

*Evaluating Voluntary Stormwater Management Initiatives in Urban Residential Areas:
Making Recommendations for Program Development in the City of Vancouver*

By

**Yota Hatziantoniou
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We accept this thesis as conforming to the required standard:

Anthony H. J. Dorsey

Timothy McDaniels

Stephen McTaggart

THE UNIVERSITY OF BRITISH COLUMBIA

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Abstract

As riparian and aquatic areas experience continued degradation from the pressures of human development, there is an increasing realization by watershed managers that measures must be taken to restore the urban hydrological cycle. Voluntary stormwater management and water conservation practices, such as those advocated by the Engineering Services Department (ESD) in Vancouver, British Columbia, provided an opportunity for homeowners to participate in the management of their water resources. Unfortunately, due to a number of unknown factors, the stormwater pilots in this city failed to receive the widespread adoption that was required for their subsequent expansion.

To inform the design of an integrated water management program that is capable of attracting a sufficient number of participants, a program evaluation framework was developed to assess the *Downspout Disconnection Pilot Project*, the *Perforated Sump Pilot Project* and the *Rain Barrel Program* in Vancouver, as well as the more popular *Downspout Disconnection Program* in Toronto, Ontario. Interviews of government staff and program participants, as well as reviews of theoretical and program literature, were used to understand the program variables that may have contributed to the different rates of program uptake observed in each city.

The results of the evaluations have been used to inform the design and implementation of future stormwater management initiatives in urban residential areas, as well as to recommend specific areas of program improvement for the City of Vancouver. The specific areas of program improvement identified include: *i*) dedication of adequate program resources, *ii*) implementation of complementary policies, *iii*) exploitation of opportunities for interdepartmental collaboration, *iv*) innovative program promotion, *v*) facilitation of homeowner participation, and finally, *vi*) monitoring of program performance over time and adoption of change. Through the design and implementation of an integrated water management program, the City of Vancouver would be able to demonstrate a commitment to innovative problem mitigation and environmental leadership, while helping to limit the impacts of urban (residential) runoff on the quality of its receiving waters.

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Chapter 1: Introduction

1.1 Sustainability and Stormwater

Urban areas are located within the circulating cycles of water, carbon, oxygen, nitrogen and minerals. For these cycles to continue functioning, they must not be overly stressed. Individual and household decision-makers play a vital role in adopting changes that would lead towards the creation of more sustainable urban environments. Ecological sustainability refers to the ability of humans to *i*) maintain life support systems, *ii*) protect bio-diversity, and *iii*) use resources efficiently (Robinson and van Bers, 1996).

Maintaining life-support systems refers to minimizing stresses on systems upon which humans and other living organisms rely for their well-being, which in the context of stormwater management, refers to components of the hydrological cycle, including soils, water and vegetation. Protecting bio-diversity refers to minimizing the loss of organisms – both those which are relied upon for sustenance, recreational or aesthetic purposes (e.g. salmonids) and those to which little human value is attributed, or about which there is little knowledge (e.g. soil microorganisms). Finally, using resources efficiently, in this context, refers to finding multiple uses for even those resources that have been traditionally thought of as highly disposable, or, of limited value.

The conversion of roof runoff into wastewater by virtue of its entry into the sewer system means not taking advantage of this resource for irrigation purposes, or ultimately, for reducing the consumption of potable water. In fact, reducing the consumption of resources in general is necessary for solving many local (and global) environmental problems (Johnson, 1995). Decisions made by people about how to carry out daily activities, or even decisions that are made for them but which they have power to influence, can affect the three components of ecological sustainability outlined above.

Ecological sustainability presumes that development can be brought into harmony with nature's limits of tolerance, by employing technological innovations, applying appropriate public policies and regulations, and by altering community and individual behaviours (Perks, 1995). According to Canada's Green Plan, environmental quality recovery is a duty that must be shared by all segments of society, and levels of government (Johnson, 1995). However, sustainable practices should be emphasized in urban areas, because this is where the majority of development takes place and where most environmental problems originate (Perks, 1995).

In recent decades, stormwater runoff has emerged as an issue of major concern to water resource managers (MELP, 1999). Stormwater affects local waterways both in terms of the volume of runoff that is generated, and the nature of the pollutants that may be conveyed (NRC, 1993). Allowing stormwater to infiltrate in urban residential areas is one way of managing runoff at-source, and by doing so, preventing a wide variety of down-stream effects.

In the City of Vancouver, the management of stormwater has been identified as one approach for minimizing the effects of impervious surface coverage and maximizing the conveyance and treatment capability of the combined stormwater/sanitary sewage system. Stormwater management practices (SMPs), and in particular, measures that promote the infiltration of rainwater into soils, can be used to decrease the imperviousness of urban residential areas, and to help restore the hydrological cycle in urban areas.

1.2 Thesis Goals and Specific Objectives

The first goal of this thesis is to evaluate the voluntary stormwater management and associated water conservation initiatives that have been introduced in Vancouver, British Columbia and Toronto, Ontario. The second goal of the thesis is to recommend stormwater management strategies for urban residential areas that could be applied to the specific case of Vancouver, British Columbia. The sub-objectives that lead to the achievement of these goals are:

- To explore the need for stormwater management and/or water conservation practices in urban residential areas, as exemplified by Vancouver;
- To explore how stormwater initiatives in the City of Vancouver, if widely adopted, could contribute to the water quality improvement goals of regional, provincial and federal agencies.
- To develop an evaluative framework based on the principles of summative/formative program evaluation, policy instrument evaluation, and community-based social marketing;
- To develop performance measures and interview questions based on the criteria identified in the evaluative framework;
- To obtain interview responses from Vancouver and Toronto program administrators regarding their experiences with the design and implementation of the various programs;
- To obtain interview responses from homeowners/program participants regarding their experience with a stormwater or water conservation program;
- To assess the voluntary stormwater (and water conservation) programs in the Cities of Toronto and Vancouver based on program documents and interview responses;
- To identify program weaknesses that need to be overcome and strengths that need to be further developed in any future initiative that integrates more than one aspect of water management;

- To make recommendations for the implementation of an integrated voluntary stormwater management initiative in the City of Vancouver.

In order to meet the thesis sub-objectives identified above, Chapter 2 explores the need for (storm) water management in Vancouver, and describes the institutional and regulatory context in which stormwater management can occur. This chapter concludes by outlining selected water management/water conservation initiatives in the Cities of Vancouver and Toronto. Chapter 3 provides a theoretical background to the evaluative framework that is subsequently developed, and Chapter 4 discusses the data collection and analytical methods that are used. Chapters 5 and 6 demonstrate the application of the evaluative framework in each of the two cities. Finally, Chapters 7 and 8 provide the results of the program evaluations, giving rise to a set of recommendations for future voluntary program development in the City of Vancouver.

Chapter 2: The Need for Stormwater Management in Vancouver

2.1 Land-Use Impacts

A variety of land-uses have been associated with the creation of stormwater that is generally higher in volume and pollutants, than stormwater emanating from undeveloped areas. Although commercial and industrial ‘point’ sources of pollution, have traditionally been the most severe threats to water quality, the past decade has brought on an increased awareness for the chronic threat of non-point sources of pollution including residential stormwater. The City of Vancouver, on which this study’s recommendations are focused, has nearly ten times more residential than industrial land area (FRAP, 1993), making residential runoff a cause for concern to stewards of local streams, rivers and estuaries.

2.1.1 Impervious Surface Coverage

The contribution of residential land-use to stormwater pollution stems from the prevalent nature of impervious surfaces (up to 60% in residentially zoned areas of Vancouver), including rooftops and roadways in these areas. Although impervious surfaces do not usually generate pollution *per se*, they *i*) contribute to hydrological changes that degrade waterways, *ii*) prevent percolation and pollution processing in soils, and *iii*) serve as an efficient conveyance system for the delivery of pollutants into waterways (Arnold and Gibbons, 1996). As a result, even relatively small rainstorms (in the range of 10 to 20 mm) can generate significant levels of runoff. Any by-products of human activity deposited on impervious surfaces, if not removed by street cleaning, wind action, or decay, will ultimately be incorporated into surface runoff. In terms of water quantity, as the intensity of a rainfall event increases, less and less runoff is able to infiltrate the ground (FRAP, 1993), causing an increasingly large volume of rainwater to flow over the land, enter into storm or combined sewer (CS) systems and become discharged into ecologically-sensitive areas.

2.1.2 Climate and Hydrology

Climate is one of the most important factors in determining the timing and magnitude of water inputs to the surface of water bodies (Moore, 1991). In fact, stormwater peak flows are largely influenced by the magnitude and frequency of rainfall events in surrounding areas, and the presence of absorptive soils and vegetation to impede the generation and conveyance of this excess flow. Other inputs that contribute to flood or overflow occurrences include moisture, groundwater, wetlands, tributaries and upstream lakes. Human activity also influences hydrologic processes through the damming, diversion, withdrawal and chemical alteration of water (Moore, 1991). In Vancouver, where the annual rainfall is high at 1170 mm (Statistics Canada, n.d. *b*), and where development activities are obstructing the infiltration of rainwater into the ground, excess stormwater generation has become a common and problematic occurrence.

2.1.3 Combined Stormwater/Sanitary Sewage System

The Vancouver sewerage area, encompassing Vancouver, University of British Columbia, northwestern Burnaby and Sea Island, has a CS system in place (Figure 1). Combined sewers convey a mixture of stormwater and municipal sewage to wastewater treatment plants (WWTPs) during low flow conditions; allowing the primary treatment of runoff from roadways and other impervious surfaces. However, during sudden rainfall events, when the capacity of WWTPs is exceeded, CSs release a combination of untreated stormwater and sewage into receiving water bodies through a series of combined sewer outfalls (CSOs) (Drinnan, 1997). In the Vancouver area, CSs typically overflow approximately 500 times per year, or 140 times each into Vancouver Harbour, the North Arm and Main Stem of the Fraser River, and 45 times into both English Bay and False Creek (GVRD, 2000*b*). The resulting discharges amount to 2% (or 36 billion litres) of the total combined stormwater and sanitary sewage which enters the GVRD's five treatment plants each year (GVRD, 2000*a*). In the aquatic environment, combined sewer discharges can pose serious threats to public health and the environment, since they convey bacteria and chemicals that may overwhelm nature's restorative capabilities, and accumulate in sediments over time. In addition, untreated rainwater can introduce persistent toxins into the environment, including chlorophenols from wood preservatives, zinc from roof housetops, copper from vehicle brake linings and water pipes, and hydrocarbons from automobile exhaust systems (GVRD, 2000*b*). In the City of Vancouver, efforts to replace aging combined sewers with separated (or twinned) sewers will take an estimated 50 years to complete (Grill, 2001). Remedial measures, such as stormwater best management practices, can help reduce combined stormwater/sewage inputs to the aquatic environment before complete separation can be achieved.

Figure 1: City of Vancouver Combined Sewer Outfall Locations

(Source: GVRD, 2000c).

2.1.4 Municipal Storm Sewers

In addition to combined sewers, storm sewers are used to collect storm drainage from private properties and roadways, and to discharge it untreated into local waterways. The intercepted runoff is directed through approximately 100 outlets to the Fraser River, or to urban streams throughout the GVRD (Schreier, Brown and Hall, 1991). Stormwater carried by municipal sewers is characterized by a number of toxins, including sediments, nutrients, trace metals and oils which are introduced via atmospheric deposition (NRC, 1993). Atmospheric pollutants enter urban runoff by settling directly onto the ground and being washed away, becoming entrained in falling raindrops, or by being deposited directly into coastal waters. These non-point sources of pollution include cadmium, strontium, zinc, nickel, lead and a variety of organics, which may be transported from distant sources. In most cities, the deposition rate of these atmospheric particles in wet and dry fallout range from 170 to 320 kg/ha/mo, depending on the degree of air pollution within the region (Ferguson and Hall, 1979). As a result, typical stormwater is often characterized as having an equal or greater concentration of suspended solids than untreated sanitary wastewater, and a five-day biochemical oxygen demand significantly greater than that of primary treated effluent (NRC, 1993).

Alleviating the sewer system of excess stormwater flows is therefore important for reducing impacts on urban streams, minimizing CSOs and their impacts on the aquatic environment, reducing wastewater treatment costs, and finally, for delaying costly upgrades to the sewer infrastructure (City of Vancouver, 1999c).

2.1.5 Wastewater Treatment Plants

As a result of increased wastewater generation, wastewater flow rates to all WWTPs discharging to the Fraser River have increased by 20% between 1985 and 1992 (Moore, 1993 in Drinnan, 1997). Flow rates to the Iona Wastewater Treatment Plant, which receives combined sewer and stormwater effluent from the City of Vancouver, can range from 180 ft³/sec on a typical Vancouver summer day, to as high as 650 ft³/sec during heavy rainfall events (Tilton, 2000). High stormwater flows to WWTPs not only increase the costs of treatment due to increased equipment wear-and-tear and energy demands, but also limit the detention and settling time required for proper wastewater treatment (Taw, 2000). Thus, high stormwater flows compromise local water quality both through their effect on sewage treatment operations, and through their contribution to combined sewer overflows.

2.1.6 Basement Flooding

The City of Vancouver periodically experiences major storms where the runoff generated greatly exceeds the capacity of the city's combined sewer system. During heavy rainstorms the increased volume of effluent in combined sewers can result in wastewater

flows out of residential and commercial plumbing (GVRD, 2000*d*). Thus, excess flows do not only result in combined sewer overflows, but also combined sewage back-ups into private residences through household sanitary fixtures (e.g. toilets, bathtubs and sinks).

In response to an increased number of storms since 1996, Vancouver's Engineering Services Department (ESD) has launched a number of initiatives to counteract the effects of basement flooding. These initiatives included impermeability controls (which maximize green space in new residential developments), a Flood Assistance Program (which provides flood protection advice to homeowners), as well as the *Downspout Disconnection* and *Rain Barrel* initiatives (City of Vancouver, 1999*h*). While these programs have the potential to prevent basement flooding by alleviating the sewer system of excess flows, they require significant participation rates in order to yield any noticeable effects. Nevertheless, future stormwater initiatives, if widely adopted, can provide the multiple benefits of improving the performance of the combined sewer system (reducing associated treatment and environmental costs), and conferring some protection against basement flooding, as is the case in Toronto.

2.2 Perception of Sustainability Initiatives

The Greater Vancouver Regional District (GVRD) has been active in developing plans that attempt to cope with population growth and sustainability issues within its boundaries, however, the implementation of these plans has been hampered both by bureaucratic opposition (FBEST, 1997) and by a lack of public awareness. The difficulty involved with adopting widely supported environmental initiatives, stems from the ambiguous nature of the 'future payoffs' to be received (Perks, 1995). Community sustainability projects may yield future benefits, but because the nature of these benefits is ambiguous, the impetus to act sustainably may be fairly limited. While each member of the public is affected by changes in environmental quality, in the absence of reassurances that others will act in the same way, people may be reluctant to take action or even inform themselves of the threat of non-action (Harrison, 2001). These types of considerations often affect interest in project proposals that offer ecologically sound investments (Perks, 1995). Ultimately, the marginal costs of sustainability projects will have to be supported by public funds, albeit with the potential for future recoveries once environmental and operational savings are realized.

In terms of stormwater management, reducing stormwater flows to an aging sewer system, and ultimately to a wastewater treatment plant (such that significant system upgrades or expansions are not required), could represent significant savings to taxpayers. For proponents of sustainability, the challenge is further to implement practices and policies that will maintain the integrity of natural systems (Healey, 1987), including the hydrological cycle, of which stormwater is a part.

2.3 Institutional and Regulatory Context

According to the BC Ministry of Environment, Lands and Parks¹, in its March 1999 *Water BC: An Action Plan* publication, the problem of non-point source pollution is only likely to be resolved through community efforts and the coordination of governmental programs (MELP, 1999). Examples of activities that are recommended within this document include promoting local stewardship efforts, preventing pollution, and developing best management practices and public education programs (MELP, 1999). The *Water BC* document refers to the past successes of community groups in restoring streams, beaches and watersheds, and disseminating information, as evidence for the fact that "...grass roots initiatives are a key component of NPS pollution prevention" (MELP, 1999, p. 35). Furthermore, it is recommended that remedial actions be designed and applied at the community level through pilot projects, and that these be monitored to determine any benefits. Any 'lessons learned' from these pilot projects should then be used to "guide NPS pollution control and prevention in other watersheds, and in on-going development of NPS management options" (MELP, 1999, p. 39). Pollution prevention at the community-scale, including indirect pollution prevention actions which improve the quality of stormwater and decrease its volume, are recognized as being considerably more cost-effective than 'end-of-pipe' mitigative actions.

2.4 GVRD Guidelines

The Greater Vancouver Regional District (GVRD), in cooperation with provincial and federal agencies, has established stormwater management objectives for its member municipalities, as discussed in its (1999) *Liquid Waste Management Plan Stage 2 Document*. Within this publication, "guiding principles" are presented for municipalities to "...tailor [stormwater management] initiatives to local priorities" (GVRD, 1999, p. 13-2). A management option is presented which involves the creation of a "...proactive integrated planning approach to municipal stormwater management... [to] integrate watershed catchment, and master drainage plans in the Official Community Planning process..." (GVRD, 1999, p. 13-8). However, this option is only intended for those areas serviced by separated stormwater sewer systems. Municipalities with combined sewer systems in place are required to initiate a separation program, albeit at a rate that is determined by the needs of each individual municipality.

Recently, the GVRD and the Cities of Vancouver and Burnaby have agreed to initiate a number of projects over the next five years to address the problem of CSOs at the Clarke Drive outfall (GVRD, 2001) (Figure 1). Nearly half the volume of all CSOs that occur in the region is released through this outfall; making upgrades in the Clarke Drive catchment area a priority (GVRD, 2001). In addition to the proposed infrastructure changes (e.g. the building of storage facilities), it is expected that voluntary lot-level initiatives may also play a role in contributing to the overall stormwater management solution (Grill, 2001).

¹ In 2001, the BC Ministry of Environment, Lands and Parks (or MELP) was split into the Ministry of Water, Land and Air Protection, and the Ministry of Sustainable Resource Management.

2.5 GVSDD Best Management Practices Guide for Stormwater

To facilitate the implementation of locally-tailored stormwater management initiatives as proposed by the GVRD, the Greater Vancouver Sewerage and Drainage District has developed a *Best Management Practices Guide for Stormwater*, which outlines several structural, non-structural and operational best management practice (BMPs) that can be implemented to manage stormwater (GVSD, 1999). Some common BMPs already in use within the Lower Mainland include: greenways (non-structural), oil/water separators (structural), and street sweepers (operational). However, since several of the BMPs which are described require implementation on private properties; the GVSD's BMP Guide also explores the need for education to improve the public's understanding of stormwater-related problems, and to increase their acceptance of any on-site BMPs that are proposed.

2.6 City of Vancouver Initiatives

In response to the stormwater quality recommendations of various governmental and non-governmental advisory groups, the City of Vancouver's ESD has launched a number of initiatives to counteract the effects of municipal stormwater on Vancouver's combined sewer infrastructure, and by extension, the quality of receiving waters. In addition to the *Downspout Disconnection* and *Perforated Sump Pilot Projects*, a sewer separation program has been established, as have new or amended by-laws regulating the disposal of wastewater and limiting the impervious surface cover of private properties.

2.6.1 Sewer Separation

The Sewer Separation Program was established by Vancouver City Council in 1978 to achieve the pollution control benefits associated with a separated sewer system (City of Vancouver, 1999f). With respect to eliminating CSOs, the program is proceeding at a rate that is determined both by Vancouver's redevelopment rate, and by the scheduled rate of replacement for aging sewers. The city, having already achieved 40% separation of its sewers, is proceeding at a rate of 1% per year (Grill, 2000) and has committed to the complete elimination of CSOs by the year 2050 (Wong, 2000). A variety of initiatives within the Sewer Separation Program, which include retrofitting sewer system weirs to capture more combined sewage during rainfall events, have reduced CSOs by approximately 30%. A decrease in dry weather flows to the Iona Wastewater Treatment Plant, has also resulted in a lower annual GVRD sewerage levy to Vancouver (City of Vancouver, 1999f).

2.6.2 Watercourse Protection Bylaws

Although there are currently no national requirements for the management of stormwater and non-point-source pollution (such as those given by the Environmental Protection Agency in the United States), a host of regulatory tools are available for use by local governments in combination with other policy instruments, to ensure the protection of local water resources. A variety of Acts pertain to the stewardship of water resources, and the responsibility for these is distributed among the various levels of government. The Federal and Provincial governments regulate the use of water, including fish and

wildlife. Local governments play a key role in environmental stewardship by constructing and maintaining water collection and discharge systems (MELP, 1999), and by designing local bylaws which have an impact on land use and development practices (MELP, 1996/97).

2.6.2.1 Zoning Schedules to Limit Impervious Surface

A recent stewardship initiative by the City of Vancouver involves by-law amendments to the RS-1/1S, RS-1A, RS-1B, RS-2, RS-3/3A, RS-5/5S, and RS-6 Zoning Schedules to Limit Impervious Surface. This initiative is intended to reduce stormwater runoff at its source, alleviate potential flooding, and promote the retention of green space. According to the General Manager of ESD, there are many benefits to minimizing the coverage of impervious surfaces, which include (Addis, 2000):

- Reducing the risk of flooding;
- Improving stormwater runoff quality [through infiltration];
- Reducing combined sewer overflows;
- Reducing [sewer] infrastructure costs;
- Recharging groundwater supplies; and
- Improving neighborhood appearance/character.

Thus, in response to the widely acknowledged benefits of maintaining ‘green’ surfaces, Vancouver’s by-law now requires that a maximum of 60% impermeable site coverage be permitted on residentially zoned land. For the average lot size, this would leave a reasonable amount for building coverage (house and garage), walkways and patios. Some exceptions may be granted, however, especially if other on-site stormwater retention/infiltration systems can be substituted in place of the recommended pervious surface coverage (Addis, 2000). Although site-by-site considerations are necessary for preventing undue hardship on the part of homeowners, retention of green space is by far the most preferred method of stormwater management (Arnold et al., 1996). The use of vegetation and soils for urban infiltration allows restoration of a site’s hydrological cycle, and supports groundwater recharge, stream base flows, water quality and aquatic life (Gribbin, 1997).

2.6.2.2 Sewer and Watercourse By-Law

On February 12, 1980, Vancouver City Council enacted the *Sewer Use Regulation By-law* in order to regulate the quantity and quality of wastewater discharged within the city (City of Vancouver, 1999d). On October 31, 1999, this by-law was replaced by the *Wastewater, Storm Water and Watercourse By-Law*, which now regulated the disposal of wastewater and stormwater, and the use of watercourses within the city (City of Vancouver, 1999g). On September 12, 2000, this by-law was amended and renamed the *Sewer and Watercourse Bylaw*. This most recently amended by-law sets sewer utility rates and regulates wastewater discharges into local waterways (City of Vancouver, 2000c). Like its predecessors, it sets guidelines for the quantity and quality of discharged wastes, including “...all direct or indirect discharges to any part of the public sewerage system, storm drainage system or any watercourse” (p. 1). Furthermore, the bylaw

indicates that “no person shall cause or permit any storm water or uncontaminated water to be discharged into a sanitary sewer... except by means of a connection with the City sewer system” (Sections 3.1(1) and (2), p. 13), and that “the City Engineer may set flow volume limits on wastewater discharged to the sewerage system or flow volume limits on uncontaminated water discharged to the storm drainage system” (Section 4.3(1), p. 21).

However, due to the unpredictable and sometimes diffuse nature of storm and wastewater discharges, Vancouver’s ESD may not be capable of detecting and preventing all discharges which are in contravention of the regulation. While the *Sewer and Watercourse By-law* incorporates the use fines and penalties for “every person who violates any of the provisions of this By-law... or who neglects to do... anything required... by any of the provisions of the by-law” (p. 46), it does not incorporate the use of a formal ticketing system to encourage compliance with the regulation (Robertson, 2000). A lack of personnel and monetary resources necessary for the inspection of potentially unlawful discharges to the sewer system (as required under Section 1.3(1)), may further preclude the ability of the *Sewer and Watercourse By-law* to achieve its goal of watercourse protection. Therefore, as the responsibility for maintaining watercourses is downloaded from senior to local levels of government, the City of Vancouver may need to promote the adoption of stormwater (and other) best management practices in order to achieve the appropriate level of public awareness and watercourse protection.

2.6.3 Voluntary Stormwater Management Initiatives

In 1996, the Vancouver Engineering Services Department’s (ESD) Sewers Design Branch took measures to promote stormwater infiltration on private properties, through the *Downspout Disconnection Pilot Project*², and in 1997 through the *Perforated Sump Pilot Project*³. In both cases, government administrators were interested in facilitating lot-level rainwater absorption through the use of various infiltration methods (Table 1, Figure 2). The disconnection of roof drains from sewers and their subsequent connection to splash zones⁴ can increase stormwater infiltration by as much as 10%. Similarly, perforated sumps can reduce yearly effluent flow by as much as 20% (Juza et al., 1996).

In addition to the City’s stormwater pilots, a *Rain Barrel Program* was established by the ESD’s Waterworks Design Branch in 1993 to increase the awareness of homeowners for the need to manage water, in this case the consumption of potable water. If used regularly, rain barrels can reduce stormwater peak flows, through the detainment and gradual infiltration of rainwater, and can help to conserve potable water, particularly during the summer months when residential irrigation accounts for 40% of domestic water consumption (City of Vancouver, 2000b).

While each of the City’s three initiatives focused on a different component of the water cycle, all had implications for the management of stormwater at its source. Thus, if viewed as having one common goal, e.g. *to manage water resources in an urban*

² In Vancouver, the *Downspout Disconnection Pilot Project* is also known as the *Roof Leader Disconnection Pilot Project*.

³ In Vancouver, the *Perforated Sump Pilot Project* is also known as the *Sump Exfiltration Pilot Project*.

⁴ A *splash zone* refers to any absorptive surface including green (vegetated or grassed) and gravel areas.

residential setting, Vancouver's three voluntary initiatives are comparable to another, more integrated⁵ stormwater/water conservation program in Toronto.

⁵ "Integrated" in this thesis, refers to the management of water in its various forms.

