Stormwater Pollution Prevention Handbook

Conservation
TORONTO AND REGION

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Ontario

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PREFACE

Pictures of Pollution

These photographs show examples of how pollution from different sources affects our lives. Our initial image of pollution is that of an industrial polluter releasing chemicals into the air and water. A closer look will reveal that our everyday habits also contribute to pollution such as chemicals and toxins from our vehicles, waste, the things we purchase, and pesticide use. We are slowing poisoning and choking the systems that sustain us.

Is there hope that this will change? The employees that strive to achieve an ISO 14001 standard for their workplace think so. So do the children that paint Yellow Fish signs on storm drains in their neighbourhoods. So do municipal councillors as they develop pollution prevention plans for their town or city. With the right information and support, many others will work towards reducing pollution in their community. It is cheaper and more effective to prevent pollution happening than it is to repair its damage and cumulative effects on our environment.

This handbook is not a policy document. It is intended to provide practical guidance to municipalities in implementing pollution prevention and flow reduction programs related to stormwater runoff and combined sewer overflows. Although this manual is semi-technical, there is something for everyone who is trying to reduce pollution at its source. Users will include community groups, businesses and many others.

The text explains the sources of urban pollution and its effects. It details many measures that can be taken to reduce pollution at source. Fact Sheets, Case Studies and useful references are provided to help learn from real life experience. This handbook will have done its job if it encourages municipal councils, business and community groups or individuals to evaluate their work and leisure practices and make some change for environmental improvement.

Summer storms may leave streets, driveways and parking lots appearing fresh and clean, but the debris and film of waste that washes from these surfaces makes its way into the storm sewers and eventually to the beaches. Beach closures can result from bacteria from the streets (pet litter) and from sanitary wastes when combined sewers overflow after heavy rains.

Local creeks and watercourses receive the drainage from urban streets and also any waste materials and toxins that are introduced to the storm sewers by accident or design. Phosphorus and other nutrients from lawn care products also impact on the streams, causing heavy algae growth, and using up oxygen that is vital to fish an other stream-creatures.

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1 BACKGROUND

With the support of the Ontario Ministry of the Environment (MOE) and the Government of Canada's Great Lakes Sustainability Fund (GLSF), a number of municipalities have carried out Pollution Prevention and Control Planning (PPCP) studies to deal with water quality problems resulting from combined sewer overflows and urban stormwater runoff. Although appropriate pollution control aspects were emphasized in all the studies, the prevention of pollution at source was not emphasized to the same degree in many of the PPCP studies. This may be due to insufficient experience in implementing pollution prevention programs. The situation is also aggravated by other influencing factors such as a perception of inconvenience by homeowners, insufficient experience with infiltration practices and lack of municipal control over private property. MOE's Procedure F-5-5, Determination of Treatment Requirements for Municipal and Provincial Combined and Partially Separated Sewer Systems, is a policy document for controlling combined sewer overflows (CSOs). One of the required minimum controls for municipalities with combined sewer systems is to establish and implement pollution prevention programs. The Ministry also has a Stormwater Management Planning and Design Manual that provides guidance on lot level controls and conveyance controls for stormwater runoff.

It was recognized that there was a need to document examples of municipal pollution prevention programs that have been successfully implemented with the aim of generating practical ideas and guidance through disseminating the experience gained from other municipalities to effectively manage stormwater runoff and reduce combined sewer overflows. Although pollution prevention can encompass a comprehensive range of municipal activities this handbook focuses on the storm, sanitary and combined sewer systems and their contributing flows and emphasizes the practical implementation aspects.

This report is a joint project between, MOE, GLSF and the Toronto and Region Conservation Authority (TRCA), with participation from the Cities of Mississauga; St. Catharines; Toronto; Waterloo; Quinte Conservation; and the Municipal Engineers Association.

1.1 Project Goals and Objectives

The goal of this handbook is to provide practical assistance to municipalities in implementing pollution prevention and flow reduction programs related to stormwater runoff and combined sewer overflow.

The conventional definition of pollution prevention includes measures that reduce the amount of pollution at the source. In stormwater management terms, this applies to activities that reduce the application of pollutants to urban surfaces. These activities include applications of fertilizers to lawns and salt and grit to roads, as well as introduction of oil and other chemicals into drains. Many of the negative effects of urban runoff are also attributed to increased volumes of runoff, resulting in flooding and channel erosion in streams. Combined sewer overflows occur because the flows in the combined sewers exceed the capacity. Reduction of the volume of runoff will also reduce pollution. In this handbook, consideration is given both to flow reduction measures and pollution source controls.

This Stormwater Pollution Prevention Handbook:

- Documents existing pollution prevention and flow reduction practices or technologies, and provides graphical illustrations. These measures are categorized according to their applications, opportunities, limitations and operation and maintenance considerations. Cost estimates for implementation of each practice should also be incorporated. Operation and maintenance costs should be included where appropriate.
- Documents pollution prevention and flow reduction projects or programs that have been implemented at the municipal level in Ontario and elsewhere. It compiles information such as program rationale and cost, factors affecting implementation, environmental benefits and stakeholders involved in the programs. The documentation also includes the steps involved in implementing the projects or programs. With the illustration of actual case studies, potential problems or barriers which have been encountered in the implementation of pollution prevention and flow reduction programs are discussed and recommendations are provided.
- Shows how pollution prevention and flow reduction projects and programs can be implemented as part of a municipal environmental management system and shows also how they can be documented as part of a Pollution Prevention and Control Plan to address CSO and stormwater runoff.
- Illustrates community-based social marketing and public education and outreach approaches to improve homeowners' knowledge and increase their participation in water pollution prevention programs.

The purposes of the Handbook are to:

- define pollution prevention and urban hydrology concepts,
- describe pollution prevention and flow reduction techniques,
- provide information on implementation approaches at the municipal level,
- serve as a technical resource in preparing pollution prevention and control plans and municipal environmental management systems plans,
- provide resources and advice on public consultation and outreach programs.

Who Are the Users?

This handbook targets municipal corporations, although many other agencies and organizations will find it useful. A municipality contains a variety of land uses such as industrial, commercial, institutional, residential, road and rail transport and utility corridors, parks and natural areas (streams and valley lands). All these land uses are potential targets for pollution prevention initiatives. This handbook focuses on residential and municipal practices, although industrial and commercial pollution prevention and control programs are also discussed. The primary users of this handbook are:

- municipal staff;
- residents and community groups;
- commercial and industrial businesses.

Municipal programs and policies directly and indirectly control commercial and industrial activities within the municipality and so can influence pollution prevention. Consequently, the handbook will identify opportunities for community or municipal actions to affect industrial and commercial activities, but will not attempt to give complete coverage of the applicable pollution prevention programs.

The handbook is organized into three parts:

Part I - Pollution Prevention Planning and Implementation

Chapter 1- An outline of the purpose of this handbook with a discussion on pollution prevention, the issues surrounding the concept, and how it fits into municipal servicing and pollution control initiatives (past and present).

Chapter 2- An overview of the pollution prevention measures available and introduction to the Fact Sheets on the measures provided in Part II of this handbook.

Chapter 3 - A discussion on how to set up and implement a pollution prevention program.

Chapter 4 –A summary of the use of public outreach for pollution prevention.

Chapter 5 - The use of social marketing in the implementation of pollution prevention programs.

Part II - Pollution Prevention Measures Fact Sheets

The fact sheets deal with source prevention, flow reduction, municipal operations and local drainage.

Part III - Case Studies

This section includes examples of watershed studies, municipally-based pollution prevention studies, and flow reduction programs. The case studies include a range of community sizes and resources, the approaches used to deal with pollution problems, and the effectiveness of the approaches:

- Centennial Creek Subwatershed;
- Emery Creek Environmental Association;
- City of Belleville Pollution Control Plan – Bay of Quinte Area of Concern;
- Town of Ancaster;
- City of St. Catharines;
- Regional Municipality of Waterloo;
- City of Hamilton;
- Toronto Watershed Infrastructure Ecology Program (WIEP).

2 INTRODUCTION

2.1 Urban Runoff Pollution – What is the Problem?

Urban land uses generate residual and waste material from a myriad of individual and group activities. Each type of land use has unique characteristics that result in the generation of pollutants and runoff volume. Density or intensity of the land use and percent imperviousness also play a part. These factors also influence the pollution prevention and flow reduction opportunities.

Pollution Sources

- **Vehicular traffic** accounts for much of the build-up of contaminants on road surfaces. Wear from tires, brake and clutch linings, engine oil and lubricant drippings, combustion products and corrosion, all account for build up of sediment particles, metals, and oils and grease. Wear on road surfaces also provides sediment and petroleum derivatives from asphalt.
- **Lawn and garden maintenance** in all types of land uses including residential, industrial, institutional parks, and road and utility right-of-way accounts for additions of organic material from grass clippings, garden litter and fallen leaves. Fertilizers, herbicides and pesticides all can contribute to pollutant loads in runoff.
- **Air pollution** fallout of suspended solids from traffic, industrial sources and wind erosion of soils builds up contaminants in soil.
- **Municipal maintenance** activities including road repair and general maintenance (road surface treatment, salting, dust control, etc.).
- **Industrial and commercial** activities can lead to contamination of runoff from loading and unloading areas, raw material and by-product storage, vehicle maintenance and spills.
- **Illegal connections** of sanitary services to storm sewers can cause contamination with organic wastes, nutrients and bacteria.
- **Illegal disposal** of household hazardous wastes can introduce waste oil and a multitude of toxic materials to storm and sanitary sewers.
- **Transportation spills** from accidents can occur on heavily travelled arterial streets and highways.
- **Construction activity** can introduce heavy loads of sediment from direct runoff, construction vehicles and wind-eroded sediment.
- **Pet faeces and litter** introduce organic contamination, nutrients and bacteria.
- **Combined sewer overflows (CSOs)** contain a mixture of sanitary, commercial and often industrial waste, along with surface drainage. CSOs can contain high levels of nutrients, suspended solids, metals, organic contaminants, oxygen demanding substances, bacteria and viruses.
- **Runoff** from residential driveways and parking areas can contain driveway sealants, oil, salt, and car care products.

Pollutant Impacts

The receiving water quality impacts from municipal discharges vary depending upon the quality and quantity of the wastewater and the assimilative capacity of the receiving waterbody. Potential water quality concerns resulting from CSOs and stormwater include:

- bacteria from faecal material in pet and wildlife litter and sanitary wastes in CSOs causing beach closures;
- nutrient enrichment, from nitrogen and phosphorous compounds, which can lead to nuisance growths of algae in the receiving waterbody;
- deposits of contaminated sediments, which can lead to degradation of benthic (bottom-dwelling) organisms and restrictions on dredging;
- toxicity from ammonia, metals, organic compounds, pesticides and other contaminants, present in the runoff and overflows; also potential endocrine disruption effects from certain organics and pesticides;
- oxygen depletion potential or biochemical oxygen demand (BOD) of the wastewater from biodegradable organic material, which can lead to oxygen deprivation of the organisms in the receiving waterbody;
- temperature changes due to an influx of water warmed by the ‘heat island’ effect of roads and buildings;
- aesthetic impacts from floatable matter and sediments (i.e., litter, grass clippings, sanitary items, soil erosion, etc.);
- contamination of groundwater with soluble organic chemicals, metals, nitrates and salt.

2.2 Hydrologic (Water) Cycle

The concept of the hydrologic cycle is used as the basis for understanding watersheds and, in particular, response of runoff and flow to precipitation and uses of water within the watershed. The hydrologic cycle concept describes the process of motion, loss and recharge of water within a watershed. A comprehensive illustration of the water cycle continuum is provided in **Figure 2.1.**

As shown, the major components of the hydrologic cycle are precipitation, evaporation, surface runoff and groundwater. Watershed management (including the pollution prevention measures in this document) is directly targeted at the runoff component, either through managing runoff processes and infiltration / recharge; or controlling contaminants entering runoff (i.e., pollutants). Some prevention measures also influence evapotranspiration including those that relate to the types of vegetation and storage, i.e., grassed waterways, vegetative buffers.

