Local Government Innovation: A Policy Analysis of Stormwater Credit and Incentive Program Implementation

by

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Abstract

This study examines environmental innovations implemented by local governments to promote the adoption of green stormwater infrastructure on private lands. Using a case study approach and interviews with local government staff, I investigate the development and implementation of stormwater credit and incentive programs in ten cities in Oregon, Washington state, and Ontario. I describe key social, economic and environmental characteristics of the communities and local governments, discuss how contextual factors influenced the adoption and implementation of stormwater policies, and identify "smart practices" through which desired effects were achieved. Using a conceptual framework taken from the literature on implementing innovations, I analyze the roles of individuals, institutional structures, and culture in the implementation of stormwater policies. I conclude by drawing lessons from the experiences of these communities and making recommendations for the City of Victoria, British Columbia, which is planning to adopt a stormwater credit and incentive program.

Keywords: stormwater; credit and incentive program; green infrastructure; local government; policy innovation

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Chapter 1.

Introduction

Local governments are facing increased pressure to manage urban stormwater services in an environmentally responsible, economically viable, and socially acceptable manner. The pursuit of these three pillars of sustainability creates several challenges for communities that need to be addressed. Urban stormwater runoff is of concern to local governments as it has been found to be a leading cause of pollution to community lakes, rivers, streams and shorelines (United States Environmental Protection Agency, 2002). The contamination of stormwater runoff can be complicated as it results from a variety of non-point[1] sources such as personal vehicle use, outdoor chemical use on households and yards, and commercial and industrial activities, unlike point source pollution which is directly discharged into the stormwater system from sources such as pipes and sewers (Environmental Law Clinic, 2010). Non-point pollution is amplified by the amount of impervious surfaces (roofs, roads, sidewalks and parking lots) constructed in communities, which collect these diffuse sources of pollution in the stormwater system. As communities alter land uses to accommodate growth, the natural systems that once filtered rainwater are transformed or removed resulting in greater amounts of pollution being present in urban stormwater systems (Makepeace, Smith, & Stanley, 1995).

"Grey" stormwater infrastructure consists of underground pipes and pumps that collect stormwater runoff and direct it into a receiving water body. Grey infrastructure has traditionally been used to replace natural hydrological systems, often resulting in increased runoff velocity and decreased water quality in lakes, rivers, streams and the ocean (Burian & Pomeroy, 2010). Historically, the use of grey infrastructure was

[1] The US EPA (2012a) notes that non-point source pollution, unlike point source pollution, does not come from discernible, confined and discrete conveyance systems from which pollutants are discharged. It comes from many diffuse sources and is caused by precipitation events which move over the ground, picking up natural and man-made pollutants before they are finally deposited into lakes, rivers, streams, wetlands or oceans.

considered by many municipal engineers and planners until the mid-1970's as the best means of moving stormwater away from private properties and reducing the risk of flooding and property damage. However, this approach does not address the cumulative social and environmental impacts that result from the release of untreated stormwater into receiving water bodies, such as habitat degradation, risks to human health, shellfish contamination and beach closures (Garrison & Hobbs, 2011). If efforts are not made to reduce the reliance on grey infrastructure, negative social, economic and environmental impacts will continue and possibly increase as communities grow.

As the cost of maintaining stormwater infrastructure increases, especially in older cities, some local governments are seeking innovative ways to address the social, environmental and economic issues that have resulted from the use of grey infrastructure. "Green" infrastructure helps to mitigate stormwater pollution by capturing, storing, and slowly releasing runoff into receiving water bodies in ways that mimic natural drainage patterns (Garrison & Hobbs, 2011). The use of green infrastructure to manage stormwater includes the installation of rain gardens, biofiltration swales and pervious paving, rainwater collection, and downspout disconnection. Cities are now taking advantage of the social, economic and environmental benefits of adopting green infrastructure to address stormwater pollution and combined sewer overflows.

Using green infrastructure has been found to provide superior hydrological performance at a lower cost than traditional grey infrastructure (Dietz & Clausen, 2008). Additional potential benefits of adopting green infrastructure include reduced urban heat island effects, energy conservation, air quality improvements, carbon sequestration, and reduced noise pollution (Wise, Braden, Ghalayini, Grant, Kloss, MacMullan, Morse, Montalto, Nees, Nowak, Peck, Shaikh, & Yu, 2010).

As more cities are acknowledging the positive role of green infrastructure, an important question to ask is, how can cities implement policies and programs to help encourage the adoption of green infrastructure? One approach is the use of stormwater credit and incentive programs to encourage green infrastructure development on private lands. These programs offer credits or incentives to rate payers that install approved green infrastructure practices that manage stormwater runoff onsite. My research examines the adoption and implementation of stormwater credit and incentive programs by local governments in the Pacific Northwest and Canada. Based on this research I

develop recommendations for the City of Victoria, British Columbia, which is planning to implement a stormwater incentive program.

1.1. Research Objectives

Cities facing stormwater infrastructure problems, in this case the City of Victoria, British Columbia, can learn from other jurisdictions that have implemented innovative programs to encourage the adoption of green infrastructure. My research examines factors that shaped the adoption and implementation of stormwater credit and incentive programs by local governments in ten cities in North America to promote green infrastructure. I conducted interviews with program managers to identify how social, economic and environmental characteristics of the community and local government under study informed and affected the design and implementation of the stormwater credit and incentive program. I use a conceptual framework, taken from the literature on implementing innovations, to develop lessons from the experiences of these communities and provide recommendations for the City of Victoria. I also reflect on potential refinements to the conceptual framework for use in similar future studies.

Stormwater management is inherently complex, due to the multifaceted and dynamic systems involved. It is influenced by decisions made at the local, regional, provincial and federal government levels. The complexities include disparate jurisdictions, varied regulatory authority, and diverse management approaches. To understand these complexities, I use the policy sciences framework for policy analysis (Lasswell 1971; Clark 2001), and consider how policy cycles and subsystems influence change in dealing with complex natural resource management issues (Howlett, Ramesh, & Perl, 2009). Many researchers have examined how best management practices or 'smart practices' can be drawn from the experiences of others and applied and adapted in new settings to improve on the status quo (Hohl & Clark, 2010; Jennings, 2007; Barzelay, 2007; Bretschneider, Marc-Aurele, & Wu, 2005; Bardach, 1998 & 1994; Brunner & Clark, 1997; Overman & Boyd, 1994). However, implementing environmental innovations in the local government setting has not been studied in great detail, as more focus has been placed on examining innovative practices adopted at the state and federal levels (Steelman, 2010). My research synthesizes existing literature on implementing innovations and best management practices at the local government level,

and uses Steelman's (2010) conceptual framework to examine how case studies from ten cities in North America can help to improve stormwater credit and incentive programs in the City of Victoria.

To meet the research objectives, I conducted qualitative interviews with local government staff in Washington, Oregon and Ontario. These interviews explored how stormwater credit and incentive programs were implemented and the impact of these programs on addressing community stormwater issues. The interviews largely focused on the approaches taken to develop these programs within the managing organization and deliver these programs to the community. Interview questions examined laws, policies, governance, organisational structures, and the factors identified by Bardach (2004) and Barzelay (2007) as important in determining whether and how to extrapolate policies from one setting to another. The analysis of these case studies then follows Steelman's (2010) framework for analyzing the implementation of innovations. This leads to a set of recommendations for the development of desirable programs in Victoria, BC, and key lessons learned from program implementation in other jurisdictions.

1.2. Report Structure

This report includes six chapters. This first chapter introduced the research. The second chapter reviews pertinent literature on stormwater management and provides an overview of the context for stormwater management in North America and British Columbia. Chapter three discusses research on policy innovations and implementation, including the conceptual framework applied to the case studies. The fourth chapter describes the methods used for case study selection and data collection, and outlines the limitations of the research. Chapter five provides a cross-case summary and analysis of the interview results. Finally, chapter six offers a suite of recommendations, discusses strengths and weaknesses of the conceptual framework, and provides conclusions and suggestions for potential future research.

Chapter 2.

Literature Review

2.1. Urban Stormwater Management Planning: An Introduction

The traditional approach to managing stormwater is "to keep people from the water, to keep the water from the people, and to protect or enhance the environment while doing so" (Debo & Reese, 2002, p. 17). This approach, which focuses on the use of gray stormwater infrastructure, is characteristic of stormwater management in Canadian communities, although the exact details of management have evolved considerably over the past two centuries. Debo and Reese (2002) identify three paradigms of stormwater management that evolved in the Nineteenth and Twentieth centuries alongside periods of social change, including "… shifted [emphasis from] exploration, to cultivation, to industrialization, to urbanization…." (p. 1). These paradigms can be summarized as follows (adapted from Debo & Reese, 2002):

1. *Stormwater in ditches*: Farmers settling in denser communities sought to ensure that everything that was liquid would run in open ditches to simulate the farm environment;
2. *Put it in pipes*: Combined sewer overflow systems resulted in wastewater (sewage, greywater, and industrial wastes) being piped along with stormwater runoff and flushed into the nearest river, stream or ocean; and
3. *Put it in stormwater pipes*: urban drainage was separated from the sewer through the efficient use of catch basins and pipes that conveyed runoff to the nearest receiving body.

These three paradigms tended to evolve as a result of successive failures (ineffectiveness, transmission of water borne-illness, and downstream flooding and channel erosion) and the adoption of the rational method for calculating peak stormwater discharge (described below) (Debo & Reese, 2002; Wanielista & Yousef, 1993). Although these three paradigms provide an accurate account of past stormwater

management practices in urban areas, a fourth paradigm has recently emerged which focuses on managing rainwater by using natural or restored stormwater systems (Porter-Bopp, Brandes, & Sandborn, 2011; Province of BC, 2010).

The following sections provide an overview of the historical, current and green infrastructure approaches to stormwater management in Canada. I describe how stormwater management objectives, governance, planning, implementation, and financing were established and have evolved over time.

2.1.1. Historical Approach to Stormwater Management in Canada

Early in Canadian history urban stormwater management focused on diverting runoff away from urban areas to mitigate the risk of flooding, in other words using the 'stormwater in ditches' approach noted above. Although this approach has been remarkably effective at reducing flooding and property damage in most urban areas, it has also resulted in two major problems: deleterious water quality from non-point pollution, and altered water quantity (Alberti et al., 2007; Goudie, 2006; Brown, 2005; American Geophysical Union, 1982). Non-point pollution results from impermeable areas in urban environments accumulating heavy metals, petroleum residues, salts and sediments which are then carried away from these surfaces during precipitation events and deposited into nearby receiving bodies of water (Arnold & Gibbons, 1996). Altered water quantity results from the loss of natural landscape features, which can capture, absorb and slowly release rainwater, in contrast to their 'flashier' urban counterparts that quickly direct rainfall into stormwater drainage pipes and tunnels resulting in greater disturbance to the bodies of water receiving these rapid stormwater discharges (Figure 2.1).

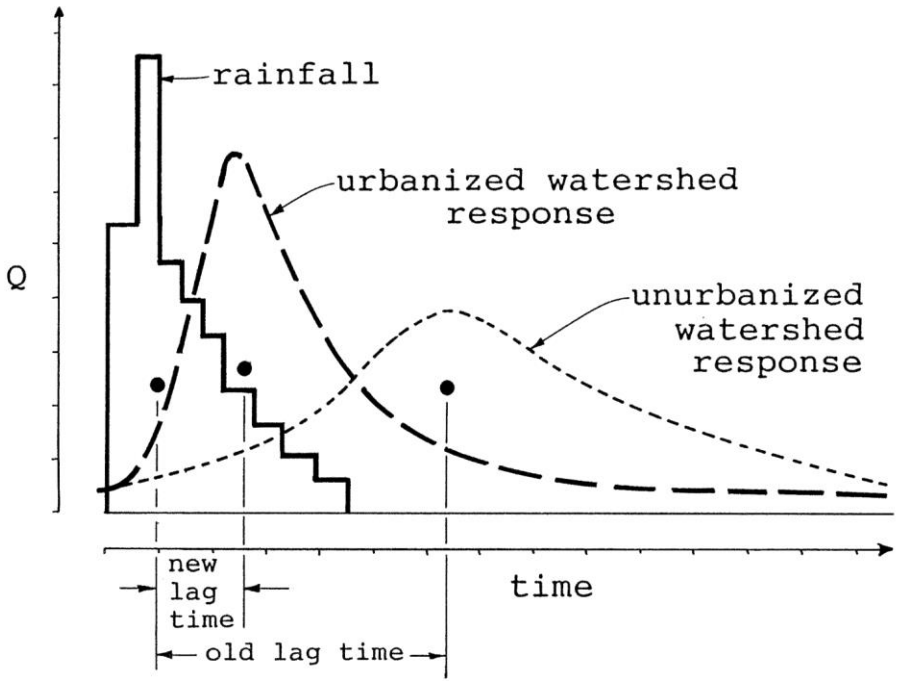

Figure 2.1. Flood Hydrograph showing the changes in peak stream flow responses to urbanized and un-urbanized watersheds and changes in lag-time of run-off due to urbanization and vegetation changes (Rogers, 1997; used with permission)

Conveying stormwater in ditches began to be problematic in urban areas as increased development created more impervious surfaces such as roofs, streets, driveways and sidewalks, increasing the risk of flooding. As a result stormwater networks needed to be developed in a manner that fit into the constraints of the urban environment. Stormwater conveyance systems generally followed the existing approach that was used for sewerage systems, involving underground pipes that transported rainfall-induced runoff away from the urban environment in underground networks (Patouillard & Forest, 2011).

Objectives

Although initial stormwater management techniques responded to the need for affordable urban developments and flood protection, the environmental impacts of the stormwater conveyance system were not adequately considered (Patouillard & Forest, 2011). Much of the early effectiveness of urban stormwater management was attributed to the use of engineered solutions. As a result, engineered solutions became the preferred approach for managing urban stormwater. However, as rapid urbanization

took place in the twentieth century, the ecology of rivers was greatly altered with aquatic systems facing deleterious water quality and quantity issues (Booth, 2005).

Governance

In the twentieth century, local government stormwater management activities were aimed at controlling floods and erosion hazards while protecting water supplies for human use through the broader application of watershed management approaches (Ffolliott, 2002; Adams, Noonan, & Newton, 2000). Although this approach to stormwater management relied heavily upon the application of engineered solutions such as the use of curbs, gutters, pipes and channels and was able to attenuate hazards in the urban environment it also resulted in deleterious effects to water quality (US EPA, 2009).

As urban development continued dramatic changes in the function of local watershed hydrology, ecology and biochemistry took place. The result of such changes to watershed systems raised awareness of the complex and multi-faceted nature of stormwater management, and the difficulties of coordinating overlapping governance and jurisdictional authorities within a watershed.

Historically, relatively little has been done in Canada to regulate stormwater quantity or quality. Rather than developing stormwater quality regulations, policy makers focused on engineering techniques because these approaches were considered to be the most efficient means for conveying stormwater away from urban areas (Porter-Bopp et al., 2011). However, relying on engineered techniques to convey stormwater flows has resulted in rapid releases of polluted stormwater into nearby water bodies, often resulting in harmful alteration of community streams, rivers, and lakes. Another weakness of these engineered systems results from their reliance on design criteria for urban stormwater infrastructure prescribed based on the estimated return period of rainfall events, typically 2 – 10 years (Watt, Waters, & McLean, 2003). Pipes were sized and installed based on such estimated peak flows. Although this approach for determining pipe sizing for stormwater infrastructure was initially successful in assimilating peak flows, the estimated return periods did not account for anticipated population growth. Consequently, as urban areas continued to grow so did the amount of stormwater flows and the costs associated with up-sizing stormwater infrastructure.

Planning

Stormwater planning efforts have varied widely across Canada as a result of variations in climate, soil types, geology, and urbanization patterns across the country (Federation of Canadian Municipalities, 2005). British Columbia is no exception, having 16 biogeoclimatic zones, which vary from alpine tundra in Northern BC to coastal Douglas-fir on Southern Vancouver Island, and diverse geological features and settlement patterns (Province of BC, 2012a).

As noted above, historical stormwater planning in BC was largely dependent on local climate, but also on the ability of local governments to develop stormwater management programs that met the needs of the community, and to navigate the diverse organizational dynamics that influence policy implementation (Morison & Brown, 2010). Rapid urbanization led to the application of engineered infrastructure to guide stormwater management within existing municipal boundaries, which did not address the full social, economic and environmental impacts of stormwater conveyance (Porter-Bopp et al., 2011).

Implementation

The initial implementation of stormwater management practices was relatively straightforward as it involved determining expected peak flows of runoff and installing pipes and pumps that would convey these flows away from low-lying areas and into nearby water bodies (Watt et al., 2003). Although growing urban areas were able to secure greater funding for public stormwater projects through general taxation, the costs of larger, more centralized stormwater systems grew and soon alternatives were sought.

Financing

Stormwater infrastructure has typically been funded through municipal spending programs that focus on creating a highly engineered network of underground conveyance systems. These systems use pipes and pumps to transport stormwater away from cities in an attempt to improve the health and well-being of urban communities that were previously subjected to outbreaks of waterborne pathogens. Although billions of dollars have been spent on grey infrastructure to eliminate flooding and polluted stormwater runoff during the nineteenth and twentieth centuries the health

and safety of water quality for humans and aquatic life still remains a major concern for most urban areas in North America (Novotny, Ahern, & Brown, 2010).

2.1.2. Current Approaches to Stormwater Management in Canada

Objectives

The management of stormwater in Canada has evolved from a largely ad-hoc installation of pipes and pumps to a systems approach that seeks to guide stormwater management efforts at the catchment or watershed scale. Stormwater management planning at the watershed scale continues to seek mitigation of flood risk while placing a more concerted effort on reducing the environmental impacts of runoff events and non-point pollution sources in the urban environment (Marsalek, 2008). However, current efforts to manage stormwater in urban watersheds can be complex as a result of overlapping jurisdictions, institutional inertia, and the absence of a single governing and coordinating agency (Nowlan & Bakker, 2007; Brown, 2005; Province of BC, 2002).

Governance

When a local government in BC considers the policies it can develop to support managing stormwater there are a multitude of guidance documents and resources available from senior government, professional associations, non-government organizations (NGOs), and research institutions, proposing a variety of stormwater management tactics (Porter-Bopp et al., 2011; Fraser Basin Council, 2011; Province of BC, 2010, 2007, & 2002; Rutherford, 2007). For example, the Province of BC (2002) highlights the areas in which local governments have the greatest ability to influence stormwater management. These include integration of specific stormwater related policies into Official Community Plans, Integrated Stormwater Management Plans, or Liquid Waste Management Plans.

Although some research (Porter-Bopp et al., 2011; Bakker & Cook 2011) has implied that the lack of adequate stormwater policies is a result of poor governance and institutional leadership, Visitacion, Booth, and Steinemann (2009) found, in their study of Puget Sound, that before effective stormwater policies can be implemented, managers require a better understanding of the economic and ecological costs and benefits of funding stormwater programs.

In Canada, local governments are typically responsible for local stormwater management and have been provided with general statutory and regulatory oversight to manage stormwater runoff through municipal and local government legislation, which varies across provinces and territories (Porter-Bopp et al., 2011). For example, in BC there are a variety of legislated measures that municipal governments can take to protect the community from flooding, provide stormwater infrastructure, and manage development through the application of zoning bylaws and development permits. However, there are no formal requirements for local governments to manage non-point pollution found in stormwater (Province of BC, 2002). In contrast, in the United States the *Clean Water Act* authorises the US EPA to manage the National Pollutant Discharge Elimination System permit program which regulates non-point pollution sources such as stormwater if the discharges go directly into surface waters (US EPA, 2012c).

Planning

According to the Canadian Institute of Planners (2012), " '*Planning'* means the scientific, aesthetic, and orderly disposition of land, resources, facilities and services with a view to securing the physical, economic and social efficiency, health and well-being of urban and rural communities." Planning for stormwater systems attempts to solve a particular problem or issue by determining the steps that can be taken to reach a desired future state that benefits communities and ecological systems, and fits within economic constraints (FBC, 2011).

One of the most frequently used modern approaches to managing stormwater in Canada is for local or regional governments to develop Integrated Stormwater Management Plans. Under the BC *Waste Management Act* (R.S.B.C. 1996. C. 482) municipalities and regional districts can create Liquid Waste Management Plans which include a stormwater protection component. Those local governments that choose to develop a Liquid Waste Management Plan must also protect stormwater through the development of an Integrated Stormwater Management Plan. An Integrated Stormwater Management Plan is often a long-range strategy that creates a set of priorities and objectives that seek to promote public health and safety, protect the environment, and guide development and economic improvements in the community (Debo & Reese, 2002). Once these broad objectives are identified they are often incorporated into local

government policy statements, the aim of which is typically to accomplish the following stormwater management goals (Debo & Reese, 2002, Ch 2, p. 2.):

1. Protecting life and health;
2. Minimizing property losses;
3. Enhancing floodplain uses;
4. Maintaining a functional stormwater system;
5. Protecting and enhancing the natural environment;
6. Encouraging aesthetics; and
7. Guiding development.

In BC, the term *Integrated Stormwater Management Plan* has become synonymous with comprehensive, ecosystem based approaches to stormwater management (Province of BC, 2002). Local and regional governments along with environmental agencies have come to recognize that this approach is favourable when compared to the traditional approach to stormwater management and acknowledges the benefit of protecting aquatic habitat from pollution, erosion and sedimentation (Province of BC, 2002).

Implementation

Currently the implementation of stormwater management practices at the local government level is often completed by a city's engineering or public works department. These departments focus mainly on the continued conveyance of stormwater, retrofitting aging infrastructure, servicing new developments, and up-sizing pipes to accommodate greater flow volumes due to increased service connections. In some cases cities may work together within shared catchment basins or watersheds but there is often little cohesive planning that takes place at this level.

Financing

In older communities across Canada, stormwater systems are approaching the end of their service life and municipal governments are searching for ways to fund critical upgrades to community infrastructure (Mirza, 2007). The typical means of paying for stormwater services in Canadian communities is through general property taxation, which often does not re-capture the full cost of delivering stormwater services. As political and community priorities for the use of general taxation funds shift over time, the amounts allocated to stormwater management vary, because it is in direct competition

with other, more highly visible, community services such as policing or road maintenance.

The use of general taxation for funding stormwater management has traditionally been considered an effective means of delivering stormwater services. However, with the growing cost of capital projects, operation and maintenance, some local governments (e.g., City of Edmonton, City of Kitchener, City of Waterloo, and the City of Halifax) have adopted user charges that seek to recapture the full costs of stormwater services from those individuals connected to the system (Porter-Bopp et al., 2011). However, this model has yet to be applied in BC for the delivery of stormwater management services.

A large issue with the current approach to funding stormwater management through general taxation arises from the external costs that are not recovered when the full cost of delivering the stormwater service is not charged to the user. These externalities are not included in the current cost of the service being delivered, resulting in negative impacts and costs being passed along to those outside of the beneficiaries of the service. As noted by Green, Shuster, Rhea, Garmestani, and Thurston (2012), although traditional centralized stormwater services are very reliable in capturing, conveying and discharging untreated stormwater, this approach externalizes many of the costs to the receiving environment (streams, rivers, and lakes).

2.1.3. Green Infrastructure: From Stormwater Management to Rainwater Management

As indicated above, the traditional approach to stormwater management does little to consider or balance the social, economic and environmental challenges that result from municipal stormwater infrastructure. There are many low-impact development or green infrastructure approaches that can be used by municipal governments to help control stormwater flows by mimicking the natural hydrological cycle. These approaches focus on managing stormwater by reducing runoff volumes at the source, also known as source control. Using source control measures can reduce stormwater volumes and pollution through various strategies for site design, infiltration and treatment (Karvonen, 2011). Porter-Bopp et al., (2011, p. 3) identify what they consider to be the three key design principles that are required to help move from the

existing stormwater management paradigm to a rainwater management paradigm in urban communities:

1. Reduce the amount of impermeable surfaces by changing the way we build and retrofit our communities;
2. Use rain as a resource and as a viable decentralized source of non-potable water; and
3. Integrate decision making on a watershed scale.

Based on these three design principles, I will now consider how policies, governance, planning, implementation and financing can play a role in transitioning to a rainwater management paradigm.

Policies and Governance

Municipal governments are key players in helping to implement green infrastructure, and reducing the negative impacts of historical stormwater management approaches, by adopting innovative design criteria for new developments and ensuring that existing developments are retrofitted in a manner that mimics the natural water cycle (ELC, 2010). Given the large variation in the terminology that can be used to describe innovative stormwater management approaches, such as best management practice and low impact development, I use the term green infrastructure to describe approaches that aim to solve urban stormwater challenges by building with nature. Some key areas where municipal governments can make a commitment to green infrastructure practices is through the integration of green infrastructure language and principles into their respective Official Community Plans; creating an integrated stormwater management plan that prioritizes green infrastructure approaches; incorporating green infrastructure practices into development permitting processes; integrating green infrastructure into municipal infrastructure projects; or creating replacement or grant programs for the adoption of green infrastructure practices such as permeable paving, rain barrels, bio-swales, or rain gardens. Changing the way we design and develop our communities by taking steps to mimic natural hydrological systems and avoid excessive runoff will also help communities become more resilient to the anticipated impacts of climate change (Porter-Bopp et al., 2011).

Planning

Local government planning processes are complex, as noted by Hodge and Gordon (2007) “[d]eciding upon the needs of a community is relatively easy. Deciding upon how to mobilize the necessary resources is more difficult because it involves reconciling viewpoints on how best to provide community needs” (p. 63). Local governments that wish to adopt green infrastructure as a means of managing stormwater must deal with this complexity; it may be somewhat straightforward to create a strategy for green infrastructure implementation within an institution; however, it is more challenging when the planning process is required to meet the needs of the residents and engage them in a multi-faceted issue such as the management of rainwater.

One way to plan for green infrastructure in a municipality is to begin by considering how to manage rainwater at its source or at the property level, followed by scaling up to the neighbourhood and then watershed levels (Marsalek & Schreier, 2010). Planning source controls at the property level is appropriate for local governments that have legislated powers to ensure that new and existing development protects the natural environment. Local governments can also provide incentives to encourage homeowners and developments to retrofit existing properties with systems that help slow runoff and increase infiltration.

Implementation

Municipalities have the ability to help design communities in a manner that limits the negative impacts of development on natural hydrological regimes. However, one of the most significant challenges is to revise stormwater systems in urban areas where modifications have already been made to the landscape and have altered environmental conditions and aquatic ecosystems (Goudie, 2006; Walsh et al., 2005; Booth 2005; Finkenbine, Atwater, & Mavinic, 2000).

One approach that has been considered effective in addressing these issues is the re-establishment of natural flow regimes through watershed restoration. Although restoration programs have been given a considerable amount of attention and resources over time their overall effectiveness is often hard to quantify and has been questioned (Booth, 2005). Bernhardt and Palmer (2007) point out that urban stream restoration

projects are often so constrained by existing developments that it is unrealistic to restore an urban stream to reflect the pre-urbanized conditions and therefore stream protection and preservation should be a priority.

As a result of the above mentioned challenges some local governments have emphasized managing stormwater in a broader, more integrated, manner that focuses on implementing strategies that reduce negative impacts throughout watersheds (FBC, 2011; Porter-Bopp et al., 2011; ELC, 2010). The City of Portland, for example, has identified a variety of best management practices for green infrastructure, with associated benefits including improved community livability, ecosystem health, reduced energy consumption, and carbon storage (Table 2.1.).

Table 2.1. Health, Energy and Community Livability Benefits of Grey to Green (G2G) Best Management Practices in Portland, Oregon (Source: City of Portland, 2010)

	Health		Energy			Community Livability		
G2G Best Management Practice	Air Quality Improve-ment	Increased Greenness	Energy savings	Greenhouse Gas Reduction	Amenity/ Aesthetics Improvement	Community Cohesion	Environmental Equity	Access to Nature
Metric	PM Removal	Enhanced Mental and Physical Health	Electri-city Usage	CO2 Reduced Emissions/ Sequestration	Property Values	Social Capital and Crime	Relative Share of BMPs in Minority/ Low Income Neighbourhoods	Number of People Affected by BMP
Ecoroofs	7.7 lbs / acre / year	Associated with improved physical and mental health	8,270+ kWh/ Acre	7.1 metric tonnes / acre / year	Possible positive effect	Possible positive effect, depends on BMP location	Possible positive effect, depends on BMP location	Magnitude is dependent on the number of people with views of or access to the ecoroofs
Green Streets	0.04 lbs / facility / year	Associated with improved physical and mental health	155+ kWh/ facility	0.3 metric tonnes / facility / year	Positive, 3 – 5% increase in home values experienced due to combined greenstreets & swales & culvert removal	Increase social capital, decrease crime	Possible positive effect, depends on BMP location	2,000 pedestrians/day in walkable areas, and 600 pedestrians in less walkable areas
Trees: Yard	0.2 lbs / tree / year	Associated with improved physical and mental health	11+ kWh/tree	0.1 metric tonnes / tree /year	Likely positive effect	Potentially increase social capital, mixed effect on crime	Possible positive effect, depends on BMP location	Positive, but relatively smaller effect
Trees: Street	0.2 lbs / tree / year	Associated with improved physical and mental health	1.4+ kWh/tree	0.1 metric tonnes / tree /year	Approximate increased home value (including to surrounding homes) of $14,500 per tree	Increase social capital, decrease crime	Possible positive effect, depends on BMP location	2,000 pedestrians/day in walkable areas, and 600 pedestrians in less walkable areas
Invasive Removal/ Revegetation	N/A	Possible positive effect	Possible positive effect	Uncertain effect	Uncertain effect	N/A	Possible positive effect, depends on BMP location	Uncertain effect
Culvert Removal	N/A	Possible positive effect	N/A	N/A	Positive, 3 – 5% increase in home values experienced due to combined greenstreets & swales & culvert removal	N/A	Possible positive effect, depends on BMP location	Uncertain effect

		Health	Energy		Community Livability			
Land Purchase	23.2 lbs / acre / year	Possible positive effect	Possible positive effect	Possible positive effect	Positive, 14% increased home value for homes within 800 – 1,000 feet of a natural park	Depends on BMP siting, possible positive effect	Possible positive effect, depends on BMP location	Possible positive effect, depends on BMP location
Planting Natural Areas	20.9 lbs / acre / year	Possible positive effect	Possible positive effect	7.0 metric tonnes / year / acre	Positive, 3 – 13% increases in property values for stream restoration efforts	N/A	Possible positive effect, depends on BMP location	Possible positive effect, depends on BMP location

It is essential that local governments understand the human dimensions of urban stream protection and restoration, rather than simply focusing on technical solutions, as the urban environment is dominated by humans. Urban stream protection and restoration efforts will be severely limited in meeting their objectives if they do not successfully integrate the social, behavioural and economic needs present within the urban setting (Walsh et al., 2005; Booth, 2005). By integrating these needs watershed protection programs can connect human and natural systems in a meaningful manner and address complex socio-ecological issues in urban communities.

Financing

The most common approach to financing stormwater management is through application of municipal property taxation, which is distributed to municipal services. This approach to financing is not conducive to the development of green infrastructure as resources are often limited and emphasis is commonly placed on the continued delivery of engineered solutions such as up-sizing of pipes, service expansion, and retrofitting old conveyance systems (Porter-Bopp et al., 2011). Conventional property taxation does not provide an incentive for private landowners to manage rainwater at its source as property owners do not receive any financial benefit from the taxation system for investing in green infrastructure. Many jurisdictions are now looking to overcome the limitations of using the general taxation financial model through the development of stormwater utilities, which create a dedicated, pay-for-use funding system that is similar to existing municipal utility programs such as sewer and potable water services. Stormwater utilities not only provide a stable funding source to support green infrastructure programs, but also an equitable means of charging property owners for the impact they place on the public stormwater conveyance system (Reese, 2007). The adoption of a stormwater utility supports rainwater management at its source by providing a dedicated funding source that can help create a rainwater management program that blends the use of both grey and green infrastructure.