Table 1: Voluntary Stormwater Management Practices (SMPs)⁶

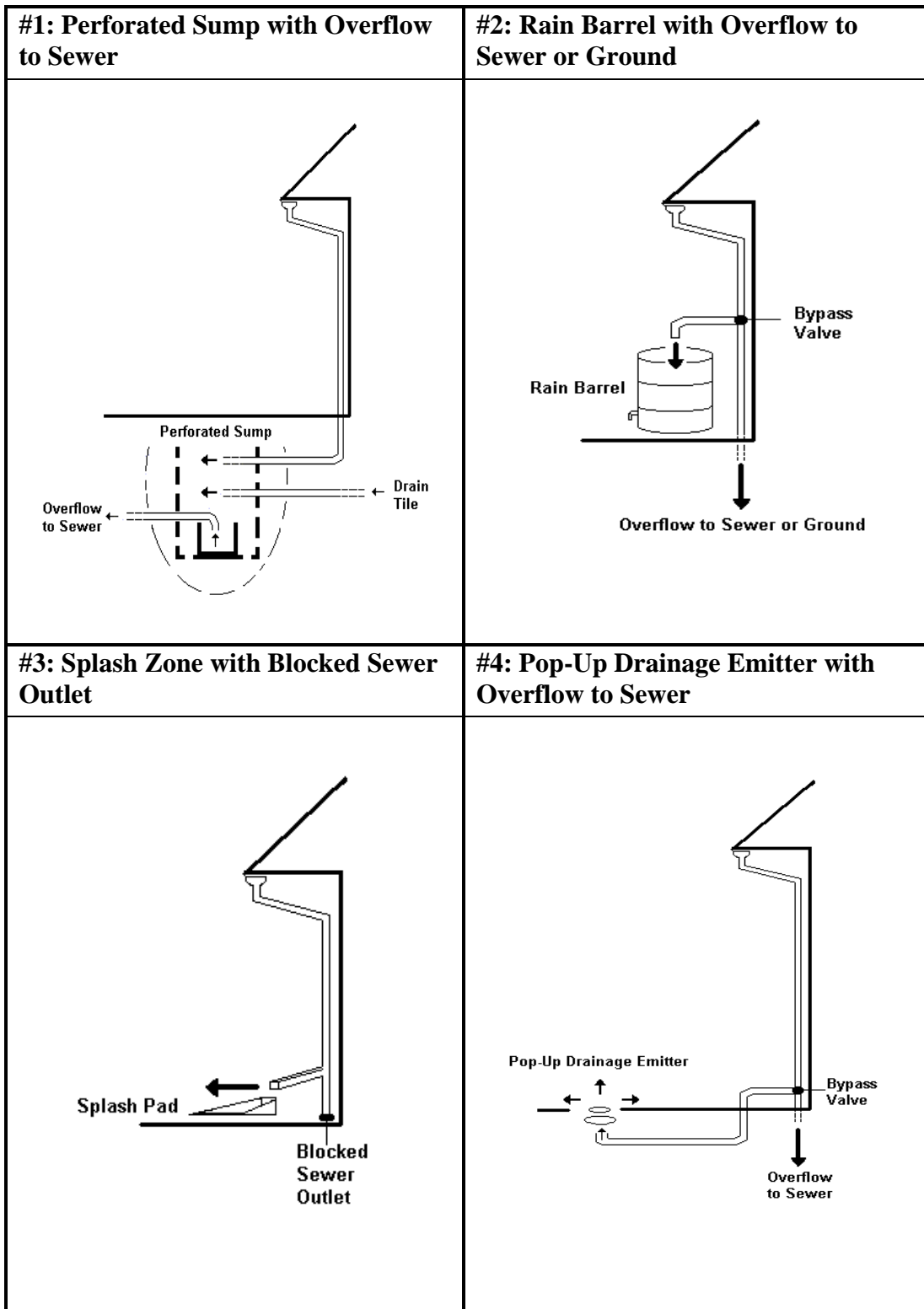
City	SMP	Configuration	Description
Vancouver, BC	Perforated Sump	Involves connection of sump to downspouts and drains. Also requires (overflow) connection to sewer.	Best suited for redeveloping properties, as sump replacement requires excavation work. Facilitates the infiltration of runoff from roofs and foundation drains.
	Downspout Disconnection w/ Rain Barrel	Involves possible relocation of downspouts/eaves ⁷ , and reconnection of one downspout to rain barrel. Also requires overflow to splash zone or sewer.	Best suited for relatively impervious areas. Diverts rainwater from rooftops; facilitates retention and possible garden irrigation. Amount of rainwater diverted is determined by rain barrel use and rainfall characteristics.
Toronto, On	Downspout Disconnection w/ Splash Zone	Involves possible relocation of eaves/downspouts, and diversion of downspouts toward splash zones for rainwater absorption.	Best suited for properties with large grassy areas. Diverts rainwater from rooftops; facilitates rainwater infiltration and garden irrigation.
	Downspout Disconnection w/ Pop-Up Drainage Emitter (PDE)	Involves possible relocation of eaves/downspouts, and diversion of one downspout underneath an impervious surface (e.g. walkway). Also requires connection to an underground PDE.	Best suited for properties with impervious surfaces near downspout, or for properties with lawns that slope toward foundation wall. Diverts rainwater from rooftops, and facilitates rainwater infiltration and garden irrigation at an alternate location.

(Sources: City of Vancouver, 2000b; Booth and Leavitt, 1999; Juza et al., 1996; Grice, n.d. a).

⁶ Other stormwater management practices, such as the use of pervious pavements can be more effective strategies for minimizing the generation of runoff, however because these options have not been promoted through voluntary programs in either Vancouver, BC or Toronto, ON, they will not be considered in this investigation. Thus in all subsequent chapters, the acronym SMP will be used to denote the subset of stormwater best management practices that includes disconnected downspouts, rain barrels, perforated sumps or other associated infiltration devices.

⁷ For some homes having up to four downspouts, it may be necessary to relocate some of the eaves or downspouts in order to redirect rainwater onto the largest possible absorptive surface. This process prevents runoff from flowing back towards the foundation wall of a home (City of Toronto, 1995a).

Figure 2: Diagrams of Four SMP Configurations



2.7 Metro-Toronto Voluntary Stormwater Management Initiative

An interesting comparison with the City of Vancouver's programs is Toronto's *Downspout Disconnection Program*.⁸ Like Vancouver, Toronto established a water conservation program in 1990 to reduce the entry of stormwater into its sewage treatment facilities, and to increase the efficient use of its water resources (Grice, n.d. a). Unlike Vancouver, Toronto's interest in stormwater management was driven by the need to lessen demands on its drinking water treatment facilities (in addition to its waste water treatment facilities), since Lake Ontario is ultimately the source and destination of all water used within the city. Following an initial pilot phase, the Works and Emergency Services Department's⁹ Soil and Water Quality Improvement Branch established the *Downspout Disconnection Program* in 1993. This program was intended to reduce the number of combined sewer overflows into Lake Ontario, the Humber and Don Rivers (*Downspout Disconnection*, 1997), and potentially to alleviate basement flooding during severe rainfall events. Toronto's program was further expanded in 1999, following an amalgamation of the former City with its adjoining municipalities.

While Toronto's voluntary program has achieved and maintained a relatively high participation rate of 8 to 10% (or 2,000 homes disconnected and 800 rain barrels sold on average per year) (Bell, 2001), Vancouver's programs have received only low to negligible participation rates. In fact, despite homeowner willingness to purchase rain barrels¹⁰ (and to disconnect their downspouts in order to install it), the *Downspout Disconnection Pilot Project* has attracted only six participants¹¹, and the *Perforated Sump Pilot Project* only three. While government administrators are unclear as to why the Vancouver pilot projects received the low participation rates that prevented their expansion, downspout disconnection remains an effective and inexpensive procedure for infiltrating stormwater on-site, and maximizing the performance and treatment capability of combined sewer systems.

⁸ Toronto's *Downspout Disconnection Program*(me) is also known as the *Recycle Your Rain Program*, and promotes the use of rain barrels where required by a particular site configuration.

⁹ The complete organizational structure under which the *Downspout Disconnection Program* is administered, consists of the Works and Emergency Services Department, the Technical Services Division, the Environmental Services Section, and finally the Soil and Water Quality Improvement Branch.

¹⁰ Approximately 300 subsidized rain barrels are sold per year as a result of Vancouver's *Rain Barrel Program*.

¹¹ The City of Vancouver has maintained no record of homeowners participating in the *Downspout Disconnection Pilot Project*.

Chapter 3: Evaluative Approaches and Framework

This chapter introduces and develops a program evaluation framework, incorporating principles of policy instrument evaluation and community-based social marketing, which are used to analyze the stormwater management initiatives in Vancouver and Toronto.

3.1 Program Evaluation

According to Weiss (1998), program evaluation is the “systematic assessment of the operation and/or outcomes of a program or policy, compared to a set of explicit or implicit standards, as a means of contributing to the improvement of the program or policy” (p. 4). As such, program evaluation is able to question the logic or structure of a program design, and judge the value or merit of any outcomes that can be attributed to the program design. Evaluations can be used to test new program ideas, establish the need for mid-course corrections during young programs, or to decide whether to abandon a long-standing program (Weiss, 1998). Alternately, evaluation research may be used to generate knowledge about the principles underlying effective program development and implementation, rather than to evaluate the effectiveness of a specific program (Clarke, 1999).

3.1.1 Summative vs. Formative Program Evaluation

Formative and summative evaluations occupy opposite ends of the program evaluation spectrum, and yet aspects of both may be addressed within the same evaluation (Clarke, 1999). The formative/summative dichotomy is primarily intended to provide a distinction between the two types of program study that are possible. An evaluation has a *formative* focus when research is being done on a program to provide information that can be used to further develop that program (Hunt, 1979). Formative evaluations are characterized by their emphasis on program ‘exploration’, and by their attempts to uncover ideas and insights that may lead to further program improvements. As a result, this approach makes use of the perceptions and experiences of program planners, practitioners and participants (Clarke, 1999), in developing action-oriented program interventions. The qualitative nature of a formative evaluation makes it ideal for investigating the City of Vancouver’s *Downspout Disconnection Pilot Project*, *Perforated Sump Pilot Project* and *Rain Barrel Program*, where further program development may be warranted. However, due to the limited program ‘efforts’ associated with these three initiatives, only a broad ‘investigative’ evaluation (having a formative focus) is conducted for Vancouver. According to Berk and Rossi (1990), each of the questions raised by a particular evaluation can be tackled at varying levels of intensity and thoroughness; leading to the use of “rough-and-ready” measures when great precision is not required.

In contrast to formative evaluation, *summative* evaluations aim to determine the overall effectiveness or impact of a program, with the goal of recommending whether or not it should continue to run (Scriven, 1967 in Clarke, 1999). The summative approach is best suited for established programs, whose effectiveness has not yet been assessed, or whose formal adoption is being considered. As a result, this approach can make use of more

objective performance measures to assess the outcome of a program or project. For example, the amount of goods or services that are being provided by a program may be considered, as well as the impacts which stem from this provision (Hunt, 1979). A program evaluation, having a summative focus, can therefore be employed to assess the City of Toronto's *Downspout Disconnection Program*. An assessment of overall program effectiveness in Toronto, as well as an understanding of 'what made it work', can be used to inform future program planning and implementation in Vancouver.

3.2 Policy Instruments for Environmental Protection

Robinson and van Bers (1996) have identified two kinds of approaches in use by government to achieve environmental protection. The first kind is market-based approaches, which rely upon market incentives to induce more environmentally responsible practices (e.g. new pricing structures for sewer system use). And the second kind is regulation-based approaches, which rely upon the power of government to prohibit environmentally destructive behaviour (e.g. limitations on impervious surface coverage). Both market and regulation-based approaches for ensuring environmental protection have experienced serious weaknesses, such as the inability to create economically efficient outcomes; making them "woefully inadequate" for satisfying societies' goals (Robinson et al., 1996, p. 52). These goals, which include environmental protection, also emphasize the need for flexibility in achieving innovative and cost-effective solutions. Although many argue that regulation is an important stimulus for, rather than an impediment to innovation (Harrison, 1998), voluntary approaches have emerged as a third group of measures for achieving the goals of flexibility and environmental protection.

3.2.1 Market-Based Approaches/Economic Incentives

Governments are able to induce desired behaviours in industries (and potentially in individuals), through the use of one of two economic mechanisms: *i*) levying a charge that discourages the undesired behaviour, or *ii*) providing a monetary advantage (e.g. reduced taxes, subsidies) that encourages the desired behaviour. Economic incentives are capable of producing the desired effect, provided that the incentives can be made large enough to attract participant involvement (NRC, 1993). However, it is often difficult to know in advance how large these incentives must be in order to produce the desired effect. As a result, all economic incentives, like other governmental initiatives, require that effective program development, monitoring and enforcement be used to ensure that the incentive chosen, is providing the environmental benefit anticipated.

3.2.2 Regulatory Approaches/Command-and-Control Measures

Regulatory systems include command-and-control (CAC) measures for restoring and protecting the quality of the environment, and consist of the following three components (NRC, 1993): *i*) *standards* for controlling those activities affecting water quality, *ii*) *permits* for limiting point-source discharges, and *iii*) *compliance promotion* for ensuring adherence to permit requirements.

Although fairly comprehensive, command-and-control measures for environmental protection have been widely criticized for being highly inefficient, adversarial, and administratively cumbersome (Nash and Ehrenfeld, 1997 in Harrison, 2001). In fact, the Federal government, which uses environmental compliance and enforcement programs to control industrial discharges, has split its programs into eight distinct phases, each requiring a significant allocation of financial resources, including up to seven years of enforcement to ensure that program goals are achieved (Krahn, 1998). Not surprisingly, the large number of private individuals who contribute to stormwater poses a challenge to CAC approaches to environmental regulation, due to "...communication challenges concerning the technical requirements of the regulations and logistical problems to inspect all facilities with limited personnel resources" (Krahn, 1998: 24). Thus, as a result of the difficulties associated with implementing successful CAC programs, governments have begun seeking alternatives to the traditional top-down approach to environmental regulation (Wyeth and Thompson, 1995).

3.2.3 *Voluntary Approaches*

As traditional approaches to environmental regulation continue to fall short of societal expectations, there has been a greater reliance on business and civil society to achieve common sustainability objectives (Harrison, 2001). As a result, voluntary environmental initiatives have arisen to overcome the regulatory burden of governments; allowing organizations or associations to declare their own methods for achieving environmental protection (Wyeth et al., 1995). Since each group of individuals has its own expertise (e.g. homeowners may know of practices to minimize flooding potential), voluntary approaches allow flexibility in determining cost-effective paths for meeting common environmental goals. Voluntary alternatives range from flexible forms of regulation to voluntary initiatives and government advisory programs, such as product eco-labeling. Although voluntary programs demonstrate a lower participation rate than regulatory initiatives (15% to 20% for voluntary programs versus more than 90% for regulatory programs on a national scale (Krahn, 1998)), voluntary programs may be capable of gaining greater support locally, where government incentives or subsidies, and ultimately, changing societal norms may significantly boost the participation rate. The threat of government intervention may also be sufficient in driving voluntary programs not mandated by formal regulations (Harrison, 2001). However, if this threat is insufficient for motivating the desired action, governments retain the option of switching to an alternative policy instrument, namely regulation, to achieve any stated goals.

According to Harrison (2001), there are four categories of government-sponsored voluntary programs: *i*) voluntary agreements, *ii*) voluntary challenges, *iii*) eco-labels, and *iv*) environmental education. Voluntary agreements, the most coercive category, are characterized by strong expectations of compliance from the target population. As a result, these types of agreements are accompanied by threats of command-and-control regulation, should the 'voluntary' initiative fail. In contrast, voluntary challenges are accompanied by fewer threats of regulation and do not specify performance standards that must be met. For this reason, voluntary challenges can appeal to a broad and diverse target population, who may choose to benefit from the positive publicity associated with participation. Lastly, both eco-labels and environmental education aim at increasing the

environmental awareness of consumers whom may be encouraged to either engage in certain behaviours, or adopt the use of certain products. Changes in consumer behaviour are expected to *i*) confer environmental benefits (e.g. through the use of stormwater BMPs), or *ii*) prevent further degradation of the environment (e.g. through reductions in CSO frequencies). Environmental education, however, is the least coercive form of intervention, and may be useful for improving the perception (and success) of more ‘threatening’ government-sponsored voluntary programs. Information programs are particularly effective when combined with incentives for changing behaviour, as shown by the success of energy conservation initiatives (Robinson et al., 1996).

3.3 Community-Based Social Marketing

According to the National Round Table on the Environment and the Economy (NRTEE), and the Institute for Research and Public Policy (IRPP) (Kelly, 1992), the provision of market information should be the first choice of governments seeking sustainable development. Providing comparisons between behavioural and/or product choices in regards to their environmental and economic impacts, is a simple and inexpensive mechanism for spreading the message of sustainability, as well as helping to “...keep consumers prosperous and at peace with their environmental conscience” (p. 16). In the case of stormwater management, structural BMPs could be successfully promoted by emphasizing their ability to conserve water, while simultaneously helping to restore the natural state of local waterways. Informational campaigns that are accurate, appealing, and targeted to specific groups (Kelly, 1992), can achieve significant public participation, or ‘consumer support’ if monetary expenditure is required. The financing and direct installation of equipment such as in water or energy conservation programs, requires that active program delivery be used to increase participation rates (Cassils, 1991). It is worth emphasizing that community-based social marketing (CBSM) will only be effective if various barriers to program implementation (such as financial or behavioural obstacles), can be systematically identified and overcome (Kassirer, 1998). Social marketing is therefore significantly more complex than its commercial counterpart, since it aims to influence people’s ideas and behaviours, in addition to promoting a tangible product (e.g. stormwater BMPs) for which a demand must be created (Novartis, 2000). Thus, social campaigns “conceived simply to educate or admonish”, without the appropriate program development, implementation and monitoring, are likely to result in little or no behavioural/consumer change (Novartis, 2000).

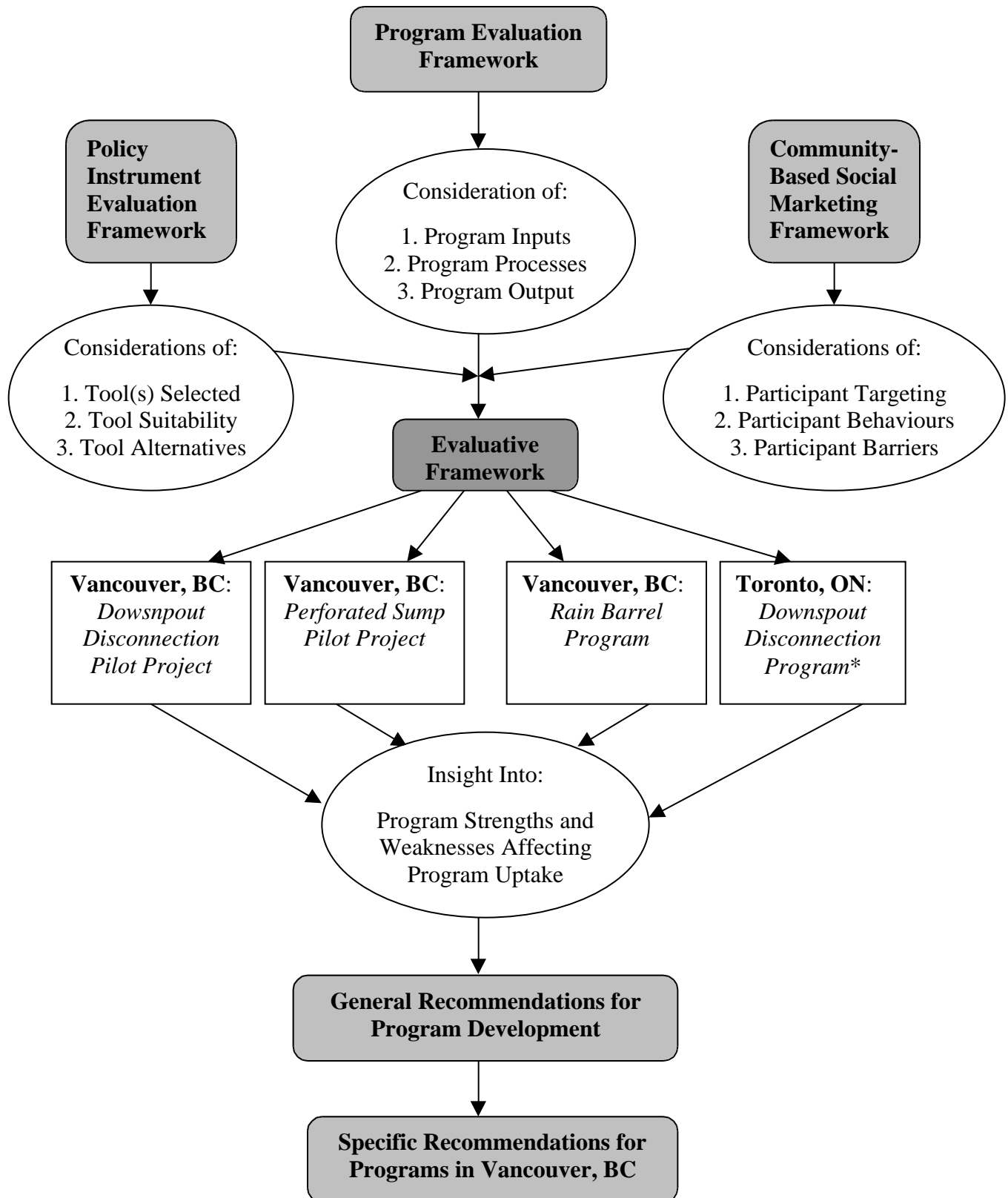
3.4 Evaluative Framework

An evaluative framework can be developed from the theories of summative/formative program evaluation, policy instrument evaluation and social marketing, and used to make a broad qualitative assessment of Vancouver’s and Toronto’s residential stormwater management/water conservation programs (Figure 3).

Firstly, aspects of program evaluation theory are used to increase knowledge of program inputs (e.g. community/participant characteristics), program process (e.g. program delivery), and program outputs (e.g. changes in participant attitudes), which are likely to influence overall program effectiveness. Secondly, aspects of policy instrument

evaluation are used to identify factors influencing policy instrument selection (e.g. administrator's familiarity with alternative policy instruments). Thirdly, aspects of community-based social marketing theory are used to expand upon the participant characteristics identified above, and to further reveal the level of participant awareness, barriers and benefits to participation, and the contextual behaviours/conditions which may have given rise to program participation.

Figure 3: Evaluative Framework Components and Thesis Objectives



* The program evaluation in Toronto has a more summative focus, whereas the program evaluation in Vancouver has a more formative focus.

3.5 Program Evaluation Framework

In order to guide the evaluation of results and future program design, an understanding of program theory is required. Program theory consists of a set of statements which describes the problem and target population for whom the program is designed, specifies the causal processes mediating program effects, and identifies its expected outcomes; including factors affecting treatment processes. Thus, a program evaluation is intended to examine the process underlying the program effects, as well as the causal connection between the program and its intended outcomes (Sidani and Sechrest, 1999).

3.5.1 Inputs

The first component of a program evaluation, or inputs, consists of variables that reflect exogenous factors and implementation issues that affect program delivery and the ability to produce anticipated outcomes. Input variables may be related to the skills of staff providing the services and to the setting in which the program is being offered (Weiss, 1998). Thus, in evaluating a particular program, the characteristics of the target population, program staff, and setting must all be considered. Target population characteristics may be classified into three categories: *i) personal* – demographic, personality traits and/or personal beliefs (e.g. age, gender, educational level and beliefs), *ii) “presenting problem characteristics”* – the level of severity of the problem (e.g. the perceived level of threat to a valued resource) and the promptness of management required, and *iii) resources available to clients* – motivations for participation (e.g. incentives) (Sidani et al., 1999). Staff characteristics affecting program delivery include personal and professional attributes, such as communication ability, demeanor, educational background, level of expertise (competence in providing program services), and beliefs and attitudes towards the problem or target population (Sidani et al., 1999; Weiss, 1998). Finally, characteristics of the setting which allow the program goals to be realized, include the physical and social features of the environment. Physical features refer to the availability of material resources necessary for delivering the program services, and to overall program attractiveness. Social features of the environment refer to the social, political, and economic context of the program, including such factors as organizational culture and composition, and norms and policies which may influence each of the above (Weiss, 1998). Finally, willingness to accept government intervention for the ‘good of the environment’, may also affect program success. List 1 summarizes a variety of the input ‘measures’ which are common in the program evaluation literature (Sidani et al., 1999; Weiss, 1998; Berk et al., 1990; Hunt, 1979), and these are listed under the following criteria headings.

- a. Community Setting/Characteristics.
- b. Philosophy/Principles of Program Operation.
- c. Budgetary Amount.
- d. Nature of Staff.

Community setting/characteristics describes the physical and social setting in which a program operates, and in doing so, identifies the nature of the problem for which the program was developed and establishes the community’s receptivity to environmental initiatives. Understanding the characteristics of a program setting is necessary for

revealing the various “raw materials” which have contributed to program performance (Weiss, 1998); thereby facilitating program development in new locations.

Philosophy/principles of program operation describes the (implicit/explicit) goals and expectations of staff members concerning program operation, and helps to reveal the level of staff consensus regarding program purpose and intended outcome (Weiss, 1998). This category also attempts to identify the sequence of events leading up to and including program delivery.

Budgetary amount explores trends in program staffing and material supplies over the course of program operation, and attempts to determine whether the availability of resources is adequate for achieving the intended program effects.

Nature of staff describes the characteristics of the staff providing the program service including their beliefs and attitudes regarding the target population, and their experience with environmental program delivery. The unique characteristics of program personnel, coupled with other program variables (such as the availability of resources), may determine the program ‘package’ that is ultimately delivered (Berk et al., 1990).

3.5.2 Process

The second major component of a program evaluation consists of processes believed to be responsible for producing the anticipated effects (in most cases, the desired ones). Process variables represent the actual program implementation, including the type of client served and the nature of the service received (Weiss, 1998), as well as the series of changes that take place over time which can lead to the achievement of program goals. In many cases, participation in a program can increase awareness for the problem to be mitigated and other related environmental challenges (Mulji, 2000). A variety of process ‘measures’ are listed in List 1 under the following criteria headings:

- a. Target Population.
- b. Program Delivery.
- c. Use of Funds.

Target population explores the program’s approach to identifying and canvassing program participants, and attempts to reveal homeowners’ motivation for participation.

Program delivery explores the fidelity of program service to planned design (Weiss, 1998), and attempts to identify deviations from the planned design which may have affected program outcomes. A program that is not being delivered as intended subverts earlier efforts and spends money under “false pretenses” (Berk et al., 1990). This category also considers the persistence of program advertising, and the quality of the service ultimately received.

Use of funds considers the allocation of funds to various program components, such as staffing versus program delivery and ultimately, SMP implementation. The availability of funds does not necessarily imply that the program service is being properly delivered.

3.5.3 *Outputs*

The final component of a program evaluation describes the ultimate outcomes of the program, and requires specification of the type and magnitude of changes that are attributable to the program. Specifically, the *type* of outcome refers to aspects of the target population's life, condition or behaviour that the program impacts (Weiss, 1998), and *magnitude* refers to the extent of program effects or the number of participants reached (Berk et al., 1990). However, for all programs, it is necessary to consider their inputs, process and outputs - particularly if they are to be replicated with any success in a different social or physical setting. A variety of output 'measures' are listed in List 1 under the following 'criteria' headings:

- a. Monitoring.
- b. Outcomes.
- c. Cost-effectiveness (estimated).

Monitoring examines whether there are any procedures in place to track the problem being addressed and/or the program's mitigating effects. Ideally, monitoring should reveal whether or not the program was achieving its goals over and above what would be expected if the program did not exist (Berk et al., 1990).

Outcomes examines the consequences of the program intervention (positive and negative), the nature of various program outcomes (awareness versus behavioural changes), and whether or not these outcomes may be attributed to internal or external program factors. Other ways of measuring outcomes include considering the size of the population being served or achievement of the program's implicit/explicit goals.

Cost-effectiveness estimates whether a program was "worth it" (Berk et al., 1990) in terms of SMP delivery and potential water quantity improvements, and attempts to determine whether other viable alternatives could mitigate the identified problem with greater effectiveness.

List 1: Program Evaluation Framework

1. Inputs

a) Community Setting/Characteristics

- i) Physical features of environment.
- ii) Level of severity of problem/promptness of management required.
- iii) Target population characteristics.
- iv) Community receptivity to environmental programs.

b) Philosophy/Principles of Program Operation

- i) Explicit and implicit department/branch goals.
- ii) Explicit and implicit program goals.
- iii) Personal goals and expectations of administrators.
- iv) Planned design of program delivery.

c) Budgetary Amount

- i) Budgetary trends.
- ii) Number of staff/material supplies allocated.
- iii) Program capacity.
- iv) Size of program effort required.

d) Nature of Staff

- i) Rate of program staff turnover.
- ii) Beliefs or attitudes regarding target population.
- iii) Credentials and experience.

2) Process**a) Target Population**

- i) Approach to identifying/targeting participants.
- ii) Target population characteristics (see also 1)a)iv) above).

b) Program Delivery

- i) Use of programmatic activities.
- ii) Quality of program service.
- iii) Timeliness of service.
- iv) Integrity of service to planned design.
- v) Responsiveness to individual needs.

c) Use of Funds

- i) Allocation of funds to various program components.

3) Outputs**a) Monitoring**

- i) Presence of monitoring procedures to track problem.

b) Outcomes

- i) Size of population being served.
- ii) Achievement of explicit and implicit goals.
- iii) Nature of program outcomes.
- iv) Effects on the target population.

c) Cost-Effectiveness

- i) Cost per unit of program delivery.

(Sources: Sidani et al., 1999; Weiss, 1998; Berk et al., 1990; Hunt, 1979.)

3.6 Policy Instrument Evaluation Framework

Policy ‘style’, or policy instrument selection, reflects a government’s approach to problem solving, and its relationship to other actors in the policy-making process (Bemelmans-Videc, 1998). Policy instruments are rarely selected on the basis of their effectiveness or on their ability to be implemented with ease (Bressers, 1998). Rather, organizational culture, including the ideologies, beliefs and attitudes which define this ‘culture’, often play a key role in influencing policy instrument choice (Bemelmans-Videc, 1998). Thus, whenever there is a need to inform future decision-making and policy instrument choice, an evaluation of current policies may be required. Policy evaluation can be defined as the systematic assessment of social intervention programs, including their conceptualization, design, implementation and utility (Fischer, 1995 in Bemelmans-Videc, 1998; Berk et al., 1990). To be effective, policy instruments must be chosen according to their ability to optimize the identified goals and means (van der Doelen, 1998), and this requires that governments use evaluations to provide feedback data on which to base improved future policies (Vedung, 1998).