The most important item to recognize from a management perspective is that the hydrologic cycle does not have a beginning or end. As water evaporates from the land or water surfaces it becomes part of the atmosphere. Water is stored until it precipitates to the earth where it is intercepted by plants and water surfaces. The precipitation which lands on the ground will either runoff or infiltrate. In Ontario, approximately one third of the intercepted water returns to the atmosphere by evaporation. Infiltrated water is stored in soil to be used or evapotranspired by plants, or travels deeper into the soil and eventually discharges to the receiving water bodies.

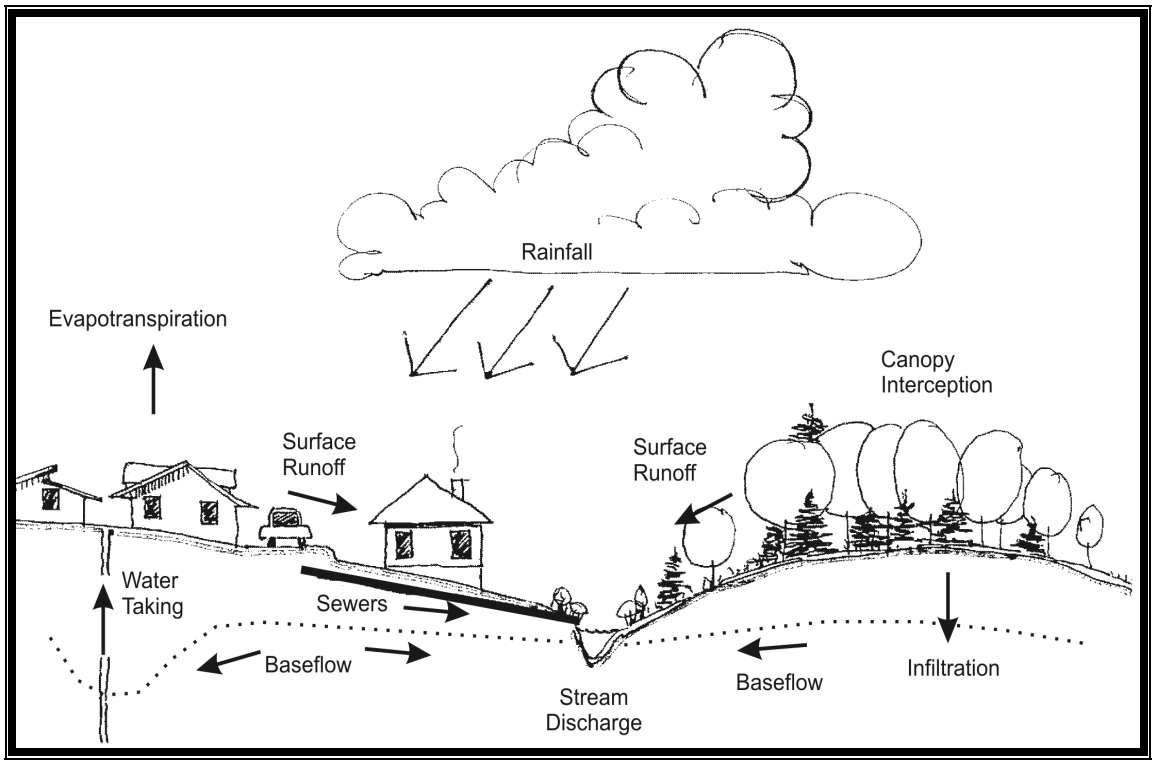


Figure 2.1 - Hydrologic Cycle Components

Impacts of Human Activity

Human activities affect or alter the water cycle in many ways. The major link in a watershed ecosystem is the flow of water. In a natural watershed, topography, geology, soil type and vegetation control water flow. How and where the water flows determines the quantity and quality of the water, the shape and stability of stream banks, the state of the groundwater, the health and diversity of vegetation, and the availability of fish and wildlife habitat.

As human activities increase in a watershed, all these natural characteristics can change. These human activities can change land drainage patterns, remove vegetation, or pave previously porous areas and consequently allow contaminants such as road salt, oil residues and pesticides to enter local streams. Unstable and eroded stream banks, poor water quality and loss of fish and wildlife habitat result, eventually diminishing the quality and quantity of surface water and groundwater and reducing the ability of humans to use and enjoy watershed resources.

Hydrologic Cycle and Pollution Prevention

Where water acts as the primary conveyor of pollution, pollution prevention measures can reduce pollution impacts by preventing pollutants from entering the flow (hydrologic cycle), or by controlling the flow (i.e., flow reduction measures – Fact Sheets Part II). In the development of an effective pollution prevention or management strategy, it is critical to understand the hydrologic cycle process to ensure that the measures are selected and implemented in an appropriate manner.

Management Implications

The impact of urbanization with the resulting input of pollutants, result in deterioration of water quality and ecosystem conditions. A watershed based management strategy provides an understanding of the ecosystem processes and helps to develop management measures to mitigate or prevent the impacts of urbanization. Common impacts considered in watershed plans and resulting management options are outlined in **Table 2.1**

Table 2.1 – Hydrologic Impacts

Hydrologic Impacts	Water Strategies or Options
• Increased runoff (volume, frequency and duration) with impervious ground cover.	• Runoff control for flood and erosion protection • Measures to maintain existing recharge rates.
• Reduced baseflows in streams because of land use changes.	• Provide measures to maintain infiltration • Provide extended detention of runoff for low flows.
• Increased pollutant loadings with runoff.	• Provide measures to reduce pollutant sources, or remove pollutants, by settlement, absorption or filtration.
• Erosion changes to stream form.	• Infiltration for control of runoff volume. • Rate of runoff control for erosion protection

Drainage systems be it natural or designed by humans, have always served the basic function of containing and transporting water (and other materials) away from a source area to a selected discharge point. The basic concept has the same principle as a stream system in that it generally follows a tree pattern. The upper branches are smaller and distributed to pick up a number of source areas and all carry the water to downstream junction points where the branches become larger. The main collector or trunk is the largest and leads to one discharge point.

Conventional drainage systems follow the principles of a stream system to convey flow with the main difference being that drainage is confined to a pipe or constructed channel that provides a specific capacity. If this capacity is exceeded the system may surcharge with resulting flooding of the source areas.

Evolution of Urban Drainage Systems

The design of urban drainage systems has followed an evolution to serve the needs of the day. The process is described below.

Early Urban Drainage Systems

When urban development first began, piped drainage systems did not exist. Drainage patterns followed the slope of the land and generally followed the roadways to any low point at streams or a body of water (see **Figure 2.2**). As hard materials began to be used for roadways, gutters were formed to convey flows along a channel to its outlet. The surface runoff carried all of the runoff and anything else that it could wash along. This included street debris, which often had waste materials from households and businesses and could even include privy waste.

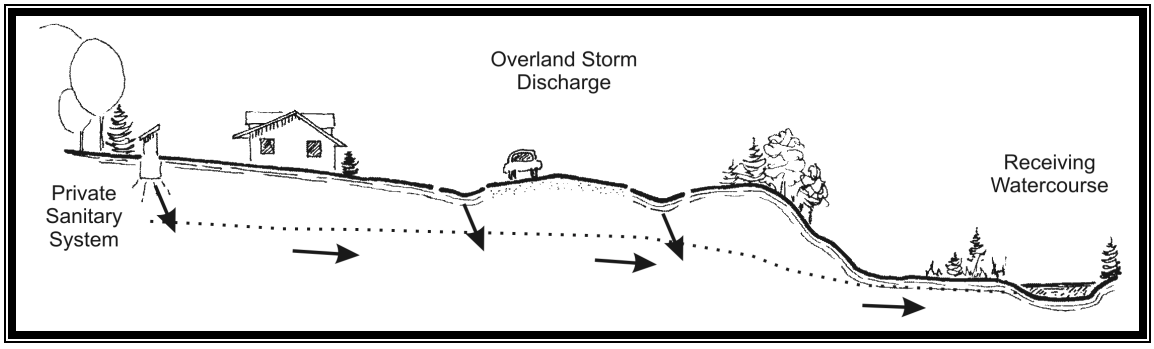


Figure 2.2 - Historic System

Introduction of Piped Drainage

The unsanitary conditions of surface drainage led to the use of pipes to carry drainage underground. The early drainage systems carried all runoff and waste previously disposed of in the streets. The earliest pipes consisted of boards and brick strapped together.

As technology advanced and alternative materials became available (clay, lead, iron) the piping was extended into homes and business to provide drainage from the inside of buildings to the streets.

During this time drainage was combined (see **Figure 2.3**). All storm drainage and waste water was discharged to an outlet point which would have been a stream or lake. This approach reduced problems with waste discharge in surface runoff but transferred the problem to the receiving waters. The impact was not immediately evident, as the relatively small population contributing to the discharge was such that the receiving water bodies could easily assimilate these loadings.

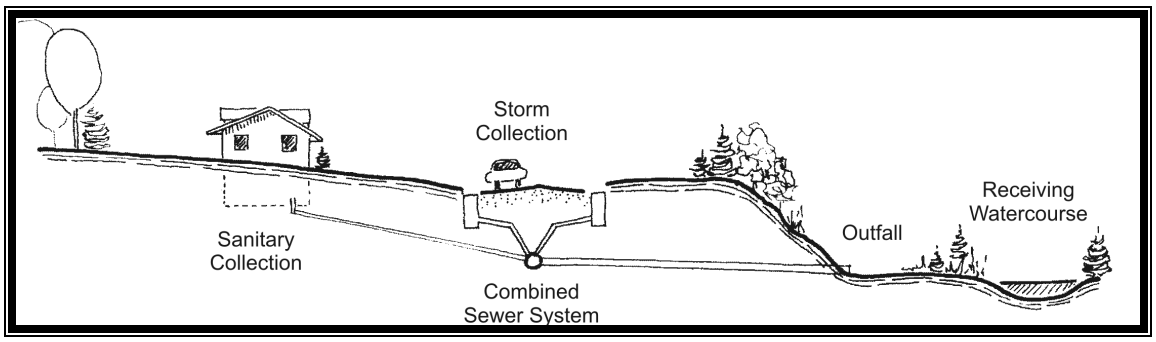


Figure 2.3-Combined Collection with No Treatment

Introduction of Sewage Treatment Plants

As the population increased in 'urban' areas, the problems with the discharge of waste to receiving waters became apparent and sewage treatment plants were introduced (see **Figure 2.4**)**.** These plants were developed to remove pollutants and pathogens. Typically treatment plants are designed to treat low flows that occurred during dry periods and some minor storm events. During larger runoff events, some of this flow bypasses the treatment system and is directly discharged to the receiving water.

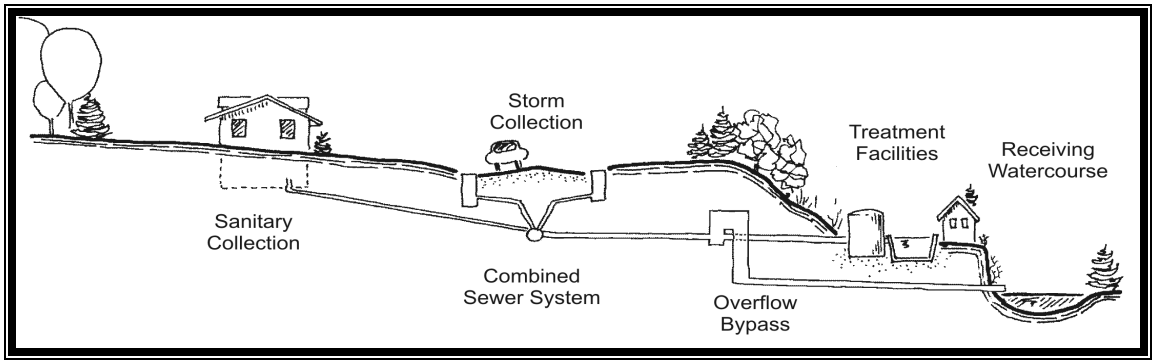


Figure 2.4 - Combined Collection with Treatment

Separation of Sewer Systems

Separate sewer systems, generally constructed since 1956 in Ontario, provide storm sewers for runoff drainage and sanitary sewers for sewage flow. This approach was introduced to avoid the problems of wastewater being flushed into receiving waters during significant runoff events (see **Figure 2.5**).