The City of Halifax initiated a stormwater utility in 2007. Several important benefits have been realized since creating the municipal utility when compared to the previous stormwater management system that relied on property taxation (adapted from Porter-Bopp et al., 2011):

- *Dedicated funding*: Applying a utility charge on individual properties provides a line item on the municipality's annual budget which can then be dedicated to stormwater management;
- *Self-sustaining funding*: The amount of revenue needed for stormwater management programs can be predicted for years to come allowing for long-term planning to take place;
- *Acts as an incentive to protect the environment*: Nuanced fee structures create incentives for homeowners and developers to provide on-site controls to reduce stormwater runoff and pollutant loads (e.g. installation of green roofs, rain barrels, or rain gardens);
- More equitable through the application of the "user pays" principle: The municipality can bill ratepayers more fairly; and
- *Charging tax exempt properties*: When funded through property taxes, tax-exempt property owners (churches, schools and government buildings) do not have to pay for stormwater services, regardless of how much they may use them. The application of a utility charge provides a mechanism to ensure that all property owners will pay for the services they use.

A dedicated funding source plays an important role in supporting the implementation of green infrastructure programs within a community and often delivers rainwater management in a more cost efficient manner.

The next section will examine the policy mechanisms that exist for local governments to develop and implement green infrastructure programs in BC.

2.2. Implementing Green Infrastructure in BC

As noted above, the current trend in BC is for local governments to encourage the adoption of green infrastructure on both private and public lands. Given the current problems with stormwater management, however, much more can be done to foster the adoption of green infrastructure. I will now explore what mechanisms and tools local governments can use to encourage the adoption of green infrastructure in their communities to meet, and in some cases exceed, what is required by federal and provincial law in BC.

2.2.1. Policy Mechanisms for Green Infrastructure

Local governments in BC have the ability to influence how land is developed and managed by private individuals. Although much emphasis has been placed on using instruments such as subsidies, voluntary measures, and command and control regulation for new land development projects, considerable opportunities exist to use these mechanisms to improve the stormwater performance of already developed lands as well. It is important to consider how urban development impacts watersheds, as increasing impervious areas between 5 per cent and 10 per cent in an urban setting has been found to result in the alteration of physical and biological characteristics of streams (Booth, 2005). As a result, new and existing developments need to encourage the preservation or restoration of a site's natural hydrological flows (Dietz & Clausen, 2008; Walsh et al., 2005).

The following sections will explore how voluntary, command and control, and market based mechanisms can be used to influence green infrastructure investments.

2.2.2. Voluntary Mechanisms

In order to improve urban stormwater flows and water quality, land development strategies need to be improved to focus on the value provided when meeting these objectives (Brown, 2005). When working with land developers on new development projects local governments provide guidance that helps to ensure a project will meet the overall goals of the community and the neighbourhood in which it is situated (District of Saanich, 2008). Two types of voluntary measures have typically been used to persuade private land owners to adopt green infrastructure: education campaigns and performance indicators.

2.2.3. Education Campaigns

Education is an important component of any stormwater management program. With targeted education programs for new and existing developments, local governments can help promote the voluntary adoption of green infrastructure while minimizing the need for public investment in grey stormwater infrastructure (Province of BC, 2002). For new developments education may be initiated in the preliminary project

design or review phase and focus on the social, environmental or economic advantages of adopting green infrastructure. On existing properties the use of non-structural stormwater management measures such as public education programs has been found to improve urban stormwater quality in the long term due to improved knowledge of pollution prevention practices and desirable behaviours (Taylor & Fletcher, 2007).

Work by Genskow and Wood (2011) found that efforts to improve stormwater quality as a result of education and outreach programs are often difficult to quantify as the primary measure of effectiveness examines the physical and chemical changes that result from these corrective actions. The authors point out that the main limitation of this approach is the fact that non-point source pollution often responds slowly to corrective measures. In order to address this limitation Prokopy et al., (2009) recommend the use of five social indicators which are expected to result in water quality improvements: awareness, attitudes, constraints, capacity, and behaviour change.

2.2.4. Performance Indicators

The use of performance indicators is often considered to be the most effective way that a local government can voluntarily evoke action and green infrastructure adoption during the development and re-development of land (Booth et al., 2004). However, local governments often establish broad stormwater performance targets (e.g. a 10% reduction in surface water runoff) which can be inclusive of a wide variety of green infrastructure approaches when compared to limiting the public by requiring specific green infrastructure techniques to be utilized (Great Lakes and St. Lawrence Cities Initiative, 2011). When local governments require the use of specific green infrastructure approaches it may reduce the cost-effectiveness and hydrological performance of the green infrastructure because it does not take into consideration site characteristics (Lloyd, Wong, & Chesterfield, 2002). As a result, local governments seeking to increase the overall cost-effectiveness and the amount of stormwater runoff being managed often develop broad performance indicators such as a peak standard where new developments are required to maintain post-development peak runoff discharges at their pre-development levels and not require the installation of a particular green infrastructure technique (Booth et al., 2004). Although the application of broad

performance indicators provides flexibility to developers it may also lead to the adoption of green infrastructure that does not conform to the unique characteristics of the site.

It is apparent from the examples above that performance indicators need to consider the hydrological context of a given site while balancing the social, environmental and economic needs of the communities in which the new development is located. Although the use of voluntary mechanisms may result in water quality improvements, the incentives may not be sufficient to motivate owners and developers to incur the cost of adopting green infrastructure practices. The use of command and control mechanisms can force the adoption of certain green infrastructure practices and may result in a larger amount of stormwater being managed (Booth et al., 2004).

2.2.5. Command and Control Mechanisms

Command and control mechanisms for stormwater management typically require individuals and corporations to abate certain amounts of stormwater runoff, and require a permit or other form of approval by the regulatory body. In order to achieve the specified abatement levels individuals may be forced to adopt certain green infrastructure techniques or else face penalties for non-compliance (US EPA, 2008). Regulations may set uniform standards and require the adoption of a certain technology (technology-based standards), or may require that a certain level of performance be attained (performance-based standards). Standards which are based on technology specify how individuals must comply with a given regulation, whereas a performance standard simply sets a uniform target for stormwater control and allows individuals the choice of abatement technology that can be utilized (Parikh, Taylor, Hoagland, Thurston, & Shuster, 2005).

There are several command and control mechanisms that can be applied to stormwater management. I will focus on those mechanisms which are particularly relevant to local governments in BC: the use of industry developed standards and development cost charges. These mechanisms are currently used by BC local governments to manage stormwater in new developments.

Industry Developed Standards

Local governments in North America are increasingly relying upon privately developed industry standards such as the Leadership in Energy and Environmental Design (LEED®) Green Building Rating System to rate buildings based on their ability to meet certain prescribed environmental criteria (Retzlaff, 2009). Under the LEED® rating system, builders of residential, industrial, commercial and institutional facilities can apply for third party certification to verify that their projects meet the established criteria (Canadian Green Building Council, 2012). These measures include aspects of water conservation and sustainable site development, both of which can influence stormwater runoff flows, and may require sites to meet peak discharge rate limits or create stormwater management plans (Canada Green Building Council, 2004).

The District of Ucluelet is a local BC municipality that used industry developed standards to provide general requirements for Development Permit Areas within its Official Community Plan (Bylaw No. 1140, 2011) stating that "All new hotels, condominiums, multi-family and commercial developments shall meet or exceed LEED Silver as a minimum standard for sustainable energy efficient construction in Ucluelet" (p. 82). The benefit of following the LEED design guidelines includes a 5 per cent density bonus on approved new construction and renovations.

By specifying that developers are required to follow certain guidelines for new developments such as LEED® ratings criteria local governments may be able to raise stormwater management standards in their communities while using widely recognized industry developed standards.

Development Cost Charges

Development cost charges are the fees that municipalities levy on developers to recover the capital costs incurred from the infrastructure that is required to service new developments within the community (Province of BC, 2000). The use of development cost charges provides local governments with a mechanism that requires private developments to pay for stormwater infrastructure that results from the services provided to their developments. Although this approach may be considered a meaningful way to finance traditional stormwater infrastructure or green infrastructure projects in the community, it does little to promote private innovations in on-site stormwater

management (Rutherford, 2007). To address this issue, West Coast Environmental Law (2003) recommends that local governments vary development cost charges to reflect the reduction in the capital costs that are required for servicing new developments which result from the adoption of on-site green infrastructure.

The application of development cost charges to support the adoption of green infrastructure can be an effective way to influence individual properties by changing development practices through the local government decision making process. However, more flexible approaches may be needed to foster innovation in private developments and encourage on-site rainwater management.

2.2.6. Market Based Mechanisms

Recently it has been suggested that market mechanisms such as trading schemes, price instruments, and credit and incentive programs can be used to support the adoption of green infrastructure and ultimately the restoration of more natural hydrological regimes in the urban environment (Parikh et al., 2005; Thurston, Goddard, Szlag, & Lemberg, 2003). Some analysts argue that the market based approach is financially superior to government interventions as they more efficiently integrate market opportunities into the provision of stormwater management services which are traditionally controlled by regulatory processes (Thurston, 2006; MacDonald, Connor, & Morrison, 2004; Hanley, Shogren, & White, 2001). The use of market based approaches is considered superior to command and control approaches as they are often more flexible and economically efficient while providing stronger incentives than public education programs (Thurston, 2006). Research by Baerenklau, Cutter, DeWoody, Sharma, and Lee, (2008) also found that the use of market based mechanisms to fund decentralized, on-site stormwater capture is often more cost effective and can provide more flexibility than command and control mechanisms which are typically government led. I will now examine two ways in which market based instruments can be used to address stormwater quality and quantity issues.

Trading Schemes

Environmental trading schemes offer two parties the opportunity to transfer a regulatory requirement, in this case a water quality or quantity standard, to lower overall

control costs (Stephenson, Norris, & Shabman, 1998). These trading programs utilize quantity instruments such as amount of effluent in water or runoff quantity, whereby the discharge performance requirements are allocated amongst individuals as allowances. For example, if landowners reduce runoff from their property below their discharge limits they may generate credits which can then be sold to others who exceed allowances (Parikh et al., 2005). Market based tradable schemes for trading runoff reductions has been considered a cost effective way to assign runoff control in urban areas (Thurston et al., 2003). A governing agency can set a cap or limit on stormwater runoff discharges that reflect economic valuation of the costs of stormwater runoff and individuals can pursue suitable low-cost options for controlling runoff by adopting a variety of technologies including green infrastructure (Parikh et al., 2005).

The problem with trading schemes for non-point pollution sources like stormwater runoff is that these sources are diffuse in nature and difficulty can arise when identifying individual contributions and the overall effectiveness of pollution controls (Tomasi, Segerson, & Braden, 1994). Work by MacDonald et al. (2004), also identify that problems can arise when transferrable permits establish rules and restrictions for trading as it may require greater monitoring of diffuse non-point sources of pollution. At the local level however, Thurston et al. (2003), note that it may be more effective to develop tradable mechanisms that focus on stormwater runoff reductions instead of pollution abatement targets. In this instance the stormwater utility will set a price for stormwater runoff, or an allowance, and the land owners can decide whether to build stormwater detention facilities. Those facilities in excess of their detention responsibilities have the ability to sell excess allowances into the stormwater market.

Incentives

The application of market based incentives is examined by Parikh et al. (2005), who consider how price instruments can be used as economic incentives to lower the amount of stormwater runoff and pollution. The use of a stormwater user fee and a runoff charge is often linked to a stormwater utility and creates a pricing instrument that can influence behaviour. Stormwater user fees are often a flat rate charge per parcel of land and do not charge users based on the impact they place on the stormwater system. However, stormwater runoff charges are considered better price signals as they incorporate more complex hydrological models and increase the ability to influence how

private landowners manage runoff (Parikh et al., 2005). These runoff charges are often administered as a stormwater utility and may be preferable as they alter the cost calculus of adopting green infrastructure and act as an incentive for property owners to reduce the runoff being discharged from their property, over which they have direct control (Kitchener - Waterloo, 2008).

2.2.7. Stormwater Utilities

A stormwater utility is a mechanism that is used to fund the cost of delivering the municipal services related to the management and treatment of stormwater (US EPA, 2008). The application and operation of a stormwater utility is similar to electric and water utilities which charge based on usage, but for stormwater it is applied based on the runoff that results from the land-use characteristics of a parcel of land. The strength of creating a utility is that it is administered and funded separately from general taxation revenues and establishes a dedicated revenue source for the management of stormwater (US EPA, 2008). The City of Victoria is specifically interested in fostering the adoption of green infrastructure for stormwater management on private land through the application of a stormwater utility. The literature on stormwater management indicates that the most common approach being used by local governments for this purpose is the creation of a stormwater utility system, in which a per-unit price is established for stormwater emission. Accordingly, my research focuses on this "stormwater utility" approach and its potential application by local governments in BC. .

Policies

Local governments, in collaboration with senior levels of government, can develop Integrated Stormwater Management Plans which set specific performance targets for runoff, watershed health, and solutions to rainwater management at the site, catchment or watershed level (Province of BC, 2010). Given the broad categorization of policies that could be included under the planning provisions of the *Local Government Act s.878(1)(d),* local governments have a considerable amount of flexibility in developing policies related to stormwater management, stormwater utilities and the adoption of green infrastructure.

New Standards

There are several powerful tools that local governments can use to develop or raise standards and adoption rates of green infrastructure associated with stormwater utilities within communities. Under Section 903 of the *Local Government Act* municipalities are given a considerable amount of flexibility and power to limit runoff through the use of their zoning bylaws, which allow municipalities to stipulate land use design features. Within the Act, specific powers also pertain to local government jurisdiction over landscaping, parking, and runoff and sediment control, which they can utilize and require the adoption of green infrastructure practices for certain zones (Rutherford, 2007). Local governments can also use development cost charges to contribute to recapture the capital cost of the infrastructure required to service a new development which could include the application of green infrastructure techniques that service a new development.

Enforcement

Section 260 of the *Community Charter* provides that a municipal council may make bylaws for the purposes of enforcing the bylaws of the municipality. An enforcement bylaw could be used to support compliance with municipal green infrastructure standards and credit and incentive programs within the community.

Governance

Some of the top governance practices that support innovation in stormwater management include (adapted from Porter-Bopp et al., 2011; ELC, 2010; Rutherford, 2007, p. 10-11):

- Visionary leadership and community champions;
- Embedding green infrastructure criteria into decision making processes;
- Emphasizing collaborative engagement with a variety of stakeholders;
- Embedding conflict avoidance and resolution mechanisms into decision making processes;
- Embracing the complex, interdepended dynamics of water, land, and human and wildlife needs and activities across a landscape; and
- Break down internal silos that exist within government to consider a systems approach and connect land and water management at the appropriate scale.

Although governance is a complex issue, a commitment to engaging the community in the development of a stormwater utility service and stormwater credit and incentive program can foster learning, build community support, and connect stakeholders (Porter-Bopp et al., 2011). The adoption of a stormwater credit and incentive program has also been considered the 'carrot' that provides individuals a means for decreasing their bills through the adoption of green infrastructure techniques.

Planning

One of the most significant results of creating a stormwater utility service is the establishment of a dedicated funding source for stormwater planning, infrastructure, and operations and maintenance activities (FBC, 2011). This may allow greater funding to be allocated to stormwater management efforts and the creation of Integrated Stormwater Management Plans, than would be possible with the allocation of general taxation funds. Prior to the adoption of a credit and incentive program, planning staff should conduct a cost-benefit analysis of green infrastructure to ensure that selection and application of credits will meet the water quality goals and objectives set out in Integrated Stormwater Management Plans. It may be beneficial to initiate pilot projects for high priority catchment areas and conduct rigorous data collection to monitor program successes and failures (Porter-Bopp et al., 2011).

Service Provision

The collection of revenues from a stormwater utility service should only be used to fund the provision of stormwater management activities to customers within the municipality. As mentioned above, the provision of stormwater services in a community should utilize an integrated approach and break down some of the perceived boundaries of responsibility across the agency (Brown, Ashley, & Farrelly, 2011). Some elements that may be required in support of a stormwater utility and stormwater credit and incentive program are listed below (adapted from City of Victoria, 2011, p. 28-29):

- Concept development – identify the feasibility of funding options;
- Detailed analysis – seek appropriate policies, bylaw amendments, billing and credit structures, and exemptions;
- Data assembly – obtain all technical and financial data such as the amount of impermeable surfaces and develop appropriate billing mechanisms;

- Public information and education – stakeholder groups should be involved in the previous three steps. Once the system is developed a comprehensive communication strategy should be used to introduce the stormwater utility service to all community members; and
- Adoption and implementation – council adoption of relevant utility bylaws, rates, guidelines, and program specifics needs to be communicated clearly to the public.

Expanding Existing Services

Once the service provisions are outlined and adopted by a municipal Council, the role of certain local government departments may be expanded as a result of increased funding related to the stormwater management program. It will likely require new dedicated staff to work in this program area. The initial focus of the dedicated team would likely be to develop a consistent strategy and allocate financial resources for operations and maintenance, credit and grant programs, capital projects, and staffing costs. In most cases it will likely include greater emphasis on rehabilitation and replacement of stormwater infrastructure that is considered a high priority. Programs may also be required to develop and make public annual reports detailing the program activities and allocation of stormwater utility funding within the community.

Departmental Integration

Internally, local governments need to integrate a stormwater utility service in a manner that fosters awareness of the program and its connection to land management which will provide opportunities to combine complementary objectives and projects and result in a more efficient delivery of community services (Porter-Bopp et al., 2011). It is anticipated that affected departments will vary across local governments; however, they are likely to include the Engineering, Finance, Planning, Public Works and Sustainability Departments.

Implementation

Implementation of a stormwater utility service and a credit and incentive program will depend largely upon the program that is acknowledged to be the most suitable for both community members and the Council. Important elements of implementation will include education programs about green infrastructure and specifics on their installation, credits for installation, guidance for installation, technical assistance, and providing a list

of certified providers/installers. Credit recipients may also receive periodic inspections of the actions taken to reduce stormwater runoff.

Financing

Although rate structures in communities vary they can be calculated using several different measures (see voluntary and market based financial mechanisms above). A common approach that has been pursued in jurisdictions across North America is to assign user fees based on the amount of impervious surface found on a given parcel of land. This approach is considered to be more equitable and efficient than a flat rate fee per property which does not take into account the real impact a parcel of land will have on the stormwater system (Cameron, Cincar, Trudeau, Marsalek, & Schaefer, 1999).

Credit and Incentive Programs

There are a number of potential ways in which private landowners can reduce runoff on their parcels of land and it is important for local governments to consider which are most appropriate in meeting program goals and are the most financially viable in the long term. The City of Waterloo (2010) noted that residential rebates provide a one-time discount to homeowners wanting to adopt stormwater controls such as rain gardens or rain water harvesting devices. These rebates could also be applied to private industrial, commercial and institutional lands to help control stormwater runoff.

Another programmatic option that has been considered by the City of Waterloo (2010) is the use of credit systems whereby a resident will pay for the installation of green infrastructure and will receive a credit based on its ability to control runoff. This would likely rely on hydrological data, design specifications and other data as supplied by qualified professionals to determine the credit that will be allocated to the property owner's stormwater utility bill.

Rate Structures

The selection of rate structures can vary depending on the overall objective of a stormwater utility. These can include the use of rate structures that assign utility costs based on the volume of runoff or pollution (Reese, 2007). Although it may seem wise to utilize pollution measurements for determining stormwater utility rate structures it is often

difficult to measure the direct pollution reductions that result from the adoption of green infrastructure, whereas runoff quantity is more easily estimated using Geographic Information Systems (Parikh et al., 2005).

Community Grants

One innovative approach that has been used by the City of Portland, Bureau of Environmental Services is the creation of community grant programs that help reduce stormwater runoff through restoration and rehabilitation projects. The Community Watershed Stewardship Program provides community groups the opportunity to apply for up to $10,000 in grants for watershed restoration activities or implementing green infrastructure projects in their community (City of Portland, 2011). This community based project has fostered community engagement by creating a learning-by-doing approach to implementing green community infrastructure projects (Shandas & Messer, 2008).

Chapter 3.

Examining the Implementation of Environmental Innovations

3.1. Introduction

Much scholarly inquiry has been devoted to determining how decision makers in one setting can learn from and adopt or adapt programs that are being implemented successfully in another setting (for example, an institution, region, or organization) (Veselý, 2011; Barzelay & Thompson, 2009; Ongaro, 2009; Hall & Jennings, 2008; Barzelay, 2007; Bardach, 2004; Overman & Boyd, 1994). In my own study I drew on two lines of this research. First, I based my interview questions on Bardach's methodology for identifying and "extrapolating" what he calls "smart practices" (Bardach, 2004; 2009). Second, I analyzed the results using Steelman's (2010) "Framework for Analyzing the Implementation of Innovation," which complements and extends Bardach's approach by identifying key individual, structural, and cultural factors that influence whether environmental innovations are successfully implemented in a particular setting. In this chapter I review these two lines of research and explain how they informed my own work.

3.2. Smart Practices Research

3.2.1. Smart Practices Analysis

As Bardach (2009) observes, "[i]t is only sensible to see what kinds of solutions have been tried in other jurisdictions, agencies, or locales" (p. 95). However, there is no single agreed upon framework for identifying smart practices suitable for extrapolation from a source site and applying the lessons learned to a target site. The ***source site*** is

the source of the practice that is under examination by another jurisdiction or organization. The ***target site*** is the site where the smart practice will be applied (Veselý, 2011). Although it may appear relatively straightforward to learn from the experience of a source site and apply it to a new target site, a considerable amount of effort is required to avoid simply replicating a practice in a setting where the conditions necessary for it to be successful are not present (Bardach, 2004). Another issue with smart practice research is that there is no consensus on what exactly it is and how one is to go about conducting it in a proper manner (Veselý, 2011). Analysis of smart practices needs to go beyond simplified descriptions of the cases being researched and delve into the unique, context dependent factors that result in varying degrees of success and failure.

3.2.2. Basic Mechanisms and Their Function

When considering the extrapolation of an experience from a source site to a target site it is critical to consider the driving elements of a given practice, which Bardach (2004) calls a "mechanism" (p. 209). He defines mechanisms as an explanatory device that helps to illuminate certain phenomena involving "causal power", but that they are not full blown "laws" nor are they simply descriptions or narratives of a given process. He is interested in mechanisms "as a method of actualizing some latent potential and converting it to any number of possible ends." By analogy, the use of a rain-barrel may store rainfall instead of allowing it to discharge into a stormwater system, which is relatively uninteresting on its own; however, it becomes interesting when one considers its potential to be applied in a variety of settings to meet a variety of diverse needs such as water storage, water conservation, reduction of peak flows, or to offset the need for investment in larger stormwater infrastructure. Veselý (2011) describes mechanisms as a principal element of every smart practice but warns that researchers must consider the institutional, political, economic and interpersonal environments in which these mechanisms are found so as to better consider the contextual factors of the source site before being transferred to the target site. Barzelay and Thompson (2009) also point out how a collective assembly of artifacts and mechanisms can produce exceptional results when constructed in a manner that reinforces one another's effects. For example, the design of a stormwater management program is an artifact that may be created with the goal of reducing peak stormwater flows within a given area. Although this artifact may

represent effective stormwater technologies and be constructed to ensure efficacy in a variety of environments, it may not include the mechanisms available to help meet diverse ends and stormwater goals, such as the use of incentives or tapping into a latent resource within the community such as a commitment to watershed protection that is lacking an outlet for effective participation by community members.

To provide a better understanding of mechanisms, Bardach (2004) goes on to explain how contingent features found within a given context of a source site that "implement or support a mechanism" should also be examined to determine if they warrant extrapolation to the target site.

Contingent Features

Bardach, (2004) argues that the operation of a mechanism is linked to contingent features of the setting in which it operates. Seeking to better understand the contingent features in a source site can help illuminate causal mechanisms and determine whether they warrant extrapolation to a target site. Barzelay and Thompson (2009) conclude that "[i]n other words, Bardach attributes a practice's performance characteristics to whether and how social mechanisms are activated or suppressed within any particular episode in which the same practice operates. Practice features, operating context, and participation by actors play the role of activating or suppressing such mechanisms" (p. 6-7). Qizilbash (2011) also notes how examining contingent features, as postulated by Bardach (2004) can provide value as it may allow for the identification of causal mechanisms which can aid in the analysis of smart practices. Bardach (2004) recognizes three types of contingent features: 1) implementing; 2) optional; and 3) supportive. Each of these features is examined in greater detail below.

Implementing features "directly implement basic mechanisms" (Bardach 2004, p. 211). They provide essential functional roles in the application of a particular mechanism, but they will often vary across sites. This is important to the research being conducted as the case studies under examination have applied similar mechanisms across a variety of sites in Canada, Washington State and Oregon State.

Optional features are not essential but they may contribute to the effectiveness of a mechanism. Optional features may vary depending on the local preferences and

constraints found in a given institution, jurisdiction, organization or community (Bardach, 2004). For example, an optional feature of a stormwater incentive could include the use of performance measures that set targets for surface runoff reduction (e.g. 20% below existing site runoff rates). This approach may provide flexibility for private landowners to adopt the green infrastructure approaches that are most suitable on the site while meeting program goals. These optional features could vary widely depending on local preferences and constraints and influence the development of the stormwater credit and incentive programs. Given the diverse set of interview participants, optional features may vary substantially which will provide less opportunity to generalize about their role as contingent features while providing a snapshot of the influence of local preferences and constraints.

Lastly, supportive features are considered to be the resources used to bring the implementation features into existence (Bardach, 2004). Some supportive features play a vital role in the implementation of mechanisms and include items such as the allocation of budgets and the institutional structuring of programs, while others play a less important role but remain essential such as organizational or political support for the initiative being implemented.

Secondary Features and Vulnerabilities

When examining the application of mechanisms in a given case study it is important to go beyond the contingent features alone and ask how the implementation of a given mechanism may have resulted in secondary effects or vulnerabilities (Bardach, 2004). These secondary effects or vulnerabilities, whether positive or negative, may influence the decision about whether to extrapolate a particular practice.

As Bardach (2004) acknowledges "[no] mechanism does only one thing" (p. 212). Consequently, it is important to establish what the intended and unintended consequences may be from the application of a given mechanism. These may include unforeseen costs or benefits that may have harmed or strengthened the program. Examining the role of secondary features in each case study will provide a better understanding of those complexities that may arise through the extrapolation of a smart practice and enhance the ability to apply smart practices wisely to their targeted site.

It is also important to consider vulnerabilities associated with the program being examined. These vulnerabilities can lead to program failure, organizational mistrust, or financial liability. For example, stormwater credit and incentive programs may be vulnerable to unforeseen administrative burdens as a result of a large number of applicants and program related inquiries, or an overly complex application or approval process may dissuade prospective participants from involvement in the program. It is important to ask questions pertaining to programmatic vulnerabilities as they are rarely found in the descriptions provided in smart practices literature.

My research aims to identify mechanisms within the case studies under examination. It is anticipated that the identification of these will provide more insightful explanations of the phenomena present within a source site and how these can be adapted to the target site. The interview questions sought to determine how mechanisms were used to produce desired effects and valued results through the examination of their contingent features, secondary features and vulnerabilities (Barzelay & Thompson, 2009).

3.2.3. Using the Smart Practices Approach in Case Study Research

Interview Question Development

The instrumental purpose of conducting case study research using a smart practices approach is not so much focused on the development of contemplative knowledge but should be more practical, seeking to provide actors with information that can help them with the design of locally feasible programs (Barzelay, 2007). This approach to case study research was used to guide the development of interview questions that focus less on examining theoretical questions and attempt to draw out practical information that can be used to guide the design of locally relevant programs at the City of Victoria.

Examining Case Studies

The current medley of approaches to extrapolation research uses a variety of terms to describe how an institution or program can learn from second-hand experience and improve on the status quo, including: best practices (Hohl & Clark, 2010; Jennings,

2007; Bretschneider et al., 2005; Overman & Boyd, 1994); extrapolation oriented case research (Barzelay, 2007); practice-based approach (Brunner & Clark, 1997); and smart practices (Bardach, 1998 & 1994). Bendixsen and Guchteniere point out that analyzing smart practices is "…about accumulating and applying knowledge of what is working and not working in different situations and contexts (as cited in Jennings, 2007, p. 678)." Regardless of the terminology used it is widely accepted by many of the above mentioned contributors to extrapolation research that two crucial problems need to be addressed to find the best performing cases; 1) identifying high performing source sites which will provide the lessons learned; and 2) determining the most effective means of extrapolating the practice from a source site and applying it to a target site (Veselý, 2011).

In the design of smart practice research and analysis, Bardach (2004, 2009) advocates for the use of a problem solving approach that not only seeks to determine the design features of an exemplar's source site, but also involves the description and diagnosis of a target site. Barzelay and Thompson (2009) point out that this is advantageous as it helps "[deal] with operating circumstances and the localized specificity of desired preferred conditions necessarily evokes dissonance with codified activities or procedures, which calls for a dose of ingenuity to adapt practices to the context at hand" (p. 7). This supports the steps taken in my research to determine the necessary processes present within the exemplar under examination and to ensure that analysis is conducted to determine how the design and application of a smart practice needs to consider the unique attributes found within the target site.

Explanation of Case Studies

Another important aspect of extrapolation based research is to identify what components of a given public program and its processes are that you would like to explain (Barzelay, 2007). Although this can be a challenging task for the analyst, the partner in my research (the City of Victoria) provided an understanding of the performance effects and processes that they wished to identify to inform the development of a stormwater credit and incentive program. Identifying how program performance is improved by understanding the underlying processes that drive specific program interventions is consistent with what Bardach (1994) suggests is imperative for illuminating the contextual factors at play within a given smart practice.

It is also important for the analyst to choose an appropriate form of explanation for a given policy intervention. The forms of explanation used in social science research to describe the phenomenon under examination often differ depending on the field of study (Mahoney & Rueschemeyer, 2003; Barzelay, 2003; Goodman, 2000; Van de Ven, 1992). Barzelay (2007) notes that "[f]or extrapolation-oriented research, narrative explanations are called for" (p. 527). However, the narrative explanation must provide an understanding of the causal structures of action and social processes instead of providing a mere description of complex social phenomena (Barzelay, 2007). Therefore, it is advantageous to look at what Bardach (2004) and other social science researchers call 'social mechanisms,' as described above. These social mechanisms are also considered by Steelman (2010). According to Barzelay (2007) the essential heuristic of extrapolation-based research design is "[crafting] contrivances with the intention of activating the same configuration of social mechanisms in the target site as that which were activated in the design exemplar and are believed to explain its outstanding performance characteristics" (p. 528). Accordingly, my case studies will be summarised using narrative explanations of the social mechanisms present, to provide insight into the causal structures affecting policy implementation.

At the target site, smart practices can be replicated, adapted, experimented with, or used to generate ideas for taking an appropriate course of action (Bardach, 2004). The use of smart practices will vary depending on the local objectives, resources and feasibility of alternatives considered. Potential benefits of learning from smart practices include reducing uncertainties of the practices under consideration and providing decision makers with an understanding of the risks and rewards of a given course of action based on the lessons learned from jurisdictions seeking to address similar public problems.

3.3. Conceptual Framework

The work of Steelman (2010), builds upon the work of Bardach by examining the mechanisms involved in fostering enduring change in environmental management through the implementation of innovative policies and programs. Steelman's (2010) framework for analysis considers the roles of individual, structural and cultural factors in

the adoption and implementation of innovative environmental practices. The application of this conceptual framework will allow for a better understanding of the case studies under examination and the factors that influence the ability to address community stormwater management issues.

3.3.1. Analyzing the Implementation of Innovations

Steelman (2010) reviews literature on the implementation of innovation from policy studies, public management, and institutional theory, and provides a synthesis of the conceptual and theoretical underpinnings in her "Framework for Analyzing the Implementation of Innovation" (Table 3.1.).

