materials. These sources were all available through the city websites, usually in pdf format.

Tables were prepared to compare the 10 cities in terms of what practices they have implemented in the area of stormwater charges and credits. Information on charges was collected to provide a context for the credit information. An effort was made to include cities that were comparable in size to the metro Halifax area.

A qualitative analysis was conducted (See section 5.0) to determine general trends within the sample as well as practices suitable for consideration by Halifax Water in the development of a stormwater credit program. Suitability was assessed through evaluation of program elements against selected guiding principles discussed in Section 4.0. Due to the small sample size, statistical analysis was not appropriate.

3.3 Stormwater Credit Approval Process

Many cities have included credit application forms and approval process flow diagrams on their websites. These were reviewed to guide the development of a draft stormwater credit approval process flow diagram for Halifax Water.

3.4 Cost Analysis

For the first part of the cost/benefit analysis, the credit approval process flow diagram is used to estimate the cost of administering the credit program. For example, there are administrative costs associated with reviewing applications, preparing correspondence and so on. The cost of administering the program is then compared with the value of the proposed credit.

The second part of the cost analysis determined the construction cost of a typical SMP using unit prices from the literature and various storage volumes corresponding to varying return frequencies of rain events and a mean impervious area of a commercial property in Halifax. The feasibility of constructing a SMP for a typical commercial property is then assessed by determining the payback period (See section 5.2.3).

4.0 Guiding Principles – Utility Rate Setting

The basic principles that guide many utilities today were originally outlined in James Bonbright's 'Principles of Public Utility Rates' (Bonbright, 1961). These principles are listed below as summarized in the Cost-of-Service and Rate Design Methodology Review and Recommendations report completed for Halifax Water in 2011(Galardi Rothstein Group, LLC. et. al., 2011).

1. Revenue adequacy - Effectively yield the revenue requirements in a fair and reasonable manner from the customers of Halifax Water without undue capital spending while meeting service and quality objectives;

2. Revenue stability - Provide revenue stability and predictability for HRWC with a minimum of unexpected changes;

3. Rate continuity - Provide stable and predictable rates with a minimum of unexpected changes that have adverse effect on HRWCs customers;

4. Cost-based rates - Establish rate structures that discourage the wasteful use of the service provided while promoting all justified uses and amounts;

5. Fairness vs. Benefits - Set rates that fairly reflect the benefits from the service provided;

6. Defendable vs. Costs - Set rates that are fair and equitable and that apportion costs of service among the different customer classes that are not arbitrary and capricious;

7. Fairness by Class - Set rate structures that avoid discrimination in rate relationships and that avoid inter-customer burdens;

8. Adaptable to Changing Circumstances - Set rate structures that are dynamic and promote innovation and that respond to changing demand and supply patterns;

9. Simple & Acceptable - Set rate structures that are simple to use and understand, convenient, understandable, economic to implement and maintain, and, are publicly acceptable while meeting the requirements of the Nova Scotia Public Utilities Act;

10. Understandable - Set rate structures and rules and regulations that are unambiguous and easy to interpret, and

11. Conservation – Establish a rate structure that promotes conservation while ensuring rates that are adequate to meet changing regulatory requirements.

To simplify assessing the value of various credit program practices, we have condensed the above principles into *revenue adequacy, fairness, equitability and simplicity*. These four are used in the analysis section to help establish which practices are most suitable for consideration by Halifax Water.

5.0 Findings

5.1 Comparison of Stormwater Programs for Selected Cities

Information collected on the stormwater charges for the ten sampled cities is given in Table B1, Appendix B. Information on credit programs is given in Tables C1 and D1, Appendices C and D.

Population – The population of the cities in the sample ranged from 60,608 in Springfield, Ohio to 1,526,006 in Philadelphia, Pennsylvania. The mean population of all cities in the sample was 500,704. By comparison, the population of Halifax in 2011 was 297,943 (Statistics Canada, 2011).

5.1.1 Charges

Basis for Charge – Eight of the ten cities in the sample use impervious area as the basis for developing stormwater charges. The most common approach is to calculate an Equivalent Residential Unit or ERU which is the mean impervious area for residential properties. Six of the eight cities use this method including Minneapolis, Orlando, Portland, Richmond, Springfield and Saskatoon. ERU areas in the sample range from 1000 square feet in Portland to 2850 square feet in Saskatoon. Stormwater charges are then easily determined based on how many ERUs a given property has.

Ann Arbour and Kitchener use impervious area, however, do not use the ERU method. Ann Arbour charges its residential customers based on four tiers (ranges of impervious area). Multi-residential and non-residential are charged on a per acre of impervious area basis. For residential properties, Kitchener has

three tiers of single detached (small, medium and large) and separate categories for townhouses and condominiums. Multi-residential and non-residential are charged on a per dwelling unit basis and non-residential are charged based on five different ranges of impervious area.

Although the impervious area method seems to have the most direct relationship to the amount of runoff generated from a property, it does not account for runoff from the remainder of the property which may be significant depending on the area, slopes, soil types, whether the ground is frozen, tree cover and so on. Many larger properties, for example may have a small percentage of the total area as impervious area and still generate a large amount of runoff because of the total or gross area. Even pervious soils reach saturation during heavy rain, after which most of the additional rain that falls on these soils becomes runoff.

Philadelphia is the only sampled city which incorporates both the gross area and impervious area of a property into its calculation of stormwater charges. For residential properties, mean gross and impervious areas are multiplied by their respective rates and then added together to arrive at a monthly charge for residential properties. For multi-residential and non-residential, the same approach is used except that gross and impervious areas are determined for each individual property. Accounting for both the gross area and the impervious area seems more equitable and also enables establishing a more accurate relationship between the runoff from a property and the costs associated with that runoff. The use of mean areas, however, for residential properties, does not

seem equitable given that all property owners pay the same monthly charge yet they may contribute vastly different amounts of stormwater to the public system.

Edmonton uses an interesting method of calculating stormwater charges that factors in property size, development intensity, a runoff coefficient (based on land zoning) and a city-wide monthly rate.

Halifax Water has taken a similar approach to the majority of other cities in the sample in that it uses total impervious area as a basis for developing stormwater charges. The residential charge is based on a mean impervious area for all lots multiplied by a rate per square metre of impervious area. Pervious areas are not currently considered in the charge calculation. For multi-residential and non-residential properties, the impervious area is measured for each lot and multiplied by the same rate per square metre that applies to residential lots. The shortcoming of this method, as discussed above is that runoff from the remainder of the property is not accounted for. Also, with the use of a mean area for residential, as we will see later in the discussion of credits, it is difficult to determine what percentage of impervious area has been diverted away from the public system if there is no specific information known about a given lot. Therefore, Halifax Water may wish to review the way it calculates charges for residential properties in the future if there is an economical way to determine the impervious areas on each specific lot.

The currently proposed residential stormwater charge includes a flat rate for properties abutting an HRM street that are inside the stormwater boundary shown on Figure A1, Appendix A. The transfer agreement between Halifax Water

and HRM stipulates that Halifax Water is responsible for just those properties abutting HRM streets (excluding provincially owned roads and private roads).