Although separate sewer systems are in use in newer areas, many municipalities still have combined sewers in the older, dense core areas of the municipalities. Significant pollutant loadings to receiving waters will continue to occur in older municipalities until measures are carried out to provide separated sewer systems or to reduce the flows to the combined sewer or the sewage treatment plant. Increasing the plant capacity is another costly alternative, which may address the problem if sufficient pipe capacity is available to transport the sewage to the sewage treatment facility.

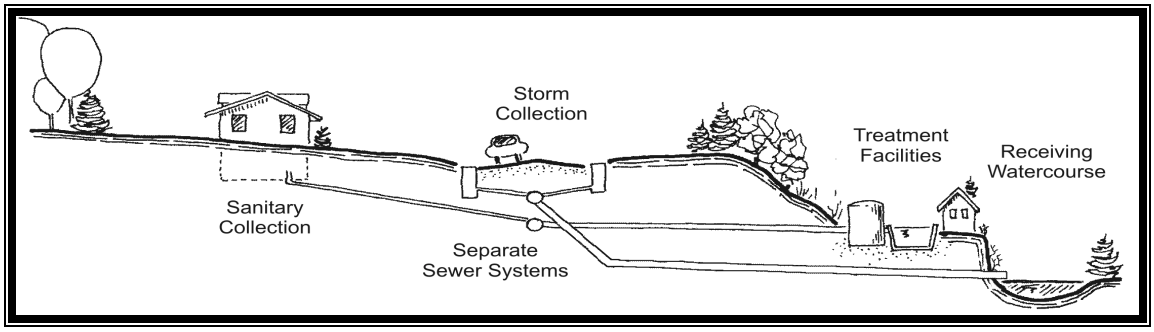


Figure 2.5 - Separate Collection with Sanitary Treatment

Sanitary Sewer Systems

The municipal sewage carried by sanitary sewers consists of domestic, commercial and industrial wastewater, which is carried to a sewage treatment plant. These sources contribute so-called conventional pollutants such as bacteria, organic matter, suspended solids and nutrients, which are treated at sewage treatment plants. In addition, hazardous chemicals from industrial and commercial sites as well as household sources are present in sanitary sewage.

Heavy rain running from roofs and other impermeable surfaces lead to overloading of sewers and can result in the overflow of combined sewers. These combined sewer overflows discharge directly and untreated to the nearest watercourse. Even with sewage treatment, persistent chemicals, such as chlorinated hydrocarbons and heavy metals, are not destroyed but pass through the treatment process into the receiving water or end up in the biosolids. One major use of biosolids is to spread them on agricultural land, but this use is curtailed if metals or other contaminants are present in excessive amounts.

Sewers are sized to handle the normal waste water flows from the usual variety of land uses plus some extraneous flows. This extraneous flow consists of infiltration, which comes from leaks in sewers (groundwater infiltration) and inflow that comes from sources such as foundation drains and household downspouts.

Some areas have abnormally high infiltration and/or inflow, termed I/I, which result in surcharged sanitary sewers during rainfall events. Remedial works to reduce the amount of extraneous flows are often necessary. One of the most effective programs to reduce this I/I is to disconnect downspouts since this can be the largest inflow contribution to a sanitary system.

Poor overland stormwater flow routes can also contribute to extraneous flows during large storms when rainwater enters the sanitary sewer via the manhole frames and covers. If a significant problem exists, mitigation can be provided through changes to overland flow routes by sealing the manhole frames and covers.

Storm Drainage System

Generally flows to a storm sewer system are more difficult to quantify than the flows in a sanitary system. A storm sewer is designed to provide conveyance for a minimum level event so that most of the storms in any given year can be accommodated. Typically this design event ranges from a 1:2 to 1:10 year event (i.e., 1:2 year is the largest event on average every 2 years). During more extreme events, which occur on average less frequently than the design event, the storm sewer system is surcharged and the higher flows are conveyed along the street. If the storm sewer system is connected to foundation drains, this can result in sewer backups and basement flooding.

Since storm sewers can only convey up to a specified event a storm drainage system is designed to provide a minor and major system (see **Figure 2.6**). The minor system (storm sewers) convey the more frequent design events (1:2 to 1:10 year). The major system is comprised of overland flow paths along roadways and open channels to provide safe conveyance of major storm events to nearby stream or river systems. The major event is generally set at a relatively high level to minimize risk to life and property (i.e., 1:100 year, or a recorded major event).

Watercourses within urban areas are often used as part of the conveyance system and suffer impacts due to changes in flows from urbanization. These impacts include higher flood levels, increased erosion and degraded water quality. These impacts ultimately result in the collective degradation of the aquatic ecosystem.

Stormwater management is practised to protect natural waterways and receiving waters from urban impacts. Controls include peak flow control for flood control, peak flow and volume control to mitigate erosion impacts and water quality controls for water quality impacts.

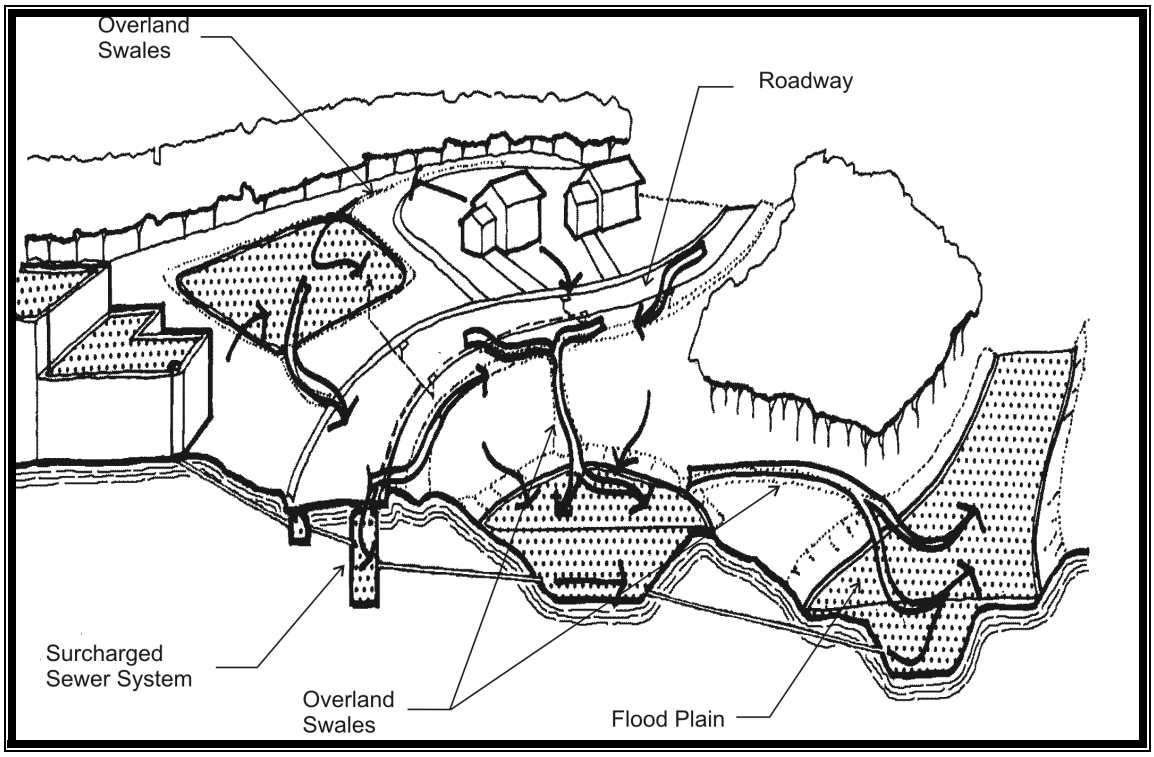


Figure 2.6 - Major Storm Overland Path

2.3 How Do We Solve the Problem?

Pollution prevention is defined as:

> "*The reduction or elimination of pollutants or wastes at the source*" (Reference: MOEE, August 1997, Ontario's Progress in Pollution Prevention).

A broader and more detailed definition of pollution prevention is given below:

> *"The use of processes, practices, materials, products, substances or energy that avoid or minimize the creation of pollutants and waste and reduce the overall risk to the environment or human health" (Reference: Canadian Environmental Protection Act, 1999)*
>
> *"Pollution prevention promotes continuous improvement through operational and behavioural changes. Pollution prevention is a shared responsibility among governments and individuals, industrial, commercial, institutional, and community concerns. It focuses on areas such as:*
>
> - *substances of concern,*
> - *efficient use and conservation of natural resources,*
> - *operating practices,*
> - *clean production practices which create less waste,*
> - *training,*
> - *equipment modifications,*
> - *process changes,*

- *materials and feedstock substitution,*
- *product design and reformulation,*
- *product life cycle,*
- *purchasing practices."*

(Reference: *A Strategy to Fulfil the CCME Commitment to Pollution Prevention*, CCME, May, 1996.)

Pollution prevention provides a means of reducing pollutant loadings resulting in an associated benefit to water quality. Pollution prevention is generally achieved by controlling pollutants at the source so that they do not enter the flow of water (i.e., surface water, streams or sewers). Pollution prevention can also be achieved through the reduction of flows or diverting the flow from the pollutant source. An example of this is the infiltration of stormwater into ground so that less surface water stays on the surface to wash pollutants off lawns or roadways.

The benefits of pollution prevention include:

- minimizing the use or avoiding the creation of pollutants;
- preventing the transfer of pollutants from one medium to another, i.e., reducing air and land pollution;
- minimizing health risks to residents and workers exposed to toxic and hazardous chemicals;
- promoting the development of source reduction technologies and using alternative methods;
- using energy, materials and resources more efficiently;
- reducing future liability for industries, commercial establishments and municipal departments, especially if carried out as part of a formal Environmental Management System;
- recognizing that waste is a cost that can be reduced;
- avoiding costly clean up in the future;
- recognizing water as a resource;
- enhancing the local living environment.

Ways in which flow reduction measures can provide pollution prevention benefits are listed below. Flow reduction benefits depend on the type of sewer system to which the flows were originally being discharged.

- **Reduced site runoff**. Flow captured and utilized on-site through methods such as downspout disconnection, rain barrels, and infiltration all reduce the amount of runoff. This reduces the load of pollutants to surface waters since clean water infiltrated into the ground eventually reaches surface water with reduced contamination.
- **Diverted flows**. Any water diverted from a combined sewer overflow (CSO) will reduce the amount of overflow and result in improved water quality.
- **Reduced control costs**. Any flow reductions to the CSO system or diversions from the combined sewer system will reduce control costs for storage or treatment.