Table 3.1. Conceptual Framework for Analyzing the Implementation of Innovation (adapted from Steelman 2010, p. 17)

Individuals	Structures	Culture
Motivation: The motivation to seek alternative solutions to public problems can result from bottom-up or top-down pressures. These include political decisions, internal champions, or public demand. ***Norms and Harmony:*** Norms can be upheld when innovative practices align with the existing structures present within an organization like billing, environmental education, and inspection approaches. Whereas harmony can be altered when changing existing systems and approaches taken by the organization such as new engineering or sign-off requirements, monitoring programs or legal challenges that result from new stormwater initiatives. ***Congruence:*** Individuals perform within a dominant culture that exists within an organization and community. Tensions can arise if innovative practices do not align with these dominant values and they may not be accepted. These include alignment with existing services and programs delivered by a local government, alignment with state and federal initiatives, and alignment with community values.	***Rules and communication:*** Both are important internally and externally when supporting innovations in stormwater management. Internally these include inspection and monitoring requirements, credit eligibility, and a strategy for communicating to the general public. Externally these include identifying the responsibilities of individuals, application processes, credit eligibility, and educational resources for community members. ***Incentives:*** These include incentive type (rebate, credit, free installation), amount (total savings), eligibility criteria (specifics on technology selection), and recognition (signage or posted on community maps). ***Opening:*** If an opening exists, the organization is often better able to create change across the organization and foster change. Openings typically occur at the political level and can result from top-down or bottom-up stressors or shocks. ***Resistance:*** These include social or political resistance, or personal and organizational resistance to alteration of the status quo. Resistance may result from lack of knowledge, low incentive rates, lack of leadership, or benefits not accruing to green infrastructure installer.	***Shocks:*** Shocks which may improve the likelihood of innovative stormwater management approaches include the loss of fish populations, beach closures due to contamination, or flooding. ***Framing:*** Public problems can be framed strategically to motivate voters, staff or politicians to act in a manner that improves the likelihood that a public problem will be addressed through innovative means. This may result from the inclusion of economic, social or environmental benefits that may result from the innovation. ***Legitimacy:*** Innovative approaches to stormwater management may gain legitimacy through community collaboration, voluntary and regulatory approaches, and participation of key stakeholder groups.

Individuals

Individual action is considered one of the most prominent aspects of fostering innovation. Individuals have the ability to influence the success of an innovation in many ways, but these influences are often limited to certain activities that fall within their spheres of influence and control (Steelman, 2010). Steelman (2010) highlights how the factors that impact individuals include influencing motivations, norms and harmony, and congruence.

An individual's motivation can be summarized as the stimulus that drives an individual to alter the status quo. This takes into account what drives a policy innovator or leader to pursue change within their respective organizational context. Steelman (2010) notes how institutional and policy and management theory suggest that individuals who are discontented with the status quo need to be adequately stimulated and motivated to implement change and are also free to devise alternative solutions. This requires a certain level of power or authority to undertake the necessary changes.

Norms and harmony relate to the individuals desire to maintain positive relationships with their co-workers. Steelman (2010) notes that existing workplace norms that emphasize the importance of innovation will make it easier for implementation of such practices to occur, as individuals seek workplace harmony. In contrast, in those situations where innovation does not align with existing workplace norms, individuals pursuing innovation in the workplace may find themselves in a situation where they are not in harmony with their fellow co-workers and face more resistance.

Congruence refers to the fact that individuals operate within agencies or organizations which have dominant cultures into which innovations must be integrated. As such, Steelman (2010) notes that individuals not aligned with the common values of the agency may find themselves out of touch with the realities of what is possible within the organization and without support for innovative practices.

Structure

Institutional or organizational structures impact how innovations are implemented in a complex environment. Steelman (2010) classifies these structural influences as those related to rules and communications, incentives, opening, and resistance.

Innovations are more likely to be implemented successfully when there are clear lines of communication, written rules, and clear information exchange processes about the innovation and the plans for its implementation. These clear rules and processes can contribute to internal and external support for pursuing such practices (Steelman, 2010).

Incentives act as a mechanism that helps to promote the adoption of desired actions (Bardach, 2004). Steelman (2010) explains that incentives work because they provide a favourable cost benefit calculus to individuals and thereby encourage them to participate in or comply with a particular program. When incentives are structured in an appropriate way they can improve the likelihood that performance will be sustained over time.

It is also important for the structures to have openings available at the political level for individuals and groups to introduce change. If the political system is closed to certain innovations or groups seeking to promote these innovations it can be very challenging to implement these improvements and sustain them over time (Steelman, 2010). However, once the opening is developed at the political level, it may be much easier to create change at the operational levels that an innovator is typically dealing with.

The final structural factor in Steelman's framework is the level of resistance of the organization to change. Often, resistance exists and positive changes are hindered due to organizational inertia or unresponsiveness. Steelman (2010) points out that the existing structures and power dynamics must be addressed, including concerns of the individuals present who seek to maintain the status quo.

Culture

The culture of an organization and the community groups and attributes that influence culture also play an important role in influencing the implementation of innovations. Steelman (2010) emphasizes the influence of shocks, framing and legitimacy in the adoption of innovations. These factors may provide pathways for breaking out of an existing cultural worldview and moving past the status quo.

Shocks refer to an event or series of events that act to alter the existing approach of managing the environment by raising awareness about the opportunity and benefits of change. These shocks provide a chance to envision how individuals would like to see the world differently in the future and seek change. Shocks may create policy windows (Howlett et al., 2009), which provide an avenue for evoking change as a result of the new realities that have been identified.

When pursuing innovation it is possible to use framing to broaden the problem definition to include areas or alternatives that shape and improve the likelihood of action (Steelman, 2010). Campbell (as cited in Howlett et al., 2009) points out that the use of framing can help improve the perceived legitimacy and public acceptance of a certain policy or initiative, when it is framed in a manner that highlights the "correctness" of a certain action. Creative framing seeks to resonate with the public's values concerning the problem while enhancing the perceived likelihood that the policy will meet the needs of those individuals it targets.

Last among the cultural factors included in Steelman's framework is the perception of legitimacy of the particular innovation within the organization. Innovative practices are more likely to be perceived as legitimate when they validate the organization in a manner that reflects positively within the broader culture of the community in which it operates (Steelman, 2010).

3.4. Stormwater Credit and Incentive Programs as Environmental Innovations

This research examines ten case studies where local governments have adopted stormwater credit and incentive programs in order to address community stormwater

management issues. Steelman (2010) defines innovative practices “as something that was perceived as new by the entity adopting it while also representing a significant departure from previous activities and responses to problems” (p. 20). Therefore, the adoption of a stormwater credit and incentive program is an innovative practice when it results in a significant departure from current government led stormwater management techniques. This departure from the status quo is typically justified by the aim to empower private residents to manage stormwater on private property, which benefits the general public.

The conceptual framework described above will be applied to the case studies in an effort to better understand the critical elements necessary for developing and implementing a stormwater credit and incentive program. The evaluation of these case studies will scrutinize the role of individuals, structures and cultural factors and their influence when implementing stormwater credit and incentive programs. It is anticipated that this will provide an understanding of how other local governments can pursue the development of similar environmental innovations that will persist over time.

Chapter 4.

Methods

4.1. Introduction

This section outlines the methodology used to identify cases, conduct interviews and collect and analyze data in this research. The first section provides a brief overview of the research design, followed by a discussion of the sources of data and the methodological approaches involved in data collection. The next section describes the steps taken to analyze the data. This is followed by a discussion of possible limitations of the research.

4.2 Research Design

This research used qualitative, comparative case studies (Yin, 2009) to examine the stormwater credit and incentive programs of selected local governments in Canada and the United States. I investigated factors that influenced the adoption and implementation of these stormwater credit and incentive programs and assessed the strengths and weaknesses of the approaches used. The research design is based on the literature review and Steelman's (2010) conceptual framework for studying policy innovation. I supplemented Steelman's framework with concepts from the literature on smart practices and the policy cycle. The smart practices literature offers insight into whether practices that have been effective in one setting will be effective in other settings, while the conceptual framework provides a synthesis of theory on the adoption and implementation of innovations.

Hill and Lynn (2005) categorize three approaches to empirical research on public management: (1) providing a descriptive and historical approach through the use of archival data and qualitative methods; (2) a smart practices approach that examines

detailed case studies to identify 'what works' about a given public policy or program; and (3) use of formal models and methods to study public policy and management. My research utilized all three approaches, qualitative methods, the smart practices approach, and Steelman's framework (a formal model) for analyzing the implementation of innovations.

4.1.1. Qualitative Methods

I used a qualitative, comparative case study research method. One of the fundamental challenges noted in the literature on policy extrapolation and smart practices is to ensure that the analysis takes into account the role that contextual variation plays in shaping the fate of proposed policies and programs. Comparative case studies allow a researcher to identify the key contextual factors that influence how policies are adopted and implemented in each case. Qualitative interviews potentially offer insight into why a program or policy is or is not achieving its intended results, and give interviewees the opportunity to elaborate on their experiences with challenging programmatic issues and any corrective measures that may have been considered or taken (Yin, 2009; Marshall & Rossman, 2006; Patton, 2002).

4.2. Data Sources

This research is based on the use of data from several sources, including: 1) secondary data; 2) stormwater program documents and online resources; 3) municipal codes; and 4) semi-structured interviews with selected participants.

4.2.1. Secondary Data

The secondary data were taken from a summary document compiled annually by the Western Kentucky University Stormwater Utility Survey, which identifies all the stormwater utilities within the United States (Campbell, 2011). Campbell (2011) notes that the information in this survey was collected primarily by conducting internet based searches. From this comprehensive list I determined that as of June 2010, 35

stormwater utilities had been established in the state of Oregon and 99 had been established in the state of Washington.

4.2.2. Stormwater Program Documents and Online Resources

Although the Western Kentucky University Stormwater Utility Survey identified jurisdictions with stormwater utilities, including the monthly fees charged by each utility, it did not indicate which communities had adopted credit or incentive programs. To obtain this additional information, I conducted an internet search for each community identified by Campbell (2011) as having a stormwater utility within Oregon and Washington states. The internet search included the community name, state and key terms such as "stormwater rebate", "stormwater credit", "stormwater incentive" and "stormwater utility" [E.g. Portland, Oregon – stormwater utility]. If a Stormwater Management Plan could be found for the local government this was also searched for the following key words: "rebate", "credit" or "incentive". Although this method may not have identified all local governments with stormwater credit and incentive programs in the study area, comprehensive stormwater credit and incentive programs typically post a substantial amount of information on their websites in an attempt to effectively communicate program information to the community. As such, my searches were an efficient means of initially identifying local governments that had comprehensive stormwater credit and incentive programs in place. I supplemented my initial list by also searching for references to stormwater credit and incentive programs in the municipal codes of those jurisdictions in Washington and Oregon that had stormwater utility programs (see below). Finally, I asked managers with the City of Victoria's Stormwater Utility Program to review my list of candidate programs and add any programs in the study region that to their knowledge had adopted stormwater credit and incentive programs. The staff was more familiar with stormwater utility creation in Canada and recommended that I explore the utilities created in the City of Edmonton, Alberta, and the Cities of Kitchener and Waterloo, Ontario, to be included in the interviews. I also conducted a brief internet search to determine if there were any other stormwater utilities in Canada. Research by Porter-Bopp et al., (2011) provided a review titled "Peeling Back the Pavement: A Blueprint for *Reinventing Rainwater Management in Canada's Communities"* which

identified the Halifax Regional Municipality as having a stormwater utility, but the funding model was combined with sanitary sewerage and not considered relevant.

4.2.3. Municipal Codes

When searching through the stormwater program documents to locate those jurisdictions with a stormwater utility, it became apparent that some jurisdictions had adopted stormwater credit and incentive programs that were only communicated within their municipal codes. Accordingly, I searched the municipal code of each of the jurisdictions in Oregon or Washington that I had identified as having a stormwater utility, using the following key words: “stormwater”, “storm water”, “stormwater utility” and “storm water utility.” These searches were targeted at areas of the municipal code that addressed stormwater management. Once the stormwater management sections of the municipal code were identified another keyword search was conducted using the following terms: “incentive”, “rebate” and “credit”.

4.2.4. Semi-Structured Interviews

The searches described above identified 36 local governments with stormwater credit and incentive programs (25 in Washington, 8 in Oregon, and 3 in Canada). I selected 11 cases for detailed investigation (the method used for case selection is described in the next section). For each selected case I interviewed local government staff responsible for the stormwater credit and incentive program. The exception to this was the City of Edmonton interviewee, who was a consultant, but who formerly worked for the city in developing and implementing their stormwater credit and incentive program. The purpose of these interviews was to explore the interviewee’s views and experiences with the development and implementation of the stormwater credit and incentive program in their community. It was anticipated that conducting these interviews would provide an opportunity to learn details about program development, implementation, and practical lessons that could not be obtained through other means such as a quantitative questionnaire. I also expected that interviewees in Oregon, Washington and Canada would differ in their perspectives and experiences with the application of stormwater credit and incentive programs. Accordingly, I sought to include maximum variation in the types of programs and jurisdictions examined. The selection

of cases and interview participants was conducted in coordination with staff from the City of Victoria Stormwater Utility Program.

4.3. Case Selection

I used a purposeful sampling approach. Merriam (1998) highlights how:

> purposeful sampling is based on the assumption that the researcher wants to discover, understand, and gain insight and therefore must select a sample from which the most can be learned. The logic and power of purposeful sampling lies in selecting information rich cases for in-depth study. (p. 61)

Non-random sampling such as this is justified when conducting qualitative interviews without the resources to obtain a representative sample of a given population (Patton, 2002).

In order to identify appropriate cases and individuals from different local governments within Oregon and Washington states, I used the maximum variation sampling strategy, which aims to capture a broad selection of the settings available when there is a great deal of variation (Patton, 2002). This allowed me to investigate core experiences and the role of unique contextual factors in each case, but also to look for common patterns and shared dimensions across settings (Patton, 2002).

As discussed above, I narrowed down the initial list of 130 local governments with stormwater utilities to 36 local governments with stormwater credit and incentive programs. Given the scope of the research and the limited resources available it was not feasible to conduct interviews with individuals in each of these jurisdictions. I further reduced the list to 11 local governments, including a variety of population sizes and program types from the two states and in Canada (4 in Washington, 4 in Oregon, and 3 in Canada).

I contacted potential interview participants by phone and email. A recruitment script was prepared that explained the objectives of the study and how the results would be used to inform program development within the City of Victoria. Only one potential interviewee, from a local government in Oregon, declined to participate, because that

individual felt that their program did not match the aims of the research. A replacement local government in Oregon was selected and contacted, and the interviewee in that jurisdiction agreed to participate in the study.

After the interviews the Edmonton case study was dropped from the research due to the fact that the interviewee only answered a few of the questions, in part because the individual was no longer working for the organization. The limited information provided by the interviewee was insufficient to allow for meaningful analysis of the case.

4.4. Interviews

Yin (2009), emphasizes the importance of conveying to interviewees the value and usefulness of providing in-depth details of the programs being examined. For the present research, at the start of each interview the interviewee was given an overview of the researcher's goals, the purpose of the study, and how the research could help to inform future policy and program development within the City of Victoria. The interview protocol combined open-ended questions with follow-up probes that encouraged interviewees to elaborate and provide detailed information about their programs (see Appendix B for a list of the interview questions).

Interviews with local governments in Washington and Oregon were conducted in person and those in Canada were conducted over the phone at a time and location of the participant's choice. All in person interviews were conducted at each city's respective local government office either in a meeting room or the office of the participant. The interviews lasted between 1 and 1.5 hours. Although the participants were not provided with the list of interview questions prior to meeting, they were sent an email reminder a few days prior to the scheduled interview and given a brief overview of the topics that would be covered and the purpose of the interview.

In accordance with the approval obtained from Simon Fraser University's Office of Research Ethics, participants were provided with a letter of informed consent to review and sign prior to commencing the interview process (Appendix A). Upon acquiring signatures of the participants each individual was provided with a set of

interview questions to help guide them through the interview. The researcher also took notes during the interview to highlight important program characteristics that could be used to probe these topics later in the interview

For those interviews conducted over the phone with staff members of Canadian local governments, participants were provided with a verbal overview of the Letter of Informed Consent. The Letter of Informed Consent was then sent to each individual upon completion of the interview and subsequently signed by the individual and sent back to the researcher. The phone participants were not provided with a written version of the interview questions. All participants in the research consented to have their interviews electronically recorded.

4.5. Data Analysis

The approach to analyzing the interview data evolved considerably over the course of this research. The research project began as an internship with the City of Victoria to interview jurisdictions in the Pacific Northwest to provide Victoria with a set of recommendations for the development and implementation of a stormwater credit and incentive program. To achieve this, the development, collection and summary of the interviews were based on Bardach's (2009) research on understanding the role of mechanisms, contingent features, and secondary features of smart practices. As such, the interview responses were initially summarized based on these three features to provide a report and a set of recommendations for the City of Victoria (Appendix D). After producing the report for the City of Victoria it was determined that there was value in further investigating the factors that influenced the successes of these innovations. After reviewing the literature, I identified Steelman's (2010) framework for analyzing the implementation of innovations as a suitably comprehensive framework to guide deeper investigation of these factors.

4.5.1. Interview Transcription

The use of open ended questions often resulted in interviewees providing more narrative about certain program elements than was necessarily relevant to the question

that was asked or the overall research objective. Therefore, interview responses were partially transcribed based on relevance to the question that was asked. When transcribing the interviews, quotes and descriptions of scenarios were identified and captured in support of observations and to enhance case descriptions.

4.5.2. Interviews Analysis

Each interview was transcribed and analyzed individually before examining where meaningful similarities and differences existed across case studies. The case studies were then analyzed collectively based on the three types of mechanisms identified by Bardach (2009) to provide a summary of coherent, locally relevant recommendations for the City of Victoria.

After completing the report for the City of Victoria the initial interview transcriptions were re-analyzed to explore how factors at the individual, structural and cultural levels may have influenced the implementation of each stormwater credit and incentive program and the likelihood of being successful. The re-analysis focused on determining the roles of individuals (motivation, norms and harmony, and congruence), structures (rules and communication, incentives, opening, and resistance), and culture (shocks, framing, and legitimacy).

The 44 interview questions from each case study were categorized based on their suitability within Steelman's (2010) framework for analyzing the implementation of innovations (Table 3.1.). The application of the framework attempted to identify where similarities between case studies existed and if they could be generalized to provide insight into larger trends or typologies that may have influenced certain program outcomes. This case study research was instrumental in design as it sought to provide actors and decision-makers with practical information to help them design locally feasible programs (Barzelay, 2007).

4.6. Limitations

This research involved a cross-case examination of a limited number of case studies, and as such the results are not broadly generalizable. The use of Steelman's

(2010) conceptual framework, however, was quite effective in providing a better understanding of the complex nature of formulating and implementing public policy innovation at the local government level. One limitation is that, because I did not adopt the conceptual framework until after the interviews were complete, the interview questions were not specifically designed to address each component of the framework. However, the questions were based on earlier literature on approaches to assessing smart practices, and included open ended questions about the mechanisms underlying the implementation of stormwater credit and incentive programs. The framework then provided a systematic approach to analyzing the narrative responses to these questions.

Another limitation is that all of the cases involved local governments with credit and incentive programs and a stormwater utility in place. Although this allowed me to focus on institutions that were in fact utilizing a variety of credit and incentive programs, this research did not attempt to identify local governments without a stormwater utility that may have developed a stormwater credit and incentive program. Also, the interviews did not include any local governments that had attempted to adopt a stormwater credit and incentive program but failed, or local governments that had not attempted to adopt such a program. It would be informative in future research to compare local governments that did adopt a stormwater utility to ones that did not, in order to understand the ways they differed. Another limitation is that no comparative assessment was made of the relative success of the different cases to identify those programs that were most successful and why. Although interviewees were asked about the effectiveness of their individual programs and the factors that influenced effectiveness, the research did not attempt to select or target only the most successful programs, and all jurisdictions' experiences in implementation were included in the analysis.

Another potential limitation of this research is that the staff of the partner organization (City of Victoria) specified what performance criteria of stormwater credit and incentive programs they wanted the researcher to examine. However, they did not otherwise constrain the research other than ensuring that the overall goals that they had set out for the project were being met. Conducting interviews based on the needs of the partner organization was important because it enhanced the likelihood that the results would be of value to the City in the development of their stormwater credit and incentive

program. Input by City of Victoria staff provided much needed guidance for the researcher and provided greater probability that the research design was able to examine context dependent factors that exist within the target site that may have been overlooked otherwise.

Chapter 5.

Results from Interviews

This chapter provides a summary and analysis of the responses of interview participants about their cities' stormwater credit and incentive programs. It will provide details about the programs and policies that were created in each city to support the adoption of innovative green stormwater infrastructure techniques. The typical approach taken by the local governments included in the study was to provide a variable stormwater fee credit that increased with the amount of stormwater managed by private properties (residential and commercial) through the installation of city approved green infrastructure techniques. Although this tactic was used in all but one jurisdiction, credit rates and eligibility varied substantially across cities. A common approach was to provide credits for properties based on the amount of stormwater managed on the property as a result of adopting green infrastructure. A summary of these credit programs, sectoral eligibility, credit/rebate program description, and credit rates is provided in Table 5.1.

Table 5.1. Summary of Stormwater Credit and Incentive Programs in the Cases Examined in Canada, Washington State, and Oregon State.

City	Credit Programs & Sectors	Description of Credit/Rebate Program	Credit Rate
Bellingham, WA	Single-family residential (applicable to parcels with building footprints of +3,000 square feet) Commercial (ICI)	**Single-family residential** • Dwellings considered to be a "large footprint residential parcel" have the opportunity to participate in credit **Industrial, commercial and institutional** • Facilities must meet or exceed design requirements in 1992 Department of Ecology (Wash.) Stormwater Technical Manual **Educational** • For publicly funded primary and secondary institutions that provide curriculum in environmental science.	**Single-family residential** • 20% credit for private on-site stormwater facilities with building footprints over 3,000 square feet. **Industrial, commercial and institutional** • 20% credit for private stormwater facilities. • 70% credit for those that meet additional criteria (direct discharge & discharge into an infiltration facility that meets DoE requirements) **Education** • 70% credit reduction on monthly fee – credit established through contract
Issaquah, WA	Single-family residential Commercial (ICI)	**Single-family residential & ICI** • Reduced charges for properties that infiltrate stormwater. • Applicant must submit a Technical Information Report, prepared by a licensed professional engineer, on facility design and effectiveness of stormwater infiltration	**Single-family residential & ICI** Private site stormwater infiltration facility may receive: • 50% fee reduction if designed to accommodate a 100-year storm • 40% fee reduction if designed to accommodate a 50-year storm • 30% fee reduction if designed to accommodate a 10-year storm
Marysville, WA	Senior Citizen Low-Income and/or Disabled Low-Income Commercial (ICI)	**Senior/Low-Income** • Relief granted to those that meet certain qualifications and requirements of a "Low-Income Senior Citizen or Low-Income Disabled Citizen" **Industrial, commercial and institutional** • Properties using LID as recommended in the Municipal Code may be eligible pursuant to said code previsions **Educational** • Public primary and secondary institutions that educate and inform students on importance of surface and groundwater resources may be eligible. Curriculum is set in a contract. • Educational institution must provide all documentation demonstrating school curriculum is above state standards.	**Senior/Low-Income** • 30% maximum credit **Industrial, commercial and institutional** • Rates are re-assessed based on amount of impervious surface that is reduced (all ICI properties are charged based on SQFT of impervious surface). **Educational** • 100% credit. Curriculum plan must be submitted to council who will then determine the credit amount. • Reduction applicable for 5 years.

City	Credit Programs & Sectors	Description of Credit/Rebate Program	Credit Rate
Seattle, WA	Stormwater Facility Credit Program Applies to single & multi-family residential, and commercial (ICI) Rainwise Program Applies to single-family residential properties	**Stormwater Facility Credit Program** • Any parcel or property can qualify if in compliance with the City Stormwater code. Large parcels with large amounts of impervious surface typically benefit the most from the program. Systems may be inspected once a year. Credit eligibility is upheld annually. **Rainwise Program** Rebate program for private installation of cisterns and rain gardens. Rebates only available for those properties that: • are within a target combined sewer overflow basin • work is completed by licensed contractor • inspections completed • rebate requested within 90 days of installation	**Stormwater Facility Credit Program** 50% maximum credit – with credit amounts being both site and system specific – which is determined by credit calculator **Rainwise Program** • 100% rebate for construction of rain gardens (max rebate of $3.50 per square foot). • Varied rebate for cisterns (dependent on size and number of cisterns installed) ranging from 58% - 100% for construction rebate ($2.02 – 3.50 per square foot).
Gresham, OR	Single-family residential Commercial (ICI) and multi-family customers Downspout disconnection program	**Single-family residential** • Credits vary depending on-site characteristics and technology used. **Industrial, commercial, institutional and multi-family customers** • Eligibility for those that exceed City design requirements for on-site stormwater mitigation facilities. Requires professional engineer sign-off. **Downspout disconnection program** • Program to encourage residents to disconnect downspouts in areas with good soil drainage. Green infrastructures program used to identify suitability. Residents can have city staff come on-site to provide the labour or do-it themselves. City provides parts and signage. Once finished, fee credit can be applied for by resident.	**Single-family residential, ICI and multi-family customers** • 27% discount for at least 75% on-site management of surface water generated on the property • 13.5% discount for at least 50% on-suite management of surface water on the property • If less than 50% of properties hard surface drain onto the property, no discount **Downspout disconnection program** • No rebate but participants receive free parts and city labour if needed. Participants can apply for a fee reduction. **Rain Garden Rebate** • Up to $200 rebate for the installation of a rain garden. 11 grants completed so far.

City	Credit Programs & Sectors	Description of Credit/Rebate Program	Credit Rate
Newberg, OR	Single-family residential Commercial (ICI) and multi-family customers	**Single-family residential** • Owners can decrease their stormwater fees if they have reduced runoff volumes through infiltration techniques such as rain gardens, pervious patios, or pervious driveways; or have trees that are not in the public right-of-way and are large enough to mitigate runoff. **Industrial, commercial, institutional, and multi-family housing** • Owners can reduce the amount of their stormwater fees by reducing runoff through infiltration, detaining runoff onsite, or educating employees or residents on runoff through newsletters, brochures, flyers, or training. Both programs require annual renewal by December 31st of each year with approval resulting in a reduced rate for the following calendar year.	**Single-family residential** 35% max fee reduction can be achieved through any combination of the following • 10% for pervious patio or walkway • 25% for pervious driveway • 10% for shade trees • 10% for swale or infiltration planter • 25% for rain garden **Industrial, commercial, institutional, and multi-family housing:** 50% max fee reduction through any combination of the following on-site techniques: • 10% for managing 2-year, 24 hour flood • 20% for managing 10-year, 24 hour flood • 30% for managing 25-year, 24 hour flood • 40% for managing 100-year, 24 hour flood • 10% for paved surfaces Best Management Practice (BMP) • 20% stormwater quality runoff BMP • 10% educational program Licensed Engineer certification required as condition of fee reduction
Portland, OR	Single-family residential & Commercial (ICI) – Clean River Rewards Eco-roof Incentive	**Single-family residential & ICI** • A variety of design approaches for on-site rainwater management are eligible for credits. Guidance on best management practices (BMPs) use is provided in City's Stormwater Manual. Permits are also required for a variety of stormwater retrofit projects. **Ecoroof Program** • The City of Portland offers an incentive to property owners and developers to add more ecoroofs. Environmental Services accepts incentive applications at any time of the year.	**Single-family residential & ICI:** 35% max fee reduction. Fee reduction determined by a credit calculator for both residential and commercial. • Residential discount based on amount of roof runoff managed on the property • Commercial discount based on how well you manage stormwater runoff from roof and paved areas. To maintain the discount, account must remain active, facilities must be properly maintained, and the city must be granted access to the property for inspections. **Ecoroof Program** • The incentive 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. Costs are not capped

City	Credit Programs & Sectors	Description of Credit/Rebate Program	Credit Rate
Sandy, OR	Single-family and commercial ICI – Stormwater Management Incentive Program	**Stormwater Management Incentive Program** • Intended to encourage property owners to utilize source control facilities on new development or redevelopment, or to make improvements to existing properties to mitigate stormwater discharges.	**Stormwater Management Incentive Program** • 33% fee reduction on the total number of Equivalent Residential Units (ERUs). Owner must have at least 3 ERUs (8250 SQFT) of impervious surface. • Use credit calculator to determine discount.
Waterloo, ON	Residential Multi-residential and non-residential properties	**Residential** • Credit based on the amount of runoff captured on the property and diverted from the municipal stormwater management infrastructure. **Multi-residential and non-residential properties** • Credit based on approved flood prevention (quantity) and pollution reduction (quality) controls.	**Residential, multi-residential and non-residential properties** • 45% maximum fee reduction. Unknown what will qualify for credits as policy still being finalized.
Kitchener, ON	Residential Non-residential and multi-residential credits	**Residential** • Credits available for impervious surfaces directed into approved stormwater quantity or quality BMPs that provide the City with a cost saving. • Program applies only for stormwater quantity control BMPs that are municipally accepted (infiltration galleries, storage devices, and landscape techniques). **Non-residential and multi-residential credits** • Credits available for properties that direct stormwater runoff to approved BMPs that provide the City with a cost saving. • Self certification reports and city inspections required to demonstrate functioning BMPs.	**Residential** 45% maximum fee reduction for stormwater quantity control. • 20% credit for capturing 200 – 800L • 30% credit for capturing 801 – 3200L • 45% credit for capturing +3201L. **Non-residential and multi-residential credits** 45% max fee reduction based on the adoption of the following techniques: • 25% for quantity control credit; • 15% for enhanced quality control (removal of 80% TSS) • 10% for normal quality control (removal of 70% TSS) • 5% for basic quality control (sweeping or salt management) • 5% education credit 85% max fee reduction for properties larger than 30 hectares, more than 50% of property lies in floodplain, and has functional stormwater BMP.

The following section provides a brief description of each case and identifies specifics on the creation of the stormwater credit and incentive program and its goals and objectives, while highlighting program successes and failures. After the individual

summaries of stormwater credit and incentive programs, the interview results are analyzed individually for each case in Table 5.2., based on the conceptual framework developed by Steelman (2010). The collective results are then discussed and comparisons and contrasts across cases are made.

5.1. Individual City Summaries of Stormwater Credit and Incentive Programs

This section provides an overview of each program, identifying specific program goals or objectives, and highlighting program successes and failures. These summaries are based on the transcribed interview results and a review of online documents and resources that detailed each cities stormwater utility and credit and incentive programs (Appendix C). These summaries are specific to each city with each having slightly different situations and approaches to managing their stormwater credit and incentive program.

5.1.1. Bellingham, Washington

The City of Bellingham, Washington has a population of over 80,000. In 1990, the Bellingham city council voted to create a stormwater utility. As of 2008, the City was required by the Federal Clean Water Act to have a stormwater management program in place. The program includes a stormwater code which specifies development designs for water infiltration projects and regulatory requirements for new developments on lots over a certain size. The City of Bellingham was an early adopter of a stormwater utility and much of their success resulted from early community involvement in program design. One notable success involves leveraging financial resources by providing public schools with an opportunity to receive a credit of up to 70 per cent on their stormwater utility fees if they deliver stormwater education within their institutions.

5.1.2. Issaquah, Washington

The City of Issaquah, Washington has a population of over 30,000. In 1988, the City of Issaquah city council voted to establish a stormwater utility to fund the

implementation of the City's stormwater program. The incentive programs developed by the city provide stormwater utility fee reductions for existing developments that install infiltration techniques to manage for 10 year or 100 year storm events. The municipal code also requires new developments to consider low impact development options first. According to the interviewee, the regulatory approach has been more effective than providing incentives. Dealing with resource constraints has challenged the credit incentive program and limited the city's delivery of education, monitoring, and targeted green infrastructure programs. Credits are also provided for schools that deliver educational programs. These schools are required to report annually on staffing hours and expenses to meet program requirements.

5.1.3. Marysville, Washington

The City of Marysville, Washington has a population of over 60,000. In 1999, the Marysville city council voted to establish a stormwater utility fee. The fundamental goal of the program is to create and maintain a stormwater system that protects against floods, reduces pollution in stormwater and minimizes damage to aquatic habitat. Like Bellingham, the City of Marysville provides an education credit for schools that deliver environmental education programs. Each school district must deliver a presentation about their program and its successes to City Council which then approves the rate reduction. The most successful part of Marysville's program has resulted from the creation of regulations that require the installation of low impact development techniques on new developments. The least successful part of the incentive program has been engaging developers to go above and beyond the regulatory requirements.

5.1.4. Seattle, Washington

The City of Seattle, Washington has a population of over 600,000. In 1987, the City of Seattle's council created the Stormwater Utility Division to administer the stormwater utility fee. The City has credit and incentive programs for commercial, industrial, institutional and residential sectors. Programs also include the stormwater municipal code, facility credit program, rainwise program, and athletic field program. The stormwater code was developed in 2009 and has been a success as it requires green infrastructure for all new construction and redevelopment parcels in excess of

700-800 square feet. The stormwater facility credit program provides drainage credits, however uptake has been limited. The rainwise program, which pays private landowners per square foot of stormwater managed on site, has been highly successful. A large driver for the rainwise program was to become compliant with combined sewer overflow requirements under the Federal Clean Water Act. The athletic fields program applies to highly pervious surfaces. Elements identified by the interviewees as key to program success included the creation of an easy application process for credits, providing training for green infrastructure providers, and coordination across municipal departments.