For the purposes of investigating the four programs in Vancouver and Toronto, aspects of policy instrument evaluation theory will be incorporated into the program evaluation framework developed above. The *Instrument-Context Approach* (ICA), defined by de Bruijn, H.A. and Hufen, H.A.M. (1998) will be used to guide the study of policy instrument use in each of these cases. The ICA is only one of three possible approaches to understanding the operation of policy instruments (Table 2), and it emphasizes both the characteristics of the instruments, and the variables from the context in which the instruments are applied. According to the ICA, relevant context variables include those stemming from the organization, the target group and other instruments, and when combined these variables influence actual policy implementation and program outcomes.

Table 2: Approaches to the Study of Policy Instruments

Approach	Philosophy	Study Focus
<i>Classical</i>	Each tool of government has its own distinctive dynamic, including its own set of implementation problems and effects.	Instrument typology, separate from context.
<i>Instrument-Context</i>	The characteristics of the instrument, as well as the context in which it operates, determines its implementation problems and effects.	Instrument context, such as the contribution of the implementing organization and target group.
<i>Contextual</i>	The characteristics of the instrument are only one of many factors that determines policy effects.	Policy systems and implementation processes, as a whole.

(Source: de Bruijn et al., 1998.)

A review of the policy instrument evaluation literature has therefore revealed a fifth input criterion for the program evaluation framework: **Choice of Policy Instrument**. This final input criterion explores the familiarity of program administrators with the selected policy instrument(s) in addition to any policy alternatives, and explores the ability of these instruments to satisfy the requirements of the problem setting identified. The importance of policy instrument selection on program performance is also explored under the input criterion: **Philosophy/Principles of Program Operation** which describes the characteristics of the chosen program instrument, and under the output criterion: **Monitoring**, which attempts to attribute policy instrument use to the types of outcomes observed.

3.7 Community-Based Social Marketing Framework

In order for an environmental program to be effective, it must be designed and delivered in a way that enhances benefits and removes barriers to participation for a large segment of the population (McKenzie-Mohr and Smith, 1999). A community-based social marketing approach to program design/evaluation emphasizes the need to consider potential program barriers, benefits and target populations characteristics, in order to facilitate tailored program delivery.

Surveys of target individuals can be used to reveal the perceived barriers or benefits associated with a particular activity. McKenzie-Mohr et al. (1999) emphasize the need to “set aside personal speculation and collect the information that will properly inform [research] efforts” (p. 19). Once identified, CBSM can be used to change the ratio of benefits to barriers; increasing the attractiveness of a new activity by increasing benefits (e.g. subsidies) or decreasing barriers (e.g. reducing taxes) associated with the desired behaviour, and/or decreasing benefits or increasing barriers associated with a competing (undesirable) behaviour. The following three questions are therefore central to the development of a CBSM evaluative framework:

- 1) What behaviours should be promoted?
- 2) Who should the program address or target?
- 3) What conditions will an individual face in deciding to adopt a new behaviour?

Aspects of these questions are incorporated in the main evaluative framework, and used to further explore the input criterion: **Community Setting/Characteristics**, and the output criterion: **Outcome**.

List 2 shows the complete evaluative framework that is used to assess Toronto’s and Vancouver’s voluntary stormwater/water conservation initiatives. Although this framework primarily draws upon the theories of program evaluation and policy instrument evaluation, community-based social marketing is used to further expand many of its individual components, and to ultimately inform the development of various performance measures (or research questions).

List 2: Evaluative Framework – Incorporating Program and Policy Instrument Evaluation and Social Marketing Frameworks

1) Inputs

a) Community Setting/Characteristics

- i) Physical features of the environment.
- ii) Level of severity of problem/promptness of management required.
- iii) Complementary behaviours/activities being promoted.
- iv) Target population characteristics.
- v) Community receptivity to environmental programs.
- vi) Perceived barriers and benefits.

b) Philosophy/Principles of Program Operation

- i) Characteristics of chosen policy instrument/program tool.
- ii) Explicit and implicit department/branch goals.
- iii) Explicit and implicit program goals.
- iv) Personal goals and expectations of administrators.
- v) Planned design of program delivery.

c) Budgetary Amount

- i) Budgetary trends.
- ii) Number of staff/material supplies allocated.
- iii) Program capacity.
- iv) Size of program effort required.

d) Choice of Policy Instrument

- i) Policy compatibility with requirements of problem setting.
- ii) Department/administrator familiarity with policy tool.
- iii) Department/administrator knowledge of alternative policy tools.

e) Nature of Staff

- i) Rate of program staff turnover.
- ii) Beliefs or attitudes regarding target population.
- iii) Credentials and experience.

2) Process

a) Target Population

- i) Approach to identifying/targeting participants.
- ii) Target population characteristics (see also 1)a)iv) above).

b) Program Delivery

- i) Use of programmatic activities.
- ii) Quality of program service.
- iii) Timeliness of service.
- iv) Integrity of service to planned design.
- v) Responsiveness to individual needs.

c) Use of Funds

- i) Allocation of funds to various program components.

3) Outputs

a) Monitoring

- i) Presence of monitoring procedures to track problem.
- ii) Contribution of policy tool/program design to goal achievement.

b) Outcomes

- i) Size of population being served.
- ii) Achievement of explicit and implicit goals.
- iii) Nature of program outcomes.
- iv) Effects on the target population.
- v) Benefits and barriers related to new activity.

c) Cost-Effectiveness

- i) Cost per unit of program delivery.

- Contribution from community-based social marketing literature
- Contribution from policy instrument evaluation literature

(SOURCES: McKenzie-Mohr et al., 1999; Sidani et al., 1999; Linder et al., 1998; van der Doelen, 1998; Vedung, 1998; Weiss, 1998; Berk et al., 1990; Chelimsky, 1987; Hunt, 1979.)

3.8 Evaluative Framework and Associated Interview Questions

From the evaluative framework developed, 11 criteria and 37 underlying attributes are used to generate a number of performance measures, in the form of research questions (List 3). Each question is intended to be a partial measure of the criterion attribute with which it is associated; thereby encompassing a fraction of the larger concept represented by that criterion (Weiss, 1998). For each question, the most likely information source is indicated by one or more of the following abbreviations: **L** – literature review (e.g. published and non-published reports/data), **G** – government employee interviews (e.g. program administrators, staff, policy-makers, engineers), and **H** – homeowner interviews (e.g. participants and non-participants of voluntary programs).

List 3: Evaluative Framework and Associated Interview Questions

1) Inputs

a) Community Setting/Characteristics

i) Physical features of the environment.

L
<i>What are the rainfall and soil characteristics?</i>
<i>What is the imperviousness of the watershed/catch-basin?</i>
<i>What is the relative contribution of residential runoff?</i>

ii) Level of severity of problem/promptness of management required.

L/G
<i>What is the problem identified by the program and its level of severity?</i>
<i>What proportion of the sewer system is served by combined sewers?</i>
<i>What are the demands on the storm/wastewater conveyance systems?</i>
<i>How is the quality of receiving waters influenced by the entry of stormwater into the sewer system?</i>
<i>How soon is problem mitigation required?</i>

iii) Complementary behaviours/activities being promoted.

L/G
<i>What other activities has the city/department promoted to save water and reduce (storm/waste) water generation?</i>

iv) Target population characteristics.

G	H
<i>What is the type of information that is revealed/made apparent by homeowners inquiring about the program (e.g. knowledge of the problem being addressed)?</i>	<i>What is your knowledge of the problem that contributed to this program's development?</i>

v) Community receptivity to environmental programs.

L/G	H
<i>Are there any social norms (widespread beliefs and values) contributing to people's interest/participation in the program?</i>	<i>Is your interest/participation in environmental initiatives influenced by that of your friends or family?</i>
	<i>Would you be willing to participate in a future stormwater initiative, assuming that program improvement could be made?</i>

vi) Perceived barriers and benefits.

G	H
<i>What barriers to participation are likely to be encountered by homeowners?</i>	<i>What were the reservations you had (if any) prior to participation?</i>
<i>What behaviours/beliefs may be competing with or preventing participation in a stormwater management program?</i>	<i>Do any activities that you or your family engages in, potentially prevent you from participating in the program, or limit your use of an SMP?</i>

b) Philosophy/Principles of Program Operation

i) Characteristics of chosen policy instrument/program tool.

L/G
<i>What combination of policy tools is being utilized to implement/deliver this program?</i>

ii) Explicit and implicit department/branch goals.

L/G
<i>What are the explicit (official) and/or implicit (assumed) department/branch goals?</i>

iii) Explicit and implicit program goals.

L/G
<i>What are the explicit (official) and/or implicit (assumed) program goals?</i>

iv) Personal goals and expectations of administrators.

G
<i>What are/have been your personal goals/expectations in regards to this program?</i>

v) Planned design of program delivery.

L/G
<i>What is/was the planned sequence of events leading up to SMP implementation?</i>

c) Budgetary Amount

i) Budgetary trends.

L/G
<i>What have been the trends in program budgeting over the course of its operation?</i>

ii) Number of staff/material supplies allocated.

L/G
<i>What efforts have been made to maintain or increase the number of staff/SMPs available to the program over time?</i>

iii) Program capacity.

L	G
	<i>How many people have worked/are working with you to implement/deliver the program?</i>
<i>How many SMPs/material supplies have been made available to the program over the course of its operation?</i>	

iv) Size of program effort required.

L/G
<i>What is the quantity of runoff diversion/rate of participation required?</i>
<i>How many homes must be successfully targeted in order for these goals to be achieved?</i>

d) Choice of Policy Instrument

i) Policy tool compatibility with requirements of problem setting.

L/G
<i>On what basis were the program's policy tool(s) selected?</i>

ii) Department/administrator familiarity with policy tool.

G
<i>How often has your department/branch applied the policy tools utilized in your program?</i>
<i>What has been your previous experience with the implementation of these tools?</i>

iii) Department/administrator knowledge of alternative policy tools.

G
<i>Are there any alternative policy tools that could be used to mitigate the identified problem?</i>
<i>What may be the impacts of an alternative policy tool on the administration of the program, or on the department/branch as a whole?</i>
<i>How do the selected policy tools compare with the alternatives in terms of ease of implementation?</i>
<i>What may be the impacts of any alternative policy tools on the target population and problem setting?</i>

e) Nature of Staff

i) Rate of program staff turnover.

G
<i>What is/has been the average number of staff and/or their length of employment?</i>

ii) Beliefs or attitudes regarding target population.

G
<i>What is your impression of the types of people normally showing interest or participating in the program?</i>
<i>Do you think that your program's selection criteria/eligibility standards are appropriate for the problem setting?</i>

iii) Credentials and experience.

G
<i>What is/has been your involvement in previous environmental programs/initiatives?</i>
<i>What educational background/experience did you bring to the program?</i>

2) Process

a) Target Population

i) Approach to identifying/targeting participants.

L/G
<i>How are/were program recipients identified and canvassed?</i>

ii) Target population characteristics (see also 1)a)iv) above).

H
<i>What have been your motivations for participation (attitudes and expectations for/of the program)?</i>

b) Program Delivery

i) Use of programmatic activities.

L/G	H
<i>What types of advertising were used to increase homeowner awareness in the program, and when or how often were these used?</i>	<i>How were you made aware of the program being offered?</i>
	<i>How often did you hear about it before you became interested/ involved?</i>

ii) Quality of program service.

L/G	H
<i>What was the response of participants regarding the service and/or SMPs provided?</i>	<i>What was your impression of the program staff who you were in contact with?</i>
<i>Have there ever been any complaints/commendations regarding program staff, service delivery or SMP performance?</i>	

iii) Timeliness of service.

G	H
<i>How quickly were you able to respond to requests for initial program delivery or follow-up?</i>	<i>How quickly, following your initial request, was the program delivered or followed-up on?</i>

iv) Integrity of service to planned design.

L/G
<i>To what extent has the program, as implemented, followed the initial design for its operation?</i>
<i>Were there any deviations from the planned design? What were the causes?</i>

v) Responsiveness to individual needs.

L/G	H
<i>Were you (or the program) able to respond to individual or site-specific needs?</i>	<i>What was your impression of the program's ability to respond to you or your household's individual needs (e.g. the program's responsiveness)?</i>

c) Use of Funds

i) Allocation of funds to various program components.

L/G
<i>What was the allocation of funds to staffing versus SMP delivery or other program components?</i>

3) Outputs

a) Monitoring

i) Presence of monitoring procedures to track problem.

L/G	H
<i>To what extent have efforts been made to monitor the problem, or to track the mitigating effects of the program?</i>	<i>Have you been given any opportunity to provide feedback on the program, following SMP implementation?</i>

ii) Contribution of policy tool/program design to goal achievement.

L/G	H
<i>To what extent have the selected policy tools or program design contributed to the observed outcome(s)?</i>	<i>In what way has the design of the program increased your interest or ability to participate in the program?</i>

b) Outcome

i) Size of population being served.

L/G
<i>What was the size of the population served (homeowners served/SMPs installed) compared to program expectations/goals?</i>

ii) Achievement of explicit and implicit goals.

L	G
<i>How well has the program achieved its goals and those of its department/branch?</i>	
	<i>How well has the program achieved your goals/expectations as a staff-member?</i>

iii) Nature of program outcomes.

L/G
<i>What are/have been the outcomes of the program (positive vs. negative)?</i>
<i>To what extent are/were the program outcomes clearly attributable to the program?</i>

iv) Effects on the target population.

G	H
<i>Have there been any observable behavioural changes in the participating population?</i>	<i>How has the program changed your perception of or awareness for the problem being addressed?</i>
	<i>What different activities/habits do you now engage in as a result of your participation?</i>

v) Benefits and barriers related to new activity.

L/G	H
<i>How could barriers to participation be removed or benefits enhanced?</i>	<i>What changes to the program do you think would enhance benefits and encourage participation?</i>

c) **Cost-Effectiveness**

i) Cost per unit of program delivery.

L/G
<i>What is/was the cost of the program per unit SMP implemented?</i>

Elements of policy instrument evaluation and community-based social marketing have been incorporated into a program evaluation framework that has been adapted for use with voluntary water management programs. The resulting evaluative framework is therefore designed to reveal those program variables that may have contributed to differential rates of program uptake observed in the Cities of Vancouver and Toronto.

Chapter 4: Data Collection and Analytical Method

Due to the nature of voluntary programs, and the need to describe the perceptions and experiences of individuals involved in these programs, only qualitative research methods were used in this investigation. Qualitative research, which involves “naturalistic” methods including uncontrolled observation, can generate rich, descriptive data that are suited for describing individual case studies (Reichardt and Cook, 1979 in Bulmer, 1986). In contrast, quantitative methods, which rely upon controlled measurements to generate “hard” data, are generally less compatible with the discovery-oriented process that is characteristic of (formative) program evaluation (Weiss, 1998).

Qualitative research was undertaken using both literature reviews and in-depth interviews of Vancouver and Toronto residents. Open-ended questions were posed to staff and participants of each program (and to non-participants where feasible), in order to reveal recurrent perceptions, themes and patterns in program operation (Weiss, 1998). Interviews were chosen as opposed to questionnaires or other data collection methods, since there had been a relatively small number of subjects involved in Vancouver’s programs, and since there was a need to explore the opinions, expectations and actions of individuals in both cities (Clarke, 1999). A consideration of the full range of interview responses has lent credibility to the results of the program evaluations, and contributed to an in-depth understanding of the program(s) in each city.

Information obtained collectively through interviews of program participants, program staff and relevant program literature, is used to produce a comprehensive set of evaluation data incorporating all three of Hunt’s (1979) data typologies: *production data* – quantifiable program outputs (e.g. number of BMPs installed), *judgmental data* – subjective evaluation by those familiar with program (e.g. quality of service), and *personal data* – researcher evaluation of changes resulting from program. Whereas program literature is used to provide production data, interview transcripts is used to provide the key source of judgmental data. Both program literature and subject interviews are used to generate personal data.

4.1 Methodology

4.1.1 Interview Data

Two sets of interviews were conducted of individuals located in Vancouver (April 23, 2001 to May 4, 2001) and Toronto (May 9 to May 16, 2001). In each city, the first set of interviews conducted were of program staff (engineers, program administrators), in order to reveal their experiences with the design and implementation of a stormwater/water conservation program. Interview questions for the government respondents were selected from the research questions identified in List 3 for this group.

The second set of interviews conducted in each city were of program participants and non-participants, in order to reveal the experience of homeowners with a voluntary program and other factors as indicated by the evaluative framework. Due to time

constraints, it was not possible to interview all program participants, let alone non-participants in Toronto. However efforts were made to elicit commentary from local policy-makers, as well as stormwater management experts in that city. Interview questions for the homeowner respondents were also selected from the research questions identified in List 3 for this group.

Convenience and purposive sampling methods were used to non-randomly select homeowner interviewees based on the availability of their contact information, and/or how recently they participated. While these methods of sampling are potentially biased, they are suitable in situations where study resources are limited, and only exploratory research is required (Sproull, 1988).

Letters of introduction and consent were sent to all potential interviewees, and recruitment was based on willingness to participate (Sproull, 1988). Telephone follow-up was used to schedule interview times, confirm the confidential nature of the proceedings, and to obtain verbal or faxed consent for the taping and use of all interviews. Study participants were also given the opportunity to receive a copy of their interview transcript in order to verify the accuracy of its contents. A copy of relevant thesis chapters was also offered to study participants. In total, 10 usable interview transcripts were obtained from Vancouver, and 12 from Toronto, not including personal communications with government staff.

All government interviews proceeded smoothly, after establishing good rapport with the interviewees. In situations where further clarification of interview responses was required, statements of encouragement (e.g. “that’s interesting tell me more about that...”) or comments (e.g. “I was under the impression that...”) were used to elicit additional responses. In only one situation did the interviewee request that the tape recorder be turned off, and this was only to search through program documents. Most interviews were 45 minutes to 1 hour and 15 minutes in length, and included opportunities for the interviewees to provide additional commentary. In all cases, government subjects indicated a desire to receive a copy of the study results.

Interviews of program participants (and non-participants) also proceeded smoothly, and revealed a fair degree of homeowner interest in the various initiatives being studied. Program participants in Toronto differed from those in Vancouver, in that they exhibited greater uncertainty as to the meaning of ‘consent’, and why it was necessary for their participation in the study. All Toronto homeowners were reassured that their participation was strictly voluntary, and that any responses obtained would be used only anonymously. The resulting interviews were generally 15 to 30 minutes in length, and this also included opportunity for the interviewees to provide additional commentary if desired.

4.1.1.1 Vancouver Interviews

The first set of interviews in Vancouver elicited responses from five municipal government staff/administrators of the *Downspout Disconnection* and *Perforated Sump Pilot Projects*, as well as the *Rain Barrel Program*. Three individuals are past (2) or

current (1) employees of the Engineering Services Department's Sewers Design Branch which administered the *Downspout Disconnection* and *Perforated Sump Pilot Projects*. The fourth individual interviewed is a current employee of the ESD's Waterworks Design Branch that administers the *Rain Barrel Program*, and the fifth individual is a current employee of the Permits and Licenses Department, Plumbing and Gas Inspection Branch. In all cases, the government interviewees had been involved with, or had knowledge of, more than one program and therefore were able to comment on each of these to some degree. Only one government interviewee was not directly involved with the design or administration of Vancouver's stormwater programs, but had a great deal of influence over the implementation (and possible expansion) of these programs. This individual received a less structured interview format, in order to more effectively elicit his/her experiences with, and impressions of the city's voluntary programs.

A second set of interviews in Vancouver elicited responses from five homeowner participants of the *Perforated Sump Pilot Project* and *Rain Barrel Program*. Participants of the *Downspout Disconnection Pilot Project* were not included in this study, due to a lack of government records providing contact information for these individuals. Records were available for all three participants of the *Perforated Sump Pilot Project*¹², and each of these individuals consented to being interviewed. Records were also available for participants of the *Rain Barrel Program*, however due to the large size of this group, the city provided contact information for only nineteen individuals who purchased a rain barrel between June 1999 and September 2000. Of these individuals, thirteen were selected as potential interviewees based on their recent purchase of a rain barrel (January to September 2000). Only recent participants were included in this study, in order to increase the likelihood of successful contact, and also to ensure that an accurate recollection of participant experiences could be obtained. Of the thirteen interview candidates, seven could not be reached by phone for further follow-up and three did not express an interest in the study. While three *Rain Barrel Program* participants were interviewed, the transcripts of only two were comprehensible, and thus, only these were used in subsequent analyses. Due to limited program information, it was not possible to locate and contact those individuals who had been targeted for these programs, but who ultimately chose not to participate.

4.1.1.2 Toronto Interviews

The first set of interviews in Toronto elicited responses from four government staff/administrators of the *Downspout Disconnection Program*. This included current implementers of the program (2 site inspectors), and both past and present program administrators (2). Information regarding earlier stages of the program (e.g. the pilot stage) was also elicited through this set of interviews.

A second set of interviews in Toronto elicited responses from five homeowner participants of the *Downspout Disconnection Program*. Due to the large size of this group, program inspectors were helpful in identifying recent program participants (1

¹² Two out of three participants in the Perforated Sump Pilot Program had some affiliation with the city, and therefore, became aware of the program directly through their city contacts.

years). As in Vancouver, recent participants were included in this study in order to increase the likelihood of successful contact, as well as to ensure that an accurate recollection of participant experiences could be obtained. Unlike the Vancouver study, efforts were also made to include the responses of individuals who reside in flood-prone areas of Toronto. This decision was based on the fact that flood victims (who are generally quite active participants in the *Downspout Disconnection Program*) could provide additional insight into factors motivating participation in the program. In total, six potential interviewees were contacted for participation, however one declined, causing only five usable interview transcripts to be obtained.

Due to the existence of a program database in Toronto it was also possible to contact several recent non-participants of the *Downspout Disconnection Program* (e.g. people who inquired about the program, but who later declined participation). City staff provided contact information for twenty individuals who inquired about the program between April 2000 and April 2001. Only four could be reached by phone for further follow-up, and of these, three consented to participation in the research study. In total, eight interview transcripts were obtained from program participants/non-participants, and of these, four were from self-described flood victims. While study scope and resources limited my ability to interview a larger randomized sample of participants in Toronto (where such sampling is possible), such an approach would undoubtedly be most appropriate for an in-depth evaluation.

4.2 Analytical Method

All interview responses were summarized and tallied in three separate tables titled: “Inputs”, “Process”, and “Outputs”. Following a summation of the interview responses, a program evaluation was completed for each city’s program(s), based on the criteria outlined in the evaluative framework. Data acquired through the literature review was used to expand upon or confirm respondent observations (Marshall and Rossman, 1995), and additionally, to contribute production data to those components of the evaluative framework requiring such information. Personal data, or data derived from researcher observation and/or the evaluation of changes resulting from each program, has also been incorporated into the respective program evaluations. Additional clarification/commentary was elicited from study participants and/or stormwater management experts where gaps were identified within each unfolding program evaluation.

All data has been analyzed and presented by considering the diversity of responses obtained from each city. Both direct quotations from interviewees and a summary or generalized statement about their 'feelings' have been used, without specific reference to the interviewees by name (unless otherwise stated). In most cases, responses are coded for anonymity using three characters to differentiate each study participant. The first character (**T** for Toronto or **V** for Vancouver) refers to location of the participant, and the second (**P** for program participant, **N** for program *non*-participant, **G** for government employee/program administrator, or **O** for other) refers to the type of respondent. Finally, the third character is numerical and distinguishes between respondents of a similar type or location. Thus, the code **TN-1** refers to non-participant #1 from Toronto.

Throughout the program evaluations, descriptors such as “majority” or “minority” are used to indicate the representative nature of an opinion regarding some aspect of a stormwater management or water conservation program. Highly divergent opinions, particularly those among program administrators and program participants, are also emphasized throughout the program evaluations.

Thus, interviewee responses along with program documents and expert commentary (where available), play an integral role in characterizing the operation of each program and informing the creation of recommendations for future stormwater management initiatives. The following two chapters consist of program evaluation results for the *Downspout Disconnection Program* in Toronto (Chapter 5), and the *Downspout Disconnection Pilot Project, Perforated Sump Pilot Project and Rain Barrel Program* in Vancouver (Chapter 6).

Chapter 5: Program Evaluation #1 - Toronto

This chapter focuses on the program evaluation results for the voluntary lot-level stormwater initiative, the *Downspout Disconnection Program*, which is currently operating in Metropolitan Toronto¹³.

This evaluation is summative in focus, in that the results presented are used to determine the overall effectiveness or impact of the program, and additionally, to inform future program planning and implementation efforts in Vancouver.

5.1 INPUTS

5.1.1 Community Setting/Characteristics

5.1.1.1 Physical Features of the Environment

Based on 30 years of rainfall data, there are an average of 139 wet weather days in Toronto, and a total of 819 mm of rainfall per year (Statistics Canada, n.d. *b*). Between the months of April and October alone, there are approximately 82 rainfall events, which contribute to excess flows to the combined stormwater and sanitary sewage system (Grice, n.d. *a*). Recently, there were three 25 to 50 year storms that occurred in the Metro Toronto area, which caused wastewater surcharges into private residences (City of Toronto, 2001*b*), and concerns about the management of rainwater.

Across the city, soil characteristics vary widely, from heavy clay soils to very porous sandy soils that are suitable for infiltration (City of Toronto, 1993). In the former city, only 28% of the land-base has been identified as having ‘suitable’ or ‘marginal’ soils, however this classification is contingent upon the presence of specially constructed soak pits for increased rainwater absorption¹⁴ (City of Toronto, 1993). Thus, the infiltration of rainwater in the former city has been limited both by the presence of heavy clay soils and the presence of paved surfaces. Outside of the former city (in what is now Metro Toronto), residential areas contribute larger lots having a higher percentage of grassed or vegetated surface, thereby facilitating a greater degree of rainwater infiltration.

Throughout Toronto, roof areas from buildings have been identified as contributing approximately 95% of the total flow from private properties draining to the sewer system, with the remainder consisting of domestic sewage and foundation drainage (City of Toronto, 1993). Increased flows to the city’s combined sewer infrastructure, as well as to its four wastewater treatment plants, are impacting the quality of the rivers and waterfront (City of Toronto, n.d. *a*), and severely impacting the recreational use of these areas

¹³ Information that is specific both to the former City of Toronto and Metro Toronto will be given where available.

¹⁴ Soak pits can be used on small lots where the size of the grassed area is not sufficient for infiltrating the volume of roof flow generated.

(Grice, n.d. a). In Toronto, normal day-to-day activities (e.g. driving to work) have also been identified as contributing to the water quality problem, by producing a wide array of pollutants that may be introduced into local waters by stormwater runoff (City of Toronto, n.d. a). As a result, the integrated management of wet weather flow (e.g. stormwater) has been identified as an environmental priority in the Metro Toronto area.

5.1.1.2 Level of Severity of Problem/Promptness of Management Required

In the former City of Toronto, approximately 60% of properties have roof drains that are connected to a combined sewer system, and the remaining 40% of properties have drains that are connected to a (separated) storm sewer system (City of Toronto, 1993). Older parts of Metro Toronto, including parts of York, East York and Scarborough, are also serviced by combined sewers (City of Toronto, 2000). Extensive urbanization¹⁵ and continued growth pressures within the region of Toronto have contributed excess levels of bacteria, nutrients, heavy metals, and other contaminants as a result of wastewater discharges emanating from sewer outfalls and wastewater treatment plants (Environment Canada, 1998).

During intense rainfall events, stormwater flows into the combined sewer system, may contribute between 20 to 30 times the amount of dry weather flow (Grice, n.d. a). Excess flows are relieved from the sewer system by discharging through 79 combined sewer outfalls along Toronto's rivers and waterfront (City of Toronto, 2000), and through approximately 2,700 storm sewer outfalls along Toronto rivers and Lake Ontario (City of Toronto, n.d. a).

Evidence of environmental degradation has resulted in the International Joint Commission's Great Lakes Water Quality Board identifying the Region of Toronto as one of the Great Lakes' 43 polluted 'Areas of Concern' (City of Toronto, n.d. a). The Board's recommendations have resulted in the establishment of a Toronto and Region Remedial Action Plan (RAP), to address ecological degradation within this part of the Great Lakes Basin, and the restorative efforts that are required (Environment Canada, 1999). In Metro Toronto, the response to this planning process has been to initiate wet weather flow management, which includes stormwater management (TO-1).

In 1992 a *Downspout Disconnection Pilot Program* was established to address basement flooding in an area of the former city where additional sewer upgrades were not possible (TG-1). The success of this initial pilot led to an expansion of the program, and to a shift in program focus from reducing the surcharge of water into basements, to reducing the surcharge of water into Lake Ontario (TG-1).

When current staff of the *Downspout Disconnection Program* were asked about the 'problem' that has been identified by the program and its level of severity, all respondents agreed that combined sewer overflows are the primary concern. Only half of respondents commented that beach closures and basement flooding are additional

¹⁵ The Region of Toronto is a 2000 square kilometer area that is home to over three million people (Environment Canada, 1998).