The new stormwater rate is proposed to have two parts as recommended in the Cost-of-Service and Rate Design Methodology Review and Recommendations (2011). The first part will be a 'lot charge' for 'site generated flows' and the second part will be for the portion of flow that is generated within the street right of way (ROW). The two part rate structure for stormwater recognizes those customers that do not contribute stormwater to the HRWC system (Halifax Water, 2012).

To establish which properties would receive a charge for stormwater services an assumption was necessary. The assumption is that any property with impervious areas that abuts an HRM street right-of-way inside of the core boundary is receiving stormwater services from Halifax Water. This service may be for surface runoff into the street from impervious services and/or from footing drains or catchbasins that connect impervious areas to the stormwater or combined sewer system located within the street or within an easement. It follows that if a property has no impervious areas and does not have frontage then it will not receive a stormwater bill.

Exemptions – Six of the ten cities sampled do not allow any exemptions from the stormwater charge. Philadelphia provides a 25% discount to seniors 65 and over as well as charities, churches, non-profit hospitals, schools and universities. Richmond exempts undeveloped properties from charges.

Halifax Water is consistent with the majority of the sampled cities in that it will not be granting exemptions from the site generated flow portion of the stormwater charge except where they are not contributing runoff to the utility's system. All properties that are contributing to the stormwater system (pipe, ditch, culvert or other conveyance) are benefitting from the utility's stormwater infrastructure. This approach is consistent with the principles of fairness and equitability. Properties may only be exempted from the site generated flow charge if they have no impervious area, all of the surface runoff drains away from the abutting street directly to the ocean or if all of the surface runoff never flows through a Halifax Water owned system. Properties that are exempted from the site generated flow charge will still be required to pay the right-of-way portion of the charge if they abut an HRM street.

This approach is also consistent with Halifax Water's application of existing water and wastewater charges, where there are no exemptions based on status such as places of worship, charities, schools, etc.

5.1.2 Credits

Objective (Quality and/or Quantity) – Eight of the ten cities sampled, including one Canadian city (Kitchener), provide credits for both reduced quantity of run-off and improved quality of run-off. Edmonton and Saskatoon provide credits only for reduction in runoff quantity.

Trends in the US clearly indicate that controlling stormwater water quality is equally, if not more important, than quantity. Stormwater runoff quality in the

US is regulated through the National Pollutant Discharge Elimination System (NPDES) permit program, authorized under the Clean Water Act. Pollutant discharges from three potential sources are regulated including municipal separate storm sewer systems (MS4s), construction activities, and industrial activities. The NPDES permitting system is intended to prevent harmful pollutants in runoff from entering local streams, rivers, lakes or coastal waters (USEPA, n.d.).

Stormwater quality is not currently regulated in Nova Scotia so there is no requirement for Halifax Water to treat stormwater before it is discharged. Until this changes, stormwater credits will likely continue to focus on reducing runoff quantity. Also, given that utilities are required to match charges to costs, if the utility has no costs associated with stormwater quality, then granting credits for quality improvement would not in any way reduce the utilities costs of ownership and maintenance of the stormwater system. When such regulations are implemented, Halifax Water may need to increase stormwater charges and consider offering credits for stormwater quality improvements.

For the above stated reasons, Halifax Water will only be granting credits for customers who reduce the quantity of runoff. For the remainder of the analysis, we will discuss only the quantity related stormwater credit practices of the sampled cities. In the following two sections, we will analyse the credit programs of the sampled cities from two perspectives: Residential and Multi-Residential/Non-Residential.

5.1.2.1 Residential

Basis for Credits and Amount – Four cities including Edmonton, Orlando, Philadelphia and Saskatoon do not offer credits to residential customers. The other six cities offer credits on the basis of stormwater diversion away from the public system.

Ann Arbour credits customers up to 25% for reducing impervious area enough to enter a lower tier, installing rain barrels and either a rain garden, cistern or dry well. As a low cost way of participating in credit programs, residents may consider purchasing a rain barrel. Ann Arbour provides a $1.96 credit quarterly for a single rain barrel, which is approximately 10% of the lowest tier of impervious area for single family and duplexes.

Kitchener has a scaled credit system that is based on the amount of water stored. The maximum credit of 45% is allowed for storage of 3201 L or more using a combination of rain barrels, cisterns, infiltration galleries, rain gardens or permeable pavers. On the lower end of the scale, storage of between 200 and 800 litres would qualify for a credit of 20% or $1.95 per month for the ‘Single detached medium’ residential property. One rain barrel holds approximately 200 litres.

Minneapolis grants a 50% credit for storing the runoff from a rain event that has a probability of occurring once in ten years (known in the industry as the ten year storm) and a 100% credit for storing the hundred year storm. Certification of the SMPs by and engineer or landscape architect is required to

receive these credits. Eligible SMPs include infiltration systems, retention and detention systems and constructed wetlands.

Portland offers credits of up 35% of the total stormwater charge, on a sliding scale, for managing stormwater on private property or for having less than 1000 square feet of impervious area. Credits are given for downspout disconnections, soakage trenches, rain gardens and rain barrels.

Richmond offers up to a 50% credit to property owners who reduce the rate or amount of stormwater flowing from their properties to the public stormwater system.

Springfield offers a maximum 10% credit for customers who install enough rain barrels to capture 100 gallons of water or install a rain garden.

Design Storm - Only Minneapolis specified the rain event that would need to be retained to be eligible for credits. 50% and 100% credits are offered for retaining the ten year and one hundred year events respectively.

Eligible SMPs - A summary of SMPs that are eligible for residential quantity credits in the sampled cities that offer credits is given in the table below.

Residential SMPs Eligible for Credits

Type	SMP	Number of Cities Offering
Storage	Rain barrels	4
	Cisterns	1
	Retention and detention systems	2
Infiltration	Reduced impervious area	1
	Rain gardens	4
	Dry wells	1
	Infiltration systems	3
	Pervious pavement	2
	Permeable pavers	1
	Downspout disconnection	1

The most commonly offered SMPs in the sampled cities are rain barrels, rain gardens and infiltration systems. This may be due to ease and cost of installation on residential properties; however, additional data is required to verify this.

When selecting which SMPs will be eligible for credits, it is recommended that Halifax Water consider the local climate, soil and groundwater conditions, development density, local flooding issues, stormwater program objectives and the feasibility of SMP ownership from the customer's perspective. A feasibility analysis for one type of residential SMP, rain barrels, is included in section 5.2.4.

5.1.2.2 Multi- Residential & Non-Residential

Basis for Credits - All of the cities in the sample offer credits to Multi-residential and non-residential property owners. The basis for credits is (in all cases) the implementation of one or more SMPs on the property, which direct

stormwater flow away from the public system in the street. However, the basis for credits varies among them.

Ann Arbour, Kitchener, Orlando and Saskatoon all have straight forward requirements to install approved SMPs to qualify for a credit.