5.1.5. Gresham, Oregon

The City of Gresham, Oregon has a population of over 105,000. The City of Gresham developed a stormwater utility as a means of providing a sustained fund for the implementation of their stormwater management plan, which was a part of their strategy to comply with the Federal Clean Water Act. The city provides stormwater rate credits for homeowners and commercial and industrial properties. One important element of the program is the delivery of safety assessments by City staff to determine the suitability of any proposed green stormwater infrastructure projects. Another unique element of this program is a downspout disconnection program where individuals are provided up to $200 for disconnecting downspouts on their own, or city staff will complete downspout disconnections for residential properties for free. Green stormwater infrastructure requirements are also compulsory for redevelopments over 1,000 square feet, and the city levies development charges for the proposed amounts of impermeable surfaces on new developments. The interviewees said that a large part of this programs success was due to collaboration with the neighbouring City of Portland and engaging public outreach campaigns. City staff noted the importance of creating a simple application process for stormwater credit and incentive program participants.

5.1.6. Newberg, Oregon

The City of Newberg, Oregon has a population of over 22,000. In 2004, the City of Newberg's city council adopted an ordinance allowing for stormwater management fee credits. This ordinance provided property owners with the opportunity to apply for

credits for on-site management that exceeded the City's design standards. Until 2010, these credits were only available for non-residential properties, but the program was then extended to single family homes. The interviewees noted that initially the City had a very rigorous application and reporting process which they felt was responsible for the low adoption rates (only two successful applicants). As a result, the application process was revised to simplify applications and encourage greater program participation. The city's program also provides private organizations the opportunity to earn credits by providing stormwater education materials to staff and clients. According to the interviewees, the low adoption rates were considered to be the result of a low stormwater fee rate which created relatively small incentives with long payback periods.

5.1.7. Portland, Oregon

The City of Portland, Oregon has a population of over 580,000. In 1977, the City of Portland's city council created a separate stormwater utility to help pay for the increasing cost of managing stormwater. As an early adopter of a stormwater utility the City of Portland has an extensive program that provides incentives for the adoption of green stormwater infrastructure. Programs include the stormwater fee reduction for on-site stormwater management, the green roof incentive which offers $5 per square foot of green roof installed, City installed green infrastructure on private land within targeted combined sewer overflow basins, and community watershed partnership program grants for removal of impervious surfaces in the community. The City conducted a thorough financial study comparing the use of grey versus green stormwater infrastructure approaches and determined that a combination of green and grey infrastructure approaches would save $58 million in stormwater management costs. According to the interviewee, the overall effectiveness of this program was the result of broad community support and participation in stormwater management planning, and key partnerships with post-secondary institutions, and commercial and industrial property owners. Another important part of the program that was noted as improving the longevity of the program was the City's emphasis on measuring program participation and cost savings, monitoring and evaluation of water flow and quality, and creating strategic partnerships with private developers.

5.1.8. Sandy, Oregon

The City of Sandy, Oregon has a population of over 9,000. In 2001 the City of Sandy's council adopted a stormwater management plan to guide the implementation of an incentive program to encourage property owners to reduce or mitigate impervious pavement on commercial, industrial and multi-family residential properties. The city requires all new developments to treat and detain stormwater for 2, 5, 20, and 25 year storm events to pre-development conditions. The city does not allow residential lots with less than 8,250 square feet of impervious surfaces to be eligible for stormwater credits, however all other land uses are eligible. The city engaged single family residential units by giving out free rain barrels which were constructed out of used materials from the city's water treatment facilities. According to the interviewees the largest impediment to program participation was that the low stormwater fee did not provide a large enough incentive. The greatest success has resulted from working with developers early on in the site planning process and requiring new developments to manage for 2, 5, 10, and 25 year precipitation events. Program support in the community was largely due to their concern about the impairment of local streams and watershed health, especially the deleterious impacts on salmon habitat.

5.1.9. Kitchener, Ontario

The City of Kitchener, Ontario has a population of over 204,000. In 2011, the City of Kitchener transferred stormwater management funding from property taxes to a utility, or user-fee program. The city created a tiered flat-fee which was calculated based on property type and size of impervious area. In 2012, the city council approved the stormwater credit policy which offers incentives for all rate payers that can demonstrate best practices for managing stormwater runoff on their property. The creation of this program involved much study and preparation in advance of public participation. This included the development of a set of program alternatives (non-residential credits, residential credits, rebate program, a combination of the three, or do nothing), impact analysis study for each alternative, and a set of evaluation criteria which was used by the city to select a preferred alternative. As the program was only recently approved by council there was little information available on program implementation.

5.1.10. Waterloo, Ontario

The City of Waterloo, Ontario has a population of over 97,000. In 2010, the City of Waterloo took a new approach to funding stormwater management by moving from a tax-based to a rate-based approach. This funding shift is being phased in over four years. In 2012, the City of Waterloo's council approved the stormwater credit program which provides for two groups to participate in the stormwater fee credit program: i) low-density residential; and ii) multi-residential, industrial, commercial and institutional. The low-density residential program is based on potential volume of stormwater captured or slowed, whereas the multi-residential and industrial, commercial and institutional program is split into stormwater quality controls (pollution reduction) and quantity controls (flood prevention). The development of the credit program involved two open houses with the public to provide feedback on the suite of options developed by city staff. The administration of this program is planned to involve a unique partnership with the Residential Energy Efficiency Project (REEP), a local non-profit organization. REEP will deliver communication materials about the program, develop educational programs in schools and engage the public through outreach, tours, workshops and educational programs. The interviewee said that this strategic partnership with REEP has allowed the city to focus on what they are good at, billing, and allowed REEP to deliver effective communication and engagement programs.

5.2. Analyzing Stormwater Credit and Incentive Programs as Environmental Innovations

After preparing a report for the City of Victoria summarizing the ten cases, I reviewed the documents and results of the interviews again to identify the roles that factors operating at the individual, structural, and cultural level played in shaping the development and implementation of each jurisdiction's stormwater credit and incentive program. I classified these factors using Steelman's (2010) framework for analyzing the implementation of innovations. In Table 3.1., the factors I identified for each case are listed and assigned a rating of "positive program attribute", "marginal program attribute," or "negative program attribute," based on my assessment of the role of each factor in implementation. The sections following Table 5.2. provide more in depth explanations of

the roles of individuals, structures and culture across case studies, highlighting common factors that worked for and against implementing the innovations.

Table 5.2. Analyzing the Implementation of Stormwater Credit and Incentive Program Innovation. (+ = positive program attribute, +/- = marginal program attribute, - = negative program attribute)

Individuals	Structures	Culture
City of Bellingham, WA		
+ Highly motivated group, acting to protect water quality. +/- Norms/harmony upheld through existing structures. Challenged when developing monitoring programs. + City values and dominant community values aligned to promote pursuit of innovation.	+/- Rules clear internally, and external communications focused on targeted audience. +/- Incentives limited: credits, system development charge reductions; targeted eligibility criteria, limited public recognition. + Opening from need to protect local water supply. - Resistance from business community due to high bills and lack of knowledge.	+ Shocks resulted from declines in source water quality. - Framing not used intentionally at program outset but now a part of larger Homeowner Incentive Program (HIP). -/+ Legitimacy comes largely from the federal regulatory requirement and water quality improvement.
City of Issaquah, WA		
+/- Motivated group, reduction in staff and financial resources altered focus to meeting legislative requirements. +/- Norms upheld initially through municipal code development. Shifting priorities altered harmony. - Congruent developer and city values with Municipal Code creation. Reduction in city staffing and programs outsourced.	+/- Clear communication and rules for the development community but limited for existing developments. - Incentives limited. Credits for existing and new developments and school education programs. + Opening due to impending federal legislation. - Initial resistance from development community as they did not perceive a benefit to them from green infrastructure.	+ Shocks included flood risk, source water quality contamination, and impending federal legislation. + Framing identified the financial benefit to new developers when investing in green infrastructure. + Legitimacy gained as water monitoring showed water quality improvements.
City of Marysville, WA		
+/- Motivated individual; State grant to alter Municipal Code and meet upcoming legislative requirements. + Norms/harmony upheld through existing structures and perceived fairness to rate payers. - City values divergent from developer values with property owner paying fees.	- Rules clear in State approved manual but external communications and monitoring limiting. - Incentives limited: credits, limited eligibility, credits for educational institutions, limited public recognition. +/- Opening due to State grant and high cost of substitutes - Resistance largely from the development community	+/- Shocks not applicable. +/- Framing not utilized beyond the cost savings that may result from green infrastructure adoption by developers. + Legitimacy resulted through the use of both voluntary and regulatory approaches and participation by key developers.

Individuals	Structures	Culture
City of Seattle, WA		
+ Highly motivated group driven by mayor and council. + Norms/harmony challenged when creating a new program. Executive supports compliance. + Divergent developer and city values overcome through collaboration.	+ Clear rules and communication internally and externally. + Good incentives: rebates and credits, varying amounts and eligibility, and signage and online recognition. + Opening resulted from impending federal legislation. +/- Some initial resistance due to alteration of the status quo and limited program uptake for commercial properties.	+ Shocks resulted from issues of poor water quality within the Puget Sound and legislative change. + Framing used strategically to promote the adoption of green infrastructure throughout the city. +/- Legitimacy threatened by failure of public green infrastructure. Overcome by use of voluntary and regulatory approaches along with participation by key stakeholder groups.
City of Gresham, OR		
+ Highly motivated group. + Norms and harmony supported through collaboration with neighboring City of Portland. + Congruence supported by pressure to keep up with the City of Portland.	+/- Clear rules and communication internally, external application process initially too burdensome. + Various financial incentives; types, amounts, eligibility, and recognition. + Opening due to impending federal legislation. +/- Initial resistance due to lack of knowledge; overcome with expanded outreach to community and simplified application process.	+/- Shock resulted from legislative change. + Skillful framing of social, economic and environmental benefits of programs. + Process legitimized through use of voluntary and regulatory approaches and pilot projects were conducted prior to citywide rollout of programs.
City of Newberg, OR		
+/- Motivated individuals, driven by code compliance. - Norms/harmony challenged due to the administrative burden and limited program uptake. - Federal legislation incongruent with dominant values within the agency. Limited motivation to pursue innovative practices.	- Clear rules internally but limited external outreach and communication. - Poor incentives. Low credit, wide eligibility parameters, and limited recognition. + Opening due to impending federal legislation. - Resistance to low rates, lack of communication, and financial risk aversion.	+/- Shock resulted from legislative change. - Framing not used. - Process not legitimized. Limited success of voluntary approach and absence of regulation for new developments.

Individuals	Structures	Culture
City of Portland, OR		
+ Highly motivated community. + Norms/harmony supported through stakeholder collaboration. + Developer and city values congruent as a result of collaboration.	+ Clear rules and communication internally and externally. + Various financial incentive types, amounts, eligibility, and recognition. + Opening from community pressure to improve local water quality. +/- Initial resistance due to dramatic alteration of the status quo.	+ Shocks resulted from river contamination and Combined Sewer Overflows (CSOs). + Skillful framing of social, economic and environmental benefits of program development + Collaborative nature of the process and both voluntary and regulatory approaches improved legitimacy.
City of Sandy, OR		
+ Highly motivated group. + Norms/harmony supported through existing capacity. - Developer values incongruent with city values.	+ Clear rules and communication internally and externally. + Financial incentives limited to non-single family residential developments. + Opening due to impending federal legislation. + Resistance limited as few properties eligible to participate in program.	+ Shocks resulted from flooding and salmon population decline. +/- Framed not used. - Limited program uptake may have done little to legitimize program efforts.
City of Kitchener, ON		
+ Highly motivated group, driven by the senior executive team. + Collaboration supported harmony among the diverse stakeholders. Norms maintained through existing structures. + City values congruent with community values, with collaboration driving the innovative process.	+ Rules and communication materials currently under development. NGO developing social marketing strategy. + Incentives: credits for all developments, school education programs, targeted eligibility criteria, and public recognition. + Opening: Revitalization of Victoria Lake Park project dovetailed with stormwater utility development. + No resistance to proposed incentive program.	+ Shocks resulted from poor water quality in Victoria Lake. + Skillful framing used to motivate community participation. +/- Collaboration on voluntary and regulatory approaches appears to be legitimizing the group.
City of Waterloo, ON		
+ Highly motivated group, driven by council. + Collaboration supported harmony among the diverse stakeholders. Norms maintained through existing structures. + City values congruent with community values with collaboration driving the innovative process.	+ Rules and communication materials currently under development. NGO developing social marketing strategy + Incentives: credits for all developments, education programs, focused eligibility criteria, and recognition. +/- Opening: Stormwater utility development in neighboring City of Kitchener. +/- No resistance to proposed incentive program.	+ Shocks resulted from increasing financial burden of operating and maintaining the municipal stormwater system. + Skillful framing used to motivate community participation. + Collaboration on voluntary and regulatory approaches appears to be legitimizing the group.

5.2.1. Individuals

Individuals play an important role in the planning, development and implementation of environmental innovations as they are capable of devising and supporting alternatives to existing environmental policies or operating to defeat the implementation of such policies. The status quo that exists in most local governments would be the pursuit of stormwater quality objectives through the development of stormwater controls implemented by the City, most often on public lands. However, the pursuit of water quality and quantity objectives through local government stormwater management controls is generally not considered to be the most cost effective means of achieving these goals (Thurston, 2012). The use of stormwater credit and incentive programs has provided individuals in local governments with the opportunity to develop programs that are suitable to the given context of the community and the organizations involved.

As noted in Steelman (2010), individuals can positively or negatively influence the implementation of environmental innovations based on their motivations, the norms and harmony which they attempt to balance, and the level of congruence that exists as a result of the dominant values present within a community and organization. Although it was difficult to classify the interview results into these three sub-categories, it is important to compare and contrast the role and complex interactions that individuals have when pursuing innovations in the local government context.

Motivation

Interviewees identified several motivational factors as important for moving past the status quo approach to stormwater management. in the U.S. case studies, innovations were most frequently pursued as a result of addressing legislative requirements from the Federal *Clean Water Act* (1972, 33, U.S.C., Sec. 1251). The *Clean Water Act* created the National Pollution Discharge Elimination System, which requires municipalities to handle stormwater runoff in a responsible manner. Municipalities rely upon a variety of stakeholders in support of their goals to protect community health and local water quality. A variety of actions were taken by industry, developers, and homeowners to help each municipality meet the specific requirements that were detailed in the National Pollutant Discharge Elimination System permits.

The incentive for local governments in the US to pursue the development of stormwater credit and incentive programs was dependent largely on the costs associated with providing municipal stormwater facilities that meet the requirements under the Act. These included a variety of stipulations related to the management of stormwater quality and quantity issues within the community, which are also dependent on the population of the community and its existing stormwater infrastructure (e.g. presence of combined sewer overflows). Although some level of flexibility was given to each community to devise their own stormwater management programs in order to achieve the goals set out in the Act, each local government is required to report out annually to the State agency that manages the permits on behalf of the US EPA.

In the Canadian cases, pursuit of the innovation was not directly the result of a top-down directive from a provincial or federal government, but was driven by the pursuit of an equitable and balanced approach to paying for stormwater services within the community. However, both interviewees noted that their stormwater credit and incentive programs built upon existing watershed protection legislation under the Ontario Government's *Clean Water Act* (2006, S.O. c. 22) which was aimed at protecting drinking water quality in communities. As a result, the development of these incentive programs did not follow a prescribed set of rules as in the US; instead in the Canadian cases the innovations were led by the local government, in coordination with the Province of Ontario, and inclusive of a wide variety of community stakeholders. Interviewees noted that city led collaboration amongst these groups was invaluable in the selection and development of suitable stormwater incentive programs.

The motivation for creating a stormwater credit and incentive program in all cases was associated with the creation of a stormwater utility in each jurisdiction. This change in funding model, which sees private land owners paying for the impact their parcel of land has on the stormwater system, creates an opportunity to reward those individuals that manage stormwater through a variety of measures on their property. Each interviewee noted the importance of having an incentive program in place to ensure that the new utility based funding model is equitable and results in individuals paying less should they adopt prescribed stormwater best management practices.

The importance of organizational and political leadership was also identified as an important factor in the commitment to developing and implementing a stormwater credit and incentive program. In those jurisdictions where political or executive leadership was not present, stormwater credit and incentive program implementation often lacked the resources and motivation for pursuing more engaging programs that promoted the adoption of stormwater best management practices in the community. Interviewees said that this lack of resources and motivation impeded their ability to mitigate stormwater issues in the community. Steelman (2010) highlights that a lack of clear leadership to catalyze action in natural resource governance is likely to result in individuals (in these cases local government staff) being less motivated to work on or prioritize these initiatives.

The results identify that the influence of political and executive leadership and federal or state and provincial legislation are key drivers in the motivation to pursue innovative stormwater credit and incentive programs.

Norms and Harmony

The influence of norms and harmony on the development of stormwater programs was particularly evident in interviewees' responses to questions asking them to identify what challenges and opportunities existed when implementing the innovation within their organization. These responses identified the program elements that upheld norms and those that altered the harmony present within the organization.

When asked to indicate who manages the overall stormwater credit and incentive program in their community, interviewees most commonly noted that it was the responsibility of the engineering department, public works, or operations and maintenance staff running the program. Only one jurisdiction, the City of Seattle, did not identify both public works and engineering, but instead named a group within the organization known as the "Utility Systems Management" group which is responsible for the provision of potable water, waste management and stormwater services. The interviewees did not identify those departments that participated in this group but highlighted that it brought together different branches of the organization that were responsible for delivering a variety of stormwater utility programs and services (finance, education, enforcement, regulatory, monitoring, planning, and oversight). Eighty per

cent of interviewees noted the importance of working across departments within the organization. Although the integration of stormwater credit and incentive programs across the organization may be beneficial in meeting the overall objectives of the program, it may also result in disharmony due to changes made to existing systems.

Norms were maintained in the majority of the case studies by creating green infrastructure requirements for new developments; using municipal powers to influence the construction of such green infrastructure facilities. Cities in both Canada and the US integrated stormwater management requirements within their Municipal Codes, by requiring adoption of green infrastructure in new developments. Norms were also upheld as the communication and delivery of stormwater education programs, billing, and inspection fell within existing services delivered to communities.

In several cases interviewees acknowledged the importance of support for the program from upper management and politicians within the organization. Such support encouraged the development and implementation of the stormwater credit and incentive program and improved the harmony within the organization by prioritizing the program and its objectives. In particular, the interviewee from Seattle emphasized the importance of having the mayor and council wholly supporting the initiative and their role in creating a shared vision for the program which lowered the amount of resistance to change within the organization. This level of political leadership resulted in sustained support for the program as all aspects were shuttled through the mayor's office and the council, which were ultimately responsible for advocating the importance of the stormwater credit and incentive program to each department.

Congruence

Individuals perform within a dominant culture that exists within their organization and the community to which it answers. The values present within these two distinct groups can influence the ability of a program to function effectively. Within the communities that developed and instituted lasting change in their approach to stormwater management, the most successful were those that promoted the multiple benefits of adopting stormwater best management practices, such as the social, economic and environmental benefits. Interviewees noted that this was critical at the implementation level as private land-owners were strategically engaged, educated and

empowered into meaningful action. Interviewees that acknowledged relatively low adoption rates over the duration of the program felt that the main factor influencing participation rates was a low utility rate and long pay-back periods for adopting green infrastructure. These interviewees also acknowledged that they limited their promotional efforts as the pay-back was small and likely not enough to incent meaningful action.

Another important issue related to congruence was determining how the program would address community stormwater issues. There were several differing opinions on what helped ensure that the agency was supportive of the stormwater credit and incentive program. Several interviewees indicated the importance of starting off incrementally through the application of pilot projects and targeted approaches that sought to maximize program performance. Taking this approach may also have helped these programs to gain legitimacy within the organization and the community. Others utilized baseline water quality data to monitor the impact of previous stormwater management efforts. Another jurisdiction identified high priority areas for stormwater management and infrastructure upgrades and developed their program around vulnerable areas within the watershed. Some took a more formal approach and conducted modeling exercises to examine the performance that certain green infrastructure approaches would have on controlling water volumes and protecting water quality in their communities. Portland modeled the overall cost/benefit of what it called taking the “grey vs. green” approach to stormwater infrastructure. The “grey” approach is simply using engineered solutions compared to the “green” approach which is to utilize green infrastructure and stormwater best management practices in an effort to comply with federal regulations under the U.S.’s *Clean Water Act*. The interviewee noted the “grey” approach alone was going to cost the city $144 million to be compliant with the federal regulations whereas a combination of “grey” and “green” infrastructure would meet the regulatory requirements while costing only $86 million.

5.2.2. Structures

Steelman’s (2010) framework recognizes three main types of structural factors: the set of rules developed and communicated internally and externally; the incentives in place to support innovation; the opening that is present to help foster change; and the level of resistance towards a new practice.

Rules and Communication

To implement a stormwater credit and incentive program all cities developed a set of rules and performance measures to help guide private landowners when adopting city approved green infrastructure. The most common rule in place was to provide a variation in credit rates available for private landowners depending on the land use type and amount of surface water being managed. These often differed substantially as some cities took a more methodologically rigorous approach to identifying the economic benefit of prescribed green infrastructure techniques, while several simply adopted credit rates based on a review of those used in other jurisdictions. Interviewees also noted the importance of conducting assessments to determine the geographic areas where green infrastructure was found to be most suitable. Identifying green infrastructure suitability was used to create a set of rules governing eligibility for various green infrastructure techniques.

It is also important for local governments to communicate with the general public to develop a level of understanding about the goals of the stormwater credit and incentive program and educate them on how they can get involved. Interviewees emphasized that although many methods of communication and outreach had been attempted (mail-outs, website information, videos, earned media, workshops and print advertisements) the most effective approach was door-to-door canvassing and offering one-time rebates for the installation of green infrastructure. Given that several interviewees highlighted that communication efforts were hindered as a result of inadequate budgetary resources it is important to acknowledge the most cost-effective methods used to engage private land owners to manage stormwater onsite. The City of Kitchener and Waterloo developed a partnership with an environmental non-profit organization called REEP Green Solutions. This group will deliver communications and other stormwater retrofit programs such as educational materials and workshops. Although Kitchener and Waterloo had not yet implemented this aspect of their stormwater credit and incentive program, the interviewees noted that this will allow the City to continue to focus on supplying stormwater services and billing customers, and leave REEP to deliver programs similar to those which they have successfully undertaken in the past involving energy efficiency programs in the community.

Communicating the benefits and piloting green infrastructure techniques can be extended by partnering with non-government organizations and local colleges and universities. Only 1 of 10 cities did not work with a university institution in support of improving community stormwater management. The benefits of these partnerships, whether formal or informal, ranged from the completion of community demonstration gardens, integration of stormwater management questions into annual community surveys, creek monitoring programs, public education programs, economic feasibility studies, and community pilot projects. These partnerships were considered to be very beneficial to the overall level of commitment and visibility of stormwater programs within the community, while building valuable skills and capacity.

Another way to communicate to residents about the benefits of green infrastructure installation was through the provision of technical support to the public. Interviewees identified the most common technical support tool as the use of guidebooks or fact sheets to guide individuals installing green infrastructure on their properties. Another approach was to provide a credit calculator that allowed residents to determine the potential cost savings that would result from the adoption of a particular green infrastructure technique on their property. Building capacity through the delivery of workshops was also a common way of communicating about stormwater credit and incentive programs, with six out of ten cities conducting workshops in the community. A unique approach used by the City of Seattle provides workshops for private companies that want to install green infrastructure, and will not approve credits unless installation is completed by a 'Rainwise Contractor'. The interviewees indicated that this approach has been successful in training professionals and increasing the program's profile in the community as contractors will often self-promote about the program and the services they deliver. The interviewee from the City of Seattle also noted that this rule limits having unqualified or inexperienced individuals or 'do-it-yourselfers' installing green infrastructure and improves the likelihood that the installations will perform as intended.

Related to communication and education is the more contentious issue of maintenance requirements, which are considered to be a critical element to the continued success of privately installed green infrastructure. Cities can use a variety of approaches to confirm that installed green infrastructure is performing as intended and having a net benefit to the city's stormwater system. The most common approach used

to ensure that green infrastructure is functional was to require new and existing developments to have inspections completed prior to receiving a credit for the amount of surface water managed on a given parcel of land. Cities requiring inspections noted the importance of clear language stipulating the right for the city to access the property to ensure the system is functional and proper maintenance is being conducted. Although not as common, some interviewees noted that their cities required additional compliance inspections to be completed by the city annually or bi-annually. In some cases individuals were required to submit self-certification reports that outline the operations and maintenance completed in order to continue to receive a credit. For new developments it was considerably easier to ensure that design standards were met through the existing developmental plan and review stages. Of the cities interviewed, most required sign-off by a designated professional (professional engineer or registered professional biologist). An important challenge, noted by the City of Maryland, is keeping track of the green infrastructure that was in place before the stormwater credit and incentive program was in place. This becomes problematic when property owners do not apply for a credit and it is unknown where and how well these systems are functioning.

When considering the liability that may result from the installation of a stormwater device or structure on private property, interviewees stressed the importance of including language that waived liability within the homeowner agreement. Interviewees also pointed out that it is the role of individuals with green infrastructure on their property to maintain it and assume liability.

It is also important to consider how non-compliance with stipulated maintenance schedules is dealt with. The common approach taken by interviewees was that non-compliance with a maintenance schedule would result in the loss of a credit. Most cities noted that fines would not be levied but education would take place in advance of any credit reduction. If a reduction in the credit was instituted, it was the responsibility of the property owner to rectify the maintenance issue at which point they could then re-apply for the credit. Another tactic that was employed in three jurisdictions was the use of fines for violators of a city's maintenance schedule. These cities noted that repeat offenders may be fined if found to be in non-compliance with the city's maintenance

schedule. In extreme circumstances a third offence could result in a fine of $1,500 per day (City of Bellingham).

Interviewees were asked to identify what resources they used to identify suitable standards for stormwater management installations in their community. The use of development standards in support of the adoption of suitable stormwater best management practices was found in each city that had implemented a stormwater credit and incentive program. The larger cities of Seattle and Portland developed their own design standards for new building design and stormwater best management practices retrofits. Other cities simply utilized state/provincial or county manuals, with some taking advantage of the design standards developed by Seattle and Portland.

Rules and communication are very important aspects of any stormwater credit and incentive program both internally and externally. Internally, implementation is more likely to be successful with a political or executive leader supporting the initiative and ensuring accountability is maintained throughout the organization. External groups need to be able to clearly and easily understand why stormwater management is important and how they can get involved to take meaningful action. If rules and tools provided are unclear or misleading this may have a negative impact on the program and its perceived legitimacy in the community.

Incentives

Incentives are a means of supporting innovations by altering the cost-benefit calculus (Steelman, 2010). It is important to understand the incentive type used (rebate, credit, or free installation), the eligibility criteria, and the recognition given to participants as a means of encouraging desirable behaviours. Howlett et al. (2009) note the importance of user charges in motivating behaviour by imposing a price on a given service (in this case the management of stormwater) to deter certain actions and control negative externalities. User charges can promote innovation as individuals will search for cheaper alternatives depending on the amount of potential savings and their eligibility (Howlett et al., 2009).

Interviewees from cities with low stormwater utility fees noted that the use of credits for existing developments was not high enough to encourage the adoption of

green infrastructure. As a result these jurisdictions highlighted the importance of utilizing regulations to ensure developers complied with stormwater objectives.

Incentives for new developments were considered to be more straightforward to implement than incentives for retrofitting existing developments. Of the US cities interviewed, all but one required new developments to incorporate green infrastructure into new construction as a part of their Municipal Code (Table 5.3.). Although this was not required under the National Pollutant Discharge Elimination System permits, it was considered one of the most straightforward means of influencing stormwater management and encouraging the adoption of green infrastructure. Most cities relied on the fact that new developments were charged for their impact on the stormwater system and that this would be enough to encourage developers to be innovative in managing on-site stormwater volumes. However, as noted by the City of Issaquah (Personal communication, June 6th, 2013) this was not always the case as “a fundamental problem with a lot of these programs that rely on stormwater fee reductions as an incentive to developers that they may not be interested at all because it isn't really a benefit to them. What they want to see is a reduction in, like, permit fees and things like that or land use benefits like increased density." This highlights the separation between developers and the eventual owners of the property in providing the rationale for adopting innovative stormwater practices. The interviewee from the City of Gresham (Personal communication, June 12th, 2013), however, noted that the opportunity to work with developers is based on the changing economics of implementing stormwater best management practices as "We've also found that by doing green development practices it’s cheaper to install and it doesn't cost as much as doing a proprietary system… so there is some added benefit by doing green development practices that basically the upfront costs are lower." The City of Gresham bases part of their System Development Charges on the amount of impervious surfaces that will be on-site as an incentive for developers to pursue stormwater best management practices.

Table 5.3. Summaries of Incentives for New Developments in Canada, Washington State and Oregon State.

City	Incentives for New Developments
Bellingham, WA	**System Development Charge** Charges on each parcel of property that is developed or redeveloped: • $678 for a single family residence. • Fee shall be calculated at the rate of $0.226 per SQFT of impervious surface on non-single-family residential properties. • Credit of 50% for developments meeting minimum thresholds for designation as a Low Impact Development
Issaquah, WA	**General Facilities Charge** • New connections to stormwater system charged $789 times the number of equivalent service units (ESUs)
Marysville, WA	**General Facilities Charge** • Based on connection to the system in terms of an impact fee as a part of construction. $95 per 3,250 SQFT.
Seattle, WA	**2009 Stormwater Code** • Use of green stormwater infrastructure is mandated for new construction and redevelopment of parcels in excess of 700 square feet. Management efforts required to a 'maximum extent feasible'.
Gresham, OR	**Development Code for Stormwater** • On-site controls required for addition or replacement of more than 1000 SQFT of impervious area. Applicants for development permits must submit a stormwater quality control plan as a part of their application utilizing appropriate best management practices as per the City's Water Quality Manual. • Maintenance is the responsibility of the owner and private facilities are subject to periodic inspection by the City. • Civil engineer must certify that on-site mitigation facility will function to designed capacity.
Newberg, OR	**Stormwater Code** • Projects creating 500 SQFT or more of net impervious area in vulnerable areas to provide engineered stormwater facilities. • Projects creating over 2,877 SQFT or more of impervious area required to provide method for treating stormwater. • Privately owned facilities operated and maintained by the owner with annual operation and maintenance reports submitted to the City. City authorized to inspect stormwater facilities and access to maintenance and operating documents at inspection.
Portland, OR	**Single-family residential & ICI** • Sites with 500 SQFT or more of impermeable surfaces must be managed for pollution reduction, quantity or flow control. Must adhere to specifics laid out in the Stormwater Management Manual. **Ecoroofs Program** • Have a Floor Area Ratio Bonus for new developments with ecoroofs.
Sandy, OR	• The City requires all new developments to treat and detain stormwater from the 2, 5, 10 and 25 year storm events to pre-development conditions, as defined in the City of Portland Stormwater Management Manual. and in the City Municipal Code
Waterloo, ON	Did not specify
Kitchener, ON	Did not specify

Some interviewees also revealed the importance of conveying the desirability of adopting green infrastructure to developers through the use of suasion. Suasion, as described in Howlett et al. 2009, refers to the urging of a targeted group to alter certain behaviours in order to induce change in a desirable manner. Interviewees noted that their suasion efforts to encourage developers to adopt green infrastructure were most effective during pre-development consultations between local government staff and developers. Although this may be considered an informal approach to addressing stormwater management issues at a site specific level this approach was considered by interviewees to be more effective than education alone. Howlett et al. (2009), suggest that this tactic is most successful "when used in conjunction with other policy instruments when they are available" (p. 118).