- **Reduced sanitary sewage flows.** Any water conservation method, flow diversion, or sewer I/I reduction that reduces flow to the sanitary sewer and sewage treatment plant (STP) reduces costs including pumping, treatment costs, sludge generation and chemical usage. Pollutant loads to surface waters from the STP will also be reduced, including those contaminants that treatment plants do not remove. In addition, expensive sewage treatment plant expansions can be avoided or delayed, providing additional capacity to handle population growth.
- **Detained flows.** Runoff that is stored temporarily, then discharged back into the combined sewer system in dry weather will avoid CSOs. This will be treated at the sewage treatment plant. Detaining flows in stormwater management ponds provides water quality benefits by reducing sediment loads.
- **Maintain or provide for pre-urban hydrologic conditions.** Reduced flows to storm sewer systems will; lower high flow rates that cause channel erosion and flooding; reduce the potential for flooding caused by storm sewer back-ups; increase the amount of water available to the groundwater system; increase the amount of baseflow in watercourses; and reduce pollutant loadings to local streams and rivers.

There have been many initiatives by both provincial and federal governments in Canada to promote pollution prevention programs:

- The Ontario Ministry of the Environment (MOE) has supported and recognized industrial, commercial and institutional sectors in implementing pollution prevention initiatives in the past and will continue to do so in the future.
- MOE provided support for Pollution Control Planning to control point sources, combined sewer overflows (CSO) and stormwater. The name was changed in the early 1990s to reflect the prevention focus (i.e. Pollution Prevention and Control Plans).
- Ontario CSO Control Procedure F-5-5 (1997) requires that a pollution prevention and control program be established as a component of the minimum CSO controls.
- The Canadian Centre for Pollution Prevention (C2P2) in Sarnia was established by Environment Canada in 1992 to encourage and support pollution prevention programs.
- The MOE and Environment Canada have established several partnerships with industry sectors, with the objective of achieving beyond compliance emissions reductions. The MOE has also produced pollution and resource guides for several industry sectors.

2.4 Sewer System Controls

A variety of control measures have been used in combined, sanitary, and storm sewer systems to control flow and pollution.

Combined Sewers

- partial separation of combined sewers to provide separate storm and sanitary systems;
- storage of combined sewer flows during rainfall events followed by treatment of the excess volume during dry periods at the sewage treatment plant.

Sanitary Sewers

- control of inflows by disconnection of inflow sources (i.e., downspouts, manhole covers);

- control of extraneous infiltration by rehabilitation or replacement of sewers;
- Sewer Use by-law development and enforcement;
- pollution prevention programs;
- sewer system maintenance and operation program.
  - inspection (closed circuit television, CCTV) and repair,
  - sewer flushing,
  - pumping station inspection,
  - emergency response system.

Storm Sewers

- stormwater management to control flows for flood and erosion control;
- stormwater management for water quality control;
- Sewer Use by-law development and enforcement;
- tracing and eliminating illicit discharges (i.e. sanitary discharges to storm sewer);
- pollution prevention programs (e.g. Yellow Fish Road);
- sewer system maintenance and operation program.
  - inspection (closed circuit television, CCTV) and repair;
  - sewer flushing;
  - catchbasin cleaning;
  - spill response program;
  - street sweeping.

2.5 Basis for Action

Many water, sediment, and biota contamination problems are a result of discharges from point and non-point sources. Point sources can include discharges from municipal and industrial treatment plants. Included in the point sources are wet weather discharges from combined, sanitary, and storm sewer overflows, and sewage treatment plant bypasses. Non-point sources include urban and rural (agricultural) runoff.

What triggers the need to carry out a pollution prevention program? The need for a pollution prevention program may arise for different reasons, including:

1. Requirements in Ontario's CSO control procedure (F-5-5) to develop Pollution Prevention and Control Plans.
2. Implementation of Remedial Action Plans (see below).
3. Municipal by-laws, such as a sewer use by-law – see Chapter 4.
4. Watershed protection - planning and implementation- see Chapter 4.
5. A history of repeated infractions under Ontario's environmental legislation.

Requirements of Ontario's CSO Control Procedure

"To meet the goals of this [policy] each municipality or operating authority of a combined sewer system will be expected to develop a Pollution Prevention and Control Plan (PPCP)…An implementation plan should show how the minimum CSO prevention and control requirements and other criteria in this [policy] are being met. The minimum CSO controls consist of the following:

Establish and implement Pollution Prevention programs that focus on pollutant reduction activities at source, e.g., reduced use of potential pollutants like fertilizer and pesticides in parks; public education programs, e.g., anti-littering and illegal dumping of used motor oil and other materials into catchbasins; water conservation to reduce dry weather sanitary flow and hence CSOs; street cleaning to reduce CSO floatables; roof-leader disconnection and installing rain barrels to reduce flows into the sewer system; education/assistance for industries to minimize the use/discharge of pollutants; and enforcement of municipal by-laws or regulations."

Remedial Action Plans (RAPs)

Remedial Action Plans (RAPs) are aimed at restoring beneficial uses to Great Lakes Areas of Concern (AOCs) designations that are assigned by the International Joint Commission. There are 42 AOCs within the Great Lakes Basin; sixteen of these are in Canada. There are fourteen impairments to the beneficial usage of AOCs and they include degradation of benthos, eutrophication causing excessive algal growth, and degradation of fish and wildlife habitat. Some impairments to beneficial uses are partly attributed to urban runoff.

Many of the problems of contamination of water, sediments or biota are a result of discharges from point and non-point sources. Point sources can include discharges from municipal and industrial treatment plants. Included in the point sources are wet weather discharges from storm sewers, combined storm and sanitary sewers (CSOs) and sewage treatment plant bypasses. Non-point sources include urban and rural (agricultural) runoff. Many RAPs call for the implementation of pollution control and prevention plans to control the contamination from urban runoff and sewage.

2.6 Information Sources for Developing Pollution Prevention Initiatives

There are many information sources for pollution prevention initiatives including reports, studies, manuals, and web sites from various organizations and associations. Many of the measures discussed in this handbook have specific references either in the main text (Part I), as part of the Fact Sheets (Part II), or Case Studies (Part III). Some general references and contacts are given in Table 2.2.

Table 2.2 – General Information Sources for Developing Pollution Prevention Initiatives

Reference	Description
Residential and Commercial Source Control Programs to Meet Water Quality Goals, Water Environment Research Foundation, Project 95-IRM-1, 1998. Order at 1-800-666-0206, or through the web site at http://werf.org/docs/publications.html and refer to stock number D72005.	Provides a resource for communities developing wastewater and stormwater pollution prevention programs; describes practices and program ideas for specific sources of pollutants; identifies public education strategies, approaches to different audiences and types of materials developed; and discusses ways to gauge program effectiveness.
California Stormwater Best Management Practices Handbooks, 1993, prepared by Camp Dresser & McKee, et al. Available from Alameda County Public Works Dept. at 510-670-5543.	Separate handbooks for municipal, industrial, commercial, and construction activity. The Municipal Handbook has chapters on how to develop a stormwater management program, Best Management Practice (BMP) selection, source control BMPs, treatment control BMPs, and measuring performance.
Stormwater Management Practices and Design Manual (1994 and updates). Aquafor Beech Ltd. and Marshall Macklin Monaghan for the Ontario Ministry of the Environment.	A planning and design manual for many stormwater control measures, including source control measures discussed in this manual. Includes many examples from Ontario.
Urban Runoff Quality Management, WEF Manual of Practice No. 23, ASCE Manual No. 87, Order at 1-800-666-0206, or through the website at http://www.wef.org/	Design and performance information for a variety of measures, including source controls.
An Evaluation of Roadside Ditches and other Related Stormwater Management Practices-second edition. J.F.Sabourin and Associates (2000). Available from Toronto and Region Conservation Authority, (416) 661-6600. http://www.trca.on.ca/2e.html	Presentation of design and cost information for alternative local street drainage systems, including grassed swales and infiltration. An Excel based selection tool is provided for assessing different methods.
Canadian Centre for Pollution Prevention, internet site: www.c2p2.sarnia.com	Provides pollution prevention training, workshops, information and advisory services. Publications may be ordered from the website.
A Guide to Pollution Prevention for Municipalities, prepared by the Region of Hamilton-Wentworth (now City of Hamilton). Available from internet site: http://c2p2.sarnia.com/	A guidance manual with additional detailed appendices and resource materials are available.
Canadian Pollution Prevention Information Clearing House Website at: www.ec.gc.ca/cppic/solns_e.cfm	Background information on policy and legislation, e.g., *Pollution Prevention – a Federal Strategy for Action.*

Reference	Description
Great Lakes Pollution Prevention Fact Sheets. From US EPA Website. http://www.epa.gov/glnpo/p2/factsh.htm	Fact sheets including the Environment Canada – U.S. EPA Strategy for the Elimination of Toxic Substances and Great Lakes Pollution Prevention Activities.
Yellow Fish Road (Storm Drain Marking Program).Contact: Toronto and Region Conservation Authority at (416)661-6600. Lake Simcoe Region Conservation Authority at (905)895-1281. Credit Valley Conservation at (905)670-1615. Trout Unlimited Canada at 1-800-909-6040.	Yellow Fish Road Programs in the urban communities of the City of Toronto, East Brampton, Vaughan, Richmond Hill, Markham, Pickering, Ajax, Caledon East, Bolton, Nobleton, King City, and Stouffville. For the area north of this jurisdiction (including Aurora, Newmarket, Bradford, Beaverton, and Barrie). For Mississauga, and the Credit River watershed (including Georgetown, Orangeville, and west Brampton). Elsewhere in Canada.
GreenOntario Provincial Strategy. Website www.greenontario.org/strategy/toxics.html	Fact sheets on issues of concern.
CEPA Environmental Registry http://www.ec.gc.ca/CEPA Registry	The CEPA Environmental Registry is a comprehensive source of public information relating to activities under the *Canadian Environmental Protection Act, 1999*. The primary objective of the Environmental Registry is to encourage and support public participation in environmental decision-making.

3 DEVELOPING A POLLUTION PREVENTION PLAN

The approach to starting a pollution prevention plan depends on the group implementing the pollution prevention plan. This section describes pollution prevention action plans that can be used by various groups to address the following groups/community:

- a municipality, i.e., municipal staff at the department or corporate level;
- an industrial or commercial establishment;
- an institutional establishment (schools, universities, hospitals); or
- a broad community or target group/agency or locally based neighbourhood interest group.

An action plan for a specific group/community can include or overlap with that of the other different groups/community, in that common component plans may be used. These component plans, such as Pollution Prevention and Control, Environmental Management Systems and Sewer Use By-law are discussed in Chapter 4.

In developing an action plan, a sequence of specific tasks is typically followed:

1. Define the problem—identify the specific problem to address, e.g., closed beaches as a result of combined sewer overflows.
2. Scope out the Area—define the geographical area to cover in the plan, e.g., watershed, waterfront, neighbourhood, single company – or a jurisdictional area within a municipality's boundary.
3. Set objectives—set objectives related to the problem to be solved, e.g., open the beaches.
4. Set targets—define specific achievable actions numerically, e.g., open the beaches. Most of the time these can be derived from subsequent steps.
5. Develop the plan—collect information, understand the problem, and its causes and effects.
6. Identify alternate solutions and pollution prevention measures—identify various ways of achieving objectives.
7. Develop the implementation plans—apply the recommended solution.
8. Implement the plan.
9. Marketing—educate and elicit support of involved parties such as residents, staff in the municipal department, or industrial staff.
10. Evaluate the success and follow-up the implementation plan—assess the structure, results and barriers encountered. This often involves management decisions.
11. Modify the implementation plan if necessary.

For each level, the type of activity can be broken down as follows:

1. Actions the group can take directly (Do)
2. Actions or resources that can be provided by others (Pull)
3. Actions that can be influenced in other groups (Push)

In considering control options, measures should be chosen that address specific concerns. **Table 3.1** provides some examples of environmental problems or objectives and typical pollution prevention measures (the list is not exhaustive). Fact sheets providing further information on these pollution prevention measures are provided in **Part II**.