[P]art of the program is to delay the building of a wastewater treatment plant... and every year that we [disconnect] homes and get the water out of the system that postpones the building of this

concerns for which the program was designed to address. When further asked to comment on how quickly problem mitigation is required, the majority of government respondents simply emphasized the long-term and incremental nature of any water-quality improvement work.

5.1.1.3 Complementary Behaviours/Activities Being Promoted

In addition to the *Downspout Disconnection Program*, a wide variety of initiatives have been promoted by various government branches, in order to realize the complementary goals of water conservation and waste water management (Table 3).

Table 3: Some Complementary Activities Being Promoted in Metro-Toronto

Activity	Goal	
	Water Conservation	Waste Water Management
<i>Environment Days:</i> • Purchase of rain barrels. • Purchase of indoor/outdoor water conservation kits.	✓	
<i>Residential and commercial toilet replacement programs.</i>	✓	✓
<i>Mandatory water metering in former City of Toronto.</i>	✓	✓
<i>Voluntary water metering outside of former City.</i>	✓	✓
<i>Retrofitting of all city buildings, Royal Ontario Museum, public schools, and other buildings.</i>	✓	✓
<i>Water audits/leak detection programs.</i>	✓	✓
<i>Mandatory isolation of all new or redeveloped homes from sewer system.</i>		✓
<i>Infrastructure upgrades (e.g. Western Beaches Storage Tunnel for combined sewage detention).</i>		✓

5.1.1.4 Target Population Characteristics

Since all voluntary programs require a certain level of public awareness in order to ensure sufficient interest in the program, staff of the *Downspout Disconnection Program* were asked to comment on the type of information revealed to them by homeowners, regarding their knowledge of the problem setting. The majority of government respondents believed that a knowledge of flooding was the primary factor motivating interest in the program, and to a lesser extent: *i*) the environmental impacts resulting from the occurrence of combined sewer overflows and *ii*) the need to conserve water. Indeed, as indicated by government staff, the majority of homeowner respondents indicated that

basement flooding, and to a lesser extent degraded water quality, are the problems for which they believe the program was designed to address.

I think [flooding] is a big problem, because all my floors are ruined. And how many times am I going to call the insurance company? They'll cancel my insurance! (TP-1)

Some of these observations are confirmed by the results of a poll that was commissioned by Toronto's Works and Emergency Services Department to assess the public's knowledge of key water quality issues (Northstar, 2000). Survey conclusions indicated that while 67% of respondents were 'very concerned' about overall lake water quality, only a minority of respondents were specifically concerned about stormwater pollution, as confirmed by this evaluation.

Although there is a marked divergence in beliefs regarding the 'problem' as identified by program designers, and the 'problem' as identified by homeowner participants, inconsistent beliefs about the nature of the problem do not appear to be causing any program difficulties. Rather, flooding victims appear to benefit by receiving additional protection from sewer back-ups¹⁶, and *Downspout Disconnection Program* administrators benefit by receiving additional funding for program implementation.

5.1.1.5 Community Receptivity to Environmental Programs

To further explore community attitudes towards the environment, program staff-members were asked to comment on whether they believed that any wide-spread social norms were contributing to the observed interest in the program. The majority of government respondents indicated that Toronto residents have an overall sense of concern for the environment, however this (according to one individual) is likely tempered by financial considerations.

I think people feel empowered when they can do something to help the environment. If it doesn't cost them money, then they're more inclined to do so (TG-3).

When program participants were asked about how the influence of others encouraged/es their participation in this and other environmental programs, the responses were almost equally divided between 'no influence of family/friends', 'some influence of family/friends', and 'some influence of government staff at public meetings'.¹⁷ Thus, if a participant's peer-group can be used in part to define 'society', the range of responses obtained does not indicate an overwhelming influence by society (or the norms imposed by it). However, in situations where program participants are not influenced by basement flooding and hence, have not received program information directly from government staff, societal influences may play a greater role in encouraging participation. This hypothesis is supported by personal observations in the field, where new program

¹⁶ Participation in the *Downspout Disconnection Program* allows flooding victims to be eligible for a range of other flood protection measures (e.g. backflow preventor valves) under the *Basement Flooding Protection Subsidy*.

¹⁷ Public meetings were held in areas of the city that were affected by basement flooding, in an effort to inform homeowners about the *Basement Flooding Protection Subsidy*, and programs affecting the sewer system, such as the *Downspout Disconnection Program*.

participants often cited the importance of their neighbours' comments, in encouraging them to participate.

The majority of program participants also indicated a desire to participate in additional environmental initiatives that are sponsored by the City of Toronto.

5.1.1.6 Perceived Barriers and Benefits

In order to aid a deeper understanding of the factors influencing participation in the *Downspout Disconnection Program*, government staff and program participants were asked whether they could identify any barriers to participation that homeowners would likely encounter, either when inquiring about the program, or when proceeding with the downspout disconnection work. The respondents indicated a wide range of potential barriers to participation, and these are listed below in Table 4:

Table 4: Barriers to Participation as Identified by Government Staff and Participants

Program Phase	Barrier Description
<i>Initial Inquiry</i>	Language barrier.
	Fear of additional flooding due to disconnection work.
	Concerns about non-feasibility of disconnection work on property.
	Perceived right to have full access to sewer system.
	Long waiting period for property inspection.
<i>Implementation</i>	Non-feasibility of disconnection work on property.
	Additional cost (to homeowner).
	Aesthetics.

Staff-members were further asked to comment on whether they believed that any behaviours or beliefs of homeowners could be preventing participation in the program. Government responses indicated that 'a lack of awareness for the issues', and/or 'a mistrust of government', are two factors that could be influencing participation.

[The program] is free, and a lot of people are very leery about that, and they don't want the city doing anything on their home. They're a bit government shy, as it were...(TG-2)

When homeowners were asked similar questions, the majority of respondents cited no barriers or 'reservations' for participating, which naturally, explains their initial interest in the program. However, the non-participants did indicate 'skepticism' over the free program (as indicated by government staff), and concerns over the quality of the replacement materials, and the need for future downspout maintenance work¹⁸.

¹⁸ Concerns surrounding the need for future maintenance work stemmed from homeowner age and disability.

<p>NO CONCERN:</p> <p><i>I didn't have any worries, because I knew if it doesn't work I could call them, and get it disconnected (TP-2).</i></p>
<p>CONCERN:</p> <p><i>In my case, I wanted galvanized eavestroughing (because that's what I've put everywhere else), but what they would offer is only aluminum ...I'd already done a lot of work on the eaves, and I wondered whether if they came in, they would simply rip everything out (TN-1).</i></p>

Thus, in addition to skepticism over the program, homeowner respondents revealed the importance of individual or site-specific factors in determining participation. However, as acknowledged by one respondent, no program, regardless of size, is able to accommodate all participant needs without sacrificing some aspect of the program (e.g. program capacity) (TN-1).

In terms of perceived benefits, interview respondents agreed on a number of positive aspects to the program (Table 5).

Table 5: Benefits for the Participating Public as Identified by Government Staff and Homeowners

Respondent		Description of Benefit
Government		Reduce wastewater treatment costs.
		Have good feelings from being a positive role model.
Homeowners		Enjoy environmental benefits/improved waterfront.
		Protect property against flooding/dampness.
		Save on water bills.
		Replace eavestroughing/increase property value.
		Store water for garden irrigation.

Thus, in addition to the program being 'free', there are a sufficient number of benefits for the homeowner (both direct and indirect) that may be helping to overcome some of the barriers identified above, and to ensure a high level of interest in the program.

5.1.2 *Philosophy/Principles of Program Operation*

5.1.2.1 *Characteristics of Chosen Policy Instrument/Program Tool*

While most program documents indicate that the *Downspout Disconnection Program* is being promoted on a voluntary basis¹⁹ (e.g. owners of existing homes within Metro Toronto are not required to disconnect their downspouts), there is evidence of additional policy instruments or program tools in operation. In fact, evidence of a somewhat ‘coercive’ component to the program is revealed by the fact that downspout disconnection (where possible) is mandatory to receive a subsidy for basement flooding protection (City of Toronto, 2001*b*). This is further confirmed by one staff-member:

It has become mandatory somewhat with the people that have floods, if they want to have any grants down the road from the city... they have to [participate in the program] first (TG-2).

For non-flooding victims, the non-voluntary component of the program takes the form of an economic incentive (or tool), in that homeowners must commit to the disconnection of their downspouts, in order to be eligible for a “free” rain barrel (City of Toronto, n.d. *b*). While it may seem surprising that this type of incentive could influence participation, one city document confirms that the provision of free rain barrels does encourage homeowners to participate in the program (City of Toronto, 2001*c*). As revealed previously, many homeowners believe that rain barrels are beneficial to their homes, in that they retain water for garden irrigation and create savings on water bills²⁰.

5.1.2.2 *Explicit and Implicit Department/Branch Goals*

According to the manager of the Soil and Water Quality Improvement Branch (Bowering, 2001), the overall mission of the Works and Emergency Services Department is to “provide essential services that affect the day to day life of Toronto residents”. These essential services include water, wastewater, solid waste, transportation, and fire and ambulance services.

Within the Soil and Water Quality Improvement Branch, the Technical Services Division’s mission is to provide “strategic environmental and engineering leadership, policy, program and project coordination, and technical support to the Works and Emergency Services Department [and] other City departments...” (Bowering, 2001). However, the specific mandate of this Division is delivered by individual “program areas”, such as the Environmental Services Section.

¹⁹ It is assumed that all voluntary programs must encompass some type of public relations or educational component in order to raise the public’s awareness for the program and problem setting, and encourage participation.

²⁰ Since many single-family residences in Metro Toronto are not metered for water, it is difficult to attribute overall program participation rates, with the desire to save water on the part of homeowners. However for those residences that *are* metered, the city’s offer of a free rain barrel (\$60 value) may provide sufficient incentive for homeowners to participate.

The Environmental Services Section is focused on providing integrated environmental strategies, and “is responsible for leading edge environmental expertise, research and policy development, and public consultation, community outreach and education” (Bowering, 2001).

The Soil and Water Quality Improvement Branch, and hence the *Downspout Disconnection Program* which it administers, are vehicles by which the city’s goals of wastewater management, environmental leadership, and community outreach may be achieved.

5.1.2.3 Implicit and Explicit Program Goals

According to one government document, the *Downspout Disconnection Program’s* objectives are to “...divert roof flow from the combined sewer system to assist in reducing the frequency of Combined Sewer Overflows (CSOs), which severely impact the quality of receiving waters, and also to provide relief to areas subject to basement flooding” (City of Toronto, 1998a). While recent floods have resulted in additional funding being allocated to the *Downspout Disconnection Program*²¹, other sources (both program documents and interview responses) do not consistently cite flood prevention as one of the primary goals of the program. Nevertheless, this could be due in part to the fact that basement flooding has received increased attention over the past year, as a result of three intense storms that flooded several areas of the city. Recent efforts of government to reduce the risk of additional flooding may explain why flood prevention is not listed as a primary objective in the program’s (1997) training manual. According to this document, the program’s objectives are only to “...divert storm flow from the city’s sewer system using non-structural methods, and to reduce the pollution of our lake front” (*Downspout Disconnection*, 1997).

Inconsistent program objectives among various government sources (including staff) may have also stemmed from a change in the promotional angle of the program - from basement flood prevention during the pilot phase, to sewer inflow reduction during the full program phase (TG-1).

We actually never advertised basement flooding as an issue beyond the pilot, because we said it was a good remedy for basement flooding, but for the average Joe, we didn’t want them to throw the pamphlet away because they weren’t experiencing basement flooding (TG-1).

Regardless of the causes, unclear program objectives make it difficult to evaluate the *Downspout Disconnection Program* based on the achievement of these objectives. For example, depending on the importance of flood prevention, the program may not necessarily be justified in focussing part of its efforts on basement flooded homes.²² If the primary goal of the program is to reduce sewer inflows, than it may be less beneficial to disconnect flooded homes located on impervious soils, as compared to those (flooded

²¹ Additional funding for the program has come from the city’s *Basement Flooding Protection Subsidy*.

²² It should be noted, that even if all disconnection work on flooded homes is covered by funds from the *Basement Flooding Protection Subsidy*, it is likely that there are other program resources (e.g. staff time) that are also being diverted toward this activity.

or non-flooded) homes that are located on more pervious soils. The importance of this distinction was recognized during the pilot phase of the program, when disconnections of flooded homes occurred in areas with heavy, clay soils – thereby limiting the amount of roof run-off that could be directed into the sub-soils and groundwater system (City of Toronto, 1993).

In addition to the primary (or official) goals discussed above, there are a number of implicit (or unofficial) program goals influencing program operation. These are *i*) to reduce the cost of the program per disconnection, *ii*) to increase customer service/satisfaction, *iii*) to increase inspector productivity, and *iv*) to reduce the number of service calls (for disconnection follow-up) (TG-1, TG-2 and TG-3). Many of these sub-objectives have been carried over from the pilot phase of the program, and can be used to evaluate overall program performance.

5.1.2.4 Personal Goals and Expectations of Administrators

Not unlike the implicit program goals, the personal goals and expectations of administrators, include: *i*) increasing the productivity of site inspectors, and *ii*) improving overall program customer service - in part by improving the communication skills of inspectors.

My personal goal is that this is the most customer service-oriented program that the city has... that I think we have to strive for excellence... (TG-3).

Together with the unofficial program goals, the personal goals of administrators reveal an ethic of self-improvement that both defines and facilitates program operation.

5.1.2.5 Planned Design of Program Delivery

Integral to the understanding of program operation, is also knowledge of the planned sequence of events that constitute ‘the program’. Table 6 below, outlines the planned delivery of the *Downspout Disconnection Program*:

Table 6: Planned Delivery of Toronto's (Current) Program

Program Phase	Event Description
Inquiry	1. City staff-members advertise the program through various media.
	2. Homeowner inquires about/express interest in the program by calling the program hot line, or by mailing a postage-paid response card to the city.
	3. Program staff place homeowner on a wait-list for property assessment.
	4. Inspector/program staff-member schedules site-visit with homeowner.
	5. Inspector assesses feasibility of property disconnection, and draws-up site plan showing the new downspout configuration, including placement of rain barrel or other SMP.
	6. Inspector describes proposed changes to homeowner, and explains whether the homeowner will be expected to incur any additional costs.
Implementation	7. Homeowner approves design and signs an agreement ²³ for work to be completed (see figure 4).
	8. Program staff-members make arrangements with city-hired contractor ²⁴ (e.g. transfer site plan and payment for work.)
	9. Contractor schedules work with homeowner, confirms feasibility of proposed changes, and completes work.
	10. Contractor/field supervisor may perform service-calls (for 2+ years) should problems arise with the disconnection work. ²⁵

Figure 4: Downspout Disconnection Permission/Release Agreement (Excerpt)

<p>In return for the benefit to the Owner's Property of the work described in this Agreement:</p> <p>The Owner agrees to permit the City's employees, contractors and equipment to enter the Owner's Property for the purpose of performing, at the City's expense, the following work:</p> <ol style="list-style-type: none"> 1. The disconnection of the downspouts and other work proposed by the Commissioner of Works & Emergency Services of the City and detailed on the sketch shown on the reverse side of this Agreement; and 2. Any remedial work, such as remedying wet basement walls and/or icy conditions, requested by the Owner, which, in the opinion of the Commissioner of Works & Emergency Services, is required as a result of the performance of the initial work for a period of two years after the initial work is performed.
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²³ The agreement "signifies the owner's agreement with the proposed plan and absolves the City of any liability for [the] work..." (Grice, n.d. b).

²⁴ Only experienced roofing and eavestroughing contractors are used to perform the disconnection work, due to potential liability issues and the specialized techniques that are required (City of Toronto, 1998b).

²⁵ There is a fee for each service call, which must be paid for in advance by the homeowner. However, should the reported problem stem from poor workmanship, and not from lack of maintenance, this fee is reimbursed to the homeowner.

The use of a colourful program pamphlet – described as ‘light and friendly’ in nature – attracts homeowner attention, and explains the program and its implications for the environment (Figure 5).

Figure 5: *Downspout Disconnection Program Pamphlet*

In addition, the inclusion of a postage-paid response card simplifies the process by which homeowners are able to elicit further program information (Figure 6).

Figure 6: Pamphlet Response Card

Following site inspection, the use of a comprehensive three-part paper form (which displays a site drawing on one side and an agreement on the other) streamlines the process of obtaining homeowner consent and likely boosts inspector productivity. The coordination between office staff, field staff and contractor also likely contributes to the high rate of program participation that is observed.

5.1.3 Budgetary Amount

5.1.3.1 Budgetary Trends

The initial *Downspout Disconnection Pilot Program* operated with a budget of \$150,000 for one year (1992) however, this was used in part to complete drain tile work on properties that were located within a severely basement-flooded area of the city (Grice, 2001).

Over the past three years, the budget for the *Downspout Disconnection Program* has remained relatively stable at \$1.5 million per year²⁶. Recent basement-flooding events have resulted in an additional \$1 million being allocated to the program from the *Basement Flooding Protection Subsidy*.

While the overall budget for the program has increased, these increases have not been tied to program expansion resulting from city amalgamation.

5.1.3.2 Number of Staff/Material Supplies Allocated

Prior to city amalgamation, city staff worked with the non-governmental environmental organization Green\$aver, to deliver a part of the *Downspout Disconnection Program*. Based on the city's provision of \$100 per signed agreement, Green\$aver staff joined city staff in boosting the program's overall participation rate. This cost-effective arrangement provided additional staff with which to implement the program, as well as motivation for city staff to increase their own productivity (TG-1). Unfortunately, technical and administrative difficulties that arose near the time of city amalgamation ended this unique relationship.

Recent attempts to increase staffing for the *Downspout Disconnection Program* have been hampered by budgetary constraints and government cutbacks. In the spring of 2001, several temporary staff-members accepted early retirement packages from the city, leaving the program severely understaffed (TG-3).

²⁶ The annual program budget covers all costs related to marketing, staffing, site inspections, and materials and labour required to complete the disconnection work (City of Toronto, 1998b).

The program we're delivering today, is five times as large as the program we were delivering a few years ago, with the same staff (TG-3).

The number of material supplies that have been available for the *Downspout Disconnection Program* (e.g. rain barrels) has also been restricted by program funds. However, increased efficiencies (in all aspects of program delivery) are likely facilitating continued program operation, despite an ever-increasing demand on program resources.

5.1.3.3 Program Capacity

The initial *Downspout Disconnection Pilot Program* had a staff of only two²⁷ (one office staff and one inspector) (TG-1), and was able to administer a target area of 93 homes. After one year, the pilot achieved a 51% disconnection rate of eligible homes (City of Toronto, 1993).

The current *Downspout Disconnection Program* has a team of up to eleven individuals, including one branch manager, one program supervisor, one field supervisor, five site inspectors, and two to three office staff (depending on the demand for disconnection work) (TG-1, TG-3). However, prior to early staff retirement this year, the program was operating with ten site inspectors, comprising a team of up to sixteen individuals (TG-3).

... We've got the same staffing levels that we had when we were a city of small size compared to five times the size. I mean if we have fifteen or twenty inspectors, we'd have a two-week turn-around time, instead of a four-month turn-around time (TG-2).

While staffing is now at pre-amalgamation levels, program administrators expect that the program will achieve its previous year's target of 2,000 homes (TG-3), albeit with a longer homeowner waiting period.

5.1.3.4 Size of Program Effort Required

In order to determine the size of the program effort required, program administrators were asked to indicate what quantity of household runoff diversion (or what numbers of program participants) would be required to mitigate the problem setting. Government respondents were unable to indicate specific numbers (as might be expected by the specific nature of this question), and one respondent questioned the necessity of these numbers, in light of the cost involved with generating them.

...we could spend some time with the modeling – give the properties... that are disconnected to our modeling people and help them evaluate that based on everything else that's going on in the area. There are ways that we could do it, but again, how expensive is it to do that, to have this number? ... So we've run those sorts of numbers and its always been a debate. I mean I think its contributing to reducing the frequency of combined sewer overflows (TG-1).

²⁷ The city-hired contractor is not included in the number of program "staff".

Thus, rather than striving to disconnect an absolute number of homes, program administrators are striving to isolate only as many homes as possible (or a minimum of 2,000 homes per year).

5.1.4 Choice of Policy Instrument

5.1.4.1 Policy Compatibility with Requirements of Problem Setting

In order to understand the dynamics of the *Downspout Disconnection Program*, government administrators were asked to comment on the basis for which the program's various policy tool(s) were selected. Government respondents indicated that a voluntary program was attractive because it represented a low cost measure for reducing flows to the combined sewer system, and additionally because it would require less government intervention (e.g. as opposed to a mandatory program). Interestingly, both administrators also indicated the value of promoting a voluntary program in situations where the program recipients (or targets) have some vested interest in the program (e.g. risk of basement flooding). Since a voluntary program was initially implemented in a basement-flooded area of the city, it appears that the policy tool chosen was appropriate to the problem setting. When the program was expanded to include all other (mostly single) family residential areas, the offer of a free rain barrel likely boosted the appeal of the voluntary program by providing a carrot to those homeowners interested in conserving water, and potentially reducing the size of their water bills. Finally, the offer of a *Basement Flooding Protection Subsidy* to those (flooded) homeowners who were willing to participate in the *Downspout Disconnection Program*, likely further boosted the appeal of this 'voluntary' program.

5.1.4.2 Department/Administrator Familiarity with Policy Tool

Several questions were also asked of program staff regarding their experience with the program's chosen policy tool(s). While most program inspectors indicated having no previous experience with the implementation of any policy tools, both past and present program administrators indicated that they had been involved with, or had knowledge of, other educational and/or voluntary initiatives, such as the voluntary water-metering program. Administrator experiences would have likely influenced the development of the *Downspout Disconnection Program*, and may explain its use of voluntary/economic policy tools. For example, both the downspout program and the water-metering program emphasized financial incentives to encourage homeowners to participate in what may otherwise be viewed as unappealing or unnecessary programs (TG-2).

While there may be some danger in choosing policy tools as a result of administrator familiarity with these tools (rather than on the ability of these tools to achieve an identified goal), this does not appear to be the case in the *Downspout Disconnection Program*. Firstly, the program was intended to *complement* rather than to *replace* traditional regulatory measures (such as sewer use bylaws) or operational measures (such as sewer upgrades). As a result, the program's choice of policy tools does appear to be appropriate to the problem setting, which is characterized in part by a lack of homeowner

awareness. And secondly, administrators acknowledge the possibility of implementing a mandatory program should there be a decision to double or triple the number of homes that are disconnected (TG-3). Indeed, the water-metering program, which remains voluntary for most of Metro Toronto, has become mandatory in what is now the former city (TG-3).

5.1.4.3 Department/Administrator Knowledge of Alternative Policy Tools

As indicated by the previous section, there is a fair degree of knowledge of alternative policy tools. In fact, when program staff were asked to describe what other tools could be used to mitigate the identified problem (e.g. the occurrence of CSOs), the responses ranged between 'mandatory' and 'education/public relations'-type programs. Thus, the responses indicate that program staff are not restricted in their view of what policy tools are available to mitigate the problem setting identified.

When further asked to comment on what the impacts of alternative policy tools might be on the administration of the program (or on the Branch as a whole), all respondents agreed that additional resources would be required – both in terms of money and staffing (Table 7).

Table 7: Anticipated Impacts of Alternative Policy Tools

Policy Tool Requirement	Alternative Policy Tool	
	Mandatory (Economic and Regulatory)	Expanded Education/ Voluntary
<i>Additional funding and/or city staffing.</i>	✓	✓
<i>Additional (external) contractor.</i>	✓	
<i>Changed tax structure.</i>	✓	
<i>By-law amendment.</i>	✓	
<i>Training for new by-law enforcement role.</i>	✓	
<i>Longer-term vision.</i>	✓	

In addition to the need for additional program resources, all respondents indicated the need for unique legal structures (taxes, by-laws) that would enable the implementation and enforcement of a mandatory program.

When you start forcing people it just becomes a headache, you're going to have so much more resistance, its going to take many more contacts to get the job done (TG-2).

To further explore the topic of policy instrument choice, government staff members were asked to comment on how the selected policy instruments compared with alternatives in terms of ease of implementation. Two government administrators reiterated many of the “impacts” listed above, citing the complex nature of administering a mandatory program.

A final question attempted to reveal what the impacts of an alternative policy tool would be on the target population and problem setting. All respondents commented that a mandatory program would result in higher costs for the target population, more responsibilities for the homeowner (e.g. to ensure the work is completed), and the potential loss of other government programs.

...money has to come from somewhere... It does impact [the taxpayer] in one way or another. Whether it's through their water rates or through their tax rates, or through the loss of other programs as a result of implementing this program. We may lose other programs, if we implemented this one on a mandatory basis (TG-3).

Clearly, the additional benefits of implementing a mandatory program must be weighed against the potential costs of the program, including such factors as reduced public acceptance. Indeed, the current voluntary program elicits many positive comments from program participants and non-participants, alike.

Well I think the voluntary nature is good, because I think that most people would do it... Where the problem comes, is if its going to cost you a lot of money to do it, then people aren't going to do it (TN-1).

5.1.5 Nature of Staff

5.1.5.1 Rate of Program Staff Turnover

As indicated in previous sections, fluctuations in program funding and/or changes in government policies such as government ‘stream-lining’ (TG-3), have resulted in the current situation in which the *Downspout Disconnection Program* is considered to be severely understaffed. Thus, it is important to note that staff attrition has not been as a result of staff dissatisfaction, program failure, or a change in the department/branch’s mandate. In fact, current staff-members indicate their immense satisfaction with the program, and specifically with their jobs, which are said to provide a great sense of accomplishment at the end of each day (TG-3).

I'd like to retire from [this job]... if that could last the next 20 years. ...I'd like to work in this program as long as I can. It's a great little job, and I don't have to get dirty anymore (TG-2).

For this reason, inspectors often stay with the program for as long as possible – five years on average, or up to eight years in the case of one inspector who has stayed with the program since its implementation.

5.1.5.2 Beliefs or Attitudes Regarding Target Population

In order to determine whether perceived target population characteristics are influencing program delivery, program staff-members were asked to comment on their impression of the types of people normally showing interest in the program. The majority of government respondents indicated that those who are generally interested in the program have something to gain – either directly through flood prevention or savings on water bills, or indirectly through the increased recreational appeal of their waterfront. However, in light of the fact that many program participants are neither metered for water nor vulnerable to flooding (and hence do not directly benefit from the program), some interviewees also indicated that “tree-huggers” comprised a portion of the program’s total participants (TG-2). As well, some program participants could be characterized as those who are environmentally aware, but whose participation in any program or initiative, is contingent upon there being little cost to them.

Government perceptions of program participants are justifiable, to the extent that they compare with the results of a previous section (Target Population Characteristics), which reveals that the majority of homeowners participate as a result of anticipated direct benefits to themselves, and to a lesser extent, because of environmental concerns. Thus, it appears that government staff-members have a realistic understanding of the population to which they are offering their program.

Government staff was also asked to comment on whether they believed that the program's eligibility standards are appropriate for the problem setting. Government responses reiterated the importance of site suitability and the incidence of basement flooding, as factors that would make homeowners eligible for disconnection work. And in fact, the program's attractive and inclusive nature excludes only those homeowners who are not interested in the program, or who do not meet the program's flexible site requirements.

If you're property isn't feasible for disconnection, if there's a chance that that water will run in and cause you a problem, you won't be eligible, we won't disconnect you. ... We [aren't] just going to go hack off downspouts anywhere, and throw water anywhere (TG-1).

Nevertheless, this program does not focus its efforts in those areas of the city that are served by a combined sewer system – which may be necessary to most effectively address the problem setting.

5.1.5.3 Credentials and Experience

In order to ascertain the type or level of experience that has been brought into the *Downspout Disconnection Program* through its various staff-members, government interviewees were asked to reveal their involvement in previous environmental initiatives, as well as their educational background or experience. Most respondents indicated that they had some form of previous experience and/or education that was related to the environment or to the promotion of either a related or unrelated environmental program. Nevertheless, according to one individual the majority of inspectors (having originated from a variety of city departments) have no previous experience with environmental programs (TG-2). While this may true, a training program has been designed by administrators to ensure that all inspectors are given the breadth of knowledge that is required for them to adequately promote and implement the program.