Opening

When a political structure is open to changing a practice or service it delivers to the community there is more opportunity for innovation, whereas a closed political structure reduces the likelihood of fostering innovation (Steelman, 2010). Openings may come as a result of top-down or bottom-up stressors or shocks (see section 5.3.1). Although it may be difficult to determine exactly how open a political structure is, interviewees were asked to identify how they fostered change within the organization and community, and were asked to identify the main drivers for the creation of a stormwater credit and incentive program.

Within their organizations, most interviewees identified that their financial department was responsible for conducting an assessment of the financial feasibility of developing a stormwater credit and incentive program. This is important because without understanding the financial impacts of adopting a stormwater credit and incentive program, stormwater utilities may not generate the amount of revenue that is needed to deliver essential stormwater programs. However, as the interviewee from the City of Newberg (Personal communication, June 14th, 2013) pointed out, the financial impact of having private property owners adopt green stormwater infrastructure may reduce the need to invest in costly capital projects in the long terms as "our feeling is that we will not have to up-size the pipes…. In the future it is going to be a decreased cost to the city." Thus, it is important to consider the cost decreases that will result from the adoption of stormwater best management practices on privately owned property and

the future cost avoidance of up-scaling 'grey' stormwater infrastructure. Some cities used pilot projects, or existing on-site stormwater installations to consider the potential adoption rates of stormwater best management practices in their communities. Interviewees from four of eight cities the U.S. emphasized that a considerable amount of financial analysis was conducted, but that the adoption rates of stormwater best management practices in their communities were so marginal that it did not negatively impact the stormwater revenues. Uncertainties surrounding the financial sustainability of stormwater credit and incentive programs may influence the openness of the political structure to take on innovative approaches. As noted by the interviewee from the City of Newberg, identifying the financial benefits of adopting a stormwater credit and incentive program may have helped to create an opening in the political structure.

Interviewees were also asked to provide recommendations to help facilitate the adoption of stormwater credit and incentive programs in other jurisdictions. The responses may be useful to identify existing openings or strategic opportunities to open up a closed political structure. There were several important recommendations:

- Utility rate needs to be large enough to motivate people to manage stormwater on-site;
- Cities need to work with developers in pre-application phase to foster change;
- Incentives may be relatively low risk as adoption rates are often marginal;
- Pilot programs help reduce uncertainties and improve political willingness to act; and
- Programs should be targeted to reflect the unique needs of the neighbourhood's and catchment areas in order to improve their likelihood of success and improve the legitimacy of the approaches being taken by the City.

Resistance

As organizations can be opposed to changes that result from the implementation of innovations, I asked interviewees to identify any challenges that were faced within the organization and community when developing the stormwater credit and incentive program. Interviewees recognized the following challenges within their organizations and community:

- Ensuring program support given internal workload and competing projects;

- Challenges in creating a maintenance and review process for new stormwater technologies;
- Role of the State plumbing code and its influence on the adoption of safety standards;
- Understanding the administrative costs of managing an elaborate stormwater credit and incentive program;
- Challenges in developing a new programmatic area that did not previously exist within the organization;
- Lack of institutional knowledge of green infrastructure design and most suitable approaches;
- Administering green infrastructure requirements within the municipal code;
- Addressing the legal issue of charging each department within the agency for the impact it places on the stormwater system;
- Incorporating the building and development community into program development to ensure support of the new initiative;
- Challenges increasing participation rates in adopting green infrastructure and getting existing properties with existing green infrastructure to apply; and
- Educating the public to ensure that activities taken to manage stormwater on-site are designed properly and working effectively.

In some cases the largest resistance within the organization appeared to be a challenge related to altering the status quo from an engineered approach which focused more on managing stormwater through physical infrastructure (pipes and pumps) to an approach that utilizes natural watershed assets and builds upon them in a manner which mimics natural hydrological conditions. However, as noted in the interview with the City of Portland, conducting a cost benefit analysis of 'grey' versus 'green' infrastructure resulted in a higher commitment to using green stormwater infrastructure than only engineered solutions as the cost-benefit calculus was more favourable when using a mixed approach that utilized both grey and green infrastructure.

When considering the level of community involvement in the development of stormwater credit and incentive programs there was considerable variation across cities. Those cities in the US that were mandated to control stormwater to meet the requirements of the National Pollutant Discharge Elimination System permits identified that public hearings were the main mechanism used in support of public participation in the development of a stormwater credit and incentive program. One city noted that this was a result of the stormwater credit and incentive program being a voluntary program

which the public can choose to participate in and therefore it was considered less important to find out the opinions of the community in advance. The irony being that a lack of community involvement in program development may have reduced the level of participation in the program once it was implemented. In contrast, the early adopters, which acted prior to the establishment of the National Pollutant Discharge Elimination System permits (Portland, Sandy, Bellingham, Kitchener and Waterloo), were more likely to stress the importance of gaining public support and feedback in developing a stormwater credit and incentive program.

Other supportive features or groups may be present in the community that can leverage capacity by improving the level of knowledge surrounding complex, multifaceted issues such as addressing stormwater management problems. As noted previously, only 1 of 10 cities did not work with a university institution in support of improving community stormwater management. Partnering with these organizations may leverage existing resources and knowledge and work strategically based on the innovations of other agencies that have experience in delivering a particular stormwater innovation.

It is also important to identify if and how stormwater management efforts are being coordinated with other jurisdictions. Cities in the US were more likely to work with State representatives to report on the steps taken to meet the criteria noted within the *Clean Water* Act. Also, staying connected with State representatives was considered by interviewees to be important because of the evolving nature of these regulations and changing requirements. The City of Maryland noted that there was a National Pollutant Discharge Elimination System “managers group” which provided a good opportunity to share information and experiences in the permitting process. In some cases US cities would also work with other local governments and with their respective counties to coordinate stormwater credit and incentive programs with other levels of government. Interviewees from cities in Canada noted that they had worked with their provincial counterparts to ensure that their stormwater credit and incentive program aligned with certain requirements of the *Municipal Act* (e.g., Kitchener and Waterloo).

5.2.3. Culture

The cultural variables in Steelman's (2010) framework include shocks, framing and legitimacy.

Shocks

Most U.S. interviewees noted that their stormwater credit and incentive program was a direct result of the implementation of the National Pollutant Discharge Elimination System permit process. More specifically, interviewees identified the following shocks that enabled the creation of a stormwater credit and incentive program:

- Federal regulation requiring stormwater systems to meet certain minimum water quality levels and water flow rates;
- Federal requirement to manage Combined Sewer Overflow's which established a deadline for implementing minimum technology-based controls (January 1, 1997);
- Federal requirement to manage Total Maximum Daily Load (TMDL's) in water's considered to be impaired by the *Clean Water Act*;
- Reduction of local drinking water quality within the community watershed;
- Loss of salmon spawning in streams; and
- Inability to finance stormwater programs as a result of increasing costs of replacing ageing infrastructure and competition for scarce financial resources at the local government level.

Some shocks resulted from the implementation of the stormwater credit and incentive program in the community and forced the program to adapt their programs. One interviewee noted that a shock resulted when an application form was considered to be too complex for single family residents and was limiting participation in the program. Consequently, this shock negatively impacted participation rates and was adjusted to reflect to improve program implementation and participation. Another interviewee noted that a shock occurred within the organization as a result of the unknown operation and maintenance costs that were associated with installed green infrastructure on public lands. As a result of this shock the organization was forced to adjust their maintenance requirements to improve implementation of the monitoring and maintenance aspects of the program.

Other shocks that occurred as a result of program implementation included an early public failure of a bio-retention facility that was heavily publicized by the media. The failure of this bio-retention facility was framed as a waste of public funds and resulted in the release of pollution into local waterways. Another shock was due to the lack of the anticipated effects of free-ridership when developing an incentive for installing an eco-roof. This resulted in considerably lower adoption rates than anticipated.

Framing

Each interviewee was asked to identify if or how financial incentives were considered to be an effective means of encouraging the adoption of stormwater best management practices in their community. Although the social norms present in each community likely varied, interviewees from communities that assessed their programs as successful in encouraging the adoption of best management practices said that previous stormwater management problems provided an opportunity to frame programs in a way that stimulated action and improved program legitimacy. These included flooding, river or stream degradation, and the loss or reduction in aquatic species present in local waterways (salmon in particular). Interviewees felt that the communities may have been aggrieved by these events and as a result supported the policies and programs needed to help improve or address the situation. Most communities framed stormwater management challenges as those that result from private activities impacting both public and private lands. Also, the problems attributed to pollution and flooding arising from non-point pollution sources in the community were often already being acknowledged by residents. As Steelman (2010) observes, innovations in watershed management, such as the creation of stormwater credit and incentive programs, can act as a coalescing force as they work not only on stormwater remediation issues but also on providing education, restoring fisheries, providing recreational opportunities, and building social capital, all while meeting regulatory requirements.

Cities often focus mainly on the economic benefit of taking action to address stormwater problems. Some interviewees, however, were quick to point out the importance of utilizing marketing approaches that focus on addressing social, environmental and economic issues to frame new stormwater management practices in a way that is inclusive of a broader audience with the hopes that it will resonate more across diverse audiences. Approaches taken often included an introduction to the

problem, what the environmental impacts are currently, and how taking action will save residents money over time.

Legitimacy

The perceived legitimacy of an organization plays a role in enhancing the likelihood of adopting innovative practices. One way of enhancing legitimacy is through partnerships with community associations and working with other leading communities. Most interviewees highlighted the importance of working with community groups and associations for stormwater restoration and community education, although few had actually harnessed this asset within their own communities. Only four of ten interviewees noted that they provided some sort of financial support for community organizations undertaking stormwater related activities (restoration or education). Two out of four of these were early adopters (City of Portland and Bellingham). Others noted that they provided other support to these organizations in the form of in-kind support, community workshops and educational events, or providing support letters for grant applications.

When communicating to the public it is important to measure the success of these programs to provide both the general public and decision makers with relevant information on the benefits of the stormwater credit and incentive program. Interviewees noted that measuring programmatic successes also fed into their responsibilities as National Pollutant Discharge Elimination System permit holders. When asked to identify what steps they had taken to measure the successes of these programs interviewees most commonly noted that water quality sampling was conducted to model program successes. Others, like the City of Seattle, also examined the number of participants in workshops, numbers of installed best management practices, the amount of square feet controlled by stormwater best management practices, and the overall cost avoidance that resulted from these programs.

Another factor that may influence social legitimacy is collaboration with or learning from other communities and resources when developing a stormwater credit and incentive program. Table 5.4. outlines which communities were recommended to the researchers by interviewees as candidates for study to learn from their successes and failures.

Table 5.4. Interviewees Recommendations on Other Cities Stormwater Credit and Incentive Programs to Study

City	Cities Recommended to Study
Bellingham, WA	Olympia, WA.
Issaquah, WA	Did not provide.
Marysville, WA	Portland, OR; Everett, WA; Redmond, WA; Bellevue, WA; and Snohomish County; WA.
Seattle, WA	Portland, OR; Puyallup, WA; Minneapolis, MN; Montgomery County, MD; and Kansas City, MO.
Gresham, OR	Bend, WA; Tacoma, WA; Salem, OR; and Eugene OR.
Newberg, OR	Salem, OR; and Keizer, OR.
Portland, OR	Eugene, OR; and Gresham, OR.
Sandy, OR	Gresham, OR; Portland OR; and Wilsonville OR.
Kitchener, ON	Waterloo, ON; and Saskatoon, SK.
Waterloo, ON	Edmonton, AB; and London, ON.

When interviewees were asked to identify what resources they drew upon to help with the development and implementation of their stormwater credit and incentive program, six of the seven who responded said they relied on provincial/state or federal guidance documents; two relied upon university research/publications; two relied on the work completed by the City of Portland; one relied on peer reviewed research; and one relied on non-government or non-profit publications and documents.

Legitimacy may also be gained from program successes and adaptively managing programs to meet the changing needs of the community. The eight interviewees that had implemented a stormwater credit and incentive program were asked if they considered their stormwater credit and incentive programs for existing properties to be an effective way of encouraging on-site rainwater management in their community. Four of eight pointed out that targeted efforts such as downspout disconnection programs and rain garden installations were considered to be the most effective; followed by three of eight acknowledging that the stormwater fee was too low to act as an incentive; and one of the eight unsure. Of the eight communities that had implemented their stormwater credit and incentive programs, only three stated that they had changed their programs over time to reflect lessons learned as a result of program implementation.

5.2.4. Endogenous Factors Influencing Success

Some of the factors described above are exogenous, in that they exist outside the control of the local government organization attempting to implement a particular policy, whereas other factors are endogenous, in that they exist within the control of the local government. Endogenous factors are particularly relevant to local government decision makers as these factors can be directly modified to improve the chances of successful program development and implementation. The most important endogenous factor mentioned in the interviews was the role of public consultation and participation in developing a program that will endure over time. Successful programs brought the community into the planning and development of the stormwater credit and incentive program. Another important endogenous factor that was perceived to influence the overall success of these programs was the presence of an internal champion at the executive level who could act as an advocate for the initiative within the organization and to political leaders. Lastly, the ability to strategically identify and plan how a program needed to be implemented across the organization was considered to be critical to long-term success. This includes having a clear vision and strategy for approaching the development and implementation of a stormwater credit and incentive program through all lines of business operations that will be affected by the policy change.

Chapter 6.

Discussion and Recommendations

This chapter reviews and discusses the mechanisms found to be most successful in facilitating the implementation of stormwater credit and incentive programs in the case studies. In doing so, the chapter highlights those priority areas that need to be considered when developing a stormwater credit and incentive program in BC as identified by the research. Appendix 4 synthesizes the study results into a specific set of recommendations for developing and implementing a stormwater credit and incentive program in the City of Victoria.

6.1. Summary of Interview Results

6.1.1. Individuals

The development and implementation of a stormwater credit and incentive program is shaped by the complex factors motivating individuals, the social norms within which they function, their desire to maintain harmony, and the alignment of values embodied in the program with those within the organization.

Motivation for pursuing stormwater credit and incentive programs by local governments in the US cases typically arose from top-down federal legislation. Those cases that were early adopters (before the main federal legislation was in place) took a considerable amount of care to develop and implement a cohesive strategy that included all stakeholders, which contributed to long-term success. This approach should be followed by other local governments that are early adopters and lack the legislative requirements to uphold the need for such a dramatic change in the way stormwater is managed. The two Canadian cities developing SCWIPs were led by internal champions, not driven by top-down legislation. These cities took approaches similar to the early

adopters in the U.S., focusing their efforts on supporting stakeholder collaboration to develop and maintain early public education and support for the program.

Successful individuals worked within the existing norms and practices of the implementing organization, such as the delivery of utilities, billing programs, environmental education, and inspection of facilities to foster support for program development and implementation. To this effect, harmony in the workplace was fostered by working across departments in the organizations on an issue of public importance which was either legislated or was highly visible to the public. Those interviewees that had experienced issues with workplace harmony often attributed these issues to poor communication amongst staff, which was soon rectified. Norms were also maintained through the use of the broad municipal powers that can be applied to stormwater management and the construction of green infrastructure facilities. Taking advantage of key elements within these municipal powers is important to providing a well-rounded program that is perceived to align with the purposes of the municipality.

Individuals work within the dominant cultures that exist in their organizations and the communities in which they operate. These cultures can influence the ability of a program to function effectively. The most successful approach to working within these value sets was to work collaboratively across the organization and in the community. Promoting the multiple social, economic and environmental benefits that can result from adopting green infrastructure was considered to be very important to inciting action.

6.1.2. Structures

The structures present within a community and organization are also important to the successful implementation of a stormwater credit and incentive program. These structures include the rules and how they are communicated internally and externally, the incentives in place to support the program, whether there is an opening for change, and any resistance that may exist.

From the case study results it is evident that rules and communication programs should include the following attributes:

- Clear performance measures to help guide private landowners when adopting green infrastructure;
- Clear technical guidelines for green infrastructure techniques;
- Clear eligibility criteria for credits and rates available for private landowners; and
- Be easily understood and clearly communicated to all members of the public.
- Build partnerships with universities, community groups and NGO's;
- Pilot projects to work out the kinks before widespread adoption;
- Develop a set of rules and communication strategies that are community specific;
- Include specific language related to monitoring schedules and non-compliance; and
- Include language in credit applications that limits city liability for any failures in the green infrastructure.

The use of a variety of incentive types contributes to an effective strategy for the implementation of a stormwater credit and incentive program. Cities need to be clear about what incentives individuals are eligible for, how these incentives relate to the charges incurred, and whether they are considered a reasonable means of motivating the desired behaviour. It is very important for cities to establish rates that reflect the true cost that properties are imposing on the stormwater system. These costs can include the maintenance and restoration of the environmental services that have been impaired by past approaches to stormwater management. In the cases examined, the greatest successes were found in programs that provided a one-time rebate for establishing structures for on-site management of stormwater. Rebate programs were often delivered by the city or city-approved contractors to limit the chance of faulty installation or failure. When this approach was used there were strict monitoring programs in place to determine the overall effectiveness of the approaches being taken and their cost effectiveness. I would recommend this as the most suitable approach to take in order to make targeted reductions to stormwater flows and improve water quality.

Developing a stormwater credit and incentive program is not an easy or quick process and the political structure needs to be open to changing the way in which it manages stormwater. Interviewees noted that program success was increased when program development included community engagement, along with adequate financial incentives and resulted in tangible stormwater flow reductions and reduced pollutant

loading in the long-term. One difficult aspect of stormwater credit and incentive programs is that it often takes a long time for positive changes in stormwater flow and improvements in surrounding ecosystems to become apparent. Therefore it is important to have a long-term commitment and resources dedicated to monitoring programs.

Resistance to stormwater credit and incentive programs can be found within both the organization and community. Interviewees pointed out two main issues found within these structures. First, within the organization there needs to be high-level program support and resources dedicated to the program or else it will conflict with competing projects and may not be considered a priority within the institution. Second, within the community the focus needs to be on working with the existing development community to ensure that new green infrastructure design standards are supported and accompanied by incentives in a manner that engages property developers. For existing developments it is important to develop a clear set of education materials, installation guidelines, application forms, and technical support resources so that individuals understand what they can do to manage stormwater on-site and how.

6.1.3. Culture

Interviewees felt that shocks, framing and legitimacy were all important factors that influenced the development and implementation of stormwater credit and incentive programs.

When shocks are present within a community as a result of how stormwater has been managed in the past (e.g., flooding or ecosystem degradation), they can provide a considerable amount of motivation to change the way stormwater is managed. Although most interviewees noted that their stormwater credit and incentive program came about as a legislative requirement, earlier adopters often felt the shocks present within their communities played an important role in the city pursuing the development of a stormwater credit and incentive program. Shocks can be used as a catalyst for change within a community.

The way in which stormwater credit and incentive programs are framed within the community can also motivate or discourage action. Interviewees noted the importance of utilizing marketing approaches that focus on addressing social, environmental and

economic issues in order to frame programs in a way that was inclusive of a broader audience and would resonate widely.

The legitimacy of an organization can also play an important role depending on the culture present within the community. If a local government is not perceived as a functional, legitimate organization, it may have a limited ability to successfully adopt a stormwater credit and incentive program. One way that interviewees noted they could enhance legitimacy was by creating strategic partnerships with community associations and liaising with state agencies and other leading communities. Another way to increase the legitimacy of a stormwater credit and incentive program in the community is through a series of pilot projects which can be used to highlight the net benefits obtained by the community when participating in the installation and maintenance of green infrastructure on public or private land.

6.1.4. Choice of Policy Instruments

The interview results provided insight into the growing use of stormwater credit and incentive programs as an effective financial incentive to encourage the adoption of stormwater best management practices. Although approaches often varied considerably, those programs that self-identified as being successful in achieving community stormwater improvements were those that implemented programs that utilized strategies that sought to influence the behavior of individuals, altered organizational structures, and took advantages of opportunities that existed within the local culture.

The most successful programs were those that used a variety of nodal, authority, treasure, and organizational policy instruments (Hoberg et al., 1986). The nodal instruments typically involved the collection and release of information about stormwater best management practices, providing advice and exhortation about the benefits of taking action, and conducting public education campaigns about the programs being offered to residents such as workshops and financial incentives. The use of authority measures included the use of command and control measures which required action by certain private organizations. These measures varied for residential and non-residential properties. For non-residential properties, a new development would often have to meet

the regulatory requirements as outlined by the City, or be responsible for obtaining independent certification from a registered professional who would acknowledge that a certain performance criterion was met. In some cases, such as the City of Kitchener and Waterloo, where there was no direct federal or provincial requirement for managing stormwater pollution, local governments relied on community consultation (nodal) as a key element of their voluntary approach to managing stormwater pollution and controlling stormwater runoff. The use of financial, or treasure instruments was typically applied through the creation of stormwater user charges. Interviewees believed that the application of these charges acted, if the user fee was large enough, as an incentive for adopting green infrastructure. In more advanced communities some of the funds from the stormwater utility were allocated to fund community groups wanting to engage in stormwater related activities. This approach was certainly innovative as it strengthened social and physical capital while contributing to stormwater restoration programs, public education campaigns, and replacement of impervious surfaces with rain gardens on properties that were typically non-taxed (churches, schools, and government properties). Finally, within those jurisdictions interviewed there was often a large emphasis placed on the use of direct action by the organization itself. An example of this was found in the City of Gresham where staff delivered a downspout disconnection program to redirect stormwater through a lawn or landscape feature prior to its eventual release into the stormwater conveyance system. The use of direct provision as a policy instrument was typical in most jurisdictions with many building strategic partnerships with local educational institutions to deliver certain elements related to improving stormwater management efforts. Although some scholars in the literature promote the option of creating a market to address community stormwater management issues, none of the cases examined utilized this approach. However, each respondent did highlight the fact that the use of incentives was the most suitable strategy for altering the cost-benefit calculus in support of stormwater best management practice adoption when compared to constructing traditional grey infrastructure.

6.2. Future Research

Future research should include a follow up assessment of the application of these research findings within the City of Victoria. This would provide excellent

information about the advantages and limitations of an academic study seeking to aid in public policy implementation.

Effort should also be made in the future to examine the application of the conceptual framework to determine its overall level of effectiveness for analyzing the implementation of innovations at the local government level. More study is needed to further test this framework and its ability to provide valuable information for local governments seeking to adopt environmental innovations.

Generally, more research needs to be conducted on the study, synthesis, dissemination and application of smart practices at the local government level. Special emphasis should be placed upon clarifying the critical elements that are needed to help public policy practitioners examine and apply smart practices. This may include the use of a larger study involving both researchers and public policy practitioners in an attempt to identify where gaps exist when moving smart practices from theory to implementation.

6.3. Conclusions

The objective of this research was to identify the most suitable and effective approaches that local governments can take when adopting and implementing a natural resource policy innovation, specifically, a storm water credit and incentive program. The research utilized Steelman's (2010) framework for analyzing the implementation of innovations to examine case studies of ten local governments in North America that have implemented or developed stormwater credit and incentive programs.

The specific research questions were:

1. What factors shape the adoption and implementation of stormwater credit and incentive programs by local governments in ten cities in North America to promote green infrastructure?
2. How do social, economic and environmental characteristics of the community and local government under study impact the design and implementation of stormwater credit and incentive programs?
3. How can the experiences of the communities interviewed provide a set of recommendations for developing and implementing a successful stormwater credit and incentive program within the City of Victoria?

The first research question was informed through the literature review, which outlined historical, current, and emerging approaches to stormwater management and planning at the local government level and answered in the interview results. The review of smart practices research and the framework for analyzing the implementation of innovations identified the specific factors that need to be considered when examining the development and implementation of innovative stormwater management practices.

This research allowed me to understand that although there are many approaches to examining the implementation of public policy innovations (e.g., Steelman, 2010; Barzelay, 2007; Bardach, 2004) these approaches are not always well connected with the needs of public policy practitioners and what they want to know in order to make decisions. My research has aimed to fill this gap by working closely with a local government agency, the City of Victoria, to identify their needs and structure my research accordingly.

The second research question was addressed through the interviews, which were designed using concepts adapted from the literature on smart practices research. Although the results identified that many mechanisms were used in each case study, and with varying levels of success, the individual cases and cross-case comparisons provided a suite of options and an assessment of strengths and weaknesses in different settings. This should allow for informed policy making and implementation which can be tailored to meet the context dependent attributes found within the jurisdiction under study. The most important program attribute was the need for a program champion whether at the political or executive level to build consensus, foster leadership, and build program credibility. The most significant structural element was a cohesive plan for engaging, educating and fostering change through pilot projects, learning by doing, and in some cases failing.

When applying the evaluation framework and providing recommendations to the City of Victoria I found that the framework only provides a rough perspective of what may be driving innovation within a particular community or local government context. It is impossible to capture all of the drivers and factors that influence a community, political leader or local government staff member to pursue innovative approaches to stormwater management. However, the evaluation framework did an adequate job in distilling the

complex nature of local government institutions and the approaches and strategies that are used to implement environmental innovations, while allowing for comparison across case studies.

The third research question was answered in the results section and discussion, in which I used the conceptual framework to identify important factors that influenced implementation, and I assessed the strengths and weaknesses of the approaches taken. The framework provided an appropriate structure for examining the complexities that exist within a community and local government organization and its ability to address a public problem. Some elements of the framework were not fully explored due to time and resource constraints.

This research attempted to break down the barrier between public policy implementation theory and the application of public policy by a policy practitioner. Although it is important to ground research in theory in order to ensure its academic relevance, it is also valuable to keep it nested in the realities of the context in which it is to be applied.

References

Adams, C., Noonan, T., & Newton, B. (2000). *Watershed management in the 21st century: national perspectives*. USDA Forest Service Proceedings RMRS-P-13. 21-29. Retrieved on July 3, 2012 from: http://www.fs.fed.us/rm/pubs/rmrs_p013/rmrs_p013_021_029.pdf.

Alberti, M., Booth, D., Hill, K., Coburn, B., Avolio, C., Coe, S., & Spirandelli, D. (2007). The impact of urban patterns on aquatic ecosystems: An empirical analysis in Puget lowland sub-basins. *Landscape and Urban Planning*, *80*(4), 345–361. doi:10.1016/j.landurbplan.2006.08.001

American Geophysical Union. (1982). *Urban Stormwater Hydrology*. Water resources monograph. Washington, D.C: American Geophysical Union.

Arnold, C. L., & Gibbons, C. J. (1996). Impervious Surface Coverage: The Emergence of a Key Environmental Indicator. *Journal of the American Planning Association*, *62*(2), 243–258. doi:10.1080/01944369608975688

Bakker, K., & Cook, C. (2011). Water Governance in Canada: Innovation and Fragmentation. *International Journal of Water Resources Development*, *27*(2), 275–289. doi:10.1080/07900627.2011.564969

Baerenklau, K. A., Cutter, W. B., DeWoody, A., Sharma, R., & Lee, J. G. (2008). *Capturing Urban Stormwater Runoff: A Decentralized Market-Based Alternative*. Policy Matters, University of California, Riverside 2(3).

Bardach, E. (1994). Comment: The Problem of Best Practice Research. *Journal of Policy Analysis and Management,* 13(2): 260-68.

Bardach, E. (1998). *Getting Agencies to Work Together: The Practice and Theory of Managerial Craftsmanship*. Brookings Institution Press.

Bardach, E. (2004). *Presidential Address—The Extrapolation Problem: How Can We Learn From the Experience of Others?* Journal of Policy Analysis and Management 23: 205–220.

Bardach, E. (2009). *A Practical Guide for Policy Analysis: The Eightfold Path to More Effective Problem Solving*. 3rd Ed. Washington, DC.

Barzelay, M. (2007). Learning from Second-Hand Experience: Methodology for Extrapolation-oriented Case Research. *Governance*, 20(3): 521-543.

Barzelay, M., & Thompson, F. (2009). *Making Public Management a Design-Oriented Science.* SSRN eLibrary. Retrieved on March 2012 from: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=979041

Bernhardt, E. S., & Palmer, M. A. (2007). Restoring streams in an urbanizing world. *Freshwater Biology*, *52*(4), 738–751. doi:10.1111/j.1365-2427.2006.01718.x

Bretschneider, S., Marc-Aurele, F. J., & Wu, J. (2005). "Best Practices" Research: A Methodological Guide for the Perplexed. *Journal of Public Administration Research and Theory*, *15*(2), 307–323. doi:10.1093/jopart/mui017

Brown, R. R. (2005). Impediments to Integrated Urban Stormwater Management: The Need for Institutional Reform. *Environmental Management*, *36*(3), 455–468. doi:10.1007/s00267-004-0217-4

Brown, R., Ashley, R., & Farrelly, M. (2011). Political and Professional Agency Entrapment: An Agenda for Urban Water Research. *Water Resources Management*, *25*(15), 4037–4050. doi:10.1007/s11269-011-9886-y

Brunner, R. D., & Clark, T. W. (1997). A Practice-based Approach to Ecosystem Management. *Conservation Biology*, *11*(1), 48–58. doi:10.1046/j.1523-1739.1997.96005.x

Booth, D. B., Karr, J. R., Schauman, S., Konrad, C. P., Morley, S. A., Larson, M. G., & Burges, S. J. (2004). Reviving Urban Streams: Land Use, Hydrology, Biology, and Human Behavior. *JAWRA Journal of the American Water Resources Association*, *40*(5), 1351–1364. doi:10.1111/j.1752-1688.2004.tb01591.x

Booth, D. B. (2005). Challenges and prospects for restoring urban streams: a perspective from the Pacific Northwest of North America. *Journal of the North American Benthological Society*, *24*(3), 724–737. doi:10.1899/04-025.1

Burian, S.J., & Pomeroy, C.A. (2010). Urban impacts on the water cycle and potential green structure implications. *Urban Ecosystem Ecology,* 277-296

Cameron, J., Cincar, C., Trudeau, M., Marsalek, J., & Schaefer, K. (1999). User pay financing of stormwater management: A case-study in Ottawa-Carleton, Ontario. *Journal of Environmental Management*, *57*(4), 253–265. doi:10.1006/jema.1999.0298

Campbell, C. W. (2011). *The Western Kentucky University Stormwater Utility Survey 2011*. Bowling Green, Kentucky. Retrieved on March 10th, 2012 from: www.wku.edu/swusurvey

Canada Green Building Council. (2004). LEED Rating System & Addendum for New Construction & Major Renovations LEED® Canada NC. Version 1.0. LEED Green Building Rating System. Retrieved on April 11th, 2012 from: http://www.cagbc.org/AM/PDF/Green%20Building%20Rating%20System%20and%20Addendum_LEED%20Canada-NC_v1_0.pdf

Canadian Institute of Planners. (2012). *Planning Is…* Retrieved on March 27th, 2012 from: http://www.cip-icu.ca/web/la/en/pa/3FC2AFA9F72245C4B8D2E709990D58C3/template.asp

Clark, T. (2001). Interdisciplinary Problem Solving in Species and Ecosystem Conservation. Yale School of Forestry and Environmental Studies, Institution for Social and Policy Studies at Yale, Northern Rockies Conservation Cooperative.

Debo, T. N., & Reese, A. J. (2002). Introduction to Municipal Stormwater Management. *Municipal Stormwater Management, Second Edition*. CRC Press. Retrieved on March 25th, 2012 from: http://www.crcnetbase.com.proxy.lib.sfu.ca/doi/pdfplus/10.1201/9781420032260.ch1

Department of Fisheries and Oceans Canada. (1993). Land Development Guidelines for the Protection of Aquatic Habitat. Retreived on April 6th, 2012 from: http://www.dfo-mpo.gc.ca/Library/165353.pdf

Dietz, M. E., & Clausen, J. C. (2008). Stormwater runoff and export changes with development in a traditional and low impact subdivision. *Journal of Environmental Management*, *87*(4), 560–566. doi:10.1016/j.jenvman.2007.03.026

Federation of Canadian Municipalities. (2005). *Stormwater Management Planning: A Best Practice by the National Guide to Sustainable Municipal Infrastructure.* National Research Council. Retrieved on March 27th, 2012 from: http://www.fcm.ca/Documents/reports/Infraguide/Stormwater_Management_Planning_EN.pdf

Ffolliott, P.F., Baker, M.B., Edminster, C.B., Dillon, M.C. & Mora, K.L., (2002). *Land stewardship through watershed management: perspectives for the 21st century*. New York, NY: Kluwer Academic/Plenum Publishers. 137 p.