Edmonton's requires property owners to demonstrate that they contribute significantly less stormwater runoff than other similarly zoned properties. This approach may be seen by applicants as unfair in that it is too open to the interpretation of the city staff reviewing the application.

Richmond and Saskatoon both have programs where credits are based on the percentage of flow that drains to the SMP. This is a sliding scale approach that seems fair, flexible and easily understood.

Minneapolis requires that SMPs reduce runoff from a property to mimic the pre-development conditions.

Edmonton and Philadelphia require certification of SMPs by an engineer as part of the approval process. Application fees are required by two of the cities including a fee of $250 for Edmonton and a $150 fee for Philadelphia.

Engineering certifications and application fees may act as barriers to entry for some property owners. Brooks (2010) suggests that cities may be able to increase participation in credit programs by keeping such barriers to a minimum. Engineering certifications, from a utility's perspective, protects its interests and ensures that SMPs are designed and working properly. If the SMP does not perform as expected, runoff is greater than expected and the credit amount is not reflective of the city's cost savings. With respect to application fees, these are

intended to recover the cost of administering the credit application and approval process. It is reasonable, based on the principles of fairness and equity, for the customer using the credit program to pay for this cost. Below, in section 5.2.1, we present a sample calculation of the cost of administering a credit program at Halifax Water.

Based on the above analysis, Halifax Water may wish to consider an approach similar to Richmond and Saskatoon with 'sliding scale' credits based on percentage of area diverted from the stormwater system using approved SMPs. Application fees may be reasonable, however, should be kept as low as possible so as not to create a barrier to entry into the credit program.

Credit Amount - Maximum credit amounts range from 25% in Kitchener and Springfield to 100% in Minneapolis and Portland. Ann Arbour offers up to approximately 30% credit, Edmonton up to 35%, Orlando up to 42%, Philadelphia up to 80% and Richmond up to 50%. The maximum credit is not specified for Saskatoon.

It is evident that maximum credit amounts vary widely across the sampled cities. The reasons for this may be related to the unique objectives of each city and the degree to which it wishes to promote SMPs on private property.

Design Storm – Six of the ten cities in the sample do not specify the rain event that must be managed on-site to qualify for credits. These are Ann Arbour, Edmonton, Kitchener, Orlando, Portland and Saskatoon. Interestingly, Portland

offers an on-line calculator to assist non-residential customers in sizing SMPs. This practice may be an alternative to requiring certification by and engineer and is recommended for further exploration by Halifax Water.

Minneapolis requires the ten year or one hundred year 24 hour duration storm to be stored for the 50% and 100% credit respectively.

Philadelphia requires the first inch of runoff to be managed. This city's program emphasizes quality objectives which explains the relatively low amount of rainfall to be managed. Most pollutants are 'flushed' from impervious area such as asphalt in the first inch of rain.

Richmond requires management of the ten year storm in its detention pond specification with the objective of flooding control.

Springfield has a peak flow limit for the two year up to the 100 year 24 hour duration storm.

Patterns of precipitation vary from city to city as does the severity of storms. Some cities have more intense but shorter duration storms while others tens to have storms that are longer but with less intensity. Another important thing to consider when looking at storms is the frequency with which they reoccur in a given location. All three factors are represented statistically on what is called an intensity/duration/frequency or IDF curve. Each climate station, such as the one at Stanfield International Airport, collects rain data on an ongoing basis and generates IDF curves using the most recent few decades of data. It is important to note that for a given duration and intensity of storm, the return frequency varies from city to city. Therefore, each city must customize its stormwater

infrastructure (including any specifications for private SMPs) to its unique history of rain events. A storage pond in Halifax designed for the one in ten year storm, for example, may not be large enough to hold Orlando's one in ten year event.

As Doll and Lindsey (1999) point out, it is critical to consider local stormwater management goals when designing a credit program. Halifax Water should examine its stormwater management objectives and decide which design storm, if any is most appropriate when designing a credit program.

Eligible SMPs - A summary of SMPs that are eligible for non-residential quantity credits in the sampled cities that offer credits is given in the table below.

Non-Residential SMP's Eligible for Credits

Type	SMP	Number of Cities Offering
Storage	Rooftop storage	1
	Storage tanks	1
	Parking lot storage	1
	rainwater harvesting	1
	Detention Basins/Ponds	4
	Retention Basins/Ponds	3
Infiltration	Infiltration trenches	4
	Reduced impervious area	1
	Rain gardens	1
	Dry wells	2
	Pervious pavement	5
	Downspout disconnection	2

The most commonly offered non-residential SMPs in the sampled cities are detention and retention basins and ponds, infiltration trenches and pervious pavements.

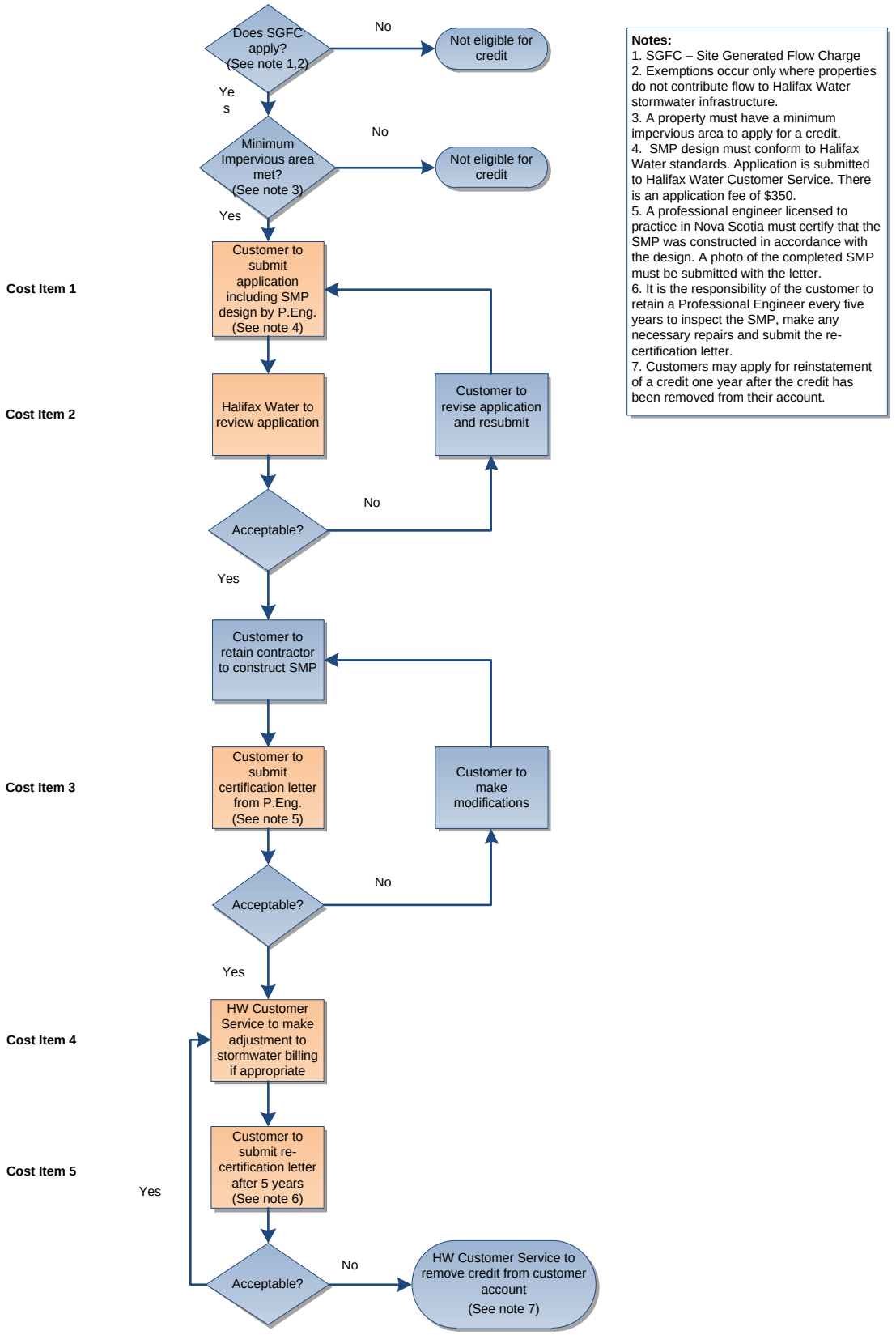
When selecting which non-residential SMPs will be eligible for credits, it is recommended that Halifax Water consider the local climate, soil and groundwater conditions, development density, local flooding issues, stormwater program objectives and the feasibility of SMP ownership from the customer's perspective. A feasibility analysis for one type of residential SMP, rain barrels, is included in section 5.2.3. A feasibility analysis for one type of non-residential SMP, detention ponds, is completed in section 5.2.4.