Table 8: Input Component of Toronto Program Evaluation - Summary of Results

Criteria	Evaluation Results	
	Strengths ²⁸	Weaknesses
<i>Community Setting/ Characteristics</i>	<ul style="list-style-type: none"> • Presence of large lots and/or sufficiently pervious soils throughout Metro Toronto • Identification of key runoff sources (e.g. building rooftops). • Initiation of Wet Weather Flow Management (including water conservation and stormwater initiatives) in Metro Toronto. • Promotion of multiple and complementary environmental programs (e.g. through government-sponsored Environment Days). • Good understanding of problem setting among downspout program staff. • Accurate government understanding of target population characteristics. • Good understanding of barriers to participation by administrators. • Encouragement of homeowner participation through program subsidies and other carrots. • Increased program profile through community meetings and neighbourhood word-of-mouth. • Benefits to participation acknowledged both by program staff and homeowners. 	<ul style="list-style-type: none"> • Extensive urbanization in Region of Toronto. • Partially combined sewer system. • Excess rainwater flows cause CSOs and incidences of basement flooding. • Region of Toronto identified as one of the INJC's Great Lakes' Areas of Concern. • Incomplete understanding of the problem setting among homeowners. • Environmental concerns of homeowners tempered by financial considerations. • Mistrust of program and government, language barriers and site-specific concerns limit participation.
<i>Philosophy/ Principles of Program Operation</i>	<ul style="list-style-type: none"> • Organizational goals stress environmental leadership, innovative environmental policy development and community outreach. • Secondary program goals (e.g. to increase inspector program productivity) facilitate program monitoring and improvements over time. • Use of complementary policy tools. • Appealing promotion of program. • Responsibility for program delivery assumed entirely by city. 	<ul style="list-style-type: none"> • Large, complex organizational structure underlies program and influences resource allocation. • Inconsistent primary program objectives. • Long-wait list due to understaffing, and presence of only one contractor.

²⁸ Program 'strengths' and 'weaknesses' may also include those facets of the physical environment, which pose challenges to, or opportunities for program implementation.

Criteria	Evaluation Results	
	Strengths ²⁸	Weaknesses
<i>Budgetary Amount</i>	<ul style="list-style-type: none"> • Consistent program funding plus additional basement flooding allocation. • Increased inspector productivity due to previous partnership with non-governmental organization. • Increased program efficiencies resulting from government streamlining. • Evidence of reduced sewer system inflows. 	<ul style="list-style-type: none"> • Funding increases have not accompanied target population increases, resulting from city amalgamation. • Failed partnership with NGO and subsequent government cutbacks has contributed to program understaffing. • Difficult to estimate the reduction in CSOs that is attributable to the program. • Difficult to estimate ideal program 'size'.
<i>Choice of Policy Instrument</i>	<ul style="list-style-type: none"> • Suitability of chosen policy tools to the identified problem setting and target population. • Good understanding of alternative policy tools among staff. • Stated willingness to adopt alternative policies if needed. 	<ul style="list-style-type: none"> • Program may be 'coercive' in nature for victims of basement flooding.
<i>Nature of Staff</i>	<ul style="list-style-type: none"> • Job satisfaction level high. • Realistic government understanding of homeowner motivation for participation. • Training of inspectors ensures their knowledge of the program and its environmental implications. 	<ul style="list-style-type: none"> • Low to moderate job security for some staff due to government streamlining efforts. • Program eligibility standards are believed sufficient for problem setting identified. • Limited environmental education/ experience among field inspectors.

5.2 PROCESS

5.2.1 Target Population

5.2.1.1 Approach to Identifying/Targeting Participants

All metro city homeowners (especially basement-flooding victims) are eligible for downspout disconnection work, but this is contingent on the disconnection feasibility of their properties. The factors that determine whether a property is suitable for disconnection work include (Grice, n.d. *b*):

- Sufficient grassed area/suitable discharge area (including suitable soils);
- Grade of lot slopes away from building foundation wall;
- No physical obstructions on property;
- No risk of flooding neighbour's property;
- No neighbour objection to the disconnection of a shared downspout;
- No internal drainage system; and
- No contaminated sub-soils (City of Toronto, 1993).

As long as these conditions can be met, or in some way created (e.g. through downspout relocation), then all homeowners are eligible to participate in the program. Interestingly, while there have been some attempts to target certain areas of the city (e.g. those located near water) there is currently no disconnection priority for those properties being serviced by a combined sanitary/stormwater sewer system. In fact, due to the volume of requests for disconnection work, program targeting now only occurs in those areas of the city in which numerous program inquiries are received, or in areas (former municipalities) where the program has yet to be delivered (TG-3). While homeowner inclusiveness is important in allowing the program's environmental message to be spread more effectively (TG-3), administrators of the program acknowledge that disconnecting homes that are served by a separated sewer system, is less beneficial to the environment than disconnecting homes that are served by a combined sewer system²⁹.

...with the city being amalgamated now, there are areas that are not part of the combined sewer system, but we still have the homeowners who say 'we want to be disconnected', and then what do you do? We don't want to give priority to those people... they're not helping us... (TG-3).

It would therefore appear that delivering the program to 'problem areas' of the city³⁰ (rather than on a first-come first-served basis) would ensure that the program makes the most efficient use of its limited resources, particularly since the program has already attained widespread public interest.

²⁹ The desire to achieve a "numbers" target in the *Downspout Disconnection Program* (e.g. 2,000 homes per year) may inadvertently divert attention away from the need to disconnect homes that are located in combined sewer areas.

³⁰ Program targeting in 'problem areas' of the city was accomplished in the pilot phase of the program, and was subsequently proposed for the expanded program in Metro Toronto (City of Toronto, 1998*b*).

5.2.1.2 Target Population Characteristics

To further expand upon the target population characteristics identified in the Inputs section above, and to determine what factors are motivating participation in the program, homeowner interviewees were asked to comment on what their expectations for the program had been prior to SMP delivery. As expected, only a minority of respondents indicated that their concern for the environment motivated their participation in the program. Most respondents confirmed that their interest in the program was motivated by some anticipated direct benefit resulting from their participation. The direct benefits anticipated were *i*) to protect homes from sewer back-ups³¹ (the mostly commonly cited benefit), *ii*) to receive new eavestroughing from the city, and *iii*) to save money on water bills.

...I wanted to get disconnected if possible, and I wanted to get some eaves on my house fixed...
(TN-1).

In light of these observations, it is clear that without the program's various incentives (economic or otherwise), it would be difficult to motivate homeowner participation in this program, particularly when other factors (such as mistrust of government) could pose significant barriers.

5.2.2 Program Delivery

5.2.2.1 Use of Programmatic Activities

To better understand how the *Downspout Disconnection Program* is attempting to reach its target population, and to increase homeowner awareness for the problem setting, a review of the available literature and government interview responses were used to generate Table 9, below.

Table 9: Repetitive Activities Used to Advertise Program

Program State	Description of Activity
<i>Pilot</i>	Door-to-door visits/pamphlet distribution.
	School visits/"Recycle Your Rain" demonstrations.
	Two mailings per target area (two months apart).
<i>Post-Pilot</i>	City-sponsored Environment Days (two per week in the spring/summer)
	City-published <i>Waste Watch</i> newspaper (bi-annual).
	Poster distribution to schools, public spaces, environmental organizations and bus shelters.

³¹ Interestingly, while participation in the *Downspout Disconnection Program* leaves the homeowner eligible for additional flood protection measures, disconnection work itself may do little to protect the property on which it was conducted. Rather, downspout disconnection is a solution to a systemic problem, benefiting the sewer system as a whole more than any one individual household.

Program State	Description of Activity
	Water conservation/stormwater school curriculum for K-8s.
	Public meetings (re: basement flooding).
	Program “kick-off” events and media releases.
	Earth Days
	Flower shows.
	Targeted mailings.
	Other (e.g. mall demonstrations).
	(Neighbourhood word-of-mouth).

(Sources: “Environment days”, 2001; City of Toronto, 2001a; *Downspout Disconnection*, 1997; City of Toronto, 1995a).

According to one individual:

Communications, as a group, does an excellent job trying to send the message out, through various media, but even these Environment Days are so well received (TG-3).

Clearly, the different ways in which the program communicates its message, as well as the repetitive nature of these communications, likely contributes to a fairly widespread knowledge of this program.

I think I heard about it from my sister, who was interested in participating in it, but I also then saw it in a number of city publications and advertisements (TN-2).

Indeed, when homeowners were asked to describe how they had first heard about the program, the majority cited their family, friends or neighbours (who had likely heard or read about the program elsewhere). In some cases, homeowners had heard about the program directly through their council members, or through other direct government means. The vast majority of homeowners also indicated that they only had to hear about the program once, before being convinced of the need to inquire further.

5.2.2.2 Quality of Program Service

To better understand the customer service abilities of “front-line” staff-members, government respondents were asked to comment on the types of complaints and commendations that are generally received by the branch, as listed in Table 10.

Table 10: Complaints and Commendations Received by Program Staff

Complaints	Commendations
Rushed property inspection.	Pleasant and/or trouble-free participation process.
Improper completion of disconnection work (e.g. not as per site plan).	High quality work by contractor.
Misleading advertisement of “free” rain barrel ³² .	Satisfaction with the performance of the rain barrel.
Reduced property aesthetic resulting from disconnection work.	

To further gauge the level of professionalism of program staff, homeowners were asked to describe their impressions of the staff whom they had come into contact with. The majority of respondents (including a few non-participants) indicated that the quality of the service they received from staff, and specifically their “response” and “explanation” abilities, were satisfactory to excellent. Additionally, many respondents cited the importance of the field supervisor’s efforts, in resolving any installation difficulties that had arisen. Only a minority of respondents indicated that the quality of the service they received was unsatisfactory, and this was generally attributed to the poor communication abilities of staff-members³³.

SATISFACTORY:

Oh, they were all very good. The city subs [subcontractors] were good, and the program coordinator was good. Yeah, I’ve got no complaints with any of them.” (TN-2).

UNSATISFACTORY:

[The program] sort of reinforced my view of city hall bureaucracy, you know? ...But, I mean I don’t think the program should be discontinued or anything, because one [inspector] was a bit of an idiot (TN-1).

5.2.2.3 Timeliness of Service

In order to determine the speed at which various program components are delivered, government interviewees were asked to comment on how quickly they were able to respond to requests for initial program delivery (e.g. site inspection), and subsequent SMP implementation. According to program staff-members, the total program turn-around time can be as long as four to six months, with a two to three month waiting period

³² The provision of a “free” rain barrel is contingent upon a homeowner disconnecting his/her downspouts through the city-sponsored program only.

³³ A limitation in the communications abilities of staff has been acknowledged by senior program administrators, who are proposing that instructional courses be offered/developed to overcome this limitation (TG-3).

required for site inspections alone³⁴. Interestingly, the total turn-around-time is substantially longer than the goal of three weeks, which was initially proposed during the pilot phase of the program (TG-1).

Well, I would say that we're close to 4 to 6 months, which is shameful in a way, because I feel that's a real long turn-a-round time (TG-2).

Fortunately, the response time for complaints is exceedingly shorter, with same or next day follow-up service by the field supervisor, and subsequent follow-up by the contractor if required.

While the required waiting period for SMP implementation may seem unnecessarily long, the majority of respondents did not indicate any annoyance with this facet of program delivery. In fact, many individuals stressed their satisfaction with the program, particularly in light of the fact that it was free.

Well, free eavestroughs and all this other stuff, it just seemed silly. [The offer] is very rich! (TP-4)

However, it should not be overlooked that the rate at which properties are inspected by the city, and ultimately disconnected, determines the ability of the program to meet its target of 2,000 disconnected homes per year, or alternately, “as many disconnections as possible”.

5.2.2.4 Integrity of Service to Planned Design

While the purpose of this sub-section is to explore whether there have been any ‘deviations’ from the planned design of program delivery, different program input factors that have arisen over the program’s operation make it difficult to distinguish these deviations from informed program ‘changes’. For example, a shift in the identified problem setting (e.g. recent flooding), a change in the size of the target area (e.g. to encompass Metro Toronto) and fluctuations in staffing levels, have necessitated certain efficiency measures that have likely permitted continued program operation.

Doing techniques like pop-up drainage emitters, and soak-away pits... we got away from those. They were very expensive, and we weren't quite sure what value that it was adding. In terms of our goal, which was to get flow out of the system, we found the rain barrel satisfied most of our design problems (TG-1).

Drawing from a review of the literature, interviewee responses and personal communications, Table 11 (below) summarizes many of the changes (and possible deviations) in program service/delivery that have occurred over the course of the program.

³⁴ Property inspections, and in some cases disconnection work, may be completed throughout the winter months, allowing the program to maintain year-round operations.

Table 11: List of Changes in Program Service Delivery

Program State	Description of Change
<i>Pilot</i>	Relaxation of a program requirement stating that only those homes having a (rare) 3:1 lawn-to-roof ratio should be eligible for disconnection work.
	Guarantee of a free rain barrel with disconnection work, stemming from complaints of misleading advertisements.
	Installation of fewer structural SMPs (e.g. PDEs).
	Emphasis on homeowner eligibility requirements, stemming from concerns over the flooding potential of unsuitable sites.
<i>Post-Pilot</i>	Discontinuation of student-conducted disconnection work, stemming from issues of high student turnover and city liability.
	Use of a more detailed sketch (site plan) depicting proposed downspout work.
	Acceleration of program through collaboration with Green\$aver ENGO and W.I.E.P. community-based social marketing organization.
	Discontinuation of Green\$aver partnership stemming from administrative/technical difficulties.
	Simplification of process to acquire homeowner consent (from mail-in of agreement, to on-site consent at time of inspection).
	Simplification of legal requirements on consent form (from requiring indemnity against third party claims to requiring permission for city to enter property and complete work).
	Provision of Do-It-Yourself (DIY) option ³⁵ for homeowners unwilling to sign consent form.
	Discontinuation of DIY option stemming from low rate of uptake ³⁶ .
	Expansion of eligible target population to include all properties suited for disconnection work
	Requirement for homeowners to give deposit for city service-call (to be reimbursed if problem is not due to poor homeowner maintenance of the eavestroughing).
	Full or partial reimbursement to homeowners for disconnection work not completed through the program. ³⁷

(Sources: Grice, 2001; City of Toronto, 1995a; Grice, n.d. b).

The variety of changes that characterize the program's 'evolution' further indicate an ethic of self-improvement, as well as the desire of administrators to increase the number of disconnected homes. While this may be admirable, the expansion of the program to

³⁵ The former Do-It-Yourself option of the program provided the homeowner with material and advice on how to carry out the disconnection work (City of Toronto, 1995a).

³⁶ Only half of all DIY packages distributed resulted in any observable disconnection work (City of Toronto, 1998b).

³⁷ Reimbursement to homeowners for disconnection work is contingent on the homeowner having previously applied through the program, and on the work meeting city standards, allowing the city to assume all liability (as through the formal program).

include those properties that are not part of the problem (e.g. do not experience basement flooding nor contribute to CSOs) may indicate a deviation of the program from its intended design.

5.2.2.5 Responsiveness to Individual Needs

In order to determine how well the program is able to adapt itself to the needs of an individual household, and hence ensure customer satisfaction, government interviewees were asked to comment on the program's ability to respond to site-specific needs. Staff responses reiterated the importance of the site plan, which depicts the proposed downspout changes, and provides an opportunity for homeowners to voice their concerns prior to city involvement. In fact, the sketches may in some cases be revised up to two to three times, before an acceptable downspout configuration (which meets both site and homeowner needs) can be reached (Biney, 2001). In addition, the use of "speedy memos" for contacting the city-hired contractor expedites any modifications to the work that are required, and ensures an immediate response to complaints.

...we're very quick to react to complaints. They always get priority over everything else. It's very important because you don't want to do anything to ruin the reputation that we've already established (TG-3).

When homeowner respondents were asked to comment on their impression of the program's responsiveness, many simply reiterated the benefits that they were receiving from the program (e.g. protection of their property from flooding), or made positive comments about the program in general.

5.2.3 Use of Funds

5.2.3.1 Allocation of Funds to Various Program Components

In order to determine what proportion of program funds is being allocated to SMP implementation, and is therefore contributing to program outcomes, program staff were asked to comment on the program's use of funds. During the pilot phase, an estimated 40 to 50% of the program's entire budget was allocated towards administrative and staffing costs (TG-1). Fortunately, this has been reduced significantly in the current program, with less than one third of total funds going towards administrative costs, and the remainder going to material supplies, labour costs, and advertising (TG-3; City of Toronto, 1993).

I think we're relatively efficient, as far as a government program would go, in that we only have two staff members working in city hall (other than the manager and the supervisor), and ... five inspectors out in the field. That's not a big group for how much territory we're covering, and the number of inspections [we're doing]... Now that we're a mega-city we're understaffed, but we're coping (TG-2).

Indeed, in light of the 2001 government streamlining efforts (and the under-staffing that has occurred as a result of this), the *Downspout Disconnection Program* has had to strive for increased efficiencies in all aspects of program operation.

Table 12: Process Component of Toronto Program Evaluation - Summary of Results

Criteria	Evaluation Results	
	Strengths	Weaknesses
<i>Target Population</i>	<ul style="list-style-type: none"> • Inclusivity of program contributes to program participation rate. • Disconnection contingent on site suitability. • Program incentives overcome barriers to participation and meet homeowner needs. 	<ul style="list-style-type: none"> • No focusing of program efforts in those areas of the city serviced by combined sewers. • Disconnection work may not necessarily provide flood-protection to individual homes.
<i>Program Delivery</i>	<ul style="list-style-type: none"> • Program advertising is repetitive and occurs through a variety of media. • Assistance of communications staff in designing and delivering informational materials. • Good city coordination in delivering program information (e.g. through public meetings). • Positive homeowner perceptions of program staff and quality of service received. • High program attractiveness. • Effective troubleshooting of problematic disconnections. • Program staff approachable and knowledgeable. • Use of efficiency measures to improve program delivery. • Program responsive to individual/site-specific needs. 	<ul style="list-style-type: none"> • Differential staff communication and/or sales abilities. • Program advertising does not specifically target 'low-uptake' groups (e.g. immigrants). • Potentially misleading advertisement of free rain barrel. • Aesthetics of proposed disconnection work could deter some participants. • Communication/customer service skills of staff may be lacking. • Long-waiting period for program delivery. • Expansion of target population to include all eligible properties.
<i>Use of Funds</i>	<ul style="list-style-type: none"> • Majority of program funds goes towards actual disconnection work. 	

5.3 OUTPUTS

5.3.1 Monitoring

5.3.1.1 Presence of Monitoring Procedures to Track Problem

In order to determine the nature of program outputs, it is necessary to understand what efforts have been made to monitor the problem, and/or to track the mitigating effects of the *Downspout Disconnection Program*.

Toronto's Water and Wastewater Services Division, in coordination with the Ontario Ministry of Health, routinely samples lake water to monitor trends in its quality (City of Toronto, 1999/00). As well, the local government is responsible for monitoring all effluents entering into the lake from WWTPs, and for examining the integrity of all wastewater collection systems (City of Toronto, 1999/00).

In addition to monitoring the potential water quality/quantity effects of the program, program administrators have monitored the target population's rate of program "uptake". A program database tracks the response rates to mailings, and the properties that have already been disconnected either by the city-hired contractor, or by homeowners themselves (City of Toronto, 2001c). As of May 2001, the total responses to the program have been 27% of mailings, and the total disconnections have been 15% of mailings (Bell, 2001), which has been characterized as an "unbelievable" rate of response (TG-1).

Interestingly, program administrators do not currently monitor for participant responses to the quality of the service received – even though this has been identified as one area of program improvement. In fact, when homeowner respondents were asked whether they had been given a formal opportunity to provide feedback on the program, the majority indicated that they felt that they had avenues of communication with program staff. However, these avenues were believed to be available for requesting service follow-up, not for rating the program's quality of service.

5.3.1.2 Contribution of Policy Tool/Program Design to Goal Achievement

To better understand the nature of program outputs, it is useful to determine whether the program's use of specific policy tool(s) has impacted its ability to reach a desirable number of participants. When asked to provide commentary on this topic, government respondents revealed conflicting beliefs regarding the presence/impact of various policy tools. While one individual indicated the importance of the program's voluntary nature, another attributed the program's success to its coercive, non-voluntary nature.

IMPACT OF VOLUNTARY TOOL:

These people are strictly volunteering because they feel it's the best thing to do (TG-3).

IMPACT OF COERCIVE TOOL:

... we have them by the balls and we can do what we want with them, in a way. If [the basement flooding victims] want our money, they've got to do this first. ...I mean the majority of the people that don't want to participate in the program are going to say 'its too ugly' (TG-2).

When homeowners were asked to comment on what aspect of the program's design encouraged their participation, the responses did not focus on the voluntary ("it's the best thing to do") aspect of the program or on the fact that it was coercive, but rather on the direct benefits that they anticipated. Thus, regardless of how, or with what intent the program is delivered, the program appears to offer enough tangible rewards to merit sufficient homeowner interest.

5.3.2 Outcomes

5.3.2.1 Size of Population Being Served

When government staff-members were asked to comment on whether the size of the population served by the program (or the number of participants) exceeded the program's goals or expectations, all respondents agreed that the program had done remarkably well.

I think the response now has exceeded the goals and expectations [of the program]... we're going gang-busters and we've never been busier, and I don't see that changing at all in the future (TG-2).

In fact, as of May 2001, the program (including the pilot) has disconnected 22,102 homes, resulting in an overall disconnection rate of 8 to 10%, and has distributed 5,860 rain barrels city-wide (Bell, 2001). According to program estimates, the rain barrels distributed alone could account for the diversion of 150,602 m³ of stormwater from the sewer system each year, or 25.7m³ of stormwater per barrel (*Downspout Disconnection*, 1997).

While the initial pilot phase of the program had a higher disconnection rate of 42%, this was likely due to the intensified targeting that was used to mitigate basement flooding in one area of the former city.

5.3.2.2 Achievement of Explicit/Implicit Goals

As indicated by the support of Toronto residents, the *Downspout Disconnection Program* appears to be achieving the environmental leadership and community outreach goals of the city's Soil and Water Quality Improvement Branch. However, as mentioned in the Inputs section, it is more difficult to evaluate the program based on the achievement of inconsistently cited official (or explicit) program goals. Thus, while the program is

achieving its “numbers target” of 2,000 disconnected homes per year, it may be doing so at a disadvantage – the disadvantage being that not all homes may be contributing equally to the problem setting. This means that a smaller or different set of homes, if successfully targeted, could potentially impact the problem setting more effectively than the current set.

Interestingly, when program staff-members were asked to comment on whether they believed their program’s goals were being successfully achieved, one individual noted that the program’s “numbers goal” could be far exceeded, if it were not for budget and/or staffing limitations.

...we know we can only serve like say 2,000 homes with the budget that we have, and we’re able to meet that... If we advertise more, then we’d have a problem, because we’d have higher expectations than the numbers that we could serve (TG-3).

Clearly, the program has generated sufficient public interest to either require expansion (so that it may serve the potential demand for disconnection work) and/or changes in targeting focus (so that it may serve a more ‘important’ subset of homes).

In addition to the program’s various official goals, the program has also established a number of implicit goals (or personal administrator goals), and these may also be used to evaluate the program. In terms of reducing the cost per disconnection, the program has clearly made strides (e.g. through ENGO collaborations and various efficiency measures) in achieving a greater number of disconnections per annual budgetary allotment. Inspector productivity has also increased as a result of the Branch’s efforts (e.g. through the use of simplified consent forms), however it should be noted that inspector productivity varies significantly with each individual, with some inspectors achieving 25% more disconnections than others (TG-3). As well, while some customer service/communication skills appear to be lacking among the staff, the program is currently investigating the possibility of providing additional training to its staff to improve this aspect of the program. Finally, the program is currently implementing a new policy to reduce the number of costly service-calls that are received, and this is also expected to streamline program operations thereby helping to meet administrator goals and expectations for the program.

In sum, the program has achieved many (but possibly not all) of its goals, and has identified areas in which various improvements could be made, as well as measures to achieve these improvements.

5.3.2.3 Nature of Program Outcomes

In order to characterize the nature of the outcomes resulting from the *Downspout Disconnection Program*, program literature and interviewee responses were reviewed to determine the range of positive versus negative program outcomes, and these are listed below in Table 13.

Table 13: Positive versus Negative Program Outcomes

Program Outcomes	
Positive	Negative
<ul style="list-style-type: none"> • Stored supply of soft non-chlorinated water for garden irrigation. • Reduced basement dampness or severity of flooding resulting from sewer back-ups. • Recharged groundwater table. • Decreased burden on sewer system and WWTPs. • Reduced incidence of CSOs into local waters. • Cleaner beaches/waterfront. • Increased homeowner awareness for the problem setting. • Good feelings of homeowner for contributing to the 'solution'. • Increased homeowner interest in other environmental initiatives. • Saved tax dollars by reducing the need for expensive end-of-pipe facilities (e.g. underground storage). • Positive image of program resulting from potential savings on water bills. • Potentially increased re-sale value of property³⁸. 	<ul style="list-style-type: none"> • Aesthetic concerns regarding downspout work. • Expectations that the maximum allotment for disconnection work (\$500/property) will be spent on each property. • Negative image of city resulting from free rain barrels given only to participants of the program. • Low risk that stormwater from downspouts (discharging onto the ground) may concentrate contaminants from the roof into one area beneath the lawn. • Low risk that 10% to 42% of roof drainage will run over sidewalks and inconvenience the public.

(Sources: City of Toronto, 1998a; *Downspout Disconnection*, 1997; City of Toronto, 1993).

While there may be some potentially negative outcomes to the program (e.g. resulting from the concentration of roof contaminants or the creation of overland runoff), many of these can often be avoided or mitigated. For example, in situations where downspout disconnection work is causing unanticipated difficulties for the homeowner (e.g. flooding), the downspouts may be reconfigured, or reconnected to the sewer system at no cost to the homeowner. Only negative perceptions of the city/program may be more difficult to overcome, as these likely arise from a fundamental lack of understanding of the program and its ultimate purpose.

Maybe [homeowners] just don't understand the logic behind it. ...if they wanted to see themselves as taxpayers, they'll realize that the city is going to have to build more capacity to treat sewage. If they can lessen the amount of water that's going into the system, they don't even need to build anything, right? (TN-2)

To further explore the more positive aspects of the program, government administrators were asked to comment on how strongly the program's beneficial outcomes could be attributed to the program itself, rather than to some other city initiative (e.g. voluntary water metering). The majority of government respondents indicated some form of

³⁸ A potential increase in the re-sale value of a disconnected property may be due to reduced basement dampness, as well as the presence of new eavestrouthing.

‘evidence’ to support the program’s impact on the problem setting, including: *i*) the results of a downspout disconnection pilot study, *ii*) the results of sewer system modeling and analysis, and *iii*) observations of reduced basement “dampness” among program participants. Indeed, a pilot study of disconnected downspouts (in an isolated area of the city) revealed a significant improvement in the quantity of water being diverted to the sewer system (TG-3). In fact, during storms of low intensity, when the majority of roof runoff is able to infiltrate the ground, 5% of rainwater may be diverted from the sewer system (assuming a 9% participation rate). During storms of higher intensity, when overland runoff is generated, approximately 3% of rainwater may be diverted (City of Toronto, 1995*b*). Thus, expanded to the scale of the metro city (which encompasses more pervious area), downspout disconnection work is expected to significantly impact the problem setting, by substantially reducing the entry of stormwater into the sewer system and ultimately into Lake Ontario. Reduced flows not only help to prevent overloading of the sewer system, but also to improve the performance and treatment capability of wastewater treatment plants. The *Downspout Disconnection Program*’s overall success has contributed to a decision to reduce the diameter of the Western Beaches (CSO) Storage Tunnel from 6.0 to 5.5 meters (TG-2).

5.3.2.4 Effects on the Target Population

As mentioned in the previous section, one of the benefits of the *Downspout Disconnection Program* is that it can help to increase homeowners’ awareness for the problem setting.

Unless the City of Toronto was running this program I wouldn’t have known that the stormwater was causing problems for the sewage treatment (TN-2).

However, while increased awareness is clearly evident among some participants, it may not necessarily lead them to engage in other pro-environmental behaviours. In fact, when government respondents were asked whether they thought that there had been any observable behavioural changes in the participating public, the responses were split between ‘yes’ (participation in other environmental programs) and ‘none’. When homeowner respondents were asked about any changes in their activities resulting from the program, the majority also indicated ‘none’. Only one individual indicated that he was interested in switching to low-flow toilets and bathroom fixtures. Nevertheless, it is important to note that the program does achieve two very important behavioural changes among homeowners, these are allowing the city to proceed with downspout disconnection work on their properties, and potentially engaging in the recycling of rainwater.

5.3.2.5 Benefits/Barriers Related to New Activity

To determine whether there are opportunities to make the program more appealing for homeowners (and hence to improve program outcomes), government interviewees were asked to comment on how program benefits might be enhanced or barriers (to participation) removed (Table 14).