Finkenbine, J. K., Atwater, J. W., & Mavinic, D. S. (2000). STREAM HEALTH AFTER URBANIZATION. *JAWRA Journal of the American Water Resources Association*, *36*(5), 1149–1160. doi:10.1111/j.1752-1688.2000.tb05717.x

Fraser Basin Council. (2011). *Rethinking our Water Ways: A Guide to Water and Watershed Planning for BC Communities In The Face of Climate Change And Other Challenges.* Retrieved on March 29th, 2012 from: http://www.fraserbasin.bc.ca/publications/documents/waterguide_oct-2011.pdf

Garrison, N. & Hobbs, K. (2011). Rooftops to Rivers II: Green Strategies for controlling stormwater and combined sewer overflows. National Resources Defense Council.

Genskow, K., & Wood, D. (2011). Improving Voluntary Environmental Management Programs: Facilitating Learning and Adaptation. *Environmental Management*, *47*(5), 907–916. doi:10.1007/s00267-011-9650-3

Goodman, P. S. (2000). *Missing Organizational Linkages: Tools for Cross-Level Research*. SAGE.

Goudie, A. (2006). *The human impact on the natural environment: past, present, and future*. John Wiley & Sons.

Great Lakes and St. Lawrence Cities Initiative. (2011). Stormwater Management in the Great Lakes and St. Lawrence Basin: Cities Charting the Way Forward. Retrieved on April 11th, from: http://www.glslcities.org/greencities/stormwater/Stormwater%20Management%20Report_English_Final2_Updated.pdf

Green, O. O., Shuster, W. D., Rhea, L. K., Garmestani, A. S., & Thurston, H. W. (2012). Identification and Induction of Human, Social, and Cultural Capitals through an Experimental Approach to Stormwater Management. *Sustainability*, *4*(8), 1669–1682. doi:10.3390/su4081669

Hall, J. L., & Jennings Jr., E. T. (2008). Taking Chances: Evaluating Risk as a Guide to Better Use of Best Practices. *Public Administration Review,* 68(4), 695–708. doi:10.1111/j.1540-6210.2008.00908.x

Hanley, N., Shogren, J. F., & White, B. (2001). *Introduction to Environmental Economics*. Oxford University Press.

Hill, C. J., & Lynn, L. E. (2005). Is Hierarchical Governance in Decline? Evidence from Empirical Research. *Journal of Public Administration Research and Theory*, *15*(2), 173–195. doi:10.1093/jopart/mui011.

Hodge, G., & Gordon, D. (2007). *Planning Canadian Communities* (5th ed.). Nelson College Indigenous.

Hohl, A., & Clark, S. G. (2010). *Large Scale Conservation: Integrating Science, Management, and Policy in the Common Interest.* Ch. 8. Best Practices: The Concept, An Assessment, and Recommendations. Yale School of Forestry and Environmental Studies Publication Series, Report 24, New Haven, CT.

Howlett, M., Ramesh, M., & Perl, A. (2009). *Studying Public Policy: Policy Cycles and Policy Subsystems* (Third ed.). Oxford University Press.

Jennings, E. T. (2007). Best Practices in public administration: How do we know them? How can we use them? *Martin School of Public Policy and Administration.* Retrieved on May 8th 2012, from: http://www.ramp.ase.ro/en/_data/files/articole/9_01.pdf

Karvonen, A. (2011). *Politics of Urban Runoff: Nature, Technology, and the Sustainable City* (1st ed.). The MIT Press.

City of Kitchener and Waterloo. (2008). *Kitchener-Waterloo Stormwater Management Program and Funding Review: Stormwater Funding Analysis.* DRAFT FINAL REPORT Oct. 2008. Retrieved on April 1st, 2012 from: http://www.city.waterloo.on.ca/Portals/57ad7180-c5e7-49f5-b282-c6475cdb7ee7/PWS_UTILITIES_documents/Stormwater_Report_Main_Body.pdf

Lasswell, H. (1971). A Pre-View of Policy Sciences. New York: American Elsevier Publishing Company.

Lloyd, S.D., Wong, T.H.F., & Chesterfield, C.J. (2002). *Water sensitive urban design: a stormwater management perspective.* Cooperative Research Centre for Catchment Hydrology. http://www.clearwater.asn.au/resources/291_1.pdf .

MacDonald, D.H., Connor, J., and Morrison, M. (2004). *Market-based instruments for managing water quality in New Zealand.* Final Report for New Zealand Ministry for the Environment Retrieved April 12th, 2012 from: http://www.clw.csiro.au.proxy.lib.sfu.ca/publications/consultancy/2004/NZ_economic_Instruments.pdf

Mahoney, J., and Rueschemeyer, D. (2003) eds., *Comparative Historical Analysis in the Social Science* Cambridge: Cambridge University Press.

Makepeace, D. K., Smith, D. W., & Stanley, S. J. (1995). Urban stormwater quality: Summary of contaminant data. *Critical Reviews in Environmental Science and Technology*. 25(2), 93–139.

Marsalek, J. (2008). *Urban water cycle processes and interactions*. Taylor & Francis.

Marsalek, J., and Schreier, H. (2010). Innovation in Stormwater Management in Canada: The way forward. *Water quality research journal of Canada*, pp. 5 – 10.

Marshall, C., & Rossman, G. B. (2006). Designing Qualitative Research. SAGE.

Merriam, S. B. (1998). *Qualitative Research and Case Study Applications in Education. Revised and Expanded from "Case Study Research in Education."* Jossey-Bass Publishers, San Francisco, CA.

Mirza, S. (2007). *Danger Ahead: The Coming Collapse of Canada's Municipal Infrastructure*. Federation of Canadian Municipalities.

Morison, P. J., & Brown, R. R. (2010). Avoiding the presumptive policy errors of intergovernmental environmental planning programmes: a case analysis of urban stormwater management planning. *Journal of Environmental Planning and Management*, *53*(2), 197–217. doi:10.1080/09640560903529329

Novotny, V., Ahern, J., & Brown, P. (2010). *Water Centric Sustainable Communities: Planning, Retrofitting, and Building the Next Urban Environment*. Hoboken, New Jersey. John Wiley & Sons, Inc.

Nowlan, L., & Bakker, K. (2007). Delegating Water Governance: Issues and Challenges in the BC Context. Report for BC Water Governance Project. UBC Program on Water Governance. Retrieved on March 29th, 2012 from: http://www.watergovernance.ca/PDF/Delegating_Water_Governance_in_BC_for_FBC_by_LN_KB.pdf

Ongaro, E. (2009). A protocol for the extrapolation of 'Best' Practices: How to draw lessons from one experience to improve public management in another situation. Retrieved on July 25th, 2012 from: http://epsa2009.eu/files/Symposium/An%20approach%20to%20the%20extrapolation%20 of%20practices_EOngaro.pdf.

Overman, E. S., & Boyd, K. J. (1994). Best Practice Research and Postbureaucratic Reform. *Journal of Public Administration Research and Theory: J-PART*, *4*(1), 67–83.

Parikh, P., Taylor, M. A., Hoagland, T., Thurston, H., & Shuster, W. (2005). Application of market mechanisms and incentives to reduce stormwater runoff: An integrated hydrologic, economic and legal approach. *Environmental Science & Policy*, *8*(2), 133–144. doi:10.1016/j.envsci.2005.01.002

Patouillard, C., & Forest, J. (2011). The spread of sustainable urban drainage systems for managing urban stormwater: A multi-level perspective analysis. *Journal of Innovation Economics*, *8*(2), 141. doi:10.3917/jie.008.0141

Patton, M.Q. (2002). *Qualitative research and evaluation methods*. 3rd Edition. Thousand Oaks, CA: Sage Publications

Porter-Bopp, S., Brandes, O. M., & Sandborn, C. (2011). *Peeling Back the Pavement: A Blueprint for Reinventing Rainwater Management in Canada's Communities*. POLIS Project on Ecological Governance, University of Victoria.

City of Portland (2010). City of Portland's Green Infrastructure: Quantifying the Health, Energy, and Community Livability Benefits. City of Portland Bureau of Environmental Services. Retrieved on February 4th, 2013 from: http://www.portlandoregon.gov/bes/article/298042

Prokopy, L. S., Genskow, K., Asher, J., Baumgart-Getz, A., Bonnell, J. E. Broussard, S., Curtis, C., Floress, K., McDermaid, K., Power, R., & Wood, D. (2009). Designing a regional system of social indicators to evaluate nonpoint source water projects. *Journal of Extension*. [On-line], 47(2) Article 2FEA1. Available at: http://www.joe.org/joe/2009april/a1.php

Province of BC. (2002). *Stormwater planning: A guidebook for British Columbia*. Stephens KA, Graham P, Reid D. British Columbia Ministry of Water, Land and Air Protection, Victoria, B.C.

Province of BC. (2010). BC's Water Act Modernization: Policy Proposal on BC's new *Water Sustainability Act.* Ministry of Environment. Retrieved on April 5th, 2012 from: http://livingwatersmart.ca/water-act/docs/wam_wsa-policy-proposal.pdf

Province of BC. (2011). *Liquid Waste Management Planning*. Ministry of Environment. Retrieved on April 11th, 2012 from: http://www.env.gov.bc.ca/epd/mun-waste/waste-liquid/lw-mgmt-plan/index.htm

Province of BC. (2012). *Biogeoclimatic Zones of British Columbia.* Ministry of Forests, Lands and Natural Resource Operations, Victoria, British Columbia. Retrieved on March 27th, 2012 from: ftp://ftp.for.gov.bc.ca/HRE/external/!publish/becmaps/PaperMaps/BGCzones.8x11.pdf

Qizilbash, A. (2011). Public-Private Partnerships and the Value of the Process: The Case of Sub-Saharan Africa. *International Public Management Review, 12*(2), 38 – 54.

Reese, A. J. (2007). Stormwater Utility User Fee Credits. *Stormwater: The Journal for Surface Water Quality Professionals.* November-December 2007. Retrieved on March 29th, 2012 from: http://www.stormh2o.com/forms/print-7447.aspx

Retzlaff, R. C. (2009). The Use of LEED in Planning and Development Regulation An Exploratory Analysis. *Journal of Planning Education and Research*, *29*(1), 67–77. doi:10.1177/0739456X09340578

Rogers, D. J. (1997). *Flood Damage: Evolving laws and policies for an ever-present risk*. Retrieved on April 11th, 2013 from: http://web.mst.edu/~rogersda/umrcourses/ge301/evolving%20laws%20for%20flood%20damage%20litigation.html#_ftn1

Rutherford, S. (2007). *The Green Infrastructure Guide: Issues, Implementation Strategies and Success Stories*. West Coast Environmental Law Research Foundation. Victoria, British Columbia.

District of Saanich. (2008). *Sustainable Saanich Official Community Plan 2008*. Victoria, British Columbia. Retrieved on April 6th, 2012 from: http://www.saanich.ca/living/community/ocp/ocp_adopted_jul808_amended_may1710.pdf

Shandas, V., & Messer, W. B. (2008). Fostering green communities through civic engagement: community-based environmental stewardship in the Portland area. *Journal of American Planning Association,* 74: 408-418.

Steelman, T. (2010). *Implementing Innovation: Fostering Enduring Change in Environmental and Natural Resource Governance.* Washington, DC*:* Georgetown University Press.

Stephenson, K., Norris, P., & Shabman, L. (1998). WATERSHED-BASED EFFLUENT TRADING: THE NONPOINT SOURCE CHALLENGE. *Contemporary Economic Policy*, *16*(4), 412–421. doi:10.1111/j.1465-7287.1998.tb00529.x

Taylor, A., & Fletcher, T. (2007). Nonstructural Urban Stormwater Quality Measures: Building a Knowledge Base to Improve Their Use. *Environmental Management*, *39*(5), 663–677. doi:10.1007/s00267-005-0398-5

Thurston, H. W. (Ed.). (2012). *Economic Incentives for Stormwater Control* (1st ed.). CRC Press.

Thurston, H. W. (2006). Opportunity Costs of Residential Best Management Practices for Stormwater Runoff Control. *Journal of Water Resources Planning and Management*, *132*(2), 89–96. doi:10.1061/(ASCE)0733-9496(2006)132:2(89)

Thurston, H. W., Goddard, H. C., Szlag, D., & Lemberg, B. (2003). Controlling Storm-Water Runoff with Tradable Allowances for Impervious Surfaces. *Journal of Water Resources Planning and Management*, *129*(5), 409–418. doi:10.1061/(ASCE)0733-9496(2003)129:5(409)

Tomasi, T., Segerson, K., & Braden, J. (1994). *Issues in the design of incentive schemes for nonpoint source pollution control. In: Nonpoint Source Pollution Regulation: Issues and Analysis,* Kluwer Academic Publishers, Dordrectht, the Netherlands, pp. 1–37.

District of Ucluelet. *District of Ucluelet: Official Community Plan 2011.* Retrieved on April 11th from: http://www.ucluelet.ca/UserFiles/File/Bylaws/OCP%20Bylaw%202011.pdf

US EPA. (2002). *National Water Quality Inventory: 2000 report*. United States Environmental Protection Agency. EPA-841-R-02-001

US EPA. (2008). *Funding Stormwater Programs.* United States Environmental Protection Agency 833-F-07-012

US EPA. (2009). *Incorporating Low Impact Development into Municipal Stormwater Programs*. United States Environmental Protection Agency 901-F-09-005.

US EPA. (2012a). What is non-point source pollution? United States Environmental Protection Agency. Retrieved December 16th, 2012, from: http://water.epa.gov/polwaste/nps/whatis.cfm

US EPA. (2012b). *National Menu of Stormwater Best Management Practices*. US EPA National Pollutant Discharge Elimination System. Retrieved December 17th, 2012 from: http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm

University of Victoria Environmental Law Clinic. (2010). *Re-Inventing Rainwater Management: A Strategy to Protect Health and Restore Nature in the Capital Region.* Retrieved on April 6th, 2012 from: http://www.elc.uvic.ca/press/documents/stormwater-report-FINAL.pdf

Walsh, C. J., Roy, A. H., Feminella, J. W., Cottingham, P. D., Groffman, P. M., & Morgan, R. P. (2005). The urban stream syndrome: current knowledge and the search for a cure. *Journal of the North American Benthological Society*, *24*(3), 706–723. doi:10.1899/04-028.1

Wanielista, M. P., & Yousef, Y. A. (1993). *Stormwater management*. Wiley-Interscience.

City of Waterloo. (2010). *Stormwater Rate Implementation.* PWS2010-031. Public Works Services & Finance Department. Retrieved April 7th, 2012 from: http://www.city.waterloo.on.ca/Portals/57ad7180-c5e7-49f5-b282-c6475cdb7ee7/PWS_UTILITIES_documents/StormwaterJuneReportPWS2010-031.pdf

Watt, W.E., Waters, D., and McLean. R. (2003). *Climate Change and Urban Stormwater Infrastructure in Canada: Context and Case Studies.* Toronto-Niagara Region Study Report and Working Paper Series, Report 2003-1. Meteorological Service of Canada, Waterloo, Canada.

West Coast Environmental Law. (2003). *Do Development Cost Charges Encourage Smart Growth and High Performance Building Design? An Evaluation of Development Cost Charge Practices in British Columbia.* Report Prepared by Coriolis Consulting Corp for West Coast Environmental Law. Retrieved on April 12th, 2012 from: http://wcel.org/sites/default/files/publications/Do%20development%20cost%20charges%20encourage%20smart%20growth%20and%20high%20performance%20building%20design%20-%20An%20evaluation%20of%20development%20cost%20charge%20practices%20in%20British%20Columbia.pdf

Wise, S., J. Braden, D. Ghalayini, J. Grant, C. Kloss, E. MacMullan, S. Morse, F.Montalto, D. Nees, D. Nowak, S. Peck, S. Shaikh, and C. Yu. (2010). Integrating Valuation Methods to Recognize Green Infrastructure's Multiple Benefits. Center for Neighborhood Technology, Chicago, 21 pp. Retrieved February 5th, 2013 from: http://www.cnt.org/repository/CNT-LID-paper.pdf

Van De Ven, A. H. (1992). Suggestions for studying strategy process: A research note. *Strategic Management Journal*, *13*(S1), 169–188. doi:10.1002/smj.4250131013

Veselý, A. (2011). Theory and Methodology of Best Practice Research: A Critical Review of the Current State. *Central European Journal of Public Policy, 5*(2), 98–117.

Visitacion, B. J., Booth, D. B., & Steinemann, A. C. (2009). Costs and Benefits of Storm-Water Management: Case Study of the Puget Sound Region. *Journal of Urban Planning & Development*, *135*(4), 150–158. doi:10.1061/(ASCE)0733-9488(2009)135:4(150)

Yin, R. K. (2009). *Case Study Research: Design and Methods*. SAGE.

Appendix A. Letter of Informed Consent

A Policy Analysis of Rebate and Incentive Programs for Stormwater Management in Local Governments

You are invited to participate in a study called "A Policy Analysis of Rebate and Incentive Programs for Stormwater Management in Local Governments," which is being conducted by me, Lee Johnson, under the supervision of Dr. Murray Rutherford of Simon Fraser University. I am a Master's Candidate in the School of Resource and Environmental Management at Simon Fraser University and I am conducting this research as my Master's project and as part of a student internship with the City of Victoria.

Goals of the Study. The goals of this research are to determine how local governments have developed and implemented rebate and incentive programs for stormwater management that address the social, economic and environmental issues that exist in their communities. By providing information about stormwater rebate and incentive programs in your jurisdiction you will assist me to develop recommendations for the City of Victoria about designing and implementing a feasible and effective rebate and incentive program in the City of Victoria. My research will also contribute to broader understanding of stormwater management programs.

What Information is Being Collected. Research of this type is important because it will help identify how local government agencies have developed and implemented stormwater rebate and incentive programs. The study will seek to determine what strategies have been utilized to prioritize rebate programs, educate residents and the development community, set rebate rates, and create installation guidelines. It will also provide the participant with the opportunity to share valuable lessons learned to enhance the success of future program development.

Voluntary Participation. Your participation in this research is completely voluntary. If you decide to participate, you may withdraw at any time by informing me at the phone number or email address listed below. If you withdraw from the study prior to release or publication of the results, the recording, transcript or notes of your interview will be destroyed. You may also choose not to answer any particular questions that I ask you.

Anonymity and Confidentiality. You may choose to remain anonymous in all records and publications, or you may choose to have your identity disclosed. If you elect to have your identity disclosed, we may refer to you by your name in research records, transcripts, quotations, presentations, reports, and publications (electronic and print). If you elect to remain anonymous, we will keep your identity confidential to the extent permitted by law, and will only refer to your responses by the name of the local government involved in your stormwater management program. However, your confidentiality may be breached if required by law.

Benefits. The primary potential benefit of your participation in this research is to share the details of your stormwater rebate and incentive programs and the lessons learned from the development and implementation process to inform the development of similar programs in other jurisdictions.

Risks. Risks associated with participation in this study are minor and you will have the opportunity to review and offer comments on the interview transcripts before the results are published or otherwise released.

Consent for Re-Contact and Reuse of Results. We may need to re-contact you in order to clarify any part of the information that was provided in the original interview. Future research projects may also reuse data collected for this project, and you may be contacted by the researchers regarding future studies.

Dissemination of Results. It is anticipated that the results of this study will be shared with others in the following ways: the study will be shared as an unpublished Master's project; a summary report will be submitted to the City of Victoria for use in the development of a stormwater rebate and incentive program; a presentation of the results will also be delivered to relevant departments within the City of Victoria. The researchers may also publish some or all portions of this research in academic journals or other publications, and may present the results at conferences and other events. If you would like access to the completed thesis please contact the researcher.

Storage and Disposal of Data. Interview recordings (if any), transcripts and notes will be kept in a locked filing cabinet when not in use, or on a password protected hard drive. After 3 years, any electronic recordings of interviews will be erased. Quotes and summaries from interviews may be used in presentations and published and unpublished research outputs.

Consent to Record Interview. I would like to record your interview to make sure that I accurately represent your views. Please indicate in the space provided at the end of this form if you consent to have your interview recorded.

I _____ (Print Name) agree to participate in the research project, ***A Policy Analysis of Rebate and Incentive Programs for Stormwater Management in Local Governments***, conducted by Lee Johnson and supervised by Dr. Murray B. Rutherford, School of Resource and Environmental Management, Simon Fraser University, on the terms described above.

If you consent to having your identity disclosed in research records, transcripts, quotations, presentations, reports and publications (electronic and print), check here [_ _] OR

If you want your identity to remain anonymous, check here [_ _].

If you consent to having your interview electronically recorded, check here **[_ _]**.

Participant Signature _____ Date_____

This study is being conducted under the auspices of Simon Fraser University and is funded by the MITACS-Accelerate internship program and the City of Victoria.

Contacts: You may contact the interviewer at: Lee Johnson, [redacted], email: [redacted]

Direct ethical concerns or complaints to: Dr. Hal Weinberg, Director, Office of Research Ethics, Simon Fraser University, [redacted] or 778-782-6593. Study ID: 2012s0353.

Direct general project inquiries and requests for draft or final results to the Principal Investigator:
Dr. Murray B. Rutherford, School of Resource and Environmental Management, Simon Fraser University, [redacted] or 778-782-4690.

Appendix B. Interview Questions

Stormwater Credit and Incentive Program – Interview Questions

Types of Programs

1. What programs and policies do you have in place to encourage the adoption of on-site rainwater management practices (previous pavement, rain barrels, rain gardens, etc.) on privately owned parcels of land – new and existing developments?
2. Are there any other programs or policies that were in place that are no longer in use? If so why are they no longer in use?
3. What was the main motivation for creating these programs?
4. If financial incentives are provided, what fee reductions or rebates are offered for private landowners (developers and homeowners) that participate in these programs?
5. How does program eligibility vary for these financial incentives? (PROBE: industrial vs. commercial and single vs. multi-family residential properties)
6. Are utility fee rebates awarded for other activities that reduce the City's Stormwater costs such as education programs? If so, what kind of programs and partnerships are in place (e.g. public school providing stormwater management information or education)? And how are these credits determined (e.g. credits based on the avoided costs to the city or the actual cost of the education programs)?

Program Selection Rationale

7. Were these financial incentives considered an effective means of encouraging on-site rainwater management in your community if so why are they considered to be effective?
8. How were the rates determined for the financial incentives used in your community (Cost-benefit analysis, adoption of other jurisdictional rates, based on stormwater utility fees)?
9. Were assessments completed to determine how the financial incentives would address the stormwater issues faced in your community? (Eg, modelling, etc.)
10. Were there any additional solutions that were considered to address the stormwater issues in your community but were not selected? If so why? PROBE: What types of other programs were considered and why were they not utilized?
11. Before the financial incentive programs were initiated did your organization consider how stormwater revenues would be affected by participation rates in these programs? E.g. anticipated a 5% reduction in overall stormwater fees. (PROBE: Explore what techniques were used to determine the level of funding that would be reduced over time)

Program Administration in the Community

12. What do you think these programs take advantage of that make them work in your community? (PROBE: Why do they think individuals are taking advantage of these programs? – eg. Rainbarrels take advantage of people desire to do something that is visibly green, it's easy and take advantage of saving money, encouraging competition.
13. What was the level of community involvement in developing on-site rainwater management programs for private parcels of land? (E.g. public consultation, open houses, community forums, etc.)
14. How do community, advocacy, and non-profit groups support the implementation of on-site rainwater management practices on private lands? (monitoring, restoration projects, education, program administration, etc.)
15. If community groups or residents are provided with financial assistance as a part of your stormwater management programs, are there limits on the amount of funds available or time constraints for project applications and completion?
16. How have Universities been involved in the development and implementation of stormwater programs in your community?
17. What do you feel are the most effective means for communicating information about the financial incentives and on-site rainwater management practices to the public (including private developers)?
18. Do these communications materials utilise marketing approaches that draw on the diverse interests of the target audiences (E.g. cost savings, green individuals, etc.).
19. Do these financial programs encouraging public or organizational competition in any way? (PROBE: How are groups competing as a part of this program and do you think it helps encourage greater participation in these programs?)

Program Operationalization within the Organization

20. Who leads the stormwater management efforts within your organization? (PROBE: Are different areas responsible for different aspects of the program and if so how?)
21. Did the city develop its own standards for the construction of on-site rainwater management facilities or utilize federal, state or county standards?
22. What guidance or educational materials do you provide residents that want to build on-site rainwater management practices on their property (e.g.) Guidebooks, do it yourself video's, workshops, etc?
23. Have your stormwater programs attempted to integrate the anticipated impacts of climate change? If so how? (E.g. education/outreach, design standards, other)
24. Have financial incentives been prioritized based on their ability to improve stormwater quality, reduce peak flows or combined sewer overflows? (E.g. is there a rating system being used or targeting of specific high priority areas?)
25. How is compliance and monitoring conducted for the adoption of on-site rainwater management practices in new and existing developments? (PROBE: are approvals completed by the City, registered professional biologists or environmental NGO's or even community or watershed stewardship groups)?

26. Are there any formal agreements or liability waivers that are signed off on following the installation of on-site rainwater management systems?
27. Are there penalties in place for non-compliance (e.g. maintenance schedule) or alteration of on-site rainwater management systems without notifying the City?
28. How have on-site rainwater management systems been integrated into your municipal code? And which do you consider to be the most effective?
29. How much of the stormwater program budget is allocated to financial incentive programs (approximate %)?
30. What challenges were faced within the organization when developing the financial incentive programs and how were these overcome?
31. How are programs encouraging on-site rainwater management practices on private lands being evaluated within the local government and how are the results being shared with the community?
32. Are stormwater management efforts being coordinated with other levels of government, if so how? (PROBE: What jurisdictions are participating and how)
33. Does an advisory committee oversee the stormwater utility and the financial incentive programs? If so, who is on this committee (PROBE: NGO's, community, federal government, counties, etc.) and how were they appointed?

Lessons Learned

34. Have community drainage problems decreased (or increased) over time as a result of these programs?
35. What, if any, unforeseen costs and benefits have arisen as a result of these programs?
36. How have these programs evolved over time to reflect the changing needs of the community?
37. How are you measuring the successes of the programs that encourage on-site rainwater management on privately owned parcels of land and new developments? (Water quality sampling, participation in outreach activities, # of credit/incentive applications)
38. What information is being collected about these programs to determine whether or not stormwater management goals and targets are being met as a result of on-site rainwater management programs?
39. If you were to start over again, what are the main recommendations you would make to improve the development and implementation of rain friendly techniques on privately owned parcels of land – new and existing developments?
40. Do you have any other recommendations that you would like to provide for a local government considering the adoption of financial incentives as a means of encouraging stormwater management on private lands?
41. What other jurisdictions would you recommend that we look at to learn from their past successes and failures?
42. What documents or literature do your use to help guide you in your efforts to encourage on-site rainwater management techniques.

43. How has your jurisdiction led by example in terms of implementing best management practices in the stormwater conveyance system? What difficulties have presented themselves when adopting stormwater best management practices on public lands (inflexibility in bureaucratic processes, political, high-costs, or inter-agency conflict)?
44. Lastly, can you tell me about a specific failure that has resulted from any of your programs?

Appendix C. Case Study Summaries

City of Bellingham (Population: 80,885)

Program Details

Those not connected to the stormwater system but can prove that they are treating to standards and are directly discharging into water and are not directly connected to the stormwater system and are eligible for a 70% discount.

Stormwater Code (2001):

- Specifies development designs that seek to infiltrate rainwater and use LID as the first consideration for a sites stormwater management plan.
- Some new developments have a regulatory requirement that results if they have plans to develop over a certain building footprint size.

System Development Charges:

- Financial incentive to those that show they can provide a certain level of LID and to reduce impervious surfaces.
- Anyone that meets certain criteria can be eligible to pay $.226 per square foot of impervious surface on a given development site.

Existing Development Credits:

- SFR in the highest tier is delineated based on total impermeable area but still have the opportunity to participate in the credit program (not the case for small and medium footprint lots which do not have credits).
- Qualified stormwater facilities get 20% off monthly fee.
- Properties that have individuals NPDES permit with industrial discharge and meet stormwater quality standards can be eligible for 20% discount.

Homeowner Incentive Program (HIP):

- Portion of the city has an aggressive LID aid program for residences - program run through a Department of Ecology grant.
- Grant of up to $6,000 for HIP grant for retrofitting of a home.
- Help residents design something simplistic and they have the ability to hire needed professionals and contractors to do the work which is then paid out.
- Pay 100% for materials, 75% of construction costs and 100% of architectural/design work (up to a limit and then 50%) after that. program so successful that they are looking at extending beyond DoE grants.
- HIP has been very successful and is a program geared towards phosphorous removal but it is still providing benefits beyond common LID suite of best management practices (BMPs).

School Credit:

- Up to %70 credit available.
- To initiate the credit the school must put together a report on the assessment of costs that is put towards the education program - the cost of these must be greater than the credit being provided. Generally in the $50,000 - 60,000 whereas education program costs are in excess of $1 million.

Program Selection Rationale

- Council wanted some equity in the rates and therefore staff came up with the three tiered rate structure.

- Resulted from protection of potable water supply which preceded regulatory requirements.
- Credit programs available for 70% of utility fees - 30% is still allocated for the general city stormwater compliance and meeting the requirements of the federal NPDES permit.
- Credit rates were derived from another jurisdiction which conducted rate analysis based on roadway cost and operation and maintenance costs.
- At the time of council's approval of the credit program, inability to delineate the total impervious surface so only the building footprint was used to determine the billing rate.

Program Administration (Community)

The City looked at multiple regulatory requirements as it was an early adopter which helped address what was needed in terms of water quality goals and how to meet them in a changing regulatory environment. After enactment there were large amounts of information requests about the program. With special phone lines being set up and having people dedicated to providing program education and responding to public complaints and inquiries.

Community Involvement in Program

Mailed out proposed billing rates to all residents providing them with impervious surface numbers that had been measured and estimates on their future billings. When it went to the public hearing process council requested a tiered system for residential rate fees. Didn't hear much from residential property owners before it was enacted but there was a large outcry from the business community. Lots of time and effort placed on meeting with the business groups opposed to rate changes. Lots of the population may be doing LID practices without seeking any credit. Community is very involved in trying to improve the city and take care of its resources.

Community Groups:

- Resources Group: Larger environmental group in western Washington provides community outreach and educational support.
- Sustainable Connections: goal to provide education and outreach for LEED and LID adoption in the area.
- Raising community profile of LID. Sometimes people get excited about LID in areas where they are not feasible and the city has to be voice of reason.
- Some small grants and funding goes to the groups from the stormwater utility.
- Also contract for services of these groups. E.g. contract with Resources who are doing the work for a stormwater education program for Whatcom and Skagit county. $250,000 grant from DoE which is then administered by the City.

Education and Training

- Washington State University extension program in Bellingham does a lot around LID and providing education programs on LID and sustainable development.
- WSU will be working on some pilot projects on rain garden effectiveness and phosphorous storage.
- Workshops, meet with neighbourhood groups, and participation in local planning efforts.

Communication Strategy

- Mostly just website content. No direct mailing as eligibility is limited for most residences.

Program Administration (Organizational)

Public works (Lead), liaises with operations, budget manager for the utility, educators, SW maintenance inspectors, green infrastructureS support staff to do billing and delineation of impervious surfaces, source control program, and work with business and providing 1-on-1 advice on how to limit pollution.

Program Structure and Oversight

- Program overseen by the public works advisory board.
- Opinions varied. Upper management considered it a necessary evil given the costs it was going to represent.

Technical Standards

- Adopted 2005 Western Washington stormwater Manual/state standards and 2005 stormwater LID guidance manual.
- Climate Change - talked about it and a re-development on the coast is looking at it how sea level rise will be addressed.

Inspection and Maintenance Requirements

- Aggressive in plan review stage - ensure that compliance meets the design standards.
- Monitoring for new developments - working on a monitoring schedule. Have the ability to inspect all of the facilities and previous to 2007 it was being conducted on an as needed basis (visual check) since 2007 though required for an annual program for facilities build after 2007.
- Working on developing a program improvement to address developments prior to 2007.
- Post 2007 there is no monitoring requirement for water quality, they are constructed to certain standards and based on construction standards it is anticipated that they will result in certain water quality improvements.
- Regulatory requirement is the large driver for the program - and the HIP program which is incentivised. If the rest of the city is not incentivised it will likely not occur.
- HIP program - there is a regulatory requirement to inspect the systems to ensure they comply with design standards.
- Penalties for a number of things - violation of vegetation removal, etc. Have the ability to be aggressive but are trying to get there through education.