5.2 Cost Analysis

5.2.1 Cost to Administer Credit Program Compared to Credit Value

The flow diagram in Figure 1 shows the stormwater credit approval process that is proposed for Halifax Water.

Figure 1 - Stormwater Credit Approval Process – New SMPs



Notes:
1. SGFC – Site Generated Flow Charge
2. Exemptions occur only where properties do not contribute flow to Halifax Water stormwater infrastructure.
3. A property must have a minimum impervious area to apply for a credit.
4. SMP design must conform to Halifax Water standards. Application is submitted to Halifax Water Customer Service. There is an application fee of $350.
5. A professional engineer licensed to practice in Nova Scotia must certify that the SMP was constructed in accordance with the design. A photo of the completed SMP must be submitted with the letter.
6. It is the responsibility of the customer to retain a Professional Engineer every five years to inspect the SMP, make any necessary repairs and submit the re-certification letter.
7. Customers may apply for reinstatement of a credit one year after the credit has been removed from their account.

Items that would incur a cost for Halifax Water are identified in the figure. Further, Table 1 includes an estimation of the total value for each cost item based on the number of hours to complete each activity and a mean hourly rate.

The cost items and diagram serve to determine the initial and ongoing costs of administering a stormwater credits program. These costs would be paid by each customer as an application/re-certification fee. For example, a customer would be required to pay a $350.00 initial fee for administration costs in year one. Similarly, a recertification fee of $87.50 would apply in year five and every five years thereafter subject to changes in the mean hourly wage rate over time. Information on application fees for two of the sample cities was collected. Edmonton's fee is $250 and Philadelphia's is $150.

Application fees and re-certification fees represent barriers to entry for customers wanting to participate in credit programs. Based on our research, participation rates in credit programs in other cities is very low. Brooks (2010) compared the success of stormwater credit programs in 12 cities using ratios that measure participation by property owners. He found that two thirds of the cities sampled reported having five or less applicants for credits each year. He concluded that the low participation rate may be partly due to barriers of entry including application fees or the requirement to have an engineer certify the SMP initially and on an ongoing basis. Szalay (2011) points out that, even where credits are relatively generous as in Philadelphia, participation rates are low. From the launch of this city's program in July of 2010 to June 2011, only a handful of applications were received. Szalay claims that the low participation

rate is due to a complex set of investment barriers faced by customers. Moreover, Doll (1999) notes that as of that year, Saint Paul Minnesota approves only three to four credit applications per year.

Based on the above, it is recommended that Halifax Water streamline the credit approval process as far as possible to reduce the initial and ongoing fees such that they do not discourage customers from applying for credits.

Based on available data, it is safe to assume that participation rates are less than one percent. However, to get a better understanding of what the actual participation rates may be in locally, it is recommended that a survey of non-residential customers could be done to determine what the rate of participation may be once the program is implemented.

With the anticipated low participation rate, we do not expect that there will be any measurable benefit in terms of the cost to operate and maintain the system. The reason for this is that the reduction in flow in the existing system (ditches and pipes) will not be sufficient to noticeably reduce the utility's costs now or in the future. For example, an assumed one percent reduction in flow will not change the cost of operating, maintaining or replacing the system.

5.2.2 Feasibility Analysis

It is reasonable to assume that the level of participation in the credits program will (to some degree) depend on the payback period. The payback period is the time taken for the value of the credits to pay for the initial investment (ignoring the time value of money). As the payback period increases the

participation rate should decrease. Brooks (2010, p. 22) found that eight of 12 cities surveyed had five or less applications for credits each year.

Credit programs allow customers to choose between continuing to pay the utility's stormwater charge or opting out of some or all of the charge by managing their own stormwater (Doll, 1999). Providing a low percentage credit may make sense to the utility especially if there are no expected benefits in terms of cost reduction. However, low value credits will not provide incentives for customers to invest in SMPs if the lower cost option is to continue to pay the full stormwater charge.

5.2.3 Feasibility of Rain Barrels as a Residential SMP

From the residential customer's perspective, rain barrels are a low cost option for participating in a credit program. Table 2 shows that with no application fee, the payback period, assuming a 10% credit, is 58 years. However, if customers use the water in the rain barrel in place of tap water for watering gardens, for example, the payback period is as short as 3.2 years with maximum usage.

From the utility's perspective, one concern may be that there is no process in place to determine whether rain barrels are maintained in working order and emptied after each rainfall. The cost to periodically inspect rain barrels would far exceed the benefit that they provide in terms of stormwater runoff reduction. Another potential concern is that the use of rain barrels to replace tap water will results in reduced revenues for Halifax Water. With no anticipated reduction in

the cost of operating the public stormwater system, stormwater rates may need to rise to offset the loss of revenue from lower consumption. However, in the interests of fairness and providing residential customers options for reducing their stormwater bill, rain barrels may be a good option to consider.

5.2.4 Feasibility of a Dry Detention Basin as a Non-Residential SMP

Table 3 gives an example of a dry detention basin SMP and the payback period for various storage (design storm) requirements. This analysis assumes that a 100 percent is granted for all design storm frequencies. In reality, a lower credit amount would likely be provided for storing the more frequent storms. However, the main point of this analysis is to show that even with a full credit, the payback period is very high (24.4 years) for the one in two year storm. For the least frequent storm, the payback period is extremely long at 54.6 years. It is difficult to imagine that a non-residential customer would invest in this type of SMP given these payback periods.