Table 3.1 – Sample List of Pollution Prevention Measures

Problem or Objective	Typical Pollution Prevention Measures	Fact Sheets
CSO control	Flow reduction measures Sewer Use by-law enforcement to reduce toxic contaminant load to sanitary sewers (part of the CSO)	FR 1-7 MO-1
Contaminated sediments	All CSO overflow control measures Storm sewer use by-law monitoring and enforcement Pesticide and herbicide reduction program Catchbasin cleaning and street cleaning programs Filter strips and grassed drainage systems	MO, LD MO-1 SP-3, 4 MO-3-5 LD
Closed beaches due to bacteria	Flow reduction for CSO and stormwater Goose/dog litter control (education and by-law enforcement) Dry weather CSO regulator maintenance Storm outfall surveys to locate cross connections	FR SP-8 LD-4 MO-10
Eutrophication from nutrients	CSO control, flow reduction for stormwater Reduced use of fertilizers	FR SP-3, 4
Flooding and channel erosion	Flow reduction measures in storm drainage	FR
Groundwater contamination	Household hazardous waste disposal control program Spill management Limit infiltration measures to residential areas Reduction in use of road salt Soil contamination management Illegal dumping management	SP-2 MO-9 FR MO 2

3.1 General Steps

A recent report prepared for the Water Environment Research Foundation provides a methodology to develop and evaluate pollution prevention programs. The report, *Tools to Measure Control Program Effectiveness* (Larry Walker Associates, WERF Project 98-WSM-2, 1999), provides information on effectiveness measurement for stormwater and wastewater pollution prevention and public education projects, including costs to implement programs. The report describes an overall process for defining a source control program, and also provides several tools for measuring effectiveness. Several detailed case studies are provided.

Suggested steps for developing a source control program are summarized below:

1. **Identify the issue.** Define the issue by:
   - Identifying a pollutant of concern or waste stream;
   - Establishing a baseline by determining pollutant loading or waste stream volume.
2. **Identify and assess sources.** Sources may be identified by monitoring, agency records, or by reviewing the literature relating to the pollutant of concern and its likely sources. Once sources are identified:
   - Determine the significance of each source by estimating its contribution to the total pollutant loading or wastestream volume;
   - Assess the ability to control each source's controllability with respect to the applicable regulations for that source and pollutant (e.g. municipal sewer use by-law, or a provincial or federal regulation).
3. **Determine available control strategies**. To identify possible control strategies for each source:
   - Consider control strategies already in use elsewhere;
   - Review strategies used by other agencies for this source;
   - Brainstorm to come up with new ideas for your situation.
4. **Evaluate and prioritize control strategies**. To determine which control strategies are most likely to achieve measurable results assess the following:
   - Participation – what portion of the targeted audience is likely to make the desired behaviour change?
   - Loading – what portion of the source's total loading will be eliminated if the entire targeted audience makes the desired behaviour change?
   - Cost – how much will it cost the agency to implement the program and how much will it cost the targeted audience?
5. **Establish a goal.** A goal may be set at any point during the development process. The goal is the desired outcome and may be set based on:
   - A reference condition (i.e., the condition that would exist without interference);
   - The reduction necessary to meet a permit limit or other regulatory or environmental standard;
   - A reduction that can be realistically achieved based on the estimated load reductions determined in the previous step (based on the control methods or technologies available);
   - Performance necessary to meet an intermediate goal;
   - Action plan for meeting final goal.
6. **Implement program.** Part of program implementation is selection of an effectiveness measurement tool to assess the program. Before choosing assessment tools, determine what information you are seeking about your program. The tools are then chosen based on:
   - The ability to measure achievement of the goal;
   - The target audience and control strategy chosen;
   - If assessment is necessary during the program or can be deferred until the program is completed;

- What stage the program is focussing on (i.e., increased awareness, behaviour change, environmental improvement).

7. **Evaluate effectiveness.** Based on the effectiveness measurement, the agency determines what it has learned from the program:
   - Has the program's goal been achieved?
   - What were the most effective aspects of the program?
   - What changes are needed to achieve better results?
8. **Modify program.** The results of the effectiveness measurement will help to determine the future direction for the program with respect to:
   - Additional strategies to address this source if the desired results were not achieved;
   - Alternate sources to pursue if no further or limited reductions are possible from the source addressed so far;
   - New issues to pursue if this pollutant or waste stream issue were adequately addressed by this program.

3.2 Municipal Pollution Prevention Planning

Options that a municipality can consider for pollution prevention planning are summarized in **Table 3.2**.

Table 3.2 - Options for Pollution Prevention Planning at the Municipal Level

Municipal Plans		
Municipal Wide	**Local**	**Watershed**
Pollution Prevention and Control Plan	**Implement pollution prevention, flow reduction**	**Watershed Study**
Environmental Management System	**Enforce by-laws in residential areas**	**Regional Action Plan Study**
By-law	**Enforce sewer use by-law for industry**	
Pollution Prevention Plan	**Implement Public Education programs**	
Best Management Practices		
Flow Reduction		
Programs – Air quality, Outfall and Monitoring		

Types of action a municipality can take include:

1. Direct Action

A description of the actions that can be taken are discussed in the following items.

- Develop a Pollution Prevention and Control Plan (PPCP) - if the problem is complex and related to multiple sources such as combined sewer overflows, stormwater and point sources from municipal sewage treatment or industry. Simpler PPCP studies can be developed for stormwater retrofit situations, to narrow the scope of study to stormwater only.
- Develop an Environmental Management System (EMS) - if pollution prevention on a broad scale is desired, and additional benefits are of interest, such as increased environmental performance, improved accountability, and reduced liability for environmental damage. The scope of the EMS can be municipality wide or apply to environmental and works departments or individual facilities.
- Develop a Pollution Prevention Plan (PPP) - if the focus is on a particular source or problem (and the scope of an EMS is too broad). A PPP can apply municipality wide, to departments or to individual facilities.
- Develop a Flow Reduction Plan - this is a type of pollution prevention plan focused on a single problem area, i.e., flows to municipal sewers.
- Develop a water conservation program. This is a component of a flow reduction program, with additional benefits for water supply system capacity and operation costs.
- Update sewer use by-law.
- Develop a community-based social marketing campaign for lot level source control and pollution prevention. This type of program integrates the requirements of the PP and Flow Reduction.

2. Involve Others (Pull)

- Obtain financial and/or technical assistance from provincial and federal resource centres and departments.
- Carry out watershed planning with conservation authorities, or RAP planning with provincial and federal involvement. These overall plans with their broad and specific objectives are particularly useful for providing the context with specific objectives and targets to apply in other plans (such as PP, EMS, flow reduction) into which PP plans can be meshed or integrated.
- Empower neighbourhood groups to apply the principles of PP by – neighbour to neighbour campaigning providing information and resources.

3. Push for Action (Push)

- Push implementation of PP and Flow Reduction plans at the neighbourhood level with delivery and action oriented education for specific programs; assistance for downspout disconnection programs; application of household hazardous wastes collection programs; water conservation.
- Enforce by-laws for residential areas, such as litter and animal control.
- Enforce Sewer Use by-law with active monitoring program, compliance follow-up, and charges when necessary.

- Use the stormwater provisions in the Sewer Use by-law to require industries to carry out Best Management Practices plans, develop PP or EMS plans, and construct stormwater control works.

By-Law Adoption and Modifications

Identify potential by-laws that could address pollution prevention activities, including: sewer use by-laws; downspout disconnection by-law (e.g., St. Catharines); water use/conservation; litter control etc. The City of Toronto's Sewer Use by-law (2000) is an example of a by-law that asks for pollution prevention.

Official Plan Policies

Modifications may be needed to enable pollution prevention and flow reduction measures. Goals of these measures could be identified. Watershed planning requirements for existing areas could be identified as well as RAP targets.

Subdivision Design Policies and Drainage Standards

Modifications may be needed to facilitate pollution prevention and flow reduction measures; stormwater management policy for municipal road and sewer construction projects, and redevelopment projects, e.g., Belleville.

3.3 Industrial / Commercial Planning

Industries and commercial establishments, and institutions can take action for their site or act collectively (**Table 3.3**).

1. Site level actions

- Develop and implement a pollution prevention plan if improved environmental performance is required for the business, or if required by the municipality. Many benefits are derived from these plans, including reduced use of raw materials, reduced waste, energy savings, reduced costs (and increased profits) and improved environmental performance.
- Develop an Environmental Management System - if the increased scope, which includes pollution prevention, and the benefits of improved environmental performance, enhanced image, increased accountability are expected, or if the municipality requires it as a provision of an updated Sewer Use by-law.
- Develop a Best Management Practices Plan - if the problem is mostly related to poor housekeeping and only stormwater is to be controlled, or if the municipality requires a BMP plan as a provision of its Sewer Use by-law.
- Construct stormwater management facilities - if the problem has been defined and pollution prevention or housekeeping measures are not sufficient.

Table 3.3 - Industrial/Commercial Plans

Industrial/Commercial Plans	
Site Plans	**Collective Action**
PP Plan	**Industrial Association**
EMS	**Community**
BMP	**Watershed**
Water Conservation	**Sector**

2. Collective Action

- Set up or join an Industrial Association - these provide a common focus, are useful for attracting resources, and provide a vehicle for peer assistance in carrying out PP, BMP, and EMS development.

Industrial sector-based associations are geared to assist in industry-specific issues, where the materials, equipment and control technologies are unique. Issues such as raw material replacement can be addressed collectively in dealing with the provincial and federal governments.

3.4 Community/Neighbourhood Level SWPP Plans

Community-based groups such as neighbourhood rate payers, service clubs, or environmental interest groups develop and apply stormwater pollution prevention programs (**Figure 3.1)**.

Get organized. Identify group goals and membership, especially those willing to contribute time and resources. Choose a leader to drive the program and to be the main contact person.

- Identify the problems or issues to be addressed.
- Contact existing groups for information.
- Contact municipality to determine best fit of issues to actions.

1. **Set scope and objectives.** Is the issue or group interest directed to a local neighbourhood, community-wide or watershed-scale problem? Do you want to address solely residential sources of pollution or all uses such as municipal activities, commercial and industrial operations and institutional sites? Choose something specific as objectives, for example, “Reduce runoff to combined sewers in our neighbourhood”, or “Change municipal practices to increase pollution prevention”, or “Reduce runoff pollution from industries in our watershed”. If a watershed plan already exists, this is a good source of objectives that are already set for your area.