Challenges

- Changes to regulatory requirements results in shifting costs.

Coordination with other agencies

- DoE also likes to see partnerships with local governments and non-profits so it benefits both organizations to be connected with one another.
- Western Washington University - institute for watershed studies - have been contracting with them for years to do watershed studies and looking at water quality issues. Lots of synergies between the work being done there are the City's goals.
- Puget Sound partnership is a great resource and also provides some financing for program development.
- Department of Ecology - APWA - stormwater manager's group that is set up as a part of the NPDES permit requirements and provide a lot of info on lessons learned.

Lessons Learned

Program Evaluation

- Largely water quality that is being examined. Had a monitoring program in place for 25 years for many streams and stream segments.20 years of monitoring and a good baseline.
- Seen declines in stream health as a result of new growth over the years but the trends are starting to go down for fecal coliform.

Key Recommendations

- Take advantage of existing materials around adoption of LID programs and also the components that have been used now for a few years and have gained public acceptance in the engineering community.
- Be sure of feasibility of LID - balance of engineering and natural systems design which will have the most desirable effect - not one or the other that is going to have the best effect.
- Be sure to consider local site conditions as not all LID techniques are applicable everywhere.
- Rate structure should be reflective of built in LID advantage - pay a higher rate unless you provide a certain level of LID.

Leading by Example

- Raingardens, providing demonstration projects on city parking lots; educational signage.

Specific Challenges/Failures

- SDCs are not large enough to become a deciding factor. People are only required to look at LID but not required to do so. People look at it as saving space and also cost in some areas.
- Program for existing developments are not very successful. Deconstruction taking place on vacant properties to avoid fees associated with these properties.
- Existing developments: credit is simply not enough to encourage adoption (can count on 1 hand who has participated in credit program).

City of Issaquah (Population: 30,434)

Program Details

Existing Developments:

- 30% stormwater fee credit/reduction if they infiltrate for the 10-year storm event.
- 50% stormwater fee credit/reduction if they infiltrate for the 100-year storm event.

New Developments:

- Code requires developers to consider LID options first and their feasibility before the selection of conventional facilities.
- Have a soil map to ID which soils are amenable to soil infiltration and therefore the adoption of LID techniques.

Educational Programs:

- City provides exemptions to schools that provide educational program.
- Strictly the school district - includes all facilities - e.g. bus maintenance facility.
- Must show that the educational activities meet program requirements and they add up the staffing hours and expenses to receive total exemption.
- Schools required to report out annually.

Program Selection Rationale

- Push to improve environmental regulations.
- Consider doing things that do not require a lot of staff. Large staffing program is fragile to economic factors (e.g. recession).
- Rate study was conducted to determine what fee exemption rates (50% maximum credit).

Program Administration (Community)

The City acknowledged the role that economics played in participation in these programs however adoption rates were limited to a few commercial and institutional groups.

Community Involvement in Program

- Participation by community members on the Rivers and Streams Board which is comprised of appointed members of the public.
- Community participation is limited to attendance at council and committee meetings which are open to the public.
- Community Groups - City partners with non-profit organizations to deliver specific projects (e.g. drain labelling).
- Outsourcing of these programs on a project specific basis is considered to be efficient as these services cannot currently be delivered by the City.

Education and Training

- Once businesses understand the value of the SW protection program they begin to understand how they can take action and they cooperate if you keep after them.
- Community groups have grant money, from the state and City utility funds, which they use to deliver various education programs and stewardship projects.
- Rely on regional campaigns to provide some targeted stormwater education materials.

Technical Guidance Materials

- Puget Sound Action Team stormwater management guide.
- Washington State, Department of Ecology guidebooks.

Communication Strategy

- Stormwater website is the disseminator of LID/stormwater information and considered to be more efficient than print materials.
- Keep language as simple as possible.

Program Administration (Organizational)

This program is led by public works and engineering but deals a lot with operations and maintenance programs as well.

Program Structure and Oversight

- Rivers and streams board - which covers development reviews and many other areas.

Technical Standards

- Adopted county standards but made a few additions to it.
- Utilize state documents on LID and refer citizens to them.
- Under state permits, must adopt the state or county manual but can make City amendments.
- Infiltration suitability determined to limit unnecessary regulations on development.
- Climate change not considered in their program.

Inspection and Maintenance Requirements

- Goes through development review to ensure proper construction.
- Long term monitoring is completed for new developments and their conventional SW facilities.
- Requirement of state permit - state LID requirement ensures adequate monitoring is conducted.
- Every year or two may do a site visit - random site visits likely in the future but they are still working on developing a monitoring program - also have limited resources.
- Have authority to go on-site. Established a covenant on the property to allow staff to go on-site.

Challenges

- Administrative costs of managing an elaborate program - and monitoring - and determine whether the financial benefits justify the program.
- Cooperation with builders and development community is important as you need to provide them with more long-term view of these benefits.
- Top down management results in pre-determined allocation of resources for SW programs and do not encourage local programs that are tailored to local needs.
- Programs evolved as a result of fiscal challenges. Have to do more with less and be more creative in targeting the problem in the community.

Coordination with other agencies

- NPDES program forced a lot of communities to share knowledge.
- Upper levels of government are disconnected and should focus on working with the community.

Lessons Learned

As development regulations have gotten more stringent over the past 10 years it has alleviated negative issues that would have resulted from the business as usual approach.

Program Evaluation

- Not really any focus on monitoring program results - under resourced and there are many priorities such as dealing with community members etc.
- Current program evaluation efforts focus on water quality sampling to measure outcomes for the stormwater programs. Education programs are tough to count participation (it is also a state requirement).
- Program success is limited in terms of participation in incentive programs - the regulatory aspect is more powerful.

Key Recommendations

- Regulations considered most economically feasible and best means of requiring LID.
- Permitting - need to get attention of the developer and those funding the development to try and showcase what is in it for them.
- Consider a reduction in permit fees, provide technical support, or expedite plan review.
- Use fee for education of individuals - e.g. How the school programs work.

Leading by Example

- Grant projects have built some LID projects - Pervious asphalt which had a monitoring component.

- Restoration projects and open space acquisition around streams to benefit salmon and aquatic and terrestrial species.
- Lots of focus on water retention not pollution reduction to improve water quality at the state level which impacts management regime.

Specific Challenges/Failures

- Problem results from developers not thinking about the long term savings on utility and may not result in LID adoption as fee reductions are not of benefit to them.

City of Marysville (Population: 60,020)

Program Details

Stormwater code:

- State grants given to incorporate LID into municipal code in 2007.

Stormwater Credit:

- Fee reductions for the adoption of pervious pavement and rain gardens on all land except for single family residential.
- Rely on the financial benefit of ratepayers wanting to pay less on their bills which is ultimately the incentive for them to adopt LID techniques.

Education Credit:

- Can't legally give an exemption but can give 100% reduction.
- Education program in place for every grade 5 student in the district.
- Students are taken out to view a stormwater facility that the school district runs.
- 5 year reporting out period.
- Schools save about $300,000 a year on the program – reduction may need to be revised.

General Facilities Charge:

- City charges for connection to the system in terms of an impact fee from development.
- $95 per 3,250 square feet of impermeable surface; so a project with a 10,000 square feet of impervious surfaces would then be divided by 3,250 and multiplied by $95 to determine the impact fee ($292).

Discounts for direct discharge - as they do not go through the city system - but they still have in impact on the system therefore charged the same.

Program Selection Rationale

- Piloting what had been done in other areas and determined what other jurisdictions were doing.
- Need to meet upcoming permit requirements.
- Driven by fairness to allow those rate payers doing work to manage stormwater and pay for service and how individuals are impacting the stormwater system.

Education Credit:

- Council approved what rate of reduction is provided based on the education program and a presentation the School District gave to council.

Program Administration (Community)

Marysville has a high adoption of LID with 100% infiltration as a result of the geography and natural permeability of soils in the community. Program relies on the cost savings of

adopting LID. It is cheaper to do infiltration projects rather than detention facilities but the long-term maintenance component is one thing that people are worried about. LID also gives them more buildable area on-site without a large pond. Driver for single family homes is largely to be green.

Community Involvement in Program

Really just a public consultation process to pass code.

Not a lot of specific outreach resulting from these programs.

Community Group:

- Non-profits (fishery task force, conservation districts, adopt a stream) that do work based on grants to develop restoration programs, rain gardens and rain barrels and try to help people implement programs for homeowners.
- Conservation district's charge city $2 per homeowner/resident to deliver programs.
- City does not provide funds - just help them out with education programs, write support letters for grants and also give staff support for workshops etc.

Education and Training

- Public education and outreach efforts required in the NPDES permit but it is not a huge focus.
- Have a TMDL for nutrients, which includes public outreach and this may meet the education component on the permit.
- Work with Everett Community College - to do some environmental monitoring projects.

Application Process

- Pre-application process allows staff to identify some LID options but they may already have a design in mind but they need to improve this outreach.

Program Administration (Organizational)

Public works and engineering manages the utility and has 20 full time employees to work on the application of the NPDES permit and also operations and maintenance work such as street cleaning, etc. Four people work on permit implementation and annual reporting.

Program Structure and Oversight

- Ultimate decision lies with council and they make decisions on the direction of the programs.
- Stormwater group makes recommendations to council/mayor who then decides.

Technical Standards

- Utilize stormwater guidebook from Department of Ecology which is the approved manual for Phase 2 communities.
- Rely heavily on the language that is included within the code.
- Climate change has not been actively considered but it may be required soon by the Department of Ecology.

Inspection and Maintenance Requirements

- Phase 2 permits - required to do private facility inspections are required and they are just starting this process now to monitor detention facilities (old way of doing things) but for commercial ones there is not a great monitoring program for this.
- Code language includes some of this around right for inspection and maintenance. Code enforcement language about financial implications for non-compliance.

- Would take away their reduction after the fact if they did not comply but they have never done that.

Challenges

- Providing incentives are not really all that effective as developers may not know about the program. After the fact someone needs to seek a fee reduction so there is a disconnect between developer and building/property owner.
- Trying to keep track of those in place is a challenge but they are working on mapping them.
- Should have required developers to submit the info on their own and also look at drainage reports for new projects. Those that are infiltrating from previous projects may not meet all LID eligibility criteria and therefore are not considered for a credit reduction.
- Legal - do we charge ourselves and is this something we should do and pull from other departments. But it is not benefiting the SW system but would benefit the city as a whole.

Coordination with other agencies

- NPDES managers group that share what they have put on their permits.
- Lots of talking with other jurisdictions to learn from their experience.
- Washington State Department of Ecology participates in these meetings as well.
- The Department of Ecology has developed in coordination with the jurisdictions a regional monitoring program which city's pay into. Lack of control over this and loss of potential knowledge in the community - but it is a more systematic, watershed based approach.
- Working with the Tualip tribe and county to keep information flowing.

Lessons Learned

Program Evaluation

- Don't evaluate internally. Submit annual report to DoE including number of LID installations.
- Keeping track of the number of LID programs in the City. Water quality monitoring also takes place as a part of their TMDL.
- Education programs conduct a pre- and post-test on participant understanding of stormwater and measure it which is also required for measuring outreach efforts within the permit.

Key Recommendations

- Change some things that are allowed through the plan review process to make LID an option for them.
- Would not do LID program as it gives benefit after the fact when should be working with the developers.

Leading by Example

- Park and ride project with pervious pavers, overflow parking in a park with pervious pavers, pervious sidewalks - but then you have to clean it out over time which was not considered.

Specific Challenges/Failures

The City may need to revise LID program in its North end as the groundwater table is high and neighbouring properties may be flooded out. Good for recharging rates of groundwater. Base flows of streams are also increasing and this issue will need to be addressed in the future. High base flow is considered a good problem, unsure if it is from LID exactly. More aware of flooding as a result of the utility and how properties affected should contact the city if a flooding problem has occurred.

The cost for the environmental education programs for schools is something that may need to be revised. Need to tighten down as it is applied to all school facilities - considering just applying to the educational institution and not areas like bus parking lots.

How should the City include community gardens and charge them along with agricultural lands. For redevelopment should it be modeled as existing forest? If it has been impervious prior to 1980 you can model it based on the current land use.

LID is hard and can be burdensome to manage. Lack of including certain things in the code but this was due to a previous council and certain items may be changed as a result of having a different council in the future.

City of Seattle (Population: 608,660)

Program Details

Program applies to commercial, industrial, institutional and residential sectors

Stormwater Facility Credit Program (2009):

- Drainage credits to recognize efforts to manage stormwater on a private property.
- Based on area being managed by the low-impact development (LID) built on the parcel.
- Up to 50% maximum stormwater fee credit.

Stormwater code (2009):

- Use of green infrastructure is mandated for new construction and redevelopment of parcels in excess of 700 or 800 square feet.
- Management efforts required to a 'maximum extent feasible'.

Rainwise Program (2009):

- Rainwise is a rebate program - pay private properties for every square foot of impermeable surface that they disconnect from the within specific combined sewer overflows (CSOs).
- Rebate $3.50 per square foot of impervious area that is run into green infrastructure.
    - Athletic Field Program:

- Fields that retain stormwater can apply if they meet specific requirements and may qualify as a highly pervious surface.

Rate Structure:

- Tiered rate structure: based on percentage of impervious surface on a given property.
- And if you have enough on your property you could qualify for a lower rate, which is a lower rate category. Also provided for unmanaged grass and natural forest.

Program Selection Rationale

Stormwater Facility Credit Program:

- Requested by City council and the Mayor's office to look at utility rate structure and potential rate and non-rate incentives.
- Modelling to determine the effectiveness of LID techniques that could be adopted.

Rainwise Program:

- Needed to comply with the Clean Water Act and address CSOs that were out of compliance.
- Conducted a cost benefit analysis for traditional stormwater approaches vs. infiltration technologies to control square feet of water.

- Cheaper to fund infiltration projects than build treatment facilities.
- Rates determined through the use of a hydrological model and models of cistern efficiency and impervious surfaces.
- Feasibility studies conducted - site conditions assessed in CSO basins to determine percentage of feasible adoption related to geographical features, and social conditions in an attempt to determine possible rage of installations and impact controlled volumes.

Program Administration (Community)

Seattle is progressive in terms of going green which ties into these programs well. Two main factors considered to drive the program - cost savings and citizens trying to make a positive difference to the environment. For new developments – it is the offset of costs over time with some developers being very proud to showcase their innovation and involve the community.

Community Involvement in Program

Program development driven by the City. Public involvement limited.

Stormwater Facility Credit Program:

- Relatively little uptake to date. More success from stormwater code requirements.
- Community Group Support - resource venture group (business association) promotes programs.
- Work with business and industry related with code compliance and stormwater inspection processes along with promoting the credit program where appropriate.

Rainwise:

- Over 120 installations to date.
- If homeowners have to pay less than $500 out of their pocket these are considered an effective means of encouraging rainwater management.
- Seen as eco-status symbols in the community and some think of it as free landscaping which the city will pay for.
- Community Groups - Creek advocacy groups support the program as it aligns with their needs/program objectives.
- Non-profits - campaign called 12,000 rain-gardens. Goal of each King County city installing 1,000 rain gardens. Grant money supports the installation of demonstration gardens and public education and workshops.
- Green Infrastructure Partnership (GRIP) leveraging local resources and find synergies - city works with them to ensure residents are provided accurate program information.

Community Group Funding:

- RFP for small contracts accessible to non-profits and community associations.
- Pilot program with $44,000 available for community groups to complete projects that the City may not be particularly good at conducting (e.g. door-to-door canvassing or grass roots initiatives).

Education and Training

Rainwise:

- Non-profits - Grant money supports public education and workshop delivery.
- Contractors - City provides 8 hours of training about the program, why it is there, messaging materials, design standards, promote and install rain gardens and cisterns.

University Participation:

- Washington State University instrumental in researching stormwater techniques and testing new technologies and system efficiency.
- Publishes a guidebook on LID systems.
- University of Washington - design charrettes, installation of a green wall watered by cisterns, and monitoring of public property bio-retention systems.

Provide technical fact sheets for do-it-yourselfer's that are not eligible for rebates.

Application Process

Rainwise:

- Only targeted CSOs eligible for rebates.
- City has map to highlight which basins are eligible for the rebates.
- Program will end in 2016.
- No limit on rebates – will pay out for every square foot of stormwater controlled.
- Will not pay more than installation actually costs.

Technical Guidance Materials

- Stormwater Code manual applies to the credit program and the Rainwise program.

Communication Strategy

Stormwater Facility Credit Program:

- Have done program promotion to businesses and neighbourhood groups.
- Focus primarily on customers with existing stormwater systems (in a database) to encourage maintenance, post cards encouraging ratepayers to apply, ads in local newspapers and neighbourhood papers.
- Focus on the economic benefit of taking action.

Rainwise:

- Communications toolbox - first class letter and flyers explaining the problem, every 6-8 weeks afterwards send out post cards with recent installations and happenings.
- Utility website and tools website to help homeowners determine their eligibility in a green infrastructureS system - type in an address and it will run an algorithm and provide them with the best projects to be conducted on their land and if they are eligible for a rebate.
- Paid advertising, banners on local blogs, local tours, events, attend local fares, give presentations to stakeholders and community groups.
- Engage contractors – most have proven to be effective at spreading the messaging.
- Encourage residents to become a part of the solution to protect waterways while getting a landscape amenity for your house.

Athletic Field Program:

- Send out letters to schools and parks encouraging them to get compensation for the infiltration taking place on their property.

Program Administration (Organizational)

The stormwater permit that is issued through Washington State governs what needs to be done within the community to address key issues related to water quality and quantity.

Program Structure and Oversight

- Information on project eligibility and suitable techniques provided through an online calculator.
- Asset management team - consisting of the department heads - report out to the utility director and represent their own divisions and work closely together on these programs. Within the context of asset management principles, City uses triple-bottom-line approach to utility delivery.
- Council is consulted about programs and provide program guidance when needed.

Technical Standards

- Stormwater Code provides a manual with technical guidance for the installation, monitoring, development and enforcement for those developing and installing green infrastructure and LID.
- Stormwater Code manual applies to the credit program and the Rainwise program.
- Rainwise projects must be completed by contractors.
- Green infrastructure considered to allow the system some resilience and flexibility.
- Anticipated climate change impacts have not been considered in design standards or modelling efforts.

Inspection and Maintenance Requirements

Stormwater Facility Credit Program:

- Inspection completed when put in the ground and then 2-years after installation of the system and every 2 years to make sure maintenance and design was appropriate.
- Waiver signed by applicant to acknowledge system maintenance requirements and allow the City to access the site for inspections.
- If not maintained may remove the credit from the bill, or if it is out of compliance with the stormwater code. Need to complete maintenance and reapply for the program.

Rainwise:

- Pre-inspection to consider on-site problems before they happen and ensure they are built right the first time.
- Post-inspection to determine if the design standards are being met.
- Operations and maintenance inspections to determine if the LID is still in place and functioning as planned.
- Document package accompanying each rebate :
- Homeowner's agreement allows access for initial and subsequent monitoring.
- Understand risk of installing system.
- Keep and maintain the system for a minimum of 5-years.
- Disclosure of system upon sale.
- Waiver of liability if building behind a rockery.
- Contractor provides a 6-month warranty as well.

Challenges

- Creating a new program where ones such as this had not existed before.
- Participation rates and how to get people involved. Very little people with stormwater facilities wanting to apply.

Coordination with other agencies

- Working with King County to coordinate management program for CSOs

Lessons Learned

Program Evaluation

Reporting out to upper management of the progress made in each program but nothing public.

Report out annually to the Washington State Department of Ecology.

Rainwise:

- Coming up with a range of the overall cost of rain garden installation to determine if they are paying too much or not enough.
- In-pipe monitoring looks at base flows and how much control over CSO flows is being utilized through LID.
- Number of rain gardens adopted.
- Square feet of stormwater controlled.
- Modeled control volumes achieved.

Key Recommendations

- Be cognizant that contractors are not given preference and provide an equitable playing field for businesses.
- Provide a program that encourages people to manage their stormwater to reduce their bills.
- Pilot projects are important if you want to test out a program and tweak it before implementing it City wide.

Rainwise:

- Spending public money on private property for public benefit can be tricky and full accountability is needed. Rainwise program is always looking at how much money when it went in, pre inspection, post inspection square feet of stormwater captured, control volumes, and put into green infrastructureS noting where SW facilities exist.
- Figure out what others have done and learn from the experience of others.

Credit:

- Make it easy to apply - simple process and make sure that you have sufficient staff to deal with the volume of applications.
- Educate people upfront about what they will need and what the credit is for and how it fits into a citizen's world.
- Make the application simple and easy to fill out.
- Creating a database that can be changed as the program progresses and evolves.
- Identify how data is going to be collected and processed.

Leading by Example

- Public bio-retention projects, street edge projects, neighbourhood redevelopment projects, Ballard rain gardens.
- A lot of coordination with public works department when dealing with public right of way projects.
- Thinking about who is responsible for maintenance in the public sphere and coordinating these internally.

Specific Challenges/Failures

Failure in a CSO - included construction of bio-retention facilities in the public right of way, $1million in federal stimulus funds which pushed up timelines, limited public

outreach occurred and ended up with projects that did not function as planned and failures captured by media and resulted in a robust list of lessons learned which informs projects development and implementation in other basins.

City of Gresham (Population: 105,594)

Program Details

Stormwater Rate Credit:

- Provided to customers if they manage their SW onsite.
- Discount is 14% or 27% (50-75% onsite rainwater management eligible for a 14% discount - if 75% or more rainwater being managed onsite then you get 27% discount).
- Discounts need to meet certain requirements (e.g. downspout disconnection, rain barrels, drywells, swales, etc.).
- May not allow certain technologies as a result of soil characteristics.
- Encouraging rain garden installation and downspout disconnection.
- Mini-grants available for homeowners to install rain gardens.
- Concerned about public health and safety and property damage and work with the building department to determine what is acceptable to them in terms of safety standards - discourage in certain areas as a result of this.
- Conduct safety assessment up front for homeowners to determine suitability of proposed projects.

Re-Development:

- Stormwater controls required for re-development projects that are over 1,000 square feet.

System Development Charges:

- Based on the square feet of impermeable surfaces and as a result new developments are allowing for more incentive to pursue green development.
- Found that green development practices are cheaper to install and the upfront costs are lower."
- Commercial Sectors needs a professional engineer to sign off on any LID projects. Given the nature of new developments and many commercial programs will see cost savings as they have high bills.

Downspout Disconnection Program:

- Will disconnect for individuals if they find ones that are safe to disconnect
- Residents are required to sign a safety form that allows city staff to go onto their property to conduct the work.
- Upon completion, individuals can apply for a credit to their SW bills.
- Offer the service, provide all the parts, labour, and guarantee the work
- Provide signage to help promote program and start a social movement.
- Reimburse up to $200.
- Programs are mostly done by individuals - only 11 grants so far and none of them have contracted labour.
- Pilot program done in a neighbourhood that drained into one stormwater pipe and looked to identify multiple benefits.
- Identified the flow reductions that results from the total square footage that was disconnected.
- Model what level of reductions you will need to meet certain flow reduction targets.
- Tried to monitor pre and post flow data - flow monitors in culverts.

- Based pilot selection area based on most suitable area - public visibility, soils, drainage basin area etc.
- 105 disconnected so far.

Program Selection Rationale

- Results in a reduction in the amount of water that needs to be managed and also treated.
- SW rate credit is more about equity not about providing an incentive.
- Outreach efforts are resource intensive and as such the City has sought and attained grants from other agencies to provide programs.

Driven be the requirements under the Clean Water Act and the NPDES.

- Really expensive end of pipe treatment which is required as a result of the NPDES permit and any offsetting of this are beneficial.

City wide analysis for suitable areas for downspout disconnections

- Counted total amount of homes that are in areas deemed suitable for disconnection which is multiplied by the pilot projects adoption rates and get a number on what they could offset in terms of SW flow reduction.
- Program costs are still lower than constructing a large treatment facility.

Program Administration (Community)

In many cases these programs draw on the fact that the city will deliver a particular service on their property for free and all they have to do is apply for a credit. For other aspects of the program such as the installation of rain gardens the City highlights how residents will get a fee reduction and also get a landscape feature when participating in certain programs.

Community Involvement in Program

- State permit requires program development to be released for public comment which is also considered to be a large part of their outreach efforts.
- Some folks putting in rain gardens are certainly aware of the environmental benefit. No one is building a rain garden for $200 to reduce their SW bill by $5.00.
- 11 people have built rain gardens to date.
- Downspout disconnection is an easy process and City staff approach homeowners and it is really straightforward thing to do.

Community Groups:

- Watershed councils in place (NPO's) - letters of support for the grants.
- Help communicate and canvass in the community and advertise City programs.
- Stream restoration efforts are driven by watershed councils.
- Watershed councils are contracted to do some restoration projects as well - City takes advantage of their ability to communicate and educate with the community and the city provides them with some budget for outreach efforts.

Universities:

- Portland State University - suitable area mapping project for downspout disconnects - lots of graduate students working on research projects like water quality monitoring.

Education and Training

- Hold workshops and give community presentations.
- Conduct onsite visits.

- Have a how-to guide; self-guided tour maps of demonstration programs.
- Have video on the website as well and link to other educational videos.
- Do tag downspouts and cap the one that would carry it to the street. Also have a phone number to call if reconnection is taking place. Only 7 have called to reconnect and updated in database.

Communication Strategy

Identify why it is a problem, then the environmental impact and cost benefit last as it is less likely that it will actually reduce bills. Looking at ways to appeal to non-traditional audiences that would likely adopt a stormwater technique anyways.

Stormwater Rate Credit:

- Don't put into newspapers - take advantage of word of mouth instead of large public outreach efforts.
- Has yet to result in any serious impact on revenue generation.

Downspout Disconnection Program:

- Canvassing is the most effective but also the most resource intensive.
- Direct mailing efforts proven to be not very effective.
- Utilize the City's website, attend farmer's market and put some ads in newspapers.
- Always adaptively managing these programs to try and ensure they are getting the most out of the programs they are delivering.

Program Administration (Organizational)

Program is led by the Department of Environmental Services alongside the Engineering Department and operations and maintenance.

Program Structure and Oversight

- Have annual strategic meetings to address the next year's goals and objectives.
- Leveraged existing operational funds through grants.

Technical Standards

- Utilized the city of Portland's resources on stormwater management practices and modified as needed. Used these to create green infrastructure manuals and other guidance materials.
- Climate Change: programs probably of benefit given uncertainties but no need to talk about it.

Inspection and Maintenance Requirements

- Initial inspection and no mention of monitoring schedule. Some new owners will reconnect downspouts upon purchase but there is no monitoring in place.
- New owners could also be informed in mail out upon purchase of a new house and get their "welcome to Gresham" mail outs.
- Commercial programs - take the word of the engineer that signs off not within the city's capacity as well.
- Sign off on the approval which results in liability being transferred to the owner.
- Downspout disconnection has a permission form to conduct the work and holds the city harmless and then it is their responsibility once the city completes work. May also require further sign-off when seeking approvals.
- Will remove discount from utility bill is found to be in non-compliance.

Challenges

- Some issues arose with the building department and municipal code but worked it out using safety standards that met everyone's needs and requirements.
- Had to use the state plumbing code unless they wanted to create their own.

Coordination with other agencies

- Required to report out on program performance to the State annually.

Lessons Learned

Program Evaluation

- Looking at analysing the program cost per unit of water managed to ensure that the programs being delivered are cost effective.
- Annual reports to the state through NPDES - measure all of the educational outcomes and data sharing with grant partners.
- Mainly through water quality monitoring, which is driven by the NPDES permit but also use the results of the program to identify/model program successes.

Key Recommendations

- Have a simplified form for single family residents.
- Canvassing is way better for participation rates than direct mail.
- Rain garden grants works best for $200 - not a single application went through when the program offered a $100 rebate.
- Utility rate needs to be large enough to incent people to manage stormwater on-site.
- Important to highlight the other services provided by the adoption of LID techniques.
- Talking to your building department is important to ensure that the process is efficient and streamlined when plans are reviewed.

Leading by Example

- Leader in the area when installing rain gardens and other LID in right-of-ways.
- Feasibility of LID is now looked at first - it used to be the use of proprietary systems first but now they look to LID systems first.

Specific Challenges/Failures

- Downspout program - pre purchased a bunch of materials - need to know what the conditions are on the ground to make sure that it is the effective/appropriate materials.

City of Newberg (Population: 22,068)

Program Details

Stormwater Code:

- Code for new developments to require reduced impermeable areas and costs are tiered based on total impermeable surfaces. Do not require a certain LID or green infrastructure to limit liability but also to increase the incentive to adopt LID.

Stormwater Fee Credit:

- Started out by creating a program for commercial and industrial rebates as their fees tend to be higher and it is more attractive to consider adopting LID and receive a credit (2005).

- Credits require submission of an annual report on the operation and maintenance of the adopted LID infrastructure and approval will result in another credit being issued for the given year.
- 50% credit for the industrial and commercial groups.
- Education programs can result in a 10% reduction in fees - tiered rebate allows for targeted areas for individuals to focus on.
- Only 2 groups have taken advantage of this so far.
- Program extended to single family homes in 2010.
- Not much uptake and they are not aggressively promoting in the community.
- Single Family Residential homes have more focus on the use of LID and promote use of specific LID techniques. Only 1 application has been submitted so far and it was not accepted.
- 35% maximum residential fee credit that will be instituted.
- 65% of fee goes towards covering the basic maintenance costs of the stormwater infrastructure.

Education Programs:

- Rebates are provided for businesses that provide some level of staff education related to stormwater management.
- Can be done through staff newsletters and bulletins.
- City suggests content but does not require certain materials to meet criteria.

Program Selection Rationale

- TMDL - Have to do certain things citywide - so everyone gets education and the likes as required under state policies.
- Analysed what other jurisdictions had done for their incentive rates to provide rationale for the use of a 24-35% residential credit in order to maintain funding for the rest of the SW system.
- Checked out what the larger regions have done and determined what issues may have arisen as a result of these programs.

Stormwater Fee Credit:

- City council was driver for the incentive - council resolution to promote the adoption of such an incentive.

Program Administration (Community)

Most of the drivers for participation in these programs were economic in nature for businesses and some institutions like universities were more aware of the environmental benefits of participation. Participation in programs may be low as a result of the administrative burden required when applying for rebate and the operation and maintenance requirements and require staff time and capacity may not exist to meet program requirements.

Community Involvement in Program

- Consultation process though public hearings and council meetings.
- Partnered with middle schools as a part of world monitoring day to make the connection between water and how it relates to them.
- SOLV (Oregon based non-profit groups SOLV.org) do restoration and clean-up programs in the community that encourages physical contact with the environment.

Universities:

- Have taken on a leadership role by providing demonstration facilities.

Education and Training

- Had a workshop on rain gardens and infiltration planters for residents which highlighted the program - good way to market the program as well.
- No real guidance materials provided to ratepayers but they point to existing guidebooks that are available from other organizations.
- Have done an LID class last year and will do another one this year.

Communication Strategy

- Budgets limited and not much effort being made to get the program message out to the community through the media.
- More of an online presence for communication about the program.
- Use of mail-outs.
- Try and engage developers in the pre-application phase of new developments.
- Cognizant of the fact that it will cost money to promote program and then reduce revenues should the program be successful.

Program Administration (Organizational)

There is three program staff responsible for the credit and incentive programs one in public works, operations and maintenance, and engineering.

Program Structure and Oversight

- Citizen rate review committee - staff help with this and they use a consultant to work on this and also include some participation with public groups.

Technical Standards

- Utilize existing resources and adopted some manuals but adapted them to their needs.
- Oregon State University has some great resources through their extension program as well.
- Climate Change: Will polarize issue in the community and therefore they avoid mentioning it.

Inspection and Maintenance Requirements

- Design plans are required to be signed off of by a Professional Engineer.
- City staff can stop in if they want to make sure they comply with their requirements.
- Have the right to inspect but they will not go out on a regular basis - not scheduled but may have an annual maintenance schedule. All forms say that the city is to have full access to monitor, inspect and verify - but no schedule for monitoring is in place.
- Maintenance agreements - private facility required to be maintained and it is determined at the developer stage. Public system is maintained by public works staff.
- Must reapply each year and be approved.