6.0 Conclusions

The literature and findings indicate that credit programs are highly customized in terms of the basis for credits, amount of credits, design storms and eligible SMPs.

The most fair and equitable basis for determining the amount of credits may be a ‘sliding scale’ approach based on a percentage of area diverted from the stormwater system using approved SMPs.

The literature indicates that participation rates in other North American cities are very low with only a few credit applications each year.

Application fees and requirements for engineering certification may serve as barriers to entry (participation) in a stormwater credits program.

A reasonable payback period for customers investing in SMPs may be an important determining factor in their decision to participate in credit programs or not.

A significant level of credit program participation would be required have a measurable impact on Halifax Water’s cost to operate its stormwater system due to very high fixed costs of infrastructure.

While removing barriers to entry and working in other ways to improve the feasibility of SMP ownership may increase participation rates, it is likely that Halifax Water’s cost of stormwater service will not be offset by reduced runoff until such time as water quality is regulated in Nova Scotia and is factored into the cost equation.

7.0 Recommendations

1. Halifax Water should examine its stormwater management objectives closely and tailor its credit program to meet those needs (e.g. selection of credit basis, credit amounts, design storm and eligible SMPs)

2. Consider an approach similar to Richmond and Saskatoon with ‘sliding scale’ credits based on percentage of area diverted from the stormwater system using approved SMPs.

3. Application fees should be kept as low as possible to limit barriers to entry into the credit program.

4. Explore alternatives to engineering certification for SMPs such as Portland’s on-line calculator to assist non-residential customers in sizing SMPs.

5. In addition to the cost to administer the program, consider feasibility of SMP ownership from the customer’s perspective when designing the credits program.

6. To get a better understanding of what the actual participation rates in a credits program may be locally, it is recommended that a survey of non-residential customers could be done to determine what the rate of participation may be once the program is implemented.

7. Consider offering credits for rain barrels as a feasible option for residential customers. Given the benefits to the utility are low with this option, a credit in the range of 10% may be appropriate.

8. Endeavour to determine what level of participation is necessary in a credit program to impact (reduce) the utility's costs of providing stormwater service.

9. Consider targeted credit programs to address issues such as flooding in certain geographical areas of the city.

10. Consider possible partnerships with HRM as part of a residential credits program.

Table 1 – Cost Break-down to Administer Stormwater Credit Program per Application (Cost items from Figure 1)

Cost Item	Description	Tasks	Responsibility	Time required (hours)	Hourly rate[1]	Cost
1	Customer to submit application including BMP design by P.Eng.	Verify completion, open file, forward to Engineering	Customer Service	1	70	70
2	Review application	Verify design meets standards, letter to customer	Engineering	2	70	140
3	Customer to submit certification letter from P.Eng.	Add to file, forward to engineering	Customer Service	0.5	70	35
3a	Review of certification letter	Verify certification meets standards	Engineering	1	70	70
4	HW Customer Service to make adjustment to stormwater billing	Customer account adjustment	Customer Service	0.5	70	35
			Total Cost Year 1	**5**	**70**	**350**
5	Customer to submit re-certification letter after five years	File, forward to Engineering	Customer Service	0.25	70	17.5
5a	Review of re-certification letter	Verify design meets standards, letter to customer	Engineering	1	70	70
			Total Cost Year 5	**1.25**	**70**	**87.5**

Notes:

1. An hourly rate of 70.00 is an estimated average of all staff that would be involved in administering the program and includes all other employer costs.

Table 2 - Feasibility Analysis for a Rain Barrel Stormwater Management Practice (SMP). Payback periods are calculated based on a credit of 10% of the annual stormwater charge and for varying degrees of usage of rain barrel water to replace tap water from Halifax Water.

Description	Units	Value
Average Area of Residential Roof	m^2	120
Rain Barrel Volume (Lee Valley Rain Barrel, 2011)	m^3	0.40
Amount of Rain to Fill Barrel (drains half of roof - 60 m^2)	mm	6.70
Residential Stormwater Charge (1 ERU)[1]	per year	21.37
Cost of One Rain Barrel (Lee Valley, 2011)	$	125.00
Credit Amount - Assume 10%[2]	$	2.14
Payback Period[3] - Credit Only	**years**	**58**
Cost of Tap Water from Hailfax Water[4]	m^3	2.30
Total Rainwater Collected per Year in One Rain Barrel (40 fills)[5]	m^3	16.00
Payback Period - Credit Plus 25% of Volume Replacing Tap Water (4 m^3)	**years**	**11.0**
Payback Period - Credit Plus 50% of Volume Replacing Tap Water (8 m^3)	**years**	**6.1**
Payback Period - Credit Plus 75% of Volume Replacing Tap Water (12 m^3)	**years**	**4.2**
Payback Period - Credit Plus 100% of Volume Replacing Tap Water (16 m^3)	**years**	**3.2**

Notes:

1. One ERU (Equivalent Residential Unit = 185.8 m^2 of impervious area) Proposed stormwater charge is 0.115 per m^2 (Halifax Water, 2013, p. 565)
2. Of the sampled cities, Ann Arbour offers a approximate 10% credit for a single rain barrel and Kitchener offers 20% for a single barrel holding a minimum of 200 L. Therefore, 10% is a reasonable credit to use for the purpose of this analysis.
3. Payback period calculation does not include the time value of money.
4. Includes both water and wastewater components of charge proposed as of July 1, 2013 (Halifax Water, 2013, p. 562-564).
5. Data from Environment Canada indicates that there are on average 40 days during the non-winter months with rainfall greater than or equal to 5 mm. It is assumed that rain barrels would not be used in the winter due to freezing. (40 fills X 0.4 m^3/fill = 16m^3)

Table 3 - Feasibility Analysis for a Dry Detention Pond Stormwater Management Practice (SMP)

Detention Pond Construction Cost	Units	Storm Return Frequency					
		100 yr	50 yr	25 yr	10 yr	5 yr	2 yr
Rainfall amount over 24 hours for given storm frequency (Shearwater)[1]	m	0.151	0.137	0.123	0.105	0.090	0.067
Average Impervious Area (Multi-Residential & Non - Residential)[2]	m^2	4,743	4,743	4,743	4,743	4,743	4,743
Runoff Volume[3]	m^3	645	586	527	447	383	288
Required Pond Storage Volume[4]	m^3	322	293	263	223	192	144
Average Unit Construction Cost[5]	$/$m^3$	$92.43	$92.43	$92.43	$92.43	$92.43	$92.43
Total capital construction cost[6]		$ 29,790.13	$ 27,087.32	$24,345.05	$20,636.08	$17,716.25	$13,297.05
Payback Period Calculation							
Equivalent Residential Unit (ERU)[7]	m^2	185.8	185.8	185.8	185.8	185.8	185.8
Number of ERUs per Multi-Residential & Non-Residential (average)[8]		26	26	26	26	26	26
Annual charge for single ERU[9]	$/$m^2$	21	21	21	21	21	21
Annual Site Generated Flow Charge (SGFC)	$	545	545	545	545	545	545
Payback Period with 100% credit for SGFC[10]	**Years**	**54.6**	**49.7**	**44.6**	**37.8**	**32.5**	**24.4**