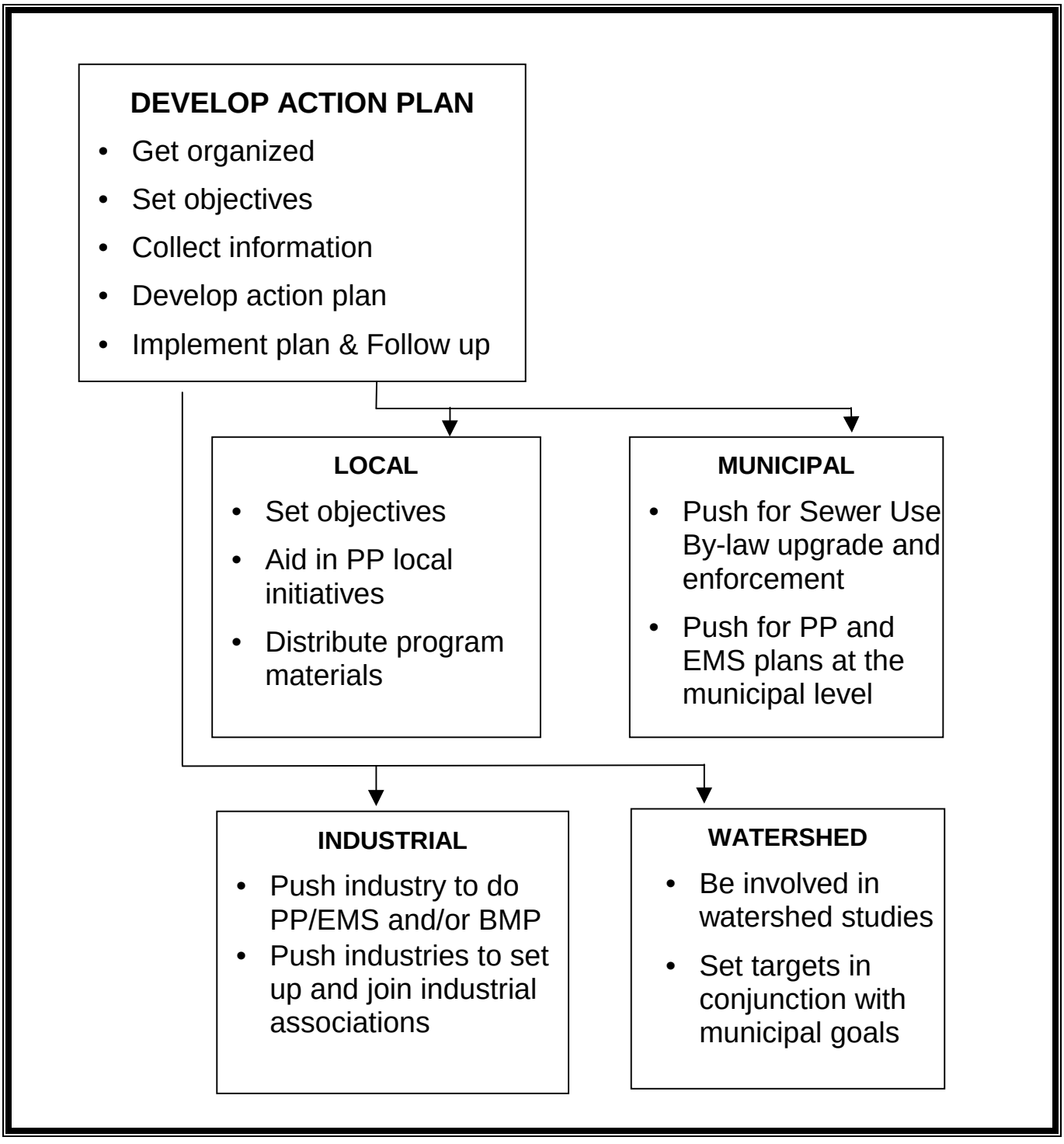


Figure 3.1-Community-Based Stormwater Pollution Prevention Programs

2. **Gather information.** Once you know your project direction, do some homework on the subject. Use the resources in this Handbook to track down information on the subject or problem. This includes obtaining other handbooks, reviewing Internet web sites, and approaching the municipality for information. Refer to the other sections in this chapter (depending on the scope and objectives adopted for your project) and find out if the measures have been adopted, such as: sewer use by-laws, pollution prevention plans, environmental management systems, watershed plans.

   Contact both federal and provincial government agencies and your municipality to determine what policies and programs exist to address your concerns; what resources (e.g. technical assistance from other groups and government) exist to provide input to policies and programs, and what funding mechanisms exist.

   Find out about pollution sources and effects in your area. This will help to focus your activities and provide support for pollution prevention efforts. Earlier chapters in this handbook can help by showing the general effects of urban runoff. Find out the type of sewer system your area drains to, as this will affect the type of control measures. Monitoring outfalls may be useful for your problem area, but be aware of the costs for lab support and the need to follow strict protocols in taking samples.

3. **Develop an action plan**. Your plan should now be focused on a list of specific actions to help achieve your objectives. Four action plans are discussed below for neighbourhood level, municipality-wide focus, industrial/commercial focus and watershed focus. These are provided as a guide to the type of activity that could be followed. Try to obtain financial support or resources for the plan (see **Tables 3.4** to **3.7**).

4. **Implement the plan.** Carry out the actions in the plan. Develop recommendations for action by other groups. Present the results to industrial groups or the municipality.

5. **Follow up and repeat.** Your group should be prepared to follow-up to monitor the implementation of the plan and repeat some activities if necessary.

Table 3.4 - Action Plan for Local Neighbourhood Group

Target: to get local residents to adopt specific practices for pollution prevention and flow reduction.
Approach:
Decide on control measures e.g. rain barrel and hazardous waste pickup.
Get brochures from municipality
Deliver brochures provided by the municipality door-to-door with a letter from the president of the neighbourhood association.
Group members adopt SWPP practices and talk to neighbours.
Obtain help from the municipality in setting up hazardous household waste pick-up points.
Distribute rain barrels and give instructions.
Follow-up: Report on results to association members with annual letter to residents and municipal councillor. Maintain programs.

Table 3.5 - Action Plan for Municipal-wide Issues

Target: to get municipality to develop and apply Pollution Prevention (PP) program.

Approach:

Review existing programs to see if they are adequate.

Push for sewer-use by-law upgrade to new model by-law distributed by the Ministry of the Environment, and make sure enforcement staff are available.

Push the municipality to use provisions of the sewer-use-by-law to improve industrial and commercial business programs.

Pollution prevention (PP) and Environmental Management System (EMS).

Push for PP and EMS plan development at the municipal level.

Request development of educational materials and technical support to deliver programs to resident groups and individual residents.

Follow-up: Expect reports on progress from the municipality. Attend council meetings and ask questions.

Table 3.6: Action Plan for Industrial, Commercial and Institutional Areas

Target: Control of discharges from industries in your area.

Approach:

Review status of industrial control by talking to the municipality and the industries themselves.

Push industries to voluntarily adopt PP or EMS for their system. A stormwater control program should be adopted if specific problems are known with respect to runoff.

Ask for industrial associations to be formed to provide support for the industries and a focus for interaction with the residents.

Follow-up: Expect progress reports from the industrial associations.

Table 3.7- Action Plan for Watershed Issues

Target: develop and implement a watershed plan in order to provide a focus for PP activities. Approach: Push the municipality and conservation authority to develop a subwatershed plan for your area. Be involved in the plan development by participating in public meetings to set objectives and review plan components and implementation options. Take on a stewardship role for the watershed and be prepared to assist in plan implementation. Follow-up: in the stewardship role, be involved in monitoring programs and in distributing educational materials.

3.5 Learning from Experience

Staff from four municipalities of varying sizes (the Town of Ancaster, the Region of Waterloo, the City of St. Catharines, and the City of Toronto) were approached to discuss their experiences in implementing pollution prevention programs. The selection was based on the replies to a questionnaire circulated by the Ministry of the Environment in 1997, and an attempt to provide case studies with a range of community size, structure and responsibilities. The common problems for these municipalities included impacts from overflowing storm sewers upon local waterways or a nearby lake. All of the selected communities had initiated some form of public involvement and education, although this varied widely according to the staff and resources available. All the municipalities had included outreach and partnerships with the industrial, commercial and institutional sectors.

The three largest municipalities also initiated water efficiency and flow reduction measures to deal with problems such as sewer overflow discharges to creeks or a lake, basement flooding and conservation of groundwater supplies. These communities also included a vigorous school program to educate future consumers.

The staff interviewed for the case studies readily provided information about program successes and deficiencies to assist other communities with similar problems. Program successes had in common a strong staff commitment and leadership, policy or by-law support, and a major public education and outreach component with partnership and stewardship actively encouraged. Knowing your community and your target audience was also considered an important factor in implementing a successful program.

Factors considered detrimental to the successful implementation of some programs included:

- lack of co-ordination and designated leadership;
- failure to provide sufficient understandable public information to the target population;
- failure to use community resources such as contractors and suppliers for a toilet replacement program;
- time and effort wasted when communication links failed and a voluntary monitoring was carried out in one area while the program was implemented in another;

- lack of political support for municipally - initiated environmental measures in the face of resident's complaints and preferences.

In all of the case studies municipalities provided a wealth of public information materials such as brochures, fact sheets and newsletters. Costs were minimized where possible by using material already available from other sources or by working in partnership with other agencies or municipalities. For major community-based programs, the media was considered to have a considerable influence on the program acceptance by the public.

Elements identified as strongly contributing to the successful implementation of a pollution prevention program included:

- a strong, long-term municipal staff commitment especially as a leader or co-ordinator;
- sufficient financial resources to provide this support and create/distribute promotional materials;
- a reasonable number of clearly defined objectives that are practical, environmentally sound and attainable;
- policy or by-law support, which also implies strong political support;
- public support fostered by education and some involvement in the program development or implementation;
- recognition and use of community resources, such as the use of community contractors and suppliers where possible to provide services and materials, linkages to watershed studies, management plans and larger scenarios (e.g. RAP) as a basis for justifying the program.

3.6 Evaluating Program Effectiveness

Effectiveness measurement tools include:

- Surveys – quantitative; targeted; phone banking;
- Group feedback – focus groups; workshops;
- Pilot study – to test out an approach;
- Environmental analysis – effluent or receiving water sampling;
- Tracking responses;
- Tracking sales – e.g., hazardous household products and safer alternatives;
- Modelling;
- Cost benefit analysis;
- Inspections and site visits;
- Participation rates;
- Estimated load reductions.

The following influences the selection of the measurement tool:

- Target audience (i.e., business, residential, schools, rural population);
- Timing with respect to project planning (before, during or after a project is conducted);
- Stage with respect to environmental improvement (program implementation, increased awareness, behaviour change, environmental improvement).

Based on the case studies discussed in the report, the effectiveness tools most appropriate to a specific source control are summarized below:

- **Programs targeting business audiences.** Tools commonly used include measurement of participation or compliance rates, discharger sampling, and site visits and inspections. Other tools that have been used successfully include cost-benefit analysis, estimated load reductions, and focus groups. Participation rates are a useful measure when the control strategy used is a recognition or certification program. Discharger or effluent sampling is used most effectively when a specific business category is targeted. Effluent or influent sampling is only an effective indicator of program performance if a single source (i.e., business category) is responsible for the major portion of a pollutant's loading.
- **Programs targeting residential audiences.** Most of the control strategies used for this audience are based on educational outreach materials and methods of advertising this material to the public. Effectiveness measurement tools commonly used include quantitative and targeted surveys, tracking responses, and focus groups. Other tools that have been used effectively when adequate data is available include estimated load reductions, tracking sales, effluent toxicity, and modelling.
- **Assessment during program planning.** The most commonly used tools during the planning process include estimated load reductions, focus groups, modelling and quantitative surveys.
- **Assessment while a program is being conducted.** Certain tools can be used to assess the program while it is underway. These include inspections/site visits and participation rates for business oriented projects, and tracking responses or sales patterns for residential audience projects.
- **Assessment after a project is completed.** Discharger and effluent sampling are conducted to assess the impact of an implemented project that targets a business audience. Targeted surveys are used to assess the impact of an outreach program for the residential sector, specifically with respect to whether workshops or education materials resulted in positive behavioural changes. Quantitative surveys can also be used to assess the impact of residential outreach specifically with respect to the overall impact of an advertising campaign.

The report *Tools to Measure Control Program Effectiveness* (Stock No. D00302) may be ordered from the Water Environment Research Foundation at www.werf.org

4 TOOLS AND RESOURCES FOR DEVELOPING A POLLUTION PREVENTION PLAN

This chapter provides information on action plans/tools that could be used to implement pollution prevention at the municipal, industrial, or community group level including: watershed planning, pollution prevention and control planning, Municipal Environmental Management Systems, Municipal Sewer Use By-Law, Pollution Prevention Planning, Best Management Plans, and Codes of Management Practices.