Table 14: Ways to Increase Program Appeal

Enhancing Benefits³⁹	Overcoming Barriers
<ul style="list-style-type: none"> • Remind people to use barrel for water bill savings. • Advertise suite of environmental programs offered by city. 	<ul style="list-style-type: none"> • Advertise program in different languages. • Make program mandatory.

Interestingly, while making the program mandatory is a commonly cited option, it would not help to overcome any barriers per se, but rather, would remove them all together by forcing participation. This would not only create difficulties implementing the program, and would also likely reduce homeowners' positive image of the city, as discussed in previous sections of this evaluation. The other options presented would be valuable to the current voluntary program, however the merit of pursuing these would have to be considered in light of the fact that there are limited resources to meet current, let alone increased demands for disconnection work.

Interestingly, when homeowner interviewees were also asked about ways to increase program appeal, some respondents indicated the need for increased program flexibility (e.g. to meet special homeowner requests).

My feeling is that you'd almost be better off... if they even did a cost-sharing thing. ...I understand that the city doesn't have tonnes of money that they can throw at [replacing eavestroughing] but if I want an upgrade, I'll just pay the money. ...And that's what in my case was needed (TN-1).

Should there be an increase in program resources, then many of these suggestions (e.g. cost-sharing arrangements) could help to further increase the program's appeal, if this should be so desired.

5.3.3 Cost-Effectiveness

5.3.3.1 Cost per Unit of Program Delivery

The cost of delivering the *Downspout Disconnection Program* (not counting city-staffing costs) is \$300 on average, or a maximum of \$500 per property, and this includes material as well as labour costs. In the case of basement flooded properties, this figure rises to an average of \$500, or a maximum of \$1,500 per property. Additional costs (approximately \$20,000) are also incurred by service calls (TN-3), however this is expected to decrease in the near future, with the creation of a new policy to limit the number of unnecessary site visits by city staff. Attempts by administrators to reduce program costs demonstrates their desire to improve local water quality in the most cost-efficient manner possible.

³⁹ "Benefits" in this context, refer to positive program outcomes that may have impact on the target population and/or problem setting.

I think we need to stay on top of the calculations of how much we're spending per cubic meter of rainwater diverted, to make sure that we're not exceeding what makes sense. ...that's a potential negative outcome – that we're spending tonnes of money and not really getting a lot of value for it. We should be conscious of that, and always have that calculation running (TG-1).

While it is difficult to evaluate the *Downspout Disconnection Program* in terms of cost-effectiveness⁴⁰, the program has had a noticeable impact on the problem setting (increasing homeowner awareness and reducing sewer inflows) at a minimum of cost and complexity of operation. Along with a host of other complimentary initiatives, the *Downspout Disconnection Program* has lessened demands on the existing sewer infrastructure, and reduced the need for stormwater detention and more costly end-of-pipe solutions.

⁴⁰ The difficulty involved with estimating the cost-effectiveness of environmental programs, stems in part from the uncertain nature of the future benefits to be received.

Table 15: Output Component of Toronto Program Evaluation - Summary of Results

Criteria	Evaluation Results	
	Strengths	Weaknesses
<i>Monitoring</i>	<ul style="list-style-type: none"> Local and provincial monitoring of problem setting provide trend data. Pilot study results provide information on the program's rainwater diversion potential. Program database stores information on target population and keeps track of program uptake. Program offers enough tangible rewards to merit sufficient homeowner interest. 	<ul style="list-style-type: none"> Difficult to attribute any water quality improvements to the program itself, due to the number of initiatives underway. No formal monitoring of program's quality of service Uncertainties regarding the presence of various policy tools and their impact.
<i>Outcomes</i>	<ul style="list-style-type: none"> Total number of participants has exceeded program expectations. Program is achieving its goal of 2,000 disconnections per year. Program has implemented measures to increase the efficiency/cost-effectiveness of its operations. Program is making plans to improve customer-service/communication skills of staff-members. Service follow-up helps mitigate potentially negative program outcomes. Success of program (and other efficiency measures) has resulted in 0.5 m reduction in diameter of Western Beaches Storage Tunnel. Program has increased homeowner awareness for the problem setting. Program has caused certain pro-environmental behaviour changes to occur among the participating public. Positive outcomes of program appear to exceed negative outcomes. 	<ul style="list-style-type: none"> Participating properties may not be contributing equally to the 'solution'. 'Numbers' goal could be far exceeded if not for budget limitations. Misunderstanding of program intent/impact may cause poor homeowner perception of the city and its programs. Program has not caused broad pro-environmental behavioural changes among participating public. Program may be perceived as being unyielding to special homeowner requests.
<i>Cost-Effectiveness</i>	<ul style="list-style-type: none"> Less expensive than administering a mandatory program. Efficiency measures/policies in place to maximize program outputs. 	<ul style="list-style-type: none"> Difficult to gauge cost-effectiveness of program relative to other viable alternatives.

Chapter 6: Program Evaluation #2 – Vancouver

This chapter consists of program evaluation results for three related voluntary lot-level stormwater/water conservation initiatives: the non-operational *Downspout Disconnection* and *Perforated Sump Pilot Projects*, and the operational *Rain Barrel Program*, currently operating in Vancouver.

This evaluation will be formative in focus, in that it will attempt to uncover ideas and insights about these programs that may lead to program improvements (in the case of the *Rain Barrel Program*), or that may lead to the development of a more integrated water management initiative in Vancouver.

6.1 INPUTS

6.1.1 *Community Setting/Characteristics*

6.1.1.1 *Physical Features*

Based on 30 years of rainfall data, there are an average of 164 wet weather days in Vancouver, and a total of 1170 mm of rainfall per year (Statistics Canada, n.d. *b*). As well, the City of Vancouver periodically experiences major storms where the runoff generated greatly exceeds the capacity of the city's combined sewer system. During heavy rainstorms the increased volume of effluent in combined sewers can result in wastewater flows out of residential and commercial plumbing (GVRD, 2000*d*).

In Vancouver, the soils are predominately clay-based, but do include four pockets of sandy, pervious soils on the West Side of Vancouver (City of Vancouver, 1996). The city is also characterized by residentially zoned areas⁴¹ that comprise 65% of the city's total land base, and which have an impervious surface coverage of up to 60%. As a result, rainwater infiltration in Vancouver is limited by the volume and intensity of rainfall, the presence of clay-based soils, and by the presence of highly impervious residential areas. Nevertheless, opportunities may exist for concerted stormwater management efforts on properties with large grassy (or vegetated) areas, or on smaller properties located in sandy soils.

Stormwater management has implications for the performance of the city's combined sewage/stormwater system. Remedial measures, such as voluntary runoff diversion/infiltration efforts, may help to reduce the incidence of CSOs in the aquatic environment, prior to separation of the CS system (which comprises 60% of the sewer system).

6.1.1.2 *Level of Severity of Problem/Promptness of Management Required*

Combined sewer overflows have become a major concern for the GVRD, due to their frequency of occurrence and composition. CSs typically overflow approximately 500 times per year in the Vancouver area, or 140 times each into Vancouver Harbour, the North Arm and Main Stem of the Fraser River, and 45 times into both English Bay and False Creek (GVRD, 2000*b*). The resulting discharges comprise 2% (or 36 billion litres) of the combined stormwater and sanitary sewage which enters the GVRD's five treatment plants each year (GVRD, 2000*a*). Some of the pollutants carried within CSOs are persistent in the environment, and if concentrated, pose serious risks to public health and aquatic life (GVRD, 2000*b*).

High stormwater flows to WWTPs do not only result in CSOs, but also have implications for the treatment of effluent that is retained within the sewer system. Heightened

⁴¹ Vancouver's residential lots usually measure 100 to 120 ft from front to back (and have a 33-foot frontage), making them smaller than most lots found in suburban areas (Grill, 2000).

demands on WWTPs during rainfall events, limit the detention and settling time of effluent that is required for its proper treatment (Taw, 2000). As a result, municipal wastewater effluents are considered to be one of the largest sources of pollution (by volume) to Canadian Waters (Environment Canada, 2001b in Environment Canada, 2001).

Concerns over water quality degradation have attracted the attention of the federal and provincial governments, which are offering a combined \$6 billion to improve Canada's physical infrastructure – of which a portion will go towards green infrastructure, including municipal wastewater initiatives (Environment Canada, 2001b in Environment Canada, 2001).

The GVRD and the Cities of Vancouver and Burnaby have also recently announced their intention to undertake a range of projects that would address the occurrence of CSOs, and specifically at the Clarke Drive Outfall in Burrard Inlet (GVRD, 2001). These efforts will likely complement and expand upon existing wastewater initiatives, and may provide opportunities for the re-adoption of lot-level stormwater management initiatives in Vancouver.

In 1996, the Vancouver Engineering Services Department's (ESD) Sewers Design Branch took measures to promote stormwater infiltration on private properties, through the *Downspout Disconnection Pilot Project*, and in 1997 through the *Perforated Sump Pilot Project*. In both cases, government administrators were interested in facilitating lot-level rainwater absorption through the use of various infiltration methods. As well, a long-running *Rain Barrel Program* (established in 1993) has attempted to increase homeowner awareness for the need to conserve water. Thus, each program has tried to reduce the demand on the city's water and/or wastewater infrastructure, while at the same time, helping to restore the urban hydrological cycle.

When government staff were asked about the 'problem' for which the city's various voluntary water management programs were designed to address, the majority of respondents indicated CSOs as being the primary concern, followed by non-point source pollution, basement flooding, and 'water waste'.

With today's standards, combined overflows aren't really acceptable. So there's a lot of pressure to phase those out...(VG-1).

When further asked to comment on how quickly problem mitigation is required, the majority of government respondents indicated the long-term and incremental nature of any water quality/quantity improvement work, albeit with the potential for acceleration pending federal support.

6.1.1.3 Complementary Behaviours/Activities Being Promoted

In addition to the city's voluntary initiatives, a wide variety of non-voluntary initiatives have been implemented in order to "accelerate some of the benefits" of combined sewer separation (VG-1). Note that most of these initiatives are either regulatory or structural

in nature, and do not include initiatives (such as water metering) which may increase homeowner's awareness for the problem setting and promote pro-environmental behavioural changes (e.g. water conservation) (Table 16).

Table 16: Some Complementary Activities Promoted in Vancouver

Activity	Goal	
	Water Conservation	Waste Water Management
<i>By-law to restrict water sprinkling.</i>	✓	✓
<i>Mandatory use of water-saving devices in new homes.</i> ⁴²	✓	✓
<i>Performances of "A2Z of H2O" play for school children.</i>	✓	✓
<i>Use of perforated catch basins.</i>		✓
<i>Mandatory restriction of impervious surface coverage on all new or redeveloped (single family) residential properties.</i>		✓
<i>Catch basin cleaning.</i>		✓
<i>Combined sewer separation.</i>		✓
<i>Infrastructure upgrades (e.g. retro-fitting of weirs).</i>		✓

(Sources: City of Vancouver, 1999a, 1999h and 1995b.)

6.1.1.4 Target Population Characteristics

Administrators of the *Downspout Disconnection* and *Perforated Sump Pilot Projects*, as well as the *Rain Barrel Program* were asked about the type of information that was revealed to them by homeowners inquiring about the program (e.g. their knowledge of the problem being addressed). Government respondents indicated that participants do demonstrate some knowledge of the environment or of the need to conserve water, and that this may be motivating participation in the city's voluntary initiatives.

Interestingly, the majority of homeowner respondents revealed a more in-depth understanding of the problem setting, than what was believed to be the case by government staff. In fact, many participants indicated that CSOs, and to a lesser extent risks of flooding and drought, are the problems for which they believe the various program were designed to address.

⁴² For all new homes constructed July 1, 1994 onwards, the City of Vancouver requires the installation of ultra low-flow toilets (City of Vancouver, 1995b).

...runoff is a considerable problem, because we have a mixed sewage system here. We have stormwater going into the normal sewage, which creates a problem – too much volume to treat (VP-1).

Nevertheless, government underestimation of homeowner knowledge may stem from the non-representative nature of the individuals who participated in the programs, rather than from a lack of awareness on the part of government administrators. Indeed, many participants of the stormwater management programs were affiliated with the city or its programs, and as a result, may have been more knowledgeable about the problem setting than the general population.

6.1.1.5 Community Receptivity to Environmental Programs

To further explore community attitudes towards the environment, program administrators was asked to comment on whether they believed that any wide-spread social norms were contributing to, or preventing interest in the programs. While some government respondents indicated that Vancouver residents have an overall sense of concern for the environment, others indicated the importance of two additional social norms. These include conserving water (particularly among recent immigrants), and preventing water-related damage to personal property. Indeed, incidences of “leaky” condominiums and flooded basements in the Vancouver area have made some property-owners extremely cautious about retaining any water on their properties (VG-2).

When program participants were asked about how the influence of others encouraged/es their participation in this and other environmental programs, the majority of respondents indicated that there was ‘some influence of family/friends’ on their activities. In addition, many of these individuals also felt that they themselves had been instrumental in influencing others to engage in pro-environmental behaviours or activities.

...in our family, we’ve always had a very keen awareness of polluting the water table – we have a composting toilet, we already understand how important catchment is, so we probably influence our friends, more than they influence us (VP-2).

As noted previously, the unique knowledge of program participants for the problem setting, as acquired or reinforced by their life experiences (including affiliation with the City of Vancouver), may be highly instrumental in influencing program participation in this city.

Thus, the majority of program participants also indicated an interest in participating in other environmental initiatives sponsored by the City of Vancouver, albeit with some reservations on the part of two individuals, regarding their potential ‘degree of impact’ on the problem setting.

6.1.1.6 Perceived Barriers and Benefits

In order to aid a deeper understanding of the factors influencing (or preventing) participation in Vancouver’s various stormwater/water conservation initiatives, government staff-members were asked to identify any barriers to participation that homeowners would likely encounter. Government respondents indicated a wide range of potential barriers to participation, and these are listed below in Table 17.

Table 17: Barriers to Participation as Identified by Government Staff and Participants

Barrier Description
Cost to homeowner.
Poor example of others or limited exposure to appropriate role models.
Lack of motivation to participate (due to the perception that individuals cannot have an impact on the problem setting).
Lack of incentive to participate (e.g. no direct savings on water bills).
Concerns over non-feasibility of disconnection work on property.
Lack of skill or comprehension required to install SMP.
Need for contractor to conduct SMP work.
Fear of flooding/groundwater seepage resulting from SMP work.
Unsuitability of property for SMP work (due to size, slope, soil, and groundwater).

As one individual noted:

I think its difficult for people to understand how to do [the disconnection work]. ...Even though there’s a built-in incentive that if you do the work we actually pay for the materials, I don’t think that was incentive enough... (VG-3).

Government staff-members were further asked to comment on whether they thought that any specific behaviours or beliefs might be competing with, or preventing participation in the program. Government respondents revealed that they were perplexed as to why the stormwater programs received such low participation rates, especially when the *Rain Barrel Program* (which also requires disconnection work) has received a much higher participation rate.

It’s a good question, but tough to say... its interesting that the rain barrels have been so successful, and they still need to do some work with their downspouts in order to install [them] (VG-3).

Interestingly, when homeowners were asked similar questions about barriers to participation, the majority of respondents cited no barriers or ‘reservations’ for participating, which naturally, reflects their initial interest in the program. Only one participant of the *Perforated Sump Pilot Project* indicated that s/he had concerns over “where the water would percolate to, and at what speed...” (VP-3). When further asked to comment on any difficulties that may arise from the implementation of an SMP (e.g. a perforated sump) this individual also noted:

[A perforated sump] is not the kind of light and friendly technology, like getting a composter at the transfer station, [where you] come home, and set it up and start composting. It's a big, heavy, serious kind of thing in my view. Somebody's got to go and do it for you (VP-3).

This comment may be contrasted to that from another *Perforated Sump Pilot Project* participant, who had the device installed onto a redeveloped property.

...we were building a new house, so it made no difference to us. If you were trying to do this on a retrofit basis, then I think you're involving a much more complex process. You know its going to disrupt people (VP-4).

While the City of Vancouver has not yet aggressively promoted the use of perforated sumps on redeveloped properties (located in suitable soils), this could be accomplished through continued appeals to developers, or perhaps more effectively, through changes in the city's Plumbing codes (VG-2). Interestingly, a lack of widespread of implementation of the perforated sump was described as "mind-boggling" by one developer who had been easily convinced of the need to participate in the program. In terms of perceived benefits, interview respondents agreed on a number of positive aspects to the city's stormwater/water conservation initiatives (Table 18).

Table 18: Benefits for the Participating Public as Identified by Government Staff and Homeowners

Respondent		Description of Benefit
Government		Conserve water.
		Increase homeowner awareness for/knowledge of problem setting.
		Save money on infrastructure ⁴³ .
	Homeowners	Good feelings for homeowner (due to alleviation of ‘environmental guilt’). ⁴⁴
		Free sump for home-builder/renovators.
		Healthier garden (using rain barrel).
		Flexibility in water/ability to comply with lawn sprinkling regulations (using rain barrel).
		Environmental benefits.
		Potential protection of property against flooding (using perforated sump).
		Storage of an emergency water supply (using rain barrel).

It is interesting to note that two of the benefits that were identified both by government staff and homeowners, can be attributed directly to the *Rain Barrel Program*, these being flexibility in watering (or ability to comply with lawn sprinkling regulations), and healthier gardens. In addition, two program benefits identified by homeowners (protection from flooding and storage of water) were not identified and/or promoted by program staff, even though these may have been used to greatly increase the programs’ appeal. Nevertheless, the omission or under-emphasis of these program benefits may be due to the inaccurate beliefs of homeowners regarding the SMPs’ best use. For example, using a rain barrel to store water, rather than to irrigate the garden, may limit the device’s ability to conserve rainwater. In the case of the perforated sump, reluctance on the part of the city to place itself in a position of liability may have also prevented advertisement of the device’s potential ‘flood prevention’. Indeed, only sanitary sewer pumps and backwater valves are currently permitted for reducing the risk of sewer backups in Vancouver (City of Vancouver, 2000a).

Overall, a lack of consensus among city staff and homeowners regarding the potential and/or advertised benefits of engaging in a stormwater program may have played a role in limiting interest in these programs. As well, a lack of coordination/integration between the interrelated *Rain Barrel Program* and the *Disconnected Downspout* and *Perforated*

⁴³ While the city provided the perforated sump for free, it reimbursed homeowners only up to \$50 for the purchase of downspout disconnection materials.

⁴⁴ One government respondent also indicated that saving and re-using rainwater leads to positive feelings among homeowners, due to the intrinsic ‘archetypal’ nature of this activity (VG-4).

Sump Pilot Projects, may have contributed to an incomplete understanding of the problem setting among those who inquired about each program.

According to one government staff-member however, even full knowledge of the environmental benefits of these programs, may not have been sufficient to attract the interest of homeowners.

... just the environmental benefit alone doesn't seem to be enough for [anyone] to get on board. You might get that odd one that's really keen on [the program], but in general, its pretty tough stuff... (VG-5).

Indeed, even after all the environmental ramifications have been understood, financial considerations may ultimately determine homeowner participation.

Everyone wants to do their part, but if it's a big dollar item... they're not going to (VG-1).

6.1.2 Philosophy/Principles of Program Operation

6.1.2.1 Characteristics of Chosen Policy Instrument/Program Tool

All program materials and government respondents are in agreement regarding the purely voluntary and educational nature of the *Disconnected Downspout and Perforated Sump Pilot Projects* (City of Vancouver, 1999c, 1999e, 1999h, 1997 and 1996).

Participation was entirely voluntary, especially at the pilot project stage. And again there was a strong educational component as well (VG-3).

While this is also true of the *Rain Barrel Program*, one administrator also acknowledges the importance of the lawn sprinkling restrictions in influencing the program's observed rate of uptake (VG-4).

6.1.2.2 Explicit and Implicit Department/Branch Goals

The official goals of the Engineering Services Department, in terms of managing the sewer collection system, are to (City of Vancouver, 1999b):

- Safeguard public health and minimize impact on the environment by collecting domestic, commercial and industrial liquid wastes for disposal;
- Minimize property damage, public nuisance and impact on the environment by collecting and controlling precipitation runoff for disposal;
- Maintain and rebuild these facilities in a timely manner, so that their operating efficiency is maximized, service levels are maintained, and the City's interest are protected;
- Work towards the elimination of all raw sewage overflows into the environment over the long term in the most cost-effective way, and

- Provide quality service to our customers.

According to one administrator:

...our main goal is to phase out the combined sewer system, and to stop combined sewer overflows, and our instrument of doing that is to separate our sewer system into a fully separate storm and sanitary sewer system (VG-1).

Thus, by accelerating the benefits of combined sewer separation, the stormwater management programs were intended to help meet the department’s environmental and infrastructure service objectives.

Potentially complementing these objectives, are those of the ESD’s Waterworks Design Branch, which include “providing... customers with an adequate and *sustainable* supply of high quality water, affordably and equitably...” (City of Vancouver, 2001, italics added). In fact, by providing a sustainable supply of water (which includes recycled rainwater), the Waterworks Design Branch may be reducing the entry of roof runoff into the city’s CS system – thereby helping to achieve the overall department’s goals.

In addition to the ESD’s goals, are those of the city’s Permits and Licenses Department, Plumbing and Gas Inspection Branch⁴⁵, which include protecting homes from sewer-backups and ultimately, from the occurrence of basement flooding.

...[our] responsibility is to protect properties within the bylaw... there’s some responsibility for us to look after [private properties], and so if there’s any liability... because of the direction we take with policy... [we] always look at that first. ...So, that’s where [we’re] coming from and Engineering has their own problems with what their doing, and that’s how we’re trying to work this out (VG-2).

In spite of widespread concerns over liability, the ESD attempted to launch a “private side” stormwater management initiative with input from the Permits and Licenses Department⁴⁶, and this resulted in the creation of the *Downspout Disconnection Pilot Project* and subsequent *Perforated Sump Pilot Project*.

We did a pilot study to see what kind of response we’d get, and even with the pilot study, we’re running into a lot of roadblocks in getting through Permits and Licenses and that kind of thing. They had some legitimate concerns about potential liability issues (VG-1).

Despite the ESD’s efforts, the low participation rates encountered by the two programs caused there to be no further attempts to initiate voluntary stormwater pilots, or to coordinate the city’s various water management efforts. And, as one government staff-member regretfully noted:

⁴⁵ The Permits and Licenses Department is a division of the city’s Community Services Group.

⁴⁶ ESD’s “discussions” with the Permits and Licenses Department were intended to minimize any city liability associated with rainwater retention on private properties (VG-1).

Because of the lack of [program] continuity over the years, I think its made our working relationship with the Plumbing Branch a bit more difficult. ...They're under the impression that this program failed and I can't see them ever wanting to resurrect it again (VG-3).

6.1.2.3 Explicit and Implicit Program Goals

The initial goals of the *Downspout Disconnection* and *Perforated Sump Pilot Projects* were to disconnect at least 500 homes and install 10 perforated sumps⁴⁷, respectively (VG-3), as well as to raise homeowner awareness for the problem setting identified. Thus, as elaborated by one individual, the goals of the programs were:

...to educate homeowners - that was the most important thing. And [to] raise awareness, about some of the environmental problems that we're facing, and how individuals can actually make a difference (VG-3).

In addition to these explicit (or official) program goals, it was the expectation of administrators that the success of these programs would encourage further collaborative efforts between the Engineering Services and Permits and Licenses Departments.

If we could've actually worked with them and identified properties where this would have worked properly and gotten at least a 100 homes and been able to evaluate that over a year, [Plumbing] would actually have more confidence with the program – then we could work with them on this (VG-3).

Thus, it is possible to evaluate the two stormwater pilots based on the achievement of their explicit and implicit program goals, as well as the overarching goals of the ESD.

6.1.2.4 Personal Expectations/Goals of Administrators

Not unlike some of the program goals explored above, the personal goals and expectations of administrators included *i*) establishing SMPs as the norm, *ii*) saving money (on infrastructure upgrades and city water bills), *iii*) minimizing city liability (stemming from the pilots), and *iv*) expanding the pilots into a full program.

I was hoping that it would work out really well so that we'd have great participation – we could actually launch into a program. We could report back to council and say that we've had fantastic participation with great results, and can we actually expand our stormwater management/ educational program (VG-3).

The personal goals of administrators reveal a desire to raise homeowner awareness for the need to manage water (in its various forms), and through these and other efforts, to reduce the occurrence of CSOs.

⁴⁷ The City of Vancouver manufactured only ten perforated sumps for use in the pilot program.

6.1.2.5 Planned Design of Program Delivery

Integral to the understanding of the city’s water conservation/stormwater management initiatives, is also knowledge of the planned sequence of events that constituted each pilot program. Table 19 (below) outlines the planned delivery of the *Downspout Disconnection* and *Perforated Sump Pilot Projects*, and the *Rain Barrel Program*.

Table 19: Planned Delivery of Vancouver’s Water Conservation/Stormwater Initiatives

Program Phase	Event Description
Inquiry	1. City staff-members advertise the initiatives through various media.
	2. Homeowner/builder inquires about the programs by phoning ESDs relevant branches, or by contacting staff in-person.
Implementation	3. Homeowner receives instructions/information for relevant SMP, pays for rain barrel, or schedules an appointment for site assessment (for downspout disconnection work or perforated sump installation) ⁴⁸ .
	4. Homeowner picks up perforated sump or rain barrel (from city works yard), or purchases downspout disconnection materials from hardware store.
	5. Homeowner/hired contractor installs perforated sump or rain barrel, and/or disconnects downspouts.
	6. City reimburses homeowner for cost of disconnection materials (\$50).
	7. City conducts follow-up inspections of disconnected downspouts and perforated sumps to ensure their proper functioning.

(Sources: VG-1; VG-3; VG-4; City of Vancouver, 1997, 1996 and n.d).

Informational materials for the *Downspout Disconnection* and *Perforated Sump Pilot Projects* adequately describe the problem setting, but fail to make use of attractive visual representations, which are necessary to attract sufficient interest in the programs (Figure 7).

⁴⁸ In the case of the *Downspout Disconnection Pilot Project*, site inspections are intended to determine the number of downspouts that can be disconnected, the best method for disconnecting each downspout, and to provide any necessary “technical assistance” (DD Pamphlet). In the case of the *Perforated Sump Pilot Project*, inspections are intended to determine whether the geography, soils, and water table elevation of property make it suitable for perforated sump installation (PS Pamphlet).

Figure 7: Sewers Design Branch Stormwater Pilot Pamphlets

6.1.3 Budgetary Amount

6.1.3.1 Budgetary Trends

As the ESD's first residential stormwater management initiative, the *Downspout Disconnection Pilot Project* received a total budget of \$10,000. Due to low public interest in the program, only a small portion of the budget was expended – allowing the remainder to be used to launch the ESD's second initiative - the *Perforated Sump Pilot Project* (VG-3). In contrast, the Waterworks Branch's *Rain Barrel Program* has operated with a stable budget of approximately \$18,000 per year (VG-4; Smyth, 1999).

6.1.3.2 Number of Staff/Material Supplies Allocated and Program Capacity

Since the *Downspout Disconnection Pilot Project* and *Perforated Sump Pilot Project* were both initiatives of the ESD's *Sewers Design Branch*, each was administered by approximately the same number of staff. As such, the staffing team consisted of two (non-dedicated) staff-members, one branch manager, and several summer students. In addition, there was one on-call "sewer separation team"⁴⁹ that was available for any necessary site inspections. Nevertheless, a high turnover of city staff (including city engineers) over the duration of the programs, placed greater demands on the remaining staff and resulted in the discontinuation of these initiatives.

...we ran into staffing problems here... high staff turnover and that sort of thing, so it was hard to keep the program going, and we had a lot of vacant positions... (VG-1).

Meanwhile, the *Rain Barrel Program's* staffing team consists of one administrator (the same individual who initiated the program in 1993), as well as the occasional summer student (VG-4).

In terms of capacity, the *Downspout Disconnection Pilot Project* was designed to serve up to 500 homeowners (depending on the demand for the program's \$50 (maximum) subsidy). Using the remainder of the downspout program's funds, the *Perforated Sump Pilot Project* was able to serve up to ten participants (based on the number of perforated sumps that were manufactured by the city). Finally, the *Rain Barrel Program* (since the time of its establishment) has been able to serve approximately 300 participants, albeit with the requirement that homeowners subsidize half the cost of each barrel, e.g. \$56.09 including taxes (City of Vancouver, n.d.).

⁴⁹ Sewer separation teams consist of one sewers operation staff-member and one plumbing inspector, and normally conduct inspections of sewer connections on private properties.