Notes:

1. Rainfall amount is derived from Intensity Duration Frequency (IDF) curves for Shearwater, Nova Scotia. These amounts will occur over a 24 hour period every 100, 50, 25, 10, 5 and 2 years respectively.
2. The average impervious area for multi-residential and non-residential is determined from Halifax Water's analysis of satellite imaging data and GIS property data.
3. Runoff volume is the product of the rain amount and the average impervious area.
4. The required pond storage volume assumes that the pond is designed to release half of the runoff it receives in the 24 hours during which the storm is occurring and the other half in the subsequent 24 hours.
5. Unit construction cost for a dry detention basin are derived from Minnesota Department of Transportation, 2005. Conversion to 2012 Canadian dollars assumes parity between the US and Canadian dollars in 2005 and inflation based on price indices of apartment and non-residential building construction from 2005 to 2012 (Statistics Canada, 2013).
6. Construction costs do not include costs for annual routine maintenance (5 to 10% per year of the facility's capital cost) or the cost of eventual replacement in 25 to 50 years based on the facility (3 to 5% of capital cost). (City of Portland website).
7. From (Galardi Rothstein Group, G. A. Isenor Consulting Limited and W.H.Gates Utility Consultants Limited, 2011, p.63).
8. The number of ERUs per average multi-residential & non-residential is obtained by dividing the area of a single ERU (185.8 m^2) into the average impervious area (4743 m^2).
9. The annual charge for a single ERU is the product of Halifax Water's proposed charge per square meter of impervious area of $0.115 and the single ERU area of 185.8 m^2 (Halifax Water, 2013, p. 565).
10. In this analysis, a 100% credit is assumed for storing the runoff volume from each of the rain events.

8.0 References

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Figure A1

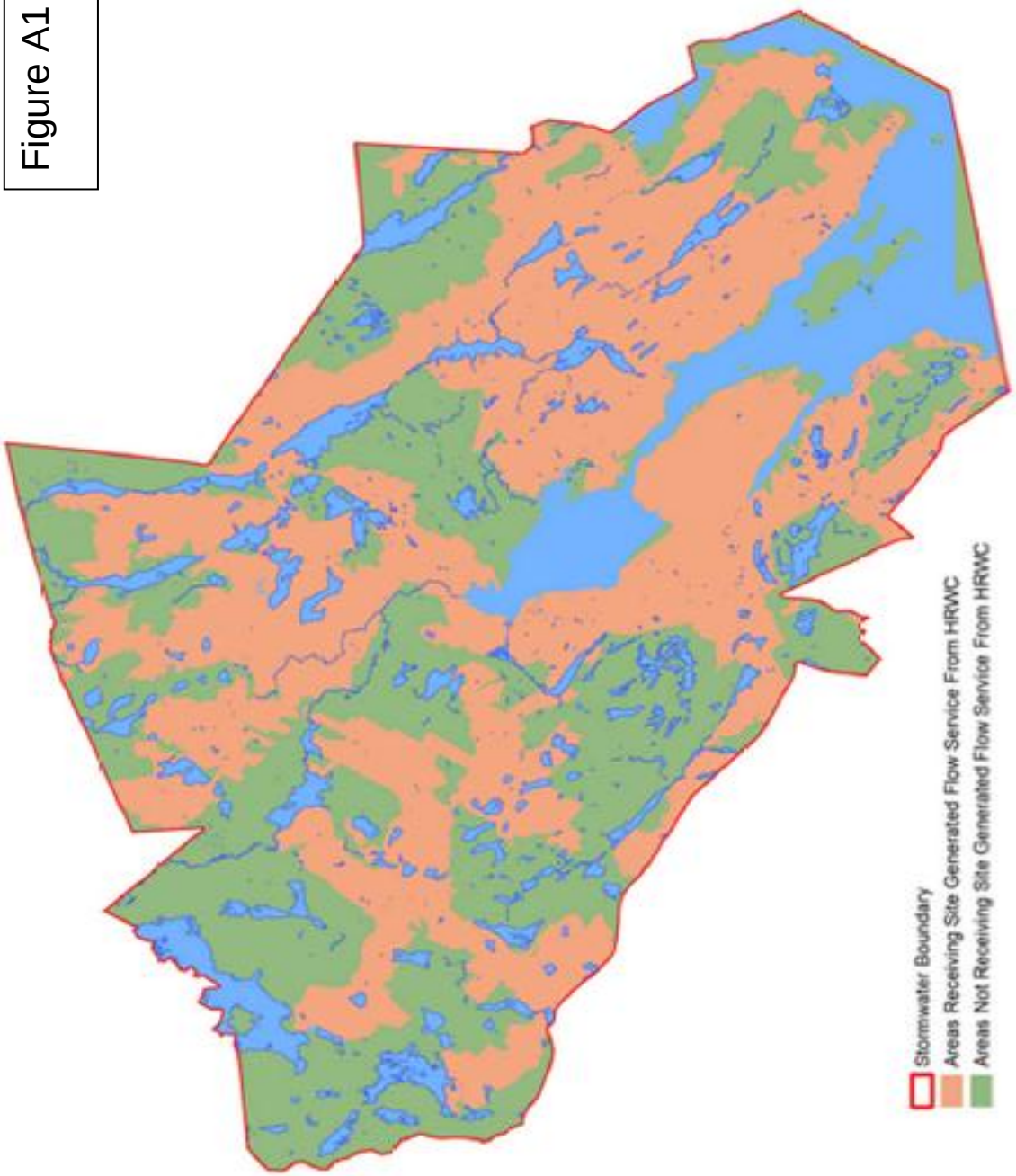
Stormwater Boundary
Areas Receiving Site Generated Flow Service From HRWC
Areas Not Receiving Site Generated Flow Service From HRWC

Table B1 - Comparison of the Stormwater Program Charges of Ten North American Cities