4.1 Watershed Planning

Watershed planning represents an approach whereby all key stakeholders can come together and share their information and interests regarding water and related land-based resources within a watershed. Options are identified to ensure the long-term protection, management and restoration of important natural features and functions, and a fair allocation of resources. One component of watershed planning is stormwater management planning . Watershed plans are implemented through a variety of tools including;

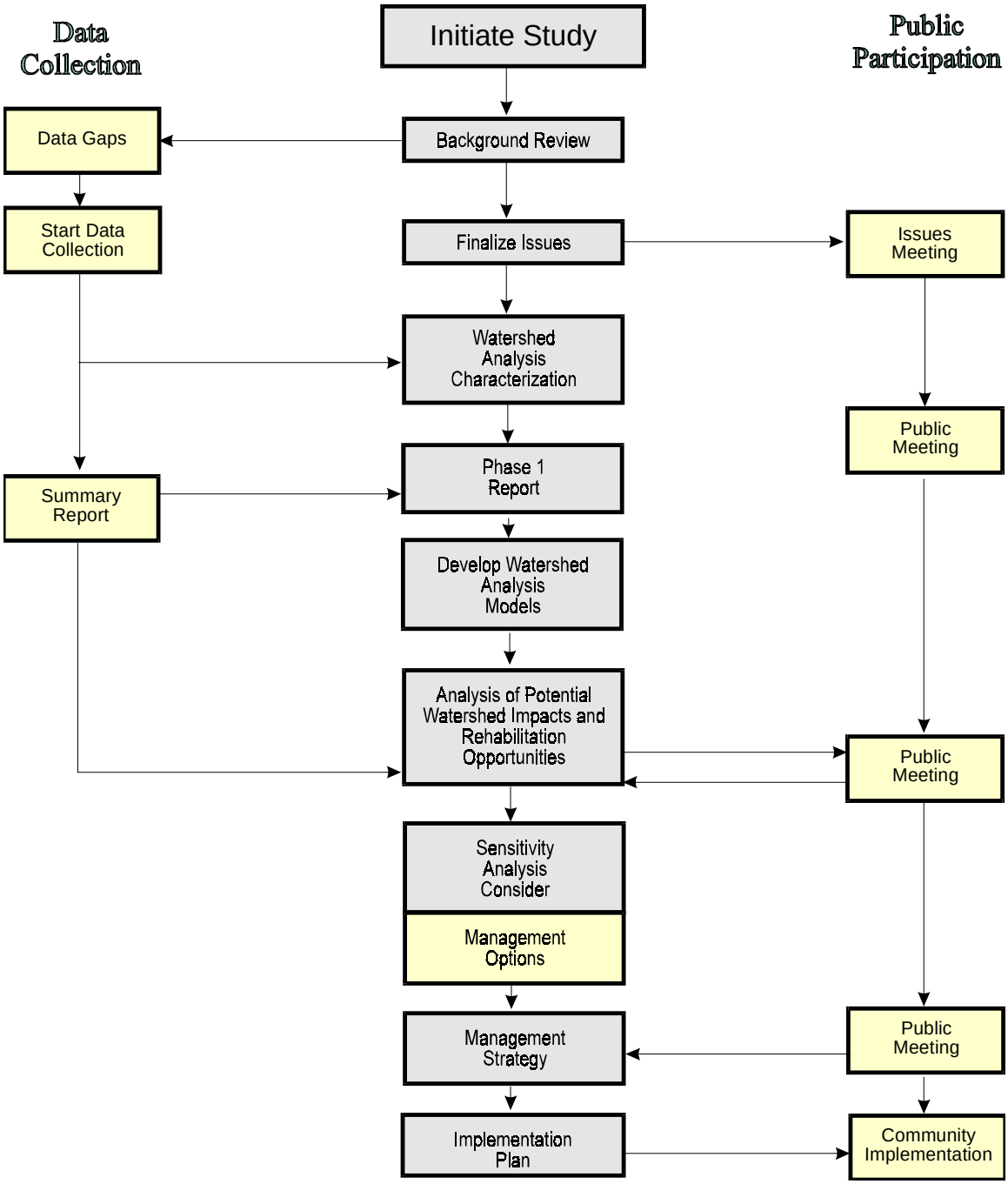
- Land use planning;
- Water and wastewater planning;
- Water use regulations;
- Stewardship programs;
- Land acquisition;
- Infrastructure;
- Remedial programs.

Watershed planning provides the most effective and efficient approach to management by facilitating the understanding of ecological processes and all the interrelationships between watershed features and the processes that occur (function). By developing a deeper understanding of the ecological processes, educated decisions can be made on how to best manage resource use and land use activities.

Assessment of watershed conditions includes identification of sources of pollutants, their transport and deposition and any potential changes in these. Invariably a watershed management scheme includes measures to control pollutants at the source, during transport or at deposition. Pollution prevention measures therefore can be an integral part of a watershed management scheme.

Recognizing watershed planning as the most effective approach to resource management has resulted in many municipalities embracing watershed planning as a part of the land use planning process. **Figure 4.1** outlines a watershed management plan development process.

Figure 4.1
Watershed Management Plan Development Process



The land use standards and servicing standards set using a watershed management approach reflect community needs, ecosystem sustainability and economic needs, and are viewed as the cornerstones of a resource management program. Each element must be considered to provide a management approach that is sustainable.

Watershed planning is used to plan future land use (i.e., new development and retrofit), and watershed regeneration planning, and to determine land use options. It is used to identify watershed features and functions to be protected, and identify any restrictions or changes to land use. A watershed planning approach provides a basis for setting stormwater quantity and quality control targets. It can also apply to surface and groundwater use restrictions (resource management and wastewater discharge standards or criteria).

Key Steps in Watershed Planning

The process followed in watershed planning is outlined in the June 1993 *Water Management on a Watershed Basis,* watershed-planning guidelines published by the Province of Ontario *(Implementing an Ecosystem Approach; Subwatershed Planning;* and *Integrating Water Management Objectives into Municipal Planning Documents).*

The steps include:

1. Developing a general understanding of the watershed or subwatershed.
    - General review of background information for an initial understanding of watershed processes, terrestrial features, streams, geology, land use, and recreation.
2. Working with the community to identify issues, concerns, a vision and goals.
    - Hold information sessions, workshops and public meetings to discuss concerns and develop a list of issues.
    - Hold workshops to develop a vision for the watershed/subwatershed and identify goals and issues to use as a framework in developing a plan.
3. Identifying key watershed processes and linkages.
    - Watershed processes are analysed to characterize the watershed for the key areas of interest such as:
        - surface water, streams,
        - hydrogeology,
        - terrestrial conditions,
        - aquatic habitat,
        - water quality.
4. Evaluating existing land use (and services) and potential changes.
    - Quantify impacts of current land use and potential impact of future land use and servicing changes on the watershed processes.
5. Identifying management needs.
    - Quantify impacts of current land uses and potential impact of future land use and servicing changes on the watershed processes.
6. Setting targets to be met and management objectives.
    - Establish key parameters and related targets to meet watershed goals.

- Determine objectives to be followed in strategy development (source controls, conveyance, end-of-pipe).

7. Developing a management and implementation strategy.
    - Outline key components of management strategy.
    - Develop an implementation plan including public outreach, delivery, monitoring and evaluation plans.

Pollution prevention measures form a key component of both the land use and servicing standards parts in the implementation of watershed plans and retrofit/regeneration strategies and stewardship programs. Some measures (i.e., urban tree planting, park maintenance, and xeric or water conserving landscaping) are integral to land use management strategies aimed at reducing quantity and quality impacts on stormwater runoff. Many measures, referred to previously as ‘source controls’ and now as ‘at source’ or ‘lot level’ control measures (i.e., roof leader disconnection, grassed swales), provide stormwater controls. ‘At source’ control works are generally recognized as effective stormwater management measures. Pollution prevention measures can also be applied as rehabilitation or retrofit tools that often form a key component of a management strategy. Often the retrofit of existing facilities is necessary to meet the goals and objectives set for the watershed.

The selection and application of pollution prevention measures are carried out in steps 6 and 7 above. Invariably, no single management tool is sufficient to meet all watershed goals. Generally, a selection of measures is required to meet all of the set targets and objectives. Pollution prevention measures that provide at-source control facilities can form an integral part of an overall strategy.

Often the measures selected can be implemented through community stewardship. Measures such as reduced pesticide use, xeric landscaping, tree planting, and roof leader disconnection are all measures that can include community involvement. The Centennial Creek Case Study in Part III provides an example of the development of a sub-watershed based plan that includes pollution prevention measures.

4.2 Pollution Prevention and Control Planning Study

Pollution Prevention and Flow Reduction in a PPCP

A Pollution Prevention and Control Plan (PPCP) is typically initiated by a municipality to address water quality concerns from a variety of sources: combined sewer overflows, stormwater runoff, sewage treatment plant effluents and industrial discharges. Often watersheds draining to, or through, the study area will contain non-point sources such as agricultural activity and road run-off in urban areas. The municipality takes a the lead role in planning and implementation of the study, although subsidies from the Ontario Ministry of the Environment and Environment Canada (for RAP areas) have been provided in the past. The Terms of Reference for a PPCP study usually follow a phased approach with the following steps:

1. Problem definition
2. Objective and target setting
3. Monitoring
4. Analysis of the system

5. Development of potential control options
6. Preferred option
7. Implementation

Guidance in carrying out a Pollution Control Plan is available from the Ministry of the Environment (MOE, 1984, Technical Guidelines for Preparing a Pollution Control Plan). However, this document does not outline pollution prevention measures.

The municipality should ensure that the terms of reference are detailed enough that pollution prevention factors are included. A Pollution Prevention and Control Plan is an ideal opportunity to analyse structural and non-structural/preventative measures concurrently. Most quantitative analysis tools (models) can handle flow reduction measures, as long as sufficient detail is allowed for lot-level factors such as percent imperviousness, and accounting for roof, sidewalk and driveway drainage. Minor modifications to existing models may be necessary to account for infiltration measures and some other flow reduction measures. On the other hand, the ability to quantitatively account for many of the pollution prevention measures is limited, primarily because little information is available on performance factors.

Table 4.1 outlines the factors considered in a typical pollution control planning study, compared to the additional factors that would be considered in a pollution *prevention* and control study.

Table 4.1 - Pollution Prevention and Control Plan Factors

Study Activity	Factors considered in Pollution Control Planning Study	Additional Factors considered in Pollution Prevention and Control Planning Study
Problem definition	Scope issues. Specific problems defined such as CSOs, beach closures, basement flooding, channel protection from flooding and erosion.	Recognize initially that pollution prevention is to be an integral part of the study; ensure that degraded natural systems are seen as problem to be addressed.
Objective and target setting	Specific targets for problems set such as: Meet MOE policy objective for CSO of 90% volumetric control; Protect beaches; Control (store) specific storm event for downstream flood and channel erosion control.	Ensure pollution prevention and flow reduction objectives are included, such as: Control maximum amounts of flow at source; Pollution prevention is to be preferred over control at end-of-pipe.
Monitoring	Measure flow and pollutants at outfalls; Define sewer network; Define receiving water impact; Inventory sewer network.	Review operational programs such as road salting, street and catchbasin cleaning, municipal practices for grass management, sewer use by-law enforcement; Monitor storm sewers in dry weather for sanitary and industrial/commercial cross connections.
Analysis of the system	Utilize rainfall runoff model linked to sewer system model to analyse storage and treatment options.	Ensure rainfall runoff model includes features that allow lot-level controls, such as downspout disconnection, and infiltration measures.
Development of potential control options	Combinations of storage, treatment, sewer separation.	Flow reduction at source, pollution prevention measures.
Preferred option	Low cost option that meets objectives, consider other environmental effects.	Ensure maximum PP and flow reduction at source. Choose programs acceptable to public.
Implementation	Project timing. Capital budgets.	Education programs, regulatory changes, EMS initiation, operation and planning budgets.

As shown in **Table 4.2**, PPCPs have been completed in many Ontario municipalities. The PPCPs for Belleville, Trenton and the Severn Sound municipalities deal with stormwater only since there are no CSOs in these municipalities. STP effluents are of concern for Cornwall, Thunder Bay and Windsor, since these municipalities provide only a primary treatment level for their sewage.