6.1.3.3 Size of Program Effort Required

In order to determine the size of the program effort required, program administrators were asked what quantity of household runoff diversion (or what number of program participants) would be needed to mitigate the problems identified. All administrators indicated the need for tens of thousands of program participants (or as many as possible), in order to achieve any noticeable water quality (or quantity) improvements.

Probably thousands I think – to really make a dent. Well, probably in the tens [of thousands]. For example the Clarke Drive outfall... the tributary area probably has like 50,000 households so you'd have to get 5, 10 [thousand] of those to start making a dent (VG-1).

While it may be difficult to attribute any reductions in CSOs to a residential stormwater program, having a large number of participants in such an initiative would ensure the diversion of the largest possible quantity of roof runoff. Or as one administrator noted, even a 1% participation rate⁵⁰ (in those areas that are feasible for disconnection work) would represent a substantial accomplishment.

One percent isn't bad... I think only around 8% of the city or 10% of the city is great candidates for disconnection. So if you get 10% of that, then wow, you're doing a phenomenal job (VG-5).

As pilots, these stormwater initiatives did not have the size required to have any discernable impact on the problem setting. Nevertheless, a lack of homeowner interest in these pilot programs prevented them from achieving even their own modest goals.

6.1.4 Choice of Policy Instrument

6.1.4.1 Policy Compatibility with Requirements of Problem Setting

In order to understand the dynamics of the ESD's various stormwater/water conservation initiatives, government administrators were asked to comment on the basis for which the program's various policy tool(s) were selected. Government respondents indicated that a voluntary/education-based program was attractive because it represented a low cost measure for reducing flows to the combined sewer system, and additionally because it would complement the city's sewer separation efforts. One administrator also alluded to the more appealing (e.g. less aggressive) nature of a voluntary program.

...cost is a big issue in all of this and I think we need to be convinced that the resources that we are spending are making a difference... That's why we've tried to stick with programs that are sort of minimal cost to begin with, and work more on public education and source control, instead of using a big hammer (VG-3).

⁵⁰ Using a (1996) population figure of 515,500 (City of Vancouver, 1998c), a 0.8% to 1.0% participation rate would necessitate the disconnection of 4,124 to 5,155 homes.

6.1.4.2 Department/Administrator Familiarity with Policy Tool

Several questions were also asked of program staff regarding their experience with the program's chosen policy tools. Except for the administrator of the *Rain Barrel Program*, most respondents indicated that they (and the Sewers Design Branch in which they were employed) had had little or no experience with voluntary programs prior to the implementation of the *Downspout Disconnection* and *Perforated Sump Pilot Projects*. However, one individual did stress that the public-relations abilities of the city have improved over time.

I'd say [we're] getting better [with education/public-relations type programs]. 10-15 years ago, maybe not so much, but the city has really been getting more active in that sort of thing. We've really started to develop our experience with [the] public (VG-1).

Clearly, the department's attempt to make use of an unfamiliar policy tool demonstrates its willingness to adopt a range of approaches for mitigating the problem setting identified. Indeed, since the problem setting is characterized in part by a lack of widespread homeowner awareness, the choice of an educational/ voluntary policy tool may be highly appropriate.

6.1.4.3 Department/Administrator Knowledge of Alternative Policy Tools

When asked about other policy tools or approaches that could be used to address the identified problem, government respondents indicated the presence of a wide range of alternatives, as well as the likely administrative impacts of these (Table 20).

Table 20: Alternative Policy Tools and their Anticipated Impacts/Requirements

Policy Tool	Policy Tool Impact
<i>Voluntary program with economic incentive (e.g. tax rebate or subsidy on one-time sewer connection fee).</i>	Need for higher staffing levels and increased program budget. ⁵¹
<i>Expanded voluntary program with use of volunteer crews.</i>	Need for greater cooperation with other city departments.
<i>Expanded education/public-awareness campaign.</i>	Need for greater cooperation with other city departments.
<i>Mandatory measures (including water metering).</i>	Need for substantially increased program budget.

In addition to the need for additional program resources and greater inter-departmental cooperation for most of these options, two individuals stressed that concerns over flooding would make the establishment of a mandatory program improbable.

⁵¹ An increased program budget could potentially be achieved by using federal 'green infrastructure' grants.

[Plumbing is] very wary and they want to have strong assurances that the soil conditions will be just right for [SMP implementation], so none of this comes back... people with flooded basements complaining, and that kind of thing. So they are very wary of it internally and definitely [would] not make it mandatory, because there are definitely places in Vancouver where it just wouldn't work (VG-1).

Some respondents also indicated the overall difficulty involved with changing an established bureaucratic structure.

...anything out of the norm is a difficult sell both to the bureaucracy that... applies the rules, and to those that are trying to exist within those rules. So, it's a queasy job [trying to implement something new] (VG-5).

While it is true that making changes in an established bureaucratic structure may be difficult, overcoming these difficulties may help to forge new and more effective inter-departmental relationships.

A final question to government staff attempted to reveal the impacts of an alternative policy tool on the target population and problem setting. Interestingly, for the mandatory or 'coercive' options, two respondents were unsure as to what the likely impacts would be on either the public or the problem setting. A third individual, however, noted that the start-up costs for a mandatory program (such as water metering) would likely be "objectionable" (VG-4).

I think we need to be convinced that the resources that we are spending are making a difference because they're so many different things that you can do in terms of environmental measures to improve quality of life. [Other cities are] spending millions of dollars, but what are they actually achieving (VG-3)?

Clearly, the potential benefits of implementing a mandatory (or coercive) program must be weighed against the higher costs of such a program.

6.1.5 Nature of Staff

6.1.5.1 Rate of Program Staff Turnover

As indicated in a previous section, fluctuations in the ESD's staffing (resulting from department relocations and work stoppages) have resulted in the current situation in which the *Downspout Disconnection* and *Perforated Sump Pilot Projects* are no longer operating. And while it is still possible for homeowners to read about the ESD's voluntary stormwater programs on the city's web site and to inquire about these initiatives (City of Vancouver, 1999e), there currently remain no dedicated resources to implement these programs on a widespread basis.

A lack of dedicated program staff, also meant that no single individual was directly accountable to the department's voluntary stormwater initiatives.

Usually what happens in a bureaucracy on that, like everybody's sort of working on it a little bit, so everybody's responsible, but nobody is really responsible. So if it was one person's job, then they pull together the resources bit-by-bit. But it never was, sort of, anybody's one main task. (VG-5).

Thus, a lack of program resources (including dedicated staff) likely prevented the full potential of these pilots from being truly realized.

6.1.5.2 Beliefs or Attitudes Regarding Target Population

In order to determine whether perceived target population characteristics are influencing program delivery, program staff-members were asked to comment on their impression of the types of people normally showing interest in the program. Government respondents indicated a diverse range of beliefs regarding the participating public, including that they are already ‘converted’ (and thus display an interest in environmental initiatives), and/or have a higher socio-economic standing⁵² (and thus benefit from a greater capacity to understand and/or to mitigate the problem setting). Other respondents indicated that program participants are those who feel that they have something to gain financially or otherwise, as is the case with avid gardeners who are interested in maintaining healthier gardens, or developers who may be interested in appearing ‘progressive’ to their clients.

IMPORTANCE OF PERCEIVED FINANCIAL GAIN:

...[participation] is not created because[people are] trying to be environmentally-friendly. Its usually because of the economic situation... I'd just like to see people say 'oh yeah, well I can [participate] because I'm in this area and it's the right thing to do' (VG-5).

IMPORTANCE OF SOCIO-ECONOMIC STANDING:

...there was actually a correlation between who was actually buying the rain barrels. We noticed that the west side of Vancouver had a disproportionate number of [participants](VG-3).

As revealed in *Target Population Characteristics*, a homeowner’s concern for the environment may influence their interest in an environment initiative. But in addition to this, a homeowner’s desire to receive some direct benefits (e.g in the form of financial savings) may ultimately determine whether or not they will become involved in that initiative. This is confirmed by a (1995) survey of British Columbians, which found that people with a strong belief in environmental action were more likely to engage in pro-environmental behaviours, but that this was especially the case when these behaviours produced a financial dividend (FBEST, 1997).

To further explore staff attitudes, government respondents were asked to comment on whether they believed that the program’s eligibility standards were appropriate for the problem setting. The majority of government respondents indicated the necessity for site suitability as the factor determining whether homeowners were eligible for downspout disconnection or perforated sump installation. And unfortunately, many areas of the city which contribute most to the problem setting (e.g. contribute directly to combined sewer overflows), also have the least pervious soils.

... for the pilot study we were just trying to pick anyplace where there[were] no soil concerns, and that's how we picked [those areas] at the time... Unfortunately, some of the areas where we do have sewer overflows are also areas where they do get ruled out because of the soils (VG-1).

Clearly, a perceived inability to overcome site-specific soil limitations prevented administrators from being inclusive of all Vancouver homeowners in their stormwater pilots.

6.1.5.3 Credentials and Experience

In order to ascertain the type or level of experience that has been brought to the city's various stormwater/water conservation initiatives, government interviewees were asked to reveal their educational background, and their experience with previous environmental initiatives. Most government respondents indicated that they had no education in an environmentally-related field, and no experience administering an environmental program. Only the administrator of the *Rain Barrel Program* indicated that he had previous experience with developing theatre productions for school-aged children, as well as other educational programs.

While the experience of staff-members in designing and promoting environmental programs is only one of many program input factors, it is likely critical for ensuring that a program is made sufficiently appealing to its intended target audience.

⁵² The West Side of Vancouver, in which many program participants reside, is generally considered to be more affluent than the East Side of Vancouver.

Table 21: Input Component of Vancouver Program Evaluation - Summary of Results

Criteria	Evaluation Results	
	Strengths ⁵³	Weaknesses
<i>Community Setting/ Characteristics</i>	<ul style="list-style-type: none"> • Presence of four pockets of sandy, pervious soils within the city. • Implementation of complementary (yet separate) water conservation/ stormwater initiatives. • Excellent understanding of problem setting among program staff. • In-depth understanding of problem setting among program participants. • Program participants are advocates of environmental initiatives. • Good understanding of potential barriers to participation among program staff. • Many tangible benefits to rain barrel use among gardeners/users of stored water. • Government belief that water quality/quantity improvement work could be accelerated with Federal grants. 	<ul style="list-style-type: none"> • Presence of small residential lots. • High level of imperviousness in residential areas. • Presence of predominately clay-based soils. • Occurrence of rainfall events throughout the year; high total rainfall. • Partially combined sewer system. • Excess rainwater flows cause CSOs and incidences of basement flooding. • Frequency and toxicity of effluents (including CSOs) are attracting Provincial and Federal government attention. • Structural or regulatory nature of current stormwater initiatives does not promote awareness of the problem setting among homeowners. • Homeowner concerns regarding potential water-damage to property may pose a major barrier to participation. • Incomplete understanding of target population (and their dis-interest in the programs) among staff. • Program participants have been limited to members of the environmental community and/or to those affiliated with the city's programs. • Lack of consensus among city staff and homeowners regarding the potential and/or advertised benefits of SMP use. • Lack of coordination/integration between the various related water-conservation/stormwater initiatives. • Reluctance on the part of the city to assume any flood-related liability. • Limited number of stormwater program incentives.

⁵³ Program 'strengths' and 'weaknesses' may also include those facets of the physical environment, which pose challenges to, or opportunities for program implementation.

Criteria	Evaluation Results	
	Strengths ⁵³	Weaknesses
<i>Philosophy/ Principles of Program Operation</i>	<ul style="list-style-type: none"> Goals of water conservation/ stormwater programs in-line with those of administering branches and overarching department. Staff consensus regarding programs' primary educational/ voluntary nature. Staff expectation that programs could be expanded – catalyzing further collaborative efforts between the ESD and PLD. Staff dedication to the phasing-out of combined sewer overflows. 	<ul style="list-style-type: none"> Liability concerns of the PLD may impede achievement of the ESD's environmental goals. Responsibility for program delivery (e.g. SMP implementation) assumed entirely by homeowner. Lack of visually appealing program brochures.
<i>Budgetary Amount</i>	<ul style="list-style-type: none"> Intended capacity of downspout disconnection initiative relatively ambitious for pilot attempt. 	<ul style="list-style-type: none"> Limited start-up funds for stormwater programs. Lack of staff dedicated to stormwater programs. High staff turnover rate/staff vacancies. High rate of participation required for any noticeable water quality/ quantity improvements to be achieved.
<i>Choice of Policy Instrument</i>	<ul style="list-style-type: none"> Potential suitability of chosen policy tools to the identified problem setting and target population. Potential complimentary of pilots to structural initiatives of ESD. Attempts to improve the city's public-relations abilities. Staff knowledge of alternative policy tools and their potential administrative impacts. 	<ul style="list-style-type: none"> Lack of staff knowledge regarding the impacts of alternative policy tools on the target population. Unwillingness on part of ESD and PLD to consider adoption of alternative policy tools and/or to change the current bureaucratic structure.
<i>Nature of Staff</i>	<ul style="list-style-type: none"> Realistic government understanding of participant characteristics. 	<ul style="list-style-type: none"> Lack of direct staff accountability in stormwater pilots. Lack of environmental program design experience among stormwater program staff.

6.2 PROCESS

6.2.1 Target Population

6.2.1.1 Approach to Identifying/Targeting Participants

All homeowners residing in one of four areas of the city having sandy soils, were targeted for participation in the *Downspout Disconnection Pilot Project*; however others with suitable soils were also eligible for participation. Soil/site suitability was also the factor determining whether homeowners/developers were eligible for a free perforated sump in the *Perforated Sump Pilot Project*.

In contrast, all City of Vancouver residents are eligible to participate in the *Rain Barrel Program* – provided that they are willing to subsidize the cost of each barrel. Nevertheless, a fair amount of targeting does occur in this program, with the target population being gardeners at flower shows and other ‘green’ events around the city.

I feel that to push these things through gardening events and so-on is a little bit of preaching to the converted, but residents who I would like to get don't go to those events. They're not really that interested or concerned... (VG-4).

Thus, while there is a high uptake of rain barrels at gardening events, this uptake is not occurring among those who have yet to be ‘converted’ (e.g. convinced of the need to store or reuse rainwater).

6.2.1.2 Target Population Characteristics

To further expand upon the target population characteristics identified in the Inputs section and to determine what factors motivate program participation; homeowner interviewees were asked to comment on what their expectations for the program were prior to SMP delivery. As expected, the majority of respondents indicated that their knowledge of the city’s sewer system (and hence their concern for the environment) motivated their participation in the program. However, these and other respondents further indicated that their interest in the program was motivated by some anticipated direct benefits resulting from their participation. The direct benefits anticipated included saving money on the purchase of a sump, and storing rainwater (the two most commonly cited benefits), as well as increasing flexibility in watering, and making use of ‘appropriate technologies’.

I envisioned something that would basically allow us to have a supply of rainwater when we wanted it (VP-1).

It is clear that perceptions of the programs’ various benefits play a role motivating homeowner participation, in addition to other factors, such as knowledge of the problem setting.

6.2.2 Program Delivery

6.2.2.1 Use of Programmatic Activities

To better understand how the city's various stormwater/water conservation initiatives are attempting to reach their target audience, and to increase homeowner awareness for the problem setting, a review of the available literature and government interview responses were used to generate Table 22, below.

Table 22: Repetitive Activities Used to Advertise Programs

Program	Description of Activity
<i>Downspout Disconnection Pilot Project</i>	2 series of door-to-door pamphlet distributions to approximately 600 homes in target area.
	Brochures at Sewers Design Branch front counter.
	Web page(s) on city web site.
	WebTV (show #11) – 9 web airings over a period of 3 weeks, and repeat television airings over a period of 6 months.
	Demonstration at <i>Compost Demonstration Garden</i> .
<i>Perforated Sump Pilot Project</i>	Brochures at Sewers Design Branch front counter.
	Web page(s) on city web site.
	WebTV (show #11) – 9 web airings over a period of 3 weeks, and repeat television airings over a period of 6 months.
	Personal recommendations to developers from city staff.
	Demonstration at <i>Compost Demonstration Garden</i> .
<i>Rain Barrel Program</i>	Web page(s) on city web site.
	WebTV (show #10) – 9 web airings over a period of 3 weeks, and repeat television airings over a period of 6 months.
	Water conservation display at city hall during <i>Environment Week</i> .
	2 television spots on <i>The Canadian Gardener</i> .
	Newspaper articles.
	K-5 theater productions (100 schools or 120,000 children per year, and additional venues).
	Program information accompanying tax newsletters (6 times per year).
	Program information/demonstration at the <i>VanDusen Flower and Plant Show</i> .
	Program information/demonstration at the <i>Native Plant Society</i> plant sale at the University of British Columbia.
Demonstration of low-irrigation garden (including rain barrel) at <i>Compost Demonstration Garden</i> .	

(Sources: City of Vancouver, 2001; Slocombe, 2001; City of Vancouver, 2000b; City of Vancouver, 1999h; Smyth, 1999; City of Vancouver, 1999c; City of Vancouver, 1999e; City of Vancouver, 1998a; City of Vancouver, 1995b).

One individual described the programmatic appeals for the *Disconnected Downspout* and *Perforated Sump Pilot Projects* in the following manner:

We put it on our web site. Had the brochures out at our front counter so that people from the counter would see them and that sort of thing (VG-1).

Thus, while the *Downspout Disconnection* and *Perforated Sump Pilot* were advertised less repetitively and through a smaller range of media than the *Rain Barrel Program*, the potential exists for all programs to be more aggressively promoted.

In fact, the limited advertising of the stormwater pilots in particular, led one participant to comment:

There was really no advertising or anything, other than somebody suggesting it to me (VP-4).

Indeed, when the remaining homeowner participants were asked to describe how they had first heard about the program, the majority cited their (or their spouse's) affiliation with city and/or the city's *Compost Demonstration Garden*. Only one non-government-affiliated participant became interested in a stormwater program after hearing about it from an employee at the Sewers Design Branch front counter. As a likely result of their affiliation, the vast majority of homeowners indicated that they only had to hear about the programs once, before they became convinced of the need to inquire further.

6.2.2.2 Quality of Program Service

In order to better understand the quality of the programs' service, and hence the type of programs that were likely received by homeowners, government respondents were asked to comment on any complaints and commendations that they may have received.

While the administrator of the *Rain Barrel Program* indicated that he had generally received positive comments about the program (Smyth, 1999), the administrators of the stormwater pilots had no knowledge of homeowner perceptions of these initiatives, including whether there had been any complaints or commendations.

To further gauge the quality of the program service received (and the professionalism of program staff), homeowner participants were asked to describe their impressions of any staff whom they had come into contact with. The majority of respondents indicated that there had been 'no problem' with any of the city staff, including any information or advice that they had been given.

Nevertheless, a few participants did reveal difficulties that they (or their contractors) had locating the city works yard (for SMP pick-up) and/or handling the SMP for subsequent transport and installation.

...when I did pick the rain barrel up, I was sort of pointed down to the far end of the lot, and had to hoist this 'mother' onto the back of my truck. So you have to be in fairly good physical shape, and with a car that's a certain size that fits the thing humped around.... Because they had been left standing up, instead of on their side [they were full of rain] ...So I [had] to empty the thing, and then I was on my own.... So they're not really big on the service part of this, in terms of actually getting this into your car or into your truck or whatever... (VP-2).

Thus, while the professionalism of program staff may have been adequate, the service aspect of these programs may have been considerably less so.

6.2.2.3 Timeliness of Service

In order to determine the rate at which various program components were delivered, government interviewees were asked to comment on how quickly they were able to arrange site inspections (where applicable) or any additional service that may have been required. According to the administrator(s) of each program, any problems and/or requests for information were handled promptly.

Oh, almost immediately. [An engineer]... is always available to deal with it, or we have inspections teams on-call for these kinds of things all the time (VG-1).

While timely service may have been true of the pilot programs, it is not clear whether this timeliness could have been maintained had these pilots experienced much higher rates of participation, when demands for program resources would have also been higher. In fact, the large number of staff vacancies that existed during the time of pilot implementation suggests that slow program service could have been expected.

6.2.2.4 Integrity of Service to Planned Design

While the purpose of this sub-section is to explore whether there have been any 'deviations' from the planned design of program delivery, the low participation rates that were encountered by the two stormwater programs, make it difficult to identify whether any deviations occurred. Nevertheless, the response of three individuals⁵⁴ indicated that no property re-inspections had occurred following the implementation of SMPs – even though this activity had been identified as one aspect of program delivery (refer to Table 19, item #7).

The intent that they were supposed to come out and pop the lid and have a look to see if this thing was working, and I don't think that's ever happened... (VP-4).

Since low participation rates in the two pilots did not likely place unreasonable demands on the programs' inspection crews, a lack of SMP 'follow-up' indicates a deviation of the programs from their planned design of delivery.

⁵⁴ Two individuals were participants of the *Perforated Sump Pilot Project*, and one individual was a participant of the *Downspout Disconnection Pilot Project*.

6.2.2.5 Responsiveness to Individual Needs

In order to determine how well the program is able to adapt itself to the needs of an individual household, and hence ensure customer satisfaction, government interviewees were asked to comment on the program's ability to respond to site-specific needs. Government responses reiterated the importance of site inspections and the use of staff expertise to ensure that SMPs were implemented only onto those properties having suitable soil conditions.

...they do look into the specifics of the particular site and that's why our inspection team goes out to see whether its actually going to work on a person's property or not... (VG-1).

While site suitability was undoubtedly considered, there is no indication that SMPs were modified or adapted to accommodate the specific needs of a household or property – once that property had been identified as suitable. Nevertheless, the process of SMP adaptation would have necessarily required greater city involvement during the SMP installation/implementation phase.

When homeowner respondents were asked to comment on their impression of the program's responsiveness, half reiterated the benefits that they were receiving from the program, while the remainder simply indicated that the program had no effect on their household, hence circumventing the need for it to be 'responsive' in any way.

Well its one of those academic things – it makes no difference to me. It makes no difference to my plumbing, it makes a difference to the city's plumbing in so much as we're told (VP-4).

6.2.3 Use of Funds

6.2.3.1 Allocation of Funds to Various Program Components

In order to determine what proportion of program funds was allocated to service delivery and SMP implementation, and therefore contributed directly to program outcomes, program staff were asked to comment on the programs' use of funds. Administrators of the stormwater pilots indicated that 100% of funds were available for the *Downspout Disconnection Pilot Project*. However due to limited interest in this initiative, the remainder of these funds went toward the manufacture of perforated sumps in the ESD's second stormwater pilot. Full budgetary allocation to the manufacture/implementation of SMPs was possible because program staff were involved in a number of projects (as is the case with the administrator of the *Rain Barrel Program*), and hence their positions were already being funded. City workers that were eligible for worker's compensation benefits (due to work-related injuries) were also available to assist with the stormwater pilots, where required.

...we used guys from the works yard... who had injuries and things... rather than have them on WCB. It's a low impact kind of thing they can do (VG-1).

Thus, the majority of funding for the stormwater pilots was available for their promotion and subsequent implementation.

Table 23: Process Component of Vancouver Program Evaluation - Summary of Results

Criteria	Evaluation Results	
	Strengths	Weaknesses
<i>Target Population</i>	<ul style="list-style-type: none"> • Disconnection work/perforated sump installation contingent upon site suitability. • Targeting of the <i>Downspout Disconnection Pilot</i> occurred in an area of city that was favourable to the PLB. • Effective targeting of the <i>Rain Barrel Program</i> to the gardening community. • Knowledge of the problem setting among homeowners may contribute to their participation. • Program participants expected to enjoy certain direct benefits. 	<ul style="list-style-type: none"> • All City of Vancouver homeowners were not eligible for participation in the pilots. • No focusing of program efforts in those areas of the city serviced by combined sewers. • Failure of <i>Rain Barrel Program</i> to reach the un-‘converted’. • Possible lack of widespread knowledge of the problem setting. • Expectation of direct benefits may determine ultimate participation in the program(s). • Possible lack of program benefits for the non-gardening community.
<i>Program Delivery</i>	<ul style="list-style-type: none"> • <i>Rain Barrel Program</i> advertising is repetitive and occurs through a variety of media. • No negative homeowner perceptions of city staff and/or the SMP advice given. • Potential for timely program service where applicable. • Considerations of site suitability prior to the city’s provision of/assistance with an SMP. 	<ul style="list-style-type: none"> • Stormwater pilot advertising occurred over a short time through a limited variety of media. • Few direct and/or aggressive appeals (e.g. door-to-door) for all programs. • Participants of stormwater pilots have generally been affiliated with the city and/or its programs. • Limited staff knowledge of participant perception of/experience with the three programs. • Some homeowner difficulties in locating city works yard and handling SMP for transport and/or installation. • Lack of property re-inspection/ follow-up, as outlined in stormwater pilot brochures. • Lack of site-specific SMP modification/adaptation.
<i>Use of Funds</i>	<ul style="list-style-type: none"> • Majority of program funds goes/has gone to SMP purchase and implementation. 	

6.3 OUTPUTS

6.3.1 Monitoring

6.3.1.1 Presence of Monitoring Procedures to Track Problem

In order to determine the nature of program Outputs, it is necessary to understand what efforts have been made to monitor the problem, and/or to track the mitigating effects of the city's stormwater/water conservation initiatives.

According to staff of the Sewers Design Branch, the Greater Vancouver Regional District conducts extensive monitoring of the trunk sewer systems (in which the City of Vancouver's sewers ultimately feed), as part of the regulations established by senior governments. As well, the regional government conducts computer modeling of the Greater Vancouver Sewerage and Drainage area to estimate annual overflow volumes and frequencies from each CSO (VG-1). Regular monitoring throughout the region also ensures that bacterial levels at major public beaches do not pose a threat to human health (City of Vancouver, 2000c). City of Vancouver officials keep apprised of the CSO situation at regular meetings, and work hand-in-hand with GVRD officials to meet Liquid Waste Management Plan objectives (VG-1).

The City of Vancouver's Environmental Protection Branch is responsible for enforcing the *Sewer and Watercourse Bylaw*, including inspecting and monitoring the treatment and discharge of industrial wastes, and eliminating the flow of volatile or other hazardous substances entering into public or private sewers (City of Vancouver, 1998a).

Not surprisingly, while there has been extensive monitoring of the problem setting, there is no evidence of the city having conducted formal assessments of the participating public, and its reasons for choosing to become involved in a voluntary (stormwater/water conservation) program. In fact, even though there was some monitoring of the *Rain Barrel Program*, this early effort was intended to assess how the rain barrels were performing (VG-4), and not how participants were responding to the program or changing their water use behaviour. In the case of the stormwater pilots, limited participation likely prevented the ESD from making any formal investments in program monitoring. Nevertheless, a lack of participant follow-up (as outlined in the *Downspout Disconnection* and *Perforated Sump Pilot Project* pamphlets) likely limited administrators' abilities to learn about the effects of the program, and whether homeowners responded positively to the use of the SMPs provided. Without this knowledge, administrators remain perplexed as to why the stormwater pilots received the low participation rates that were observed.

6.3.1.2 Contribution of Policy Tool/Program Design to Goal Achievement

To better understand the nature of program Outputs, it is useful to determine whether the program's design (e.g. its use of specific policy tool(s)) has impacted its ability of the program to reach its target population and to achieve a certain number of disconnections.

When asked to comment on this topic, some government respondents indicated that a voluntary program is suited for teaching the target population about the problem setting, particularly when there is little knowledge of stormwater and its potential impacts on the aquatic environment.

I could tell by the few people I talked to, and from what [others] told me too... they had environmental concerns but they didn't know anything about Vancouver's sewer system and some were actually misinformed into believing that raw sewage is going out all the time, which it isn't. ...By educating them that we were making changes for the better... so I think it was really worthwhile (VG-1).

When homeowners were asked to comment on what aspect of the program's design helped to encourage their participation, several respondents indicated that the free perforated sump and ample government assistance they were given (as a result of their affiliation with the city), facilitated their participation. Thus, in addition to knowledge of the problem setting and perceived direct benefits, ease of participation may play a role in determining whether a homeowner ultimately chooses to become involved. For those homeowners not affiliated with the city and/or knowledgeable about the programs' impacts, the incentive to participate may be understandably lacking.

6.3.2 Outcomes

6.3.2.1 Size of Population Being Served

When government staff-members were asked to comment on whether the size of the population served by the program (or the number of participants) exceeded the program's goals or expectations, all respondents agreed that while the *Rain Barrel Program* is achieving a satisfactory level of participation, the stormwater pilots did not.

We're actually just at a loss as to why the [response] rate wasn't a little higher... now that we have a little more staff time available, we're going to try to investigate, what if anything, can be done to try and boost the rate (VG-1).