City	Web Address[1]	Date Accessed	Population	Basis for Charge	Charge		Exemptions
					Residential	Multi-Residential/Non-Residential	
Ann Arbour	http://www.a2gov.org/government/publicservices/systems_planning/waterresources/StormWater/Pages/StormWater.aspx	16-Mar-13	113,934 (2010)	Impervious area	Single Family and Duplexes Four tiers based on amount of measured impervious area Up to 2,187 square feet - $13.68/quarter 2,187 to 4,175 square feet - $23.94/quarter 4,175 to 7,110 square feet - $41.04/quarter 7,110 square feet - $71.82/quarter An additional $6.77 customer charge per quarter is applied to all properties.	$342.00 per acre per quarter, plus a $6.77 customer charge per quarter.	Properties that do not use the public stormwater system
Edmonton	http://www.edmonton.ca/for_residents/flooding_sewers/stormwater-utility.aspx	23-Mar-13	1,159,869 (2011)	Charges are based on property size (A), development intensity (I)[2], and a runoff coefficient (R) based on land zoning and a city-wide monthly rate. The charges are calculated as follows: A x I x R x Rate = Stormwater Utility Charge	Monthly charge of $0.025898 per square metre Typical single family home charge is $6.00/mo	Monthly charge of $0.025898 per square metre For multi-residential, A = proportion of building lot area attributable to each unit for multiple units sharing a single building or property.	None
Kitchener	http://www.kitchener.ca/en/livinginkitchener/StormwaterManagement.asp	20-Mar-13	477,160 (2011)	Impervious area and type of development	Single detached small - $5.84/mo Single detached medium - $9.73/mo Single detached large - $12.79/mo Townhouse - $6.95/mo Residential condominium - $3.89/mo	Multi-residential (2-5) units - $3.90/unit/mo Greater than 5 units - 1.95/unit/mo Five categories of non-residential based on ranges on impervious area - Charges from $18.63/mo to $1980.91/mo	None
Minneapolis	http://www.minneapolismn.gov/publicworks/stormwater/index.htm	17-Jul-12	382,578	Impervious area - Equivalent Stormwater Unit (ESU) is 1530 square feet.	Three categories: High 1.25 ESU = $14.27/mo Medium 1.00 ESU = $11.42/mo Low 0.75 ESU = $8.56/mo	Gross Lot Size in square ft. X Runoff Coefficient (based on Land Use class) divided by 1,530 square ft = # of ESU's	None
Orlando	http://www.cityoforlando.net/public_works/stormwater/fee.htm	7-Apr-13	238,300 (2010)	Impervious area - Equivalent Residential Unit (ERU) is 2000 square feet.	$119.88 per ERU with a maximum xharge of 1.25 ERUs for single family - Vacant parcels are charged $62.40 per acre with minimum one acre charge. Minimum charge of $42.00/yr for all properties for ROW drainage (rain falling on streets).	Parcels will pay based on how many Equivalent Residential Units, or "ERUs", there are on the parcel. Minimum charge of $42.00/yr for all properties for ROW drainage (rain falling on streets).	None
Philadelphia	http://www.phila.gov/water/Stormwater/pdfs/SCAA_Manual.pdf	10-Feb-13	1,526,006	Combination of Gross Area (GA) and Impervious Area (IA)	Uniform monthly charge based on a mean Gross Area (GA) of 2110 square feet and a mean impervious area of 1050 square feet. $10.51 per month	Non-residential and Condominium properties are charged based on property-specific measurements of GA and IA.	None - 25% discount to seniors 65 and over as well as charities, churches, non-profit hospitals, schools and universities

Table B1 - Comparison of the Stormwater Program Charges of Ten North American Cities (Continued)

City	Web Address[1]	Date Accessed	Population	Basis for Charge	Charge		Exemptions
					Residential	Multi-Residential/Non-Residential	
Portland, Oregon	http://www.portlandoregon.gov/bes/47952	10-Feb-13	583,776	Impervious area. 1000 square feet used as the basic unit for single family residential.	**Single Family and Duplexes** Off-site charge $15.54 per user account per month On-site charge $8.36 per user account per month	**Multi-Residential** 3-Plex and 4-Plex Residences Off-site charge $6.47 per dwelling unit per month Off-site charge $6.47 per dwelling unit per month Developments of 5 or More Units Off-site charge $6.47 per 1,000 square feet of impervious area per month On-site charge $8.36 per 1,000 square feet of impervious area per month **Non-Residential** Off-site charge $6.86 per 1,000 square feet of impervious area per month On-site charge $3.69 per 1,000 square feet of impervious area per month	None
Richmond, Virginia	http://www.richmondgov.com/dpu/stormwaterutility.aspx	10-Feb-13	204,214	Impervious area - Equivalent Residential Unit (ERU) is 1424 square feet.	**Single Family** Parcels less than 1,001 sq. ft = $25/yr Parcels between 1,001 and 2,399 sq. ft. = $45/yr Parcels greater than 2,400 sq. ft. = $70/yr	Multi Residential - $45/ERU Non-Residential including commercial, non-profits, churches, schools, colleges/universities - $45/ERU	Undeveloped Properties
Springfield	http://www.ci.springfield.oh.us/swu/index.htm	21-Mar-13	60,608	Impervious area - Equivalent Stormwater Unit (ESU) is 1,898 square feet.	1 to 999 square feet (0.4 ESU) $0.52/mo 1000 to 1699 square feet (0.75 ESU) $0.97/mo 1700 to 2099 square feet (1.0 ESU) $1.30/mo 2100 to 3399 square feet (1.3 ESU) $1.69/mo Over 3399 square feet (2.0 ESU) $2.60/mo	Individually calculated impervious area divided by the ESU area of 1898 square feet. Charge is $1.30 per ESU per month Vacant and agricultural parcel charge is determined by multiplying the gross area of the parcel by the appropriate runoff coefficient and then dividing by the area of a single ESU (1898) to obtain the ESU multiple.	None
Saskatoon, SA	http://www.saskatoon.ca/DEPARTMENTS/City%20Clerks%20Office/Documents/bylaws/8987.pdf	24-Mar-13	260,600 (2011)	Impervious area - Equivalent Runoff Unit (ERU) equals 265.3 square meters.	$4.40/mo or $52.80 per year	Charged according to the number of ERUs with a minimum charge of 2 ERUs and maximum of 100 ERUs. Parcels with over 10 ERUs are being phased in to 2018. Charge is $4.40 per ERU per month	None

Notes:

1. Information on the stormwater programs for each city was obtiained from the city's website.

Table C1- Comparison of Stormwater Programs - Residential Credits

City	Objective (Quality, Quantity or Both)	Residential			
		Basis for Credit	Amount (% or dollar value)	Design Storm	Eligible SMPs
Ann Arbour	Both	Reducing impervious area enough to enter a lower impervious area category Installing rain barrels or installing a rain garden cistern or dry well	**Quarterly Credit Amount** Reduced Impervious Area - Charge difference between tiers Rain Barrels - $1.96 Rain Garden, Cistern or Dry Well - $3.06 (Total potential quantity credit of $5.02 or approximately 25% of total charge for tier 1 properties)	Not given	Reduced impervious area Rain barrels Cisterns Dry wells
Edmonton	Quantity	Not eligible	Not eligible	Not eligible	Not eligible
Kitchener	Both	Based on the volume of runoff that SMP can hold.	200-800 L - 20% 801-3200 L - 30% 3201 L or more - 45%	Not given	Rain barrels Cisterns Infiltration Galleries Rain Gardens Permeable Pavers
Minneapolis	Both	Implementation of SMPs to retain 10-year or 100 year storm event to pre-developed conditions. application must be certified by a state licensed engineer or landscape architect	50% credit for retaining 10 year event 100% credit for retaining 100 year event	10-year or 100 year, 24-hour storm	Infiltration systems, retention & detention systems, constructed wetlands
Orlando	Both	Not eligible	Not eligible	Not eligible	Not eligible