Coordination with other agencies

- Partner with the bureau of land management to provide free tree's for residents.
- Quite isolated watershed and not a large need to work with other jurisdictions.
- City of McMinnville – population of 30,000 - is starting to reach out to work on TMDL's to share funds for education programs.
- Regional groups - clean rivers and streams that include several metro cities and clean water services provides certain services and are willing to work with one another to share resources.

Lessons Learned

Program Evaluation

- Incentive is not large enough for single family residential at 35% max and therefore the payback period is not substantial enough.
- No modeling completed to determine the overall effectiveness of the programs/private facilities.
- Rely more on qualitative rather than quantitative measures.

Key Recommendations

- Need to make the process as simple as possible and not require them to use a professional in order to be eligible.
- Pilot the incentive program with the business community first given the higher bills that will result from the utility. Vital lessons learned from this pilot can then be applied to the roll-out of a residential program.
- Provide more flexibility with annual reporting out requirements - and the timing of when these come in to staff (e.g. not during tax season).
- Do lots of outreach - including stakeholders who have the opportunity to turn on you and need to listen to stakeholders and participants to drive program adoption and community needs. Get as many groups involved at multiple venues.

Leading by Example

- City street improvement projects with rain gardens installed with signage that provides public education. This is a low-impact stormwater initiative taking place within the right of way.

Specific Challenges/Failures

- Relying on LID techniques then you definitely need to have a maintenance agreement in place.

City of Portland (Population: 583,776)

Program Details

Municipal code:

- Requires stormwater management on private property for new developments or re-development projects.

Stormwater Fee Reduction:

- For on-site stormwater management on existing sites.
- Apply to the adoption of rain gardens, eco-roofs, trees, pervious pavement.
- Design approaches outlined in the City’s stormwater management manual (this is used to inform the code and also how to measure how you get the discount).
- Rate discount capped at 35% fee reduction on the currently stormwater bill.

Eco-roof Incentive:

- Will pay residents $5 for every square foot of eco-roof you choose to do.
- Large, small, any kind of project. Can be new, or redevelopment.
- Costs are not capped - no one has applied beyond the funds available. Largest was an $185,000 project (35,000SQFT).

LID Installation in CSO's:

- City approaches residents to see if they are willing to have the City install a LID on their site and then the residents can apply for the rate reduction.
- 29,000 CSO's throughout the City – targeted approach to the installation of LID projects.

Community Watershed Partnership Program:

- Grant program to incentivize watershed improvement techniques.
- Community groups submit application for grant funds to conduct specific projects to reduce the amount of impervious areas within the City and build infiltration systems.

Downspout Disconnection Program (Past program):

- Disconnected 50,000-60,000 downspouts.
- Program concluded as it met its goals and reduced the volume of water entering the stormwater system.
- Goal was to divert 50% of on-site stormwater flows from these properties.

Program Selection Rationale

- Stormwater management fee - someone had the common sense to break this away from the sewer fee that was being charged.
- Inequity of the financing system that existed and needed to be addressed.

Modeled grey infrastructure (traditional stormwater approaches) vs. green infrastructure (LID) and the ability of each to address stormwater issues in the community.

- Assessments to determine the net cost benefit analysis of CSOs.
- Pilot project used to determine the overall effectiveness.
- E.g. if we get 100% of SW flows off this street we will mitigate CSOs or reduce the need for expensive capital upgrades.
- Lots of piloting of rain gardens to prove that they worked in the community and how they will work in the community.
- Started off with small pilot projects then a $144 million program to re-do CSOs using the grey approach - compared to using green approach to determine overall cost which was $11 million of green which reduced the grey cost down to $75 million so $86 million vs. $144 million.

Program Administration (Community)

These programs place emphasis on the triple-bottom line approach and consider the needs and goals of each program in terms of their social, economic and environmental performance. The City spent a long time trying to talk about the environmental benefits, then onto the social aspects, but now the business case for green stormwater management approaches are better and cost less.

Community Involvement in Program

- Went to the community in the 1990's and said that federal law requires stormwater management.
- The adoption of the municipal code, requiring new and re-development to consider their impact on stormwater took 5 years to develop and complete using a collaborative community based process.

Community Groups:

- Involved through the Community Watershed Stewardship Program grants.

Universities:

- Conducted economic feasibility, outreach, planning and engineering projects.

Education and Training

- Eight staff members focus on the delivery of outreach and education alone - not including special presentations by managers to professional community and others.
- Work with neighbourhood groups and other professional outreach and education.
- Eco-roofs: Hold annual conference for developers and a free 1-day class with around 100 participants.
- Portland's Green Info Think-Tank also communicates and educates the public online.
- Have outreach staff at events, for information calls and also conducting site visits.

Application Process

- Some funds are limited as a result of state and federal deadlines.
- CWSP – application deadlines in place for annual grant programs.
- Deadlines for community building grants for CSO projects that accompany CIPs.

Technical Guidance Materials

- Design approaches outlined in the City's stormwater management manual (this is used to inform the code and also how to measure how you get the discount).
- Guidance materials include workshops, videos, online materials and training sessions.
- Have 1-page fact sheets, guidance documents, pamphlets and CDs.

Communication Strategy

- Communication strategy focuses on encouraging the participation in these programs and their ability to meet mutually beneficial goals of social, economic and environmental sustainability.

Program Administration (Organizational)

Program Structure and Oversight

- The City's Bureau of Environmental Services leads stormwater management in coordination with engineering and the finance department.
- A watershed group also oversees program efforts within the City's operations.
- Prioritise program focus areas based on the areas with the worst sewer back-ups and to reduce peak flows.
- Sensitive Stream areas are also prioritized for the use of green infrastructure in order to maintain the integrity of these sensitive streams.
- Grey to Green 5-year program (2008) – eco-roofs, tree planting, green streets, rain gardens, purchasing property for watershed benefits, removing impassible culverts for fish passage and $5 million of which went to the eco-roofs program.
- Stormwater Advisory Technical Team - evaluate function and performance of these programs.

Technical Standards

- Developed a stormwater manual specific for the City of Portland.
- Climate change: Adoption of green infrastructure will help reduce the urban heat island effect but uncertain what quantifiable effects might be.

Inspection and Maintenance Requirements

- If a property is required to meet the SW manual it must submit documentation on what it is supposed to do and manage the facilities as required.

- Random property inspections are conducted and properties are required to submit an operations and maintenance plan and the facility is put on the deed of the property.
- No liability waivers – it is agreed upon that those folks with infrastructure on their property are required to deal with it.
- Code authority allows them to apply penalties but they use a softer approach to addressing any issues.

Challenges

- Incentives - looking at finances and allocating the $ to incentive programs - need to have people within the program to look at how to squeeze out money for the incentive projects.
- Management decides that an incentive program will work or not and may go to city council.

Lessons Learned

Program Evaluation

- Measure what we do relative to the types of projects and the types of people involved to keep track of how much we want to do and track to see if we accomplish those goals.
- Monitoring the number of people that are applying.
- Rate of functioning systems in the community through inspection process.

Key Recommendations

- Have certification/list of folks that have completed the workshop on green infrastructure. Impossible with the staff levels to identify if everyone is doing the right thing.
- Work with as many partners as possible on projects.
- Partnered with private developers to combine resources and projects which provide an opportunity that if not responded to would not come up again for 20 + years.
- Monitor and evaluate the flow and quality of these systems.

Leading by Example

- Public projects provide an opportunity to meet with the community/neighbourhood associations and what it will mean for their property and how it functions.

Specific Challenges/Failures

- Unknowns about the operation and maintenance costs of certain programs.
- Designing for the urban context associated with a given urban setting to make sure that the water is getting into the stormwater facility (e.g. slope or gradient issues).
- Calculating the number of eco-roofs that could be achieved and determining how much money is needed to do an eco-roof - and came up with the $5 figure - when looking at how many eco-roofs that they were getting per year (about # acres per year without an incentive) and they said they would get 3 acres per year that would be doing it anyways and then estimated that there would be other adopters. Those that would have done it anyways still ended up applying for an eco-roof grant.

City of Sandy (Population: 9,570)

Program Details

Stormwater Code:

- New developments are required to treat and detain for 2-year, 5-year, 10-year and 25-year rainfall precipitation patterns.

- Rate will be reduced based on the adoption of LID instead of business as usual
- Land-use process has a pre-application process to identify how they can store and treat your rainwater at which point the City often showcases what other properties have done.
- Ask individuals to not look at the conventional approach.

Stormwater Rate Credit (2005):

- Must have at least the 3 times the equivalent of an Equivalent Residential Unit to be eligible to receive a 1/3 credit on their bill which is about a $3.00 fee reduction.
- Rate is too low and this is limiting existing customer participation.
- Some do the cost-benefit analysis and see that it is cheaper overall.
- Small businesses get it but the big chains won't really look too far outside of the box. Some are seeing that it can benefit their image but the smaller businesses tend to be much better.
- Does not apply to Single-Family Residential Properties.

Rain Barrels Giveaway:

- Give out free rain barrels – been giving out about 30 rain barrels for the past 3 years.
- None this year and may have reached saturation.

Program Selection Rationale

- Financial incentives created to mollify people's concerns about the fee and its impact on larger property owners.
- Motivation for creating the utility was a push from the friends of tickle creek organization. Taking a leadership role as they were not required by the state to do so and the council saw that the regulations would be coming down the pipe eventually.
- Sold the idea to council in advance of pending regulations once a certain population level was hit and it would help the City be prepared for when this time comes.
- Early on program development was in response to community flooding issues and they needed a way to address stormwater issues but the funding was not there.

Program Administration (Community)

The reality of it is that participation in the programs is all about the cost savings. The rate is set so low however that there is little incentive for smaller parcels of private land to participate. Some of the larger properties have placed more emphasis on being sustainable and to set an example within the community. The stream that runs through the creek has salmon in it which is highly visible and it raises community awareness.

Community Involvement in Program

- Community not involved early on as staff were responsible for developing the programs which then went to public hearings for review and comment.

Community Groups:

- When developing the program, Friends of Tickle Creek was integral in guiding the program development and encouraging green stormwater management practices not just piping it all away. This group is no longer active which has constrained public outreach efforts.
- Advocacy groups have not been utilized to their full potential.
- When utility was set up there was money set up for outreach and demonstration projects but little has been done to date.

School Programs:

- Getting the schools to participate is difficult as you have to rely on teachers to be interested and wanting to develop curriculum.

- When school district was building for LID, they got a little bit nervous about the performance of the permeable surfaces.

Community involvement in the program is low as those that are doing onsite rainwater management would be doing it regardless of the program incentives.

Stream protection and health is a key community priority that is largely supported by the public and efforts are largely community driven.

Education and Training

- Have a Master's in Public Administration student develop a stormwater 101 and private stormwater facility maintenance program to educate the public.
- Will conduct site visits to help promote the use of LID techniques in the community.

Communication Strategy

- The City tries to make it really easy for developers of new developments to take advantage of green infrastructure.
- Have a blurb in utility billing mail outs.
- Lots of online resources.
- Feel that visible community projects are the best way to promote LID in the community.
- Used to have a brochure or a map providing some tour info for LID projects.

Program Administration (Organizational)

Had consultant do a stormwater master plan - proposed piping solutions - then had it redone by another consultant as the public did not like the pipe only solutions and the second consultant proposed green infrastructure - created a hybrid of these two.

Program Structure and Oversight

- Council is the ultimate reviewers of the program and are the ultimate policy makers.
- Public works and engineering work on the program.
- Priority given to properties next to streams that will limit the impact of direct discharges.
- Have a calculator to help ratepayers determine eligibility for the credit program.

Technical Standards

- Used Portland's stormwater management manual but adjusted it to reflect the greater amount of rainfall that occurs in Sandy.
- Provide a lot of resources online to steer people towards the appropriate places/resources.
- Climate Change: Have not adjusted flood event for increased rainfall events.

Inspection and Maintenance Requirements

- City is responsible for public easements and therefore must maintain.
- Small systems on a private lot are not managed by the city but if it is serving multiple lots or a right of way then the city will manage the site. Some continue to be managed privately though.
- Residential programs are more of an inspection issue.
- Once it is on private property it goes through the inspection process.
- Working on an inventory and also an on-site inspection program.
- Developers are supposed to maintain their systems but they are not too diligent in monitoring.
- City is protected under Oregon law and liability falls on the homeowner.

- Facilities are not being monitored - need better inventory to see what compliance rate is. Happen to know about these systems and their function as it is a small town. First penalty is really just education and then they may reduce the credit.

Challenges

- Largest problem from an eager individual and design was flawed as some knowledge is lacking in the community in terms of green infrastructure.
- Lack of current knowledge of LID design is a big issue.

Coordination with other agencies

- TMDL's requirements in 2007 resulted in cross-jurisdictional coordination but little has come from that.

Lessons Learned

Program Evaluation

- Could run the numbers but have not yet done so to analyze the business as usual project and how they went above and beyond this to recognize their efforts better.
- Have seen greater salmon numbers and higher up in the creek which is positive.
- Had lots of development and the water volumes have increased but they feel it is less than it would have been if these programs had not been in place.
- Have not quantified anything specific with regards to program success.

Key Recommendations

- Need to work with the developers to make sure that LID is considered and will work in the area.
- Have a monitoring program in place before you start the program.
- Have more demonstration projects on public land and properties.
- Incentives are a good idea because they are relatively low financial risk as you provide the public with an alternative but very few have taken advantage of this program. Improves public acceptance of the utility fee as well.
- Incentive programs are a good idea but the rate has to be large enough to encourage the public's participation in the program.
- Need to work more with private sector as they currently leave things alone in that realm and aren't too sure how well performance is going.

Leading by Example

- A few green street projects with roadside swales.
- Some of the publicly funded sidewalks use permeable sidewalks and permeable pavers.
- Police department has a rain garden that is very visible and also permeable pavement.
- Did do some stream restoration and day lighting projects.

Specific Challenges/Failures

- Cost of monitoring private facilities was not incorporated and as such they have not been doing much of this at all.
- Large push just to monitor and identify where these systems exist and also have a green infrastructure layer where the rain barrels exist. Not 100% sure where they are still in use or not.
- Some permeable parking lot areas failed. Another challenge results from a lack of infiltration and requires rain gardens to still have an overflow into the conveyance system.

City of Kitchener (Population: 204,668)

Program Details

This program is just being implemented within the community and will not have the same level of lessons learned but it will still provide insight into essential program design elements for the City of Victoria.

Stormwater Fee Credit:

- 45% maximum fee credit.
- Assessed existing on-site stormwater controls to recognize those that already had onsite controls and to determine the effectiveness of maintaining and enhancing source water protection.

Education Programs:

- Working on developing partnerships with the school boards.

Program Selection Rationale

- Based fee credit on the City of Portland's fee reduction.
- Determined total cost allocation and line items in stormwater budget to determine what could be impacted by private property owners implementing best management practices and what are not going to be impacted by private homeowners (e.g. replacing aging infrastructure) which are identified as fixed costs. Pond clean outs (reduced sediment loading) and such represent the variable costs.
- Recognized that they cannot know all of the impacts and challenges in the SW system.

Program Administration (Community)

Community Involvement in Program

- Proposed alternatives to the community - approximately 50 people came to each community meeting.
- Tailored the program to meet the needs identified in the community.
- When they first started with the utility they were not going to have a residential program but lots of phone calls came in from the community. They thought a rebate program would be good for a one-time rebate but the community wanted a credit reduction similar to that being applied in the commercial sector.
- Focusing project - Victoria Lake Park project which was full of sediment and was falling apart and the community wanted it to be revitalized. Community was strongly advocating for project completion. Timing overlapped with stormwater utility development and they said we could help fund revitalization of Victoria Park as a part of the stormwater utility.
- Need to get people that support program to come out and support it at council meetings the angry people will show up regardless.

Universities:

- University of Waterloo does an annual survey which they asked to include a section on SW to gauge what the community needed would need to see in order to become engaged in the program.

Communication Strategy

- RAIN program will help achieve/support program implementation. Program utilizes advanced social marketing.
- Showcase properties with BMPs on them and encourage further adoption.

- RAIN will be doing workshops, YouTube videos and a whole suite of social marketing techniques as a part of the three year program that received $3million in program budget from the province.

Program Administration (Organizational)

Program Structure and Oversight

- Champion was the director of engineering - Grant Murphy. Four Deputy CAO's that guide the program development within all aspects of the city's departments. Senior leadership team.

Technical Standards

- Currently developing these materials. REEP will have a checklist of things residential properties can do and they will do a site visit to look at downspouts and slope and they will provide homeowners with an indication of the rebates that will be available to the resident and how much money they will save on their bill.
- Utilized provincial guidelines, City Development Standards, LID standards, and non-residential design standards.

Inspection and Maintenance Requirements

- Non-residential: inspection before receive credits and bylaw states that they must submit annual self certification reports to ID maintenance that has been done and why we should keep getting the credit. O&M - if they are not being maintained they are not functioning.
- Residential: more projects. Will do an annual sampling and have summer students check out the property and talk to the owner to determine what the compliance level is and determine program effectiveness and some general compliance trends.
- Non-compliance results in a lost credit that you have received since the last inspection and will not be eligible to re-apply for one year.

Challenges

- The credit program was a lot less controversial than when implementing the rate. Largest challenge was internal workload with competing projects - needed to make sure it was high enough on the totem pole to keep people working on these projects.

Coordination with other agencies

- Worked with the province on the Clean Water Act from 2006 which required watersheds to develop source water protection programs to ensure clean drinking water supply.
- Provincial government downloaded the responsibility to develop source water protection policies to address SW quality issues. Currently providing a suite of four different incentive programs - Ag properties (Grand River rural water quality program), business operations (provide secondary containment for gas storage facility), salt and snow storage (chloride getting into ground water supply). E.g. providing a 5% SW credit if companies are providing a salt management plan.
- Received some funding from the provincial government to fund the education and outreach program until 2014 - Showcasing water innovation grant from the province funded this.
- Also partnered with Green Communities Canada, The city of waterloo, and the REEP (RAIN) to develop public outreach tools pilot projects, demonstration projects and a home outreach program that is modeled after the delivery of the federal eco-energy audit program.

Lessons Learned

Program Evaluation

- Solid baseline of SW quality as a result of water quality monitoring program that started in 2001.

Key Recommendations

- Define basic principles and the need to move forward.
- Use consultants with a broad spectrum of background not just engineering.
- Expect credit program development to be a 3 year + process.
- Need champions within the organization and council.
- Ensure credit programs are fair and equitable.
- Easier if credits are approved at the same time as the rate implementation – now they have to back pay credits.
- Use simple and effective messaging.
- Partner with other organizations - NGO's chamber of commerce, etc.
- Apply credits to property owners not renters.
- Base rates and credits for impervious area - keep it simple.

City of Waterloo (Population: 97,475)

Program Details

Program implementation is just commencing in the community.

Stormwater Fee Credit:

- Two groups can participate
- Maximum 45% credit for both groups
- Low-density residential
- Low-Density Controls - rain barrels, cisterns, green roofs, permeable pavement, infiltration galleries, engineered landscape features (e.g. downspout disconnection to a constructed vegetation area), and tree diameter at breast height (minimum 8 inches at that height and 40 inches total required.
- Based on potential volume of stormwater captured.
- Required to demonstrate that nearly all of their rainwater is being captured.
- Multi-residential and ICI
- Split into quality controls (pollution reduction), quantity controls (flood prevention control - SW management ponds, rooftop storage, parking or underground storage), and education component. All detailed in SW management reports online. Will acknowledge cisterns and those that have installed as a part of the LEED program which will be a quantity controls. Will offer exemptions for green roofs. Quantity controls - oil grease separators, paved area sweeping programs - needs to be demonstrated, salt management plan - 'companies hired as salt smart', Education component - spill response plan that has been communicated to employee's they will be eligible for a credit. These will be offered initially.

Program Selection Rationale

- Council requested staff to develop a credit and rebate program as a part of their stormwater utility.
- Rates determined based on the total management costs that could be attributed to private actions that can manage runoff compared to the amount that the city will be providing to the overall public indefinitely.

- Residential side - rain barrel program uptake, used green infrastructureS and made some assumptions. House age used to determine tree requirements (less than 5 years probably won't meet tree requirement) and size of the lot (large lot more likely to have more trees and gave a probability for meeting tree requirements).

Program Administration (Community)

Community Involvement in Program

- Two public open houses to showcase credit and rebate program and to allow the community to provide feedback on suite of options that were developed by the City staff.

Communication Strategy

- RAIN partnership - handling most of the communications materials through a grant from the province.
- RAIN responsible for approaching school boards and developing educational programs.
- City responsible for communicating with the business community.
- RAIN to engage general public through outreach, tours, workshops and educational materials.
- 5 main criteria driving the education and focus of the REEP program. RAIN to target specific neighbourhoods - criteria used to identify suitable target neighbourhoods to deliver messaging to. Criteria looked at areas that were densely populated and had limited stormwater management area is known to have flooding issues, receiving waterway have water quality issues - bad smell, or stormwater infrastructure is old or in need for replacement.

Program Administration (Organizational)

Program Structure and Oversight

- Water services and public works - planning department through the site plan process reviews stormwater controls and ensures standards get met, operations also plays a large role.

Technical Standards

- REEP will develop a guide for the best practices that will be communicated but City is not certain if they are going to be the appropriate ones to assess that.
- Part of the credit system will be on the honour system.

Inspection and Maintenance Requirements

- Spot check and field check process in place but will not hit every single applicant to review.
- Every application that comes in will automatically linked to the green infrastructure system to do a review (and map them all) but also will also use to flag certain property types based on certain characteristics - e.g. 5 year old house with certain tree's etc.
- Will have language stating that by applying you allow the city to visit your property with review focusing on the flagged properties.
- 1st 6 months - 1 year will be really lenient to start off (e.g. application process selection option).
- May suspend credit accounts for 2 years if they are flat out falsifying info. And may charge an additional $25 or $50 for processing these - but not set in stone yet.

Challenges

- One is the tree control - manager of trees liked the idea but they wanted tree canopy as the measure which created challenges and then they went with DBH.

- Challenge with maintenance review process for demonstration and maintenance of certain technologies such as stormwater receptors.

Coordination with other agencies

- Approval of the credit program set out in the municipal act and needs to abide by certain areas of the legislation mainly for providing the user fee system in a non-traditional manner.

Lessons Learned

Program Evaluation

- Solid baseline of SW quality as a result of water quality monitoring program that started in 2001.

Key Recommendations

- Partnership with RAIN has allowed the city to focus on what they are good at - billing- and allow RAIN to deliver programs which they are used to doing in an effective manner.
- Accessing what information you need/have before you start converting to the utility you to establish how rates will be assigned and do it in a clear, understandable method. Large level of work goes into this e.g. large level of work to use green infrastructureS to showcase impervious surface layers in the city.
- IT related - understand the billing system and how you will be instituting that fee. Revenue director knows that every bill will cost a certain amount and as a result the SW fee has been added to the water utility bill to save money and streamline the process.
- Credit program should probably also try and do a little bit more analysis of the uptake of the program to reduce uncertainties around administrative burden.
- Provincial government is often behind and therefore they often look to other municipalities and what they are up to.

Appendix D. Recommendations for the City of Victoria

Creation of Residential Credits

Stormwater control credits are the most common credit provided for single-family residential properties with only two jurisdictions not having them in place. Credits should be provided to eligible residential property owners based on the volume of stormwater which is diverted from entering the municipal stormwater system as a result of the installation of green infrastructure. Although quality controls may be considered small for a single family residential property, if applied throughout the City the magnitude of change in stormwater quantity outcomes may be substantial. An important aspect of the residential credit is to establish, through financial analysis, what the base level of the stormwater rate is for providing basic stormwater provisions and services. Although many jurisdictions used arbitrary rates based on those adopted by other jurisdictions, all have a base rate that allows for funds to be allocated to the ongoing management of public stormwater facilities which benefits the entire community. As such, it is very important to determine what variable stormwater costs can be reduced as a result of the adoption of green infrastructure by private properties and what costs are fixed and cannot be impacted by private homeowners' activities. This will result in a credit that does not diminish stormwater revenues in a way that is detrimental to fixed stormwater costs in the community. As identified through the interviews, the following are a list of the most common green infrastructure techniques in use for residential credits:

- Rain gardens;
- Infiltration basins;
- Rain barrels;
- Downspout disconnection;
- Permeable pavement; and,
- Shade trees.

Residential credit programs provide a regular reduction on monthly stormwater utility charges, dependent on the volume of runoff being managed on-site. Although more stormwater pollution typically occurs from non-residential sites, a residential credit program could include a credit for the adoption of pollution preventing green infrastructure. A pollution prevention credit could be done by utilizing an educational survey which intends to influence the behaviors of residents when it comes to their daily actions that affect the quality of stormwater runoff. Specific behaviors to targets could include:

- Not washing vehicles on impervious surfaces;
- Picking up pet waste and disposing of it responsibly;
- Minimizing the use of lawn fertilizers;
- Minimizing the use of de-icing salts;
- Properly disposing of used engine oil; and,
- Sweeping dirt into lawns and the garbage as opposed to into the street.

Although the options for residential and non-residential and multi-residential properties can have a great deal of variation, it is important that the alternatives are developed in coordination with the community and internal and external stormwater working groups. This will ensure that the programs under consideration are relevant and supported by the community members at large and feasible given the available resources and physical constraints that are found within the City of Victoria.

Creation of Non-residential and Multi-residential Credits

The properties that could be included in this category include public and private schools, universities, colleges, government (federal, provincial and regional) buildings, commercial buildings, industrial facilities, places of worship, and multi-residential properties. Several credit options could be created to accommodate for these property types including water quality (pollution reduction), water quantity (flood prevention), and education credits. Stormwater rate reductions, and the maximum allowable credit varied across the 10 local governments interviewed (Table 5.1.). Some of the more innovative programs such as the City of Kitchener and the City of Newberg clearly provide several options for achieving the maximum allowable credit. This is achieved by dividing up the rate reduction depending on the technologies overall effectiveness in addressing stormwater quality and quantity controls, or public and staff education programs. The City of Kitchener for example provides up to a 25% rate reduction for pollution reduction (quality control), 15% for flood prevention efforts (quantity control), and 5% for staff education (education programs). These credits would then result in a 45% maximum stormwater fee credit.

Stormwater Quantity Control Credits

Stormwater volume controls are achieved through a variety of ways, which vary depending on local government, such as infiltration and extended detention by the following mechanisms:

- Infiltration ponds and percolation basins;
- Infiltration trenches;
- Extended (dry) detention basins;
- Preservation of significant vegetated open spaces; and,
- Porous Pavement.

When stormwater flows are directed through a best management practice or are controlled on-site in vegetated spaces, then a site could become eligible for specific credit amount. Credits for stormwater volume controls are typically based upon several different data types including hydrologic data, water quantity data, design requirements or regulations, and data supplied by qualified professionals that approve of the best management practice being installed on the property.

It is commonplace for cities to reward on-site quantity control credits for the adoption of green infrastructure in a manner that is proportional to the overall benefit to the municipality's stormwater management system. It is important to specify how City staff will access properties in order to conduct routine facility maintenance and inspection schedules, and to validate that the green infrastructure facility is providing its intended benefit in order to receive their credit reduction. The City also needs to specify if and when it requires stormwater facility reports to be prepared by the property owner and submitted to the municipality. One city noted the importance of considering the administrative burden that will be placed on non-residential and multi-family residential building owners as a result of annual reporting out requirements and monitoring efforts. It was determined that program participation was limited in some cases as businesses lacked appropriate resources to fulfill reporting out requirements.

Stormwater Quality Control Credits

The actual percentage of a stormwater quality control credit should be based on an evaluation of the overall benefits that have been provided and pollution abatement achieved as a result of the adoption of a best management practice. Stormwater quality control efforts may provide a single benefit or a combination of benefits, in which case credits should be additive. Structural best management practices that are eligible for stormwater quality control credits can include, but are not limited to, the following:

- Vegetated Swales and Filter Strips;
- Buffer Strips and Swales;
- Retention (Wet) Ponds;
- Constructed Wetlands;
- Media Filtration; and,
- Oil/Grit Separators.

It is important to acknowledge that quality control credits may be adopted based their overall ability to meet water quality objectives in the community. However, it is also imperative for city staff to review and determine the suitability of stormwater quality controls within their city based on natural factors such as slope, hydrology and soil characteristics to ensure the effectiveness of City recommended best management practices.

Stormwater Education Credits

Education credits are typically available to commercial and institutional properties since these types of properties have the ability to influence and educate both staff and clients. Those commercial and industrial properties wishing to receive a fee credit for educating students, employees and or customers about stormwater management and watershed protection should be required to meet a set of minimum standards. For example:

- Devoting recommended hours annually to educating one grade level of students about water quality awareness and protection. The municipality may assist with providing materials for the education program to ensure it incorporates locally relevant information. Topics covered through these programs could rotate annually, or become part of the curriculum for the same grade level each year.
- Devote an hour annually to educating employees about water quality awareness and watershed protection efforts. Programs may also be required to provide basic stormwater management information to new employees and report out annually on the educational activities being implemented by the employer. Topics should be required to rotate on at least an annual basis. Copies of materials may be required to be provided to the municipality as well.
- Posting stormwater and water quality specific educational information, obtained from the municipality, province/federal environmental agencies, or another reputable educational resource, in employee/student frequented areas. Information being posted should be clearly visible to staff and topics could be required to rotate on at least an annual basis.
- Distribute stormwater and water quality-specific literature obtained from the municipality, province/federal environmental agencies, or another reputable educational resource to target students and all employees on an annual basis. May require copies of these materials alongside the annual self-report. Topics would be required to rotate on at least an annual basis.

Although the delivery of education programs may have a varying impact, it is important to note that the credits for employee education should be relatively marginal when

compared to the resource intensive exercise of developing stormwater curriculum within schools. As such, it is a commonplace for cities to provide schools with a much larger credit for the delivery of such a program as it will likely have a much larger impact on stormwater education in the community.

Requiring the Adoption of Stormwater Best Management Practices in New Developments

Given the low participation rates in existing stormwater credit programs, most jurisdictions pointed out that the most successful means of mitigating stormwater flows was by requiring the adoption of best management practices through their municipal code. In BC, under the *Local Government Act* (R.S.B.C. 1996, c. 323) and *Community Charter* (S.B.C. 2003, c. 26), local governments are provided a significant opportunity to manage and protect stormwater in a variety of ways. The planning frameworks that are established in the *Local Government Act* provide municipalities with the tools and direction to incentivise community action on stormwater management (Rutherford, 2007). This includes the purposes and possible policy content that is to be included within local government OCPs including the provision of storm drain and drainage infrastructure. Within Section 878(1)(d) of the *Local Government Act* OCP policy statements can include those related to "…the preservation, protection, restoration and enhancement of the natural environment, its ecosystems and biological diversity." This provides yet another tool by which local governments can begin to address stormwater issues and focus on a variety of protection and restoration efforts within OCPs.

Under Part 26 of the *Local Government Act* council can adopt zoning and other development regulations in support of stormwater management objectives through the creation of permeability criteria for parking lots, runoff controls, and landscaping requirements under Sections 906, 907 and 909.

Community drainage issues can also be addressed through the use of Development Permit Areas (DPAs) which are utilized to protect certain features of the natural environment. Within section 919.1 of the *Local Government Act* a DPA designation can be used by a municipality to stipulate specific conditions which must be met before it grants a permit for a subdivision, alteration of land, construction or addition to a building in a given area.

Although the majority of the City of Victoria is already developed, this presents a great opportunity to utilize development cost charges to offset the portion of the costs related to the services that will be provided as a result of new developments in the community. Three of the local governments noted that they used similar charges on new developments (System Development Charges or General Facilities Charges) to provide an incentive for developers to manage stormwater on-site through development cost charge reductions. The general method of charging for development cost charges in these jurisdictions was to require that new developments pay for the amount of impermeable surface that will be on the site. The development cost charge fees could be calculated in different ways but two examples from Bellingham are the use of a set fee per square foot of impervious area or a 50% credit for developments meeting minimum green infrastructure thresholds.

Lessons for the City of Victoria

Given the broad powers to regulate, prohibit or impose requirements under these areas, local governments have the flexibility and jurisdiction to take considerable steps towards mitigating the negative impacts of stormwater in absence of senior government regulations. The application of these planning tools, as they relate to stormwater management on new developments, can help the City develop a suite of requirements that allow for green infrastructure to be required under certain municipal powers or encouraged through the development permitting processes. The use of smart practices will vary depending on the local objectives, resources and feasibility of alternatives considered.