In fact, as of April 2001, the *Rain Barrel Program* has provided approximately 1,400 rain barrels, whereas the *Perforated Sump Pilot Project* has provided three perforated sumps, and the *Downspout Disconnection Pilot Project* has subsidized the disconnection of only six homes – thereby failing to meet administrators' expectations for the programs. As well, assuming that the six disconnected homes resulted from the distribution of 500 to 600 program brochures, then the response rate to the *Downspout Disconnection Pilot Project* was only 1.0 to 1.2% of the target area.

6.3.2.2 Achievement of Implicit/Explicit Goals

Out of the three voluntary programs considered in this evaluation, only the *Rain Barrel Program* appears to be meeting the modest goals of its branch – in terms of distributing the maximum number of rain barrels for which funding is provided. The program may therefore be helping to mitigate the problem setting by conserving potable water, and

potentially, by diverting a small portion of roof runoff from the city's sewer system. However, due to the intensity of rainfalls in Vancouver, and the seasonal pattern of rain barrel use (VG-2), it is difficult to quantify the actual contribution of the *Rain Barrel Program* to the achievement of the branch's sustainability goals. As well, an acknowledgement by the program's administrator that the city's rain barrels could be advertised more aggressively (and thus reach a wider audience), suggests that some of the administrator's expectations for the program are also not being fully realized.

My target is just to get as many rain barrels installed as possible, and I think that we've been pretty lacking in our promotion of the rain barrel... we created it in response to people's queries about it, so we basically made it available but we haven't really made an effort to advertise it (VG-4).

In regards to the stormwater pilots, low participation rates caused these programs to fail to meet the objectives of their department and administering branch (in terms of increasing homeowner awareness for the problem setting and accelerating the benefits of combined sewer separation), as well as the goals and expectations of administrators.

The response rate was much lower than we thought... we didn't mislead ourselves into thinking we would have this huge response, at the same time, we thought we'd have better than we did (VG-1).

Perhaps most unfortunate, however, is that the perceived failure of the stormwater pilots has strained the working relationship between the Engineering Services and Permits and Licenses Departments, thus potentially compromising the departments' willingness to collaborate on future initiatives.

I think its made our working relationship with the Plumbing Branch a bit more difficult... they're under the impression that this program failed and I can't see them ever wanting to resurrect it again (VG-3).

In sum, the city's voluntary water conservation/stormwater programs have achieved few of their goals, and furthermore, have created an organizational setting in which coordinated water conservation/stormwater management initiatives may be difficult to establish in the future.

6.3.2.3 Nature of Program Outcomes

In order to characterize the nature of any outcomes resulting from the city's water conservation/stormwater management initiatives, program literature and interviewee responses were reviewed to determine the range of positive versus negative program outcomes, and these are listed below in Table 24.

Table 24: Positive versus Negative Program Outcomes

Program Outcomes	
Positive	Negative
<ul style="list-style-type: none"> • Increased homeowner education/awareness for the problem setting. • Changed water use behaviour. • Good feelings of homeowner for contributing to the 'solution'/alleviation of environmental guilt. • Flexibility in water/compliance with lawn sprinkling regulations. • Free sump (for developers). • Potentially prevent flooding. • Stored supply of soft non-chlorinated water for garden irrigation. • <i>Rain Barrel Program</i> has resulted in homeowner interest outside of the city. • <i>Perforated Sump Pilot Project</i> has resulted in widespread use of perforated catch basins in the city. 	<ul style="list-style-type: none"> • Strained working relationship between the ESD and PLD, as a result of attempted stormwater pilots. • Homeowner cost of hiring contractor for SMP pick-up and installation and/or need for labourer.

(Source: Smyth, 1999).

As mentioned previously, many program benefits can/could be attributed directly to the *Rain Barrel Program* as opposed to the city's two stormwater pilots. Nevertheless, the limited allocation of resources to these two programs may have undermined their ability to present an attractive program 'package' – including incentives, which may have boosted homeowner participation.

To further explore the more positive aspects of the program, government administrators were asked to comment on how strongly some of the program's beneficial outcomes could be attributed to the programs themselves, rather than to some other initiative (e.g. lawn sprinkling restrictions). The majority of government respondents indicated that there were no tangible program outcomes that directly influence/d the problem setting, and/or that this question could not be answered in the case of the stormwater pilots, since these received negligible rates of participation. Nevertheless, it is believed that the stormwater initiatives could have potentially made an impact on the problem setting, regardless of the difficulty involved in quantifying this impact.

...we weren't quite sure what the quantities [of CSO reduction] would be, but we felt we could do some low cost measures – every little bit would help (VG-1).

6.3.2.4 Effects on the Target Population

As mentioned in the previous section, one of the potential benefits of the city’s water conservation/stormwater initiatives is that they may help to increase homeowners’ awareness for the problem setting.

...if you make the effort to buy a rain barrel, you’re going to be conscious of how much water is in that rain barrel, and your going to be conscious about how much water your using when you do water your plants... I think your awareness of water use changes, and I think that your general behaviour will change as a result of that (VG-4).

While increased awareness may have resulted from the *Perforated Sump Pilot Project*, where participation was likely contingent on the provision of a free sump rather than on a previous understanding of the problem setting, this may not be true in the case of the *Rain Barrel Program*. In fact, it appears that the majority of rain barrel owners interviewed had some prior knowledge of the problem setting, which was not further enhanced by their participation in the program. Thus, as noted by one government respondent, there may have been little direct effect of the various programs on City of Vancouver residents, as participants may have already been knowledgeable about the problem setting prior to their involvement in the programs.

6.3.2.5 Benefits/Barriers Related to New Activity

To determine whether there are opportunities to make the program more appealing for homeowners (and hence to improve program outcomes), government interviewees were asked to comment on how program benefits might be enhanced or barriers to participation removed (Table 25).

Table 25: Ways of Increasing Program Appeal

Enhancing Benefits ⁵⁵	Overcoming Barriers
<ul style="list-style-type: none"> • Dedicate more staff time. • Provide tax rebate for participants. • Provide direct incentive to builders (for perforated sump installation). • Use trained crews to conduct SMP work (e.g. downspout disconnection). 	<ul style="list-style-type: none"> • Continue making appeals to the public re the importance of ‘natural practices’. • Reduce direct costs to homeowner and/or further subsidize programs. • Make use of SMPs (e.g. perforated sumps) mandatory. • Find ways to minimize city’s liability in the event of a flood. • Deliver SMPs to properties and/or assist with installation. • Boost educational/public-relations efforts by city.
<ul style="list-style-type: none"> • Expand programs regionally. 	

⁵⁵ “Benefits” in this context, refer to positive program outcomes that may have impact on the target population and/or problem setting.

Interestingly, the majority of suggestions for enhancing program benefits or overcoming barriers indicates the need for greater governmental involvement during the program delivery phase, and additional resources in the form of incentives and dedicated staffing.

I think it would have helped if we had trained a city crew or trained volunteer crew that actually visited each home and showed them how simple it was (VG-3).

When homeowner interviewees were asked about ways in which the programs' appeal could be increased, they too gave a number of suggestions, including increasing program exposure, seeking corporate involvement or sponsorship, and potentially, making the use of certain SMPs mandatory.

[A voluntary program] has to be more widely advertised or a decision really needs to be made as to whether this [SMP] is going to be beneficial, and then continue with the process of incorporating its requirements within bylaws and/or standards (VP-4).

Clearly, a decision needs to be made regarding whether SMPs will benefit the problem setting sufficiently to merit more aggressive promotion and/or possible inclusion into the city's by-laws or building codes.

6.3.3 Cost-Effectiveness

6.3.3.1 Cost per Unit of Program Delivery

As mentioned previously, the money allocated for the *Rain Barrel Program* has been \$18,000 per year, or \$60 per City of Vancouver participant. Similarly, the budget used to establish the *Downspout Disconnection Pilot Project* was \$10,000 or \$50 (maximum) per participant, for the purchase of any materials required. The unused portion of this pilot's funds was then later used to establish the *Perforated Sump Pilot Project*, in which each participant (up to a maximum of ten) was given a free perforated sump having a value of approximately \$600.

Thus, while the cost per unit of program delivery is/was low in both the *Rain Barrel* and *Downspout Disconnection* programs, the low to modest participation rates encountered by all three programs has likely caused them to be cost-ineffective. Nevertheless, future water conservation/stormwater management programs (if widely adopted) may be helpful in diverting stormwater from the sewer system, and reducing overall expenditures on problem mitigation.

Table 26: Output Component of Vancouver Program Evaluation - Summary of Results

Criteria	Evaluation Results	
	Strengths	Weaknesses
<i>Monitoring</i>	<ul style="list-style-type: none"> • Extensive monitoring and computer modeling of problem setting by GVRD. • City of Vancouver partnerships with other municipalities and GVRD to mitigate problem setting. • City of Vancouver enforcement of <i>Sewer and Watercourse Bylaw</i>. • Some monitoring of rain barrel performance. • Potential suitability of programs' educational policy tool, to the problem setting identified. • Free SMPs and government assistance enjoyed by some participants. 	<ul style="list-style-type: none"> • No evidence of the city having conducted formal assessments of the participating public, and of the reasons behind its willingness to adopt a voluntary (stormwater/water conservation) program • Lack of participant/SMP follow-up during <i>Downspout Disconnection</i> and <i>Perforated Sump Pilot Projects</i>. • Difficulty attributing any (potential) improvements in the problem setting to the city's voluntary initiatives.
<i>Outcomes</i>	<ul style="list-style-type: none"> • Satisfactory achievement of <i>Rain Barrel Program</i> goals, based on level of participation. • Potential ability of stormwater pilots to impact the problem setting (if adopted on a sufficiently widespread basis). • Possible increase in awareness among some <i>Perforated Sump Pilot Project</i> participants. • Many opportunities for enhancing benefits/removing barriers associated with all three of the city's programs. 	<ul style="list-style-type: none"> • Low uptake of <i>Downspout Disconnection Pilot Project</i> in target area. • Poor achievement of stormwater pilot goals, based on level of participation. • Perceived failure of stormwater pilots has strained the working relationship between the ESD and PLD. • Limited advertisement/promotion of the <i>Rain Barrel Program</i>. • Difficulty attributing any improvements in the problem setting to the <i>Rain Barrel Program</i>. • Few benefits to homeowners resulting from participation in the stormwater pilots. • Little increase in awareness among those participants having prior knowledge of the problem setting.
<i>Cost-Effectiveness</i>	<ul style="list-style-type: none"> • Total cost of voluntary programs low. • Cost per participant (or per unit SMP) is low in <i>Rain Barrel Program</i> and <i>Downspout Disconnection Pilot Project</i>. 	<ul style="list-style-type: none"> • Cost per participant (per unit SMP) high in <i>Perforated Sump Pilot Project</i>. • <i>Cost-effectiveness</i> of all three programs likely low, due to low participation rates and unknown/negligible impacts on problem setting.

Chapter 7: Recommendations for Future Programs in Vancouver

7.1 General Recommendations for Voluntary (Storm) Water Management Initiatives

In order to inform the future planning and implementation of water management programs in Vancouver and in other urban residential areas, it is necessary to consider the program strengths and weaknesses that were revealed in each of the program evaluations conducted. A series of direct comparisons are not made between the programs in Vancouver and Toronto, as differences in the level of each program's development would prevent any fair and accurate conclusions from being drawn. Instead, summaries of the positive and negative aspects of the four programs are made, emphasizing those aspects that will likely be most relevant to the setting of Vancouver.

Table 27 highlights some program weaknesses that may need to be overcome in future initiatives, and Table 28 (below) highlights some program strengths that may need to be further developed in order to ensure overall program success. In this chapter, program "success" is defined as a state of program operation that is exemplified by Toronto's *Downspout Disconnection Program*, and to some extent, by Vancouver's *Rain Barrel Program*.

Table 27: Overview of Program Weaknesses to be Overcome in Vancouver

Component	Criteria	Weaknesses
Inputs	<i>Community Setting/ Characteristics</i>	<ul style="list-style-type: none"> • Incomplete understanding of the problem setting among homeowners. • Homeowner concerns regarding potential water-damage to properties. • Incomplete government understanding of target population (and their disinterest in the programs). • Lack of consensus among city staff and homeowners regarding the potential and/or advertised benefits of SMP use. • Lack of coordination/integration between the city's various water-conservation/stormwater initiatives. • Reluctance on the part of the city to assume any flood-related liability.
	<i>Principles of Program Operation</i>	<ul style="list-style-type: none"> • Reliance upon homeowner to deliver program (e.g. to implement SMP). • Lack of appealing program materials.
	<i>Budgetary Amount</i>	<ul style="list-style-type: none"> • Limited start-up funds for stormwater programs. • Lack of full-time staff dedication.
	<i>Choice of Policy Instrument</i>	<ul style="list-style-type: none"> • Lack of staff knowledge regarding the impacts of alternative policy tools on the target population. • Unwillingness to consider the adoption of alternative policy tools and/or a change in the current bureaucratic structure.
	<i>Nature of Staff</i>	<ul style="list-style-type: none"> • Lack of environmental program design experience among stormwater program staff.

Component	Criteria	Weaknesses
Processes	<i>Target Population</i>	<ul style="list-style-type: none"> • No focusing of program efforts in those areas of the city serviced by combined sewers. • Inability of programs to reach the environmentally 'unconverted'. • Lack of widespread knowledge about the problem setting.
	<i>Program Delivery</i>	<ul style="list-style-type: none"> • Few direct and/or aggressive appeals (e.g. door-to-door) for all programs. • Limited staff knowledge of participant perception of/experience with the three programs. • Homeowner difficulties locating city works yard and/or handling SMP for transport and/or installation. • Lack of site-specific SMP modification/adaptation. • Potential for decreased aesthetic of properties having SMPs.
	<i>Use of Funds</i>	-
Outputs	<i>Monitoring</i>	<ul style="list-style-type: none"> • Lack of formal assessment of the participating public and its reasons for participating. • Lack of participant/SMP follow-up following program implementation. • Difficulty attributing any (potential) improvements in the problem setting to the city's voluntary programs.
	<i>Outcomes</i>	<ul style="list-style-type: none"> • Lack of increased awareness and/or changes in pro-environmental behaviour among participating public. • Strained working relationship between city departments. • Limited advertisement/promotion of the city's initiatives. • Limited number of benefits/incentives associated with water conservation/stormwater management.
	<i>Cost-Effectiveness</i>	<ul style="list-style-type: none"> • Difficulty gauging cost-effectiveness of programs relative to other viable alternatives. • Low participation rates and unknown/negligible impacts on problem setting may result in low program cost-effectiveness.

It is apparent from Table 27 that government staff in Vancouver may need to better characterize the community setting, and in particular, the target population's willingness to adopt a voluntary city-sponsored initiative. Knowledge of factors that motivate interest in environmental programs would help to inform future program design efforts, and ensure that measures are in place to attract a significant number of participants. Dedicated staffing and/or additional program resources may also help to prevent a situation in which an initial lack of homeowner interest results in program atrophy.

Table 28: Overview of Program Strengths to be Further Developed in Vancouver

Component	Criteria	Strengths
Inputs	<i>Community Setting/ Characteristics</i>	<ul style="list-style-type: none"> • Identification of key runoff sources. • Promotion of multiple and complementary environmental programs. • Increased program profile through community meetings and neighbourhood word-of-mouth.
	<i>Principles of Program Operation</i>	<ul style="list-style-type: none"> • Use of complementary policy tools. • Appealing promotion of programs. • Responsibility for program delivery assumed entirely (or in part) by city.
	<i>Budgetary Amount</i>	<ul style="list-style-type: none"> • Consistent program funding.
	<i>Choice of Policy Instrument</i>	<ul style="list-style-type: none"> • Knowledge of alternative policy tools (and their impacts on the problem setting) among staff. • Willingness to adopt alternative policies if needed.
	<i>Nature of Staff</i>	<ul style="list-style-type: none"> • Government understanding of target population characteristics, including motivations for, and potential barriers to participation.
Processes	<i>Target Population</i>	<ul style="list-style-type: none"> • Ability of programs to be inclusive of most homeowners. • Considerations of site suitability. • Presence of program incentives to overcome barriers and meet homeowner needs.
	<i>Program Delivery</i>	<ul style="list-style-type: none"> • Repetitive and varied program advertising. • Assistance of communications staff to design and deliver informational materials. • City department coordination in delivering program information. • Ability of programs to respond to individual or site-specific needs. • Timely delivery of program services/SMPs. • Effective troubleshooting of problematic installations.
	<i>Use of Funds</i>	<ul style="list-style-type: none"> • Large proportion of program funds allocated to actual SMP work.
Outputs	<i>Monitoring</i>	<ul style="list-style-type: none"> • Ability of pilot study to provide information on the rainwater diversion potential of future programs. • Use of program database to store information on target population and to keep track of program uptake. • Partnerships with other organizations and levels of government to mitigate problem setting.
	<i>Outcomes</i>	<ul style="list-style-type: none"> • Ability to monitor program effects on the problem setting. • Ability to monitor increases in homeowner awareness for the problem setting and/or changes in the pro-environmental behaviours adopted.
	<i>Cost-Effectiveness</i>	<ul style="list-style-type: none"> • Use of efficiency measures to minimize program costs and maximize positive impacts on problem setting and target population.

The identification of key residential runoff sources (as well as the most effective methods for managing these sources) may be required if stormwater programs are to merit further investment by the City of Vancouver. As well, collaborative efforts between the city's various groups (including the Environmental Protection Branch) may be instrumental in helping the city achieve a number of integrated urban environmental goals, including

protecting urban areas from incidences of flooding, conserving water, and reducing the occurrence of CSOs.

7.2 Specific Recommendations for Voluntary (Storm) Water Management Initiatives

By drawing upon the ‘lessons learned’ by government staff in both the Cities of Toronto and Vancouver, a number of specific recommendations can be made regarding the design of future programs in Vancouver. These recommendations take into account many of the positive and negative aspects of program operation identified in the previous section.

7.2.1 Inputs

7.2.1.1 Dedication of Adequate Program Resources

While municipal governments often experience difficulties locating funds to operate ‘non-essential’ programs, opportunities exist for Vancouver to canvass the support of higher levels of government, in particular, the green infrastructure funds that are being set-aside for innovative environmental initiatives. Alternately, it may be possible to allocate those revenues generated from violations of the city’s *Sewer and Watercourse Bylaw*, or savings from GVRD sewage treatment costs⁵⁶, to the general operating budget of a stormwater program. In this way, revenues from one green initiative (in this case a by-law) could be recycled through use by a second green initiative (e.g. a voluntary water management program) to more effectively mitigate the problem setting.

According to a FBEST (1997) study, the majority of Lower Mainland residents (58%) feel that the government should do more to protect the environment, despite their opposition to increased taxation. In addition, a strong majority of respondents (>65%) were slightly to very concerned about the quality of the environment in their local area, with 75% believing that humans were strongly abusing the environment. Thus, while wary of taxation, City of Vancouver residents are likely to support the establishment of an environmental initiative, particularly one that they believe is able to impact the problem setting. And, as experienced in Toronto, government dedication to innovative program development and community outreach, has the potential to improve homeowners’ perceptions of the city and its environmental leadership abilities.

7.2.1.2 Implementation of Complementary Policies

Although most types of government initiatives to protect the environment encounter some difficulties during the implementation and monitoring stages, voluntary initiatives that combine economic or regulatory aspects, may increase the ability of voluntary

⁵⁶ A 4 gal/cap/day reduction in sewage flows to GVRD treatment plants would result in an annual savings of more than \$250,000 (City of Vancouver, 1995b).

programs to achieve their goals. In fact, new or existing regulatory initiatives⁵⁷ (e.g. water sprinkling initiatives) could be used to support the goals of a voluntary program (as observed in the *Rain Barrel Program*), while economic incentives (or disincentives) could be used to increase overall program uptake. Thus, through combined or complementary government approaches, specific water management goals can be achieved - albeit in a more innovative and cost-effective manner than through any one approach alone (Harrison, 2001). However, without considering the range of policy tools that are available, or the potential impacts of these on the target population and problem setting, it may be exceedingly difficult to achieve the high levels of program uptake that are required.

In Vancouver's case, the provision of a one-time tax grant to participants of a water conservation/stormwater management/flood prevention program may be critical for attracting a sufficient number of participants, even if these taxes are eventually recovered in some other manner. In the absence of an economic incentive, the program(s) offered must be capable of supplying a sufficient number of other (real or perceived) benefits to the target population, such that these benefits are able to overcome any perceived barriers.

7.2.1.3 Exploitation of Opportunities for Interdepartmental Collaboration

Due to the diverse nature of Vancouver homes, including varying soil permeability and flooding potential, there may exist an opportunity to integrate a number of initiatives which relate to the management of stormwater, and as well to customize program delivery to meet the needs of individual homes. This integration of water management 'tools' would not only increase program appeal (or at least program inclusiveness), but also help to align the goals of the Engineering Services and Permits and Licenses Departments. For example, if stormwater diversion and flood prevention became the two primary goals of a future program, then efforts could be made to coordinate the provision of backflow preventor valves, with the disconnection of downspouts and/or the attachment of rain barrels for subsequent rain water infiltration. This 'coordination' would entail identifying the device or property modification that would most benefit a particular homeowner, and then making the provision of this modification contingent upon the homeowner's acceptance of a second device or property modification that would most benefit the problem setting. Assuming that this second modification or requirement would not lessen the beneficial effects of the first, then the provision of a "carrot" (albeit with "strings attached"), could be expected to significantly increase program uptake. However, should downspout disconnection work be observed to increase the dampness of a particular property, then the city's assurance that all remedial work will be performed free of charge, may go a long way towards alleviating the fears of homeowners. In Toronto, where downspout disconnection is a prerequisite for flood protection assistance by the city, homeowners have become wait-listed for participation

⁵⁷ Even though City of Vancouver staff are cautious about implementing a blanket by-law that would affect all properties equally, it may be possible to include a provision that would exempt those properties not suited for SMP work. This would not only benefit the problem setting, but also protect the city and homeowners from potential negative impacts of the by-law.

in the *Downspout Disconnection Program*, and interest in the program continues to increase without any further program appeals.

By creating an interdepartmental program design team that consists of one individual each from the Engineering Services Department, the Plumbing and Gas Inspection Branch, and potentially the Environmental Protection Branch, it may be possible to begin the process in which mutual goal achievement and coordinated program delivery may be realized. Consultations with social marketers, graphic design experts and others with marketing experience, may also be useful to ensure that a highly appealing program ‘package’ is put forth. However, the ultimate success of the program would undoubtedly hinge upon consistent program funding (as mentioned previously) and upon the provision of one or more dedicated staff-members that would implement the program and ultimately remain accountable to it.

7.2.2 Process

7.2.2.1 Innovative Program Promotion

Although reports of degraded water quality have become common and problematic occurrences throughout the Greater Vancouver area; the need to manage urban stormwater runoff has yet to become a subject of public concern. To some extent, indifference to, or a general lack of emotionality about environmental issues (Szagun and Pavlov, 1995) may play a role in determining lack of action. The public’s perception of hazard controllability may also determine the level of complacency about ‘the problem’, even if its impacts are serious and options exist for its control (FBEST, 1997). In the case of stormwater management, education can serve to inform property-owners about practices for protecting local water quality, and may serve to increase feelings of personal efficacy in the fight against aquatic pollution. For this reason, any future programs that are developed by the City of Vancouver must be accompanied by an educational campaign to increase knowledge of *i)* the problem setting, *ii)* options that are available to mitigate this setting and *iii)* the potential (personal) benefits that may be enjoyed through participation.

While program promotion can occur through a variety of means, program targeting should attempt to reach that segment of the population, which does not normally attend gardening shows or other city-sponsored events. For example, by targeting homeowners at shopping malls or gas stations, the program’s message may be able to reach those who have not been previously exposed to the city’s initiatives, and who therefore remain ‘unconverted’. This approach is particularly important for ensuring that a program receives widespread adoption by the target population. In fact, participant self-selection has been identified as one obstacle to the success of formalized voluntary programs (Harrison, 2001 and 1998), allowing those who have already made the desired change (potentially in response to other forces) to seek recognition through the program.

Additionally, repeat mailings and/or direct door-to-door appeals to those homeowners residing in problematic discharge areas of the city – such as the Clarke Drive area of

Vancouver, would allow the program to maximize its impact on the problem setting⁵⁸. In terms of Toronto's own advertising experience, one city staff-member indicated that the number of pamphlets mailed should be four times greater than the expected number of respondents, or seven times greater than the expected number of participants. These figures are based on the fact that the program's current mailings receive a 25% response rate (in terms of people inquiring about the program), and a 15% participation rate (in terms of people who proceed with the actual disconnection of their homes) (Bell, 2001). Other program staff further indicated the importance of conversing with the principal decision-maker of each household (where possible), and stressing the impact that each individual can have on the problem setting, for example, that they *can* "make a difference".

7.2.2.2 Facilitation of Homeowner Participation

As mentioned in previous sections, there is much that the city (or administering departments) can do to aid the homeowner in choosing to participate in a voluntary program. Aside from providing carrots (or perceived benefits) to the homeowner, city-staff can act to remove many of the barriers that are associated with the pick-up, delivery, and ultimate installation of a structural BMP. There is also much that program staff can do to improve on-site support (leading up to full-scale program coordination and hiring of a contractor). For example, a soils engineer could be contracted to conduct percolation tests on questionable properties (e.g. those having high water tables) and together with city-staff, recommend whether the use of one or more BMPs is advisable. Additionally, city-crews⁵⁹ could assist with the installation of a BMP, and this would include making any modifications that would improve the performance of the BMP, or that would attempt to meet the homeowners' needs in terms of property aesthetics.

While these suggestions would substantially increase the costs associated with program delivery, they would undoubtedly ensure that the program's intended outcomes are achieved.

7.2.3 Outputs

7.2.3.1 Monitoring of Program Performance over Time and Adoption of Change

For all programs, including those which are only at the pilot stage, it is necessary to establish monitoring procedures to track homeowner responses to the program, and the nature of any outputs (including both positive and negative program outcomes). For example, a program database such as that being used in Toronto could provide valuable information to administrators seeking to make decisions about future program delivery. Without knowledge of the quantity of rainwater diverted within the pilot area, or the number of participants attracted (and their reasons for participating), there may be little

⁵⁸ Note that while homeowner inclusiveness is important (allowing a 'community' of program supporters to be created), it is also important for a program to target its efforts in those areas of the city where participation will have the greatest impact on the problem setting.

⁵⁹ While the use of trained student or volunteer crews is a possibility for Vancouver, in Toronto this practice was found to increase both city liability and program inefficiencies.

hope of securing the continued support of city council-members, and hence the funds needed for future program expansion.

Finally, it is within the interest of all GVRD member municipalities to share their experiences with the design and implementation of environmental programs, and to identify common opportunities for mutual gain. Aquatic pollution recognizes few boundaries, and for this reason individuals, departments, and municipalities must all cooperate to begin minimizing the impact of urban development on receiving water quality.

Chapter 8: Conclusion

The management of stormwater runoff need not occur in isolation of other urban environmental initiatives. By pulling together the resources and expertise of more than one department in the City of Vancouver, it may be possible to create a program package that meets both homeowner concerns for flood protection, and city concerns for sewer performance and water quality. In addition, by integrating the management of stormwater with the conservation of potable water and the protection of homes from basement flooding, it may be possible to widen the range of benefits received by the target population, and at the same time, increase the program's ability to impact the problem setting.

A program evaluation framework has been used to take into account the inputs, process and outputs that characterize the stormwater/water conservation programs in each of the Cities of Vancouver and Toronto. The incorporation of policy instrument evaluation and community-based social marketing theory into this framework has helped to further inform and elaborate upon each program component, and to reveal a wide range of program 'strengths' and 'weaknesses'.

Through the evaluations made, six areas of program 'improvement' have also been identified to help eliminate any barriers associated with the design of a future integrated program, and to facilitate the creation of an institutional setting in which effective program delivery can be accomplished. These six areas of program improvement are: *i)* dedication of adequate program resources, *ii)* implementation of complementary policies, *iii)* exploitation of opportunities for interdepartmental collaboration, *iv)* innovative program promotion, *v)* facilitation of homeowner participation, and finally, *vi)* monitoring of program performance over time and adoption of change. The outcomes that could be expected as a result of these improvements include: reduced pressures on Vancouver's combined sewer system and drinking water supplies, fewer occurrences of basement flooding and combined sewer overflows, and increased homeowner awareness for the urban hydrological cycle.

Through the design and implementation of an integrated water management program, the City of Vancouver would be able to demonstrate a commitment to innovative problem mitigation and environmental leadership, while helping to limit the impacts of urban (residential) runoff on the quality of its receiving waters.

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