Table C1- Comparison of Stormwater Programs - Residential Credits (Continued)

City	Objective (Quality, Quantity or Both)	Residential			
		Basis for Credit	Amount (% or dollar value)	Design Storm	Eligible SMPs
Philadelphia	Both	Not eligible	Not eligible	Not eligible	Not eligible
Portland, Oregon	Both	**Single family and duplex properties** Partial credit is available on a sliding scale for properties that manage any portion of stormwater on their site or have less than 1,000 square feet of total impervious area (roofs, driveways and paved areas).	Up to 100% discount off on-site fee, or 35% of total stormwater charge One-time user fee discount for the planting of qualifying yard trees equal to 50% of the purchase price of each yard tree up to $50 for eligible native trees, and $40 for all other eligible trees	Not given	Downspout disconnect, soakage trenches, rain gardens, rain barrels
Richmond, Virginia	Both	Customers who take measures to reduce the stormwater rate or volume flowing from their properties to the Richmond stormwater system or to surrounding bodies of water, can receive a reduction in their stormwater fee.	Up to 50% 1/2 *(stormwater fee) * (% of impervious area treated)	Not given	Rain Garden, on-site storage, pervious pavement
Springfield, Ohio	Both	Installation of enough rain barrels to capture 100 gallons or installation and maintenance of a rain garden.	Maximum 10%	Not given	Rain barrels or rain garden. Other options will be considered.

Table C1- Comparison of Stormwater Programs - Residential Credits (Continued)

City	Objective (Quality, Quantity or Both)	Residential			
		Basis for Credit	Amount (% or dollar value)	Design Storm	Eligible SMPs
Saskatoon, SA	Quantity	Not eligible	Not eligible	Not eligible	Not eligible

Table D1- Comparison of Stormwater Programs - Non-Residential Credits

City	Objective (Quality, Quantity or Both)	Non-Residential			
		Basis for Credit	Amount (% or dollar value)	Design Storm	Eligible SMPs
Ann Arbour	Both	Installation of stormwater management systems that meet city code or other eligible SMPs	Quarterly Credit Amount Installation of a stormwater management system that meets city code - 29.5% of discharge rate Other eligible SMPs - 6.4% of discharge rate and 17.3% of service charge	Not given	Infiltration and Percolation Basins and Trenches Porous Pavement Extended (Dry) Detention Basins Retention (Wet) Ponds Constructed Wetlands
Edmonton	Quantity	Development intensity factor (I) may be reduced for properties where owners demonstrate that they contribute significantly less stormwater runoff than other similarly zoned properties. Application must be prepared by a Professional Engineer. Renewal required every 5 years $250 application fee	Up to 35% or more in some cases	Not given	Large non-residential undeveloped, parking lot storage and drainage directly to North Saskatchewan River.
Kitchener	Both	Approved flood prevention SMPs	Quantity - 25%	Not given	Stormwater management ponds Rooftop storage Underground storage Parking lot storage Filter strips Paved area sweeping program Salt management plan
Minneapolis	Both	Implementation of SMPs to retain 10-year or 100 year storm event to pre-developed conditions. application must be certified by a state licensed engineer or landscape architect	50% credit for retaining 10 year event 100% credit for retaining 100 year event	10-year or 100 year, 24-hour type II SCS storm event	Quantity - Infiltration systems, retention & detention systems, constructed wetlands
Orlando	Both	Properties that have existing stormwater management facilities in accordance with the Orlando Urban Stormwater Management Manual (OUSWMM), or those planning such facilities, may have their fee reduced or pro-rated as determined by the Utility Division Chief.	Up to 42% of the charge but must still pay the minimum charge	Design to be in accordance with Orlando Urban Stormwater Management Manual (OUSWMM)	Not given

Table D1- Comparison of Stormwater Programs - Non-Residential Credits (Continued)

City	Objective (Quality, Quantity or Both)	Non-Residential			
		Basis for Credit	Amount (% or dollar value)	Design Storm	Eligible SMPs
Philadelphia	Both	Owners of Non-residential or Condominium property with at least 500 square feet of gross area who construct, operate, and maintain Stormwater Management Practices (SMPs) that reduce a parcel's contribution of stormwater runoff. $150 non-refundable admin charge	IA - Maximum of 80% GA - Maximum of 80%	Customer must demonstrate applicable management of the first inch of runoff from impervious areas on the property.	**Impervious Area Stormwater Credit (IA Credit)** for impervious area reductions based on tree canopy cover, downspout disconnection, pavement disconnection, green roofs and porous pavement. **Gross Area Stormwater Credit (GA Credit)** based on runoff potential as represented by the Curve Number.
Portland, Oregon	Both	**Commercial, multi-family residential (3 units or greater), industrial, and institutional properties -** roof and paved areas - Partial credit is available on a sliding scale for properties that manage any portion of stormwater on their site or less than 1,000 square feet of total impervious area (roofs, driveways and paved areas).	Up to 100% discount off on-site fee, or 35% of total stormwater charge One-time user fee discount for the planting of qualifying yard trees equal to 50% of the purchase price of each yard tree up to $50 for eligible native trees, and $40 for all other eligible trees	Not given - Spreadsheet based commercial calculator on website to assist customers in sizing facilities.	Ecoroof, contained planter, pervious pavement, disconnected downspouts, vegetated basin, Infiltrating planter, soakage trench, ponds, detention tank, drywell
Richmond, Virginia	Both	The amount of credit earned by a property is determined by the type of SMP installed, the number of SMPs installed and the percentage of the impervious area on the site that drains to the SMP.	Up to 50% 1/2 *(stormwater fee) * (% of impervious area treated)	Design to be in accordance with Virginia Stormwater Management Handbook (e.g. detemtion ponds to be designed for 10 year storm for flood control)	Quantity: Rooftop disconnection, vegetated filter, rainwater harvesting, vegetated roof

Table D1- Comparison of Stormwater Programs - Non-Residential Credits (Continued)

City	Objective (Quality, Quantity or Both)	Non-Residential			
		Basis for Credit	Amount (% or dollar value)	Design Storm	Eligible SMPs
Springfield, Ohio	Both	Reducing flow to the drainage system. For new developments and re-developments, the percentage credit is based on the degree to which storage exceeds the City's existing stormwater management ordance requirements.	Up to 25%	Peak discharge limit for 2 year up to 100 year 24 hour storm	Stormwater Detention Basins Stormwater Retention Basins Stormwater Channels Infiltration and Percolation Basins Percolation Trenches Porous Pavement Extended (Dry) Detention Basins Retention (Wet) Ponds Constructed Wetlands, and
Saskatoon, SA	Quantity	Implementation of SMP to reduce the amount of run-off	Owners are 'credited' for the equivalent amount of runoff that would be diverted during a storm event, due to the improvement.	Not given	Private storage ponds, storage tanks, green roofs, permeable paving, rain gardens or other "soft" landscaping