Table 4.2 - Pollution Prevention and Control Plans

Municipality	Area of Concern/Watershed
Thunder Bay	Thunder Bay – Lake Superior
Sault Ste. Marie	St. Mary's River - Lake Huron
Penetanguishene, Midland	Severn Sound
City of Sarnia	St. Clair River
City of Windsor	Detroit River
City of London	Thames River
City of St. Catharines	Lake Ontario
City of Hamilton	Hamilton Harbour – Lake Ontario
City of Toronto – Wet Weather Flow Management Master Plan underway	Toronto Waterfront
City of Belleville, City of Trenton	Bay of Quinte
City of Peterborough	Otonabee River (Trent River)
City of Kingston	Lake Ontario
City of Cornwall	St. Lawrence River

Beneficial use impairment attributed to municipal effluents and addressed by the Plans include:

- degradation of benthos due to accumulation of heavy metals and organic chemicals in bottom sediments;
- degradation of aesthetics caused by algae and floatables;
- negative impact to fish and wildlife habitat (e.g., fish advisories, and poor aquatic habitat);
- limitations on recreational use of the receiving waters (e.g., beach postings and fish consumption limits).

Case studies are presented in Part III for the City of Hamilton and the City of Belleville.

4.3 Municipal Environmental Management System (EMS)

An EMS is a commitment to manage environmental affairs of an organization. The International Organization for Standardization provides a formal standard for what constitutes an EMS. The standard ISO 14001 "Environmental Management System—Specification with Guidance for Use" is a widely accepted standard.

In general the procedures are to be documented. Certification with the standard by an outside group is optional and the performance of the management system can be audited. The point is that the process is accountable and that proof of performance of the management system can be established.

What are ISO, ISO 14000, and ISO 14001?

ISO stands for the International Organization for Standardization, located in Geneva, Switzerland. ISO promotes the development and implementation of voluntary international standards, mostly for particular products but with recent initiatives toward Quality (ISO 9000) and Environmental Management Systems (ISO 14000). ISO 14000 refers to a series of voluntary standards in the environmental field. Included in the ISO 14000 series are the ISO 14001 EMS Standard and other standards in fields such as environmental auditing, environmental performance evaluation, environmental labelling, and life-cycle assessment.

Steps in the ISO 14000 Procedures:

- General Requirements
- Environmental Policy
- Planning
- Implementation and Operation
- Checking and Corrective Action
- Management Review

Canadian municipal experiences with EMSs are limited to a few examples:

1. The City of Hamilton is developing an EMS for its Environmental Department – see case study in Part III.
2. The Region of Waterloo developed an EMS for its Waste Management Operations. Cost for the three year period of development to registration (obtained in 1999) include: one full time co-ordinator; two part time support staff (15%); $10,000 for training; in house costs for printing materials; registration audit $21,000.
3. Toronto is developing EMSs for three facilities as a pilot before considering EMS on a larger scale.
4. The Lakeview Water Treatment Plant in Peel Region, operated by the Ontario Clean Water Agency, has completed the development of an EMS and received its ISO14001 registration.
5. Additional details on a municipal EMS are provided below.

What must a municipality do to have an EMS that meets the ISO 14001 standard?

The ISO 14001 standard requires that a community or organization put in place and implement a series of practices and procedures that, when taken together, result in an environmental management system. ISO 14001 is not a technical standard and as such does not in any way replace technical requirements embodied in statutes or regulations. It also does not set prescribed standards of performance for organizations. The major requirements of an EMS under ISO 14001 include:

- A policy statement that includes commitments to prevention of pollution, continual improvement of the EMS leading to improvements in overall environmental performance, and compliance with all applicable statutory and regulatory requirements.
- Identification of all aspects of the community or organization's activities, products, and services that could have a significant impact on the environment, including those that are not regulated.
- Establishing the management system which links back to the commitments established in the community or organization's policy (i.e., prevention of pollution, continual improvement, and compliance).
- Implementing the EMS to meet these objectives, including training of employees, establishing work instructions and practices, and establishing the metrics by which the objectives and targets will be measured.
- Establishing a program to periodically audit the operation of the EMS.
- Checking and taking corrective and preventive actions when deviations from the EMS occur, including periodically evaluating the organization's compliance with applicable regulatory requirements.
- Undertaking periodic reviews of the EMS by top management to ensure its continuing performance and making adjustments to it, as necessary.

Is an EMS under ISO 14001 relevant to municipalities?

Yes. Because ISO 14001 is essentially a system designed to help communities and other types of organizations meet their environmental obligations and reduce the impact of their operations on the environment, it is relevant to all types of organizations. Counties, municipalities, towns, townships and conservation authorities typically oversee a number of separate facilities and operations. EMSs can be used as a framework to help these operations improve their environmental performance and make greater use of pollution prevention approaches.

What are some of the potential benefits of an EMS based on ISO 14001?

- Improvements in overall environmental performance and compliance;
- Provides a framework for using pollution prevention practices to meet EMS objectives;
- Increased efficiency and potential cost savings when managing environmental obligations;
- Promotes predictability and consistency in managing the environment;
- More effective targeting of scarce environmental management resources;
- Enhances position with the public;

- Sets a good example for industries and commercial businesses to follow in managing their environmental concerns;
- Improves employee safety, and reduces the liability associated with the management of hazardous materials and wastes.

Can existing environmental management activities be integrated into the EMS under ISO 14001?

Yes. The standard is flexible and does not require organizations to necessarily "retool" their existing activities. The standard establishes a management framework by which an organization's impacts on the environment can be systematically identified and reduced. For example, many organizations, including counties and municipalities, have active and effective pollution prevention activities underway. These could be incorporated into the overall EMS under ISO 14001. (Reference: EPA Office of Water, Fact Sheet on Web site www.epa.gov).

ISO 14000 Guidance Document for a Business Community

An example of an Ontario-based resource material for an ISO 14000 tailored for environmental protection is found in the ISO 14000 Guidance Document for a Business Community, Queen's Printer for Ontario, October 1998. This document was prepared for the Ontario Ministry of the Environment and the Emery Creek Environmental Association by the Canadian Centre for Pollution Prevention.

The Guidance Document (GD) is tailored to small and medium sized businesses in the Emery Creek Environmental Association, but can be used by any business of a similar size. It helps to focus activities especially if the businesses are organized in an industrial association with common environmental concerns and a goal to improve a local watercourse or the environment in general.

The GD assists these businesses to learn about the usefulness of the ISO 14000 Environmental Management System (EMS) in addressing their common environmental challenges. The document features include:

- Answers in simple language to some of the commonly-asked questions about EMSs and ISO 14000, and why a company should establish an EMS for its business.
- Hands-on workbook format with checklists, simple flow diagrams and pull-out tables make the document user friendly.
- Builds on a company's existing EMS and on user's previous knowledge.
- Can be used as a first-step introductory guide or a source of references for more advanced learning and implementation for self-certification. The user has a choice; do it yourself, get involved in a group, or, if required, get external help. It informs the user where to get professional help for speedy implementation, and how to make use of outside services in the most cost-effective manner.
- Examples of successful solutions to environmental problems as provided by local businesses are included.
- Lists performance indicators for evaluating a company's environmental management.

Benefits to industry include:

- The ISO 14000 or equivalent EMS helps a company to identify opportunities for resource conservation, cost savings, efficiency and productivity.
- The exercise of reviewing, analyzing, formulating and implementing environmental policy procedures and practices required for an EMS will raise a company's awareness of the impact of its operations and products on the environment.
- Conforming to regulations is facilitated and the cost of compliance is reduced as potentially risky situations are recognized and reduced.
- Annual reviews and audits render efficiency and productivity improvements as an ongoing exercise.
- A company's environmental responsibility can be more easily demonstrated.
- A good corporate image and reputation with the public, community groups, investors, bankers, insurance companies, and regulatory authorities are created.
- Clear lines of environmental accountability and responsibility within a company's organization can be created.

A sample environmental policy, from the document, is shown on the following page.

Sample Environmental Policy

With this declaration *Company XXX* publicly recognizes and commits to conducting its business in full awareness of its obligations to the environment. The company understands that it must provide a positive attitude towards compliance with regulatory requirements that govern its industry, minimize risks to adverse effects from its operations and share this responsibility of stewardship with employees, customers, shareholders and the community. In recognition of this responsibility the company will:

1. Endeavor to ensure familiarity with industry standards and compliance with all pertinent federal, provincial and municipal regulatory requirements.
2. Encourage suppliers, agents and distributors to pursue sound environmental practices and programs.
3. Ensure that all employees are aware of their environmental responsibilities and that they are appropriately trained, involved and motivated.
4. Minimize environmental, health and safety risks, conserve energy and natural resources and minimize waste of all kinds.
5. Commit sufficient resources to allow for the proper implementation of efforts and programs to achieve environmental goals.

We wish to promote and challenge everyone in this global community to join us and adopt these statements as basic elements of their responsibility to their respective community and our planet.

_____ President

_____ Date

The guidance document can be obtained from:

The Emery Creek Environmental Association, 857 Fenmar Drive, Weston, Ontario, M9L 1C8, Tel: (416) 749-6373. E-mail: emery@interlog.com

Canadian Centre for Pollution Prevention, 100 Charlotte St. Sarnia, Ontario, N7T 4R2. Tel: (519) 337-3423, Fax: (519) 337-3486, E-mail: c2p2@sarnia.com

Information Officer, Environmental Partnerships Branch, MOE, 40 St. Clair Ave. W. Toronto, Ontario. Tel: 416 327-7721.

4.4 Municipal Sewer Use By-Laws

Many municipalities in Ontario have sewer use by-laws to control discharges to municipal sewers (storm, sanitary, and combined sewers). The *Municipal Act* provides municipalities with the authority to enact by-laws for "prohibiting, regulating and inspecting the discharge of any gaseous, liquid or solid matter into land drainage works, private branch drains and connections to any sewer, sewer system or sewage works for the carrying away of domestic sewage or industrial wastes or both, whether connected to a treatment works or not".

Each municipality must evaluate their operational system and discharges to system in order to establish requirements that control the environmental impacts of these discharges. Local municipal sewer use by-laws can be an effective tool to encourage industries and commercial facilities to prevent pollution because they can:

- prohibit discharges of hazardous waste;
- specify numerical discharge limits e.g., metals, organics, suspended solids, and biological oxygen demand.

Sampling, enforcement, and education play an important role in an effective sewer use control program. Sewer use programs can encourage pollution prevention by increasing awareness of pollutants of concern as well as providing incentives to control discharges and avoid penalties.

City of Toronto Municipal Sewer Use By-Law Example

The City of Toronto adopted a by-law in 2000 to regulate the discharge of sewage and land drainage to municipal sewer systems. This by-law (No. 457-2000) includes different limits for discharge to sanitary and combined sewers, and for storm sewers as well as a specific requirement for pollution prevention planning.

4.5 Sewer Systems, Pollution Prevention, and Management Practices

Pollution prevention planning, best management plans, codes of management practice and environmental management systems can be used as management tools for municipalities and dischargers and can lead to enhanced environmental performance. These tools are often used to complement or enhance quantitative sewer use controls (i.e., discharge limits).

Pollution Prevention Planning (P2)

The term pollution prevention reflects the philosophy that, from both an environmental and a business perspective, prevention is better than cure. In practice this means trying to avoid the costs and risks associated with managing wastes, by not producing wastes in the first place.

Pollution prevention can be achieved by material substitution, product changes, process changes and operational practices. Pollution prevention could be applied to individual specific sites, specific industrial groups or commercial sectors, or all dischargers in a municipality. Approaches for developing a pollution prevention plan are described in Chapter 3.

For example, as part of their sewer use by-law and program, the City of Toronto requires subject sector industries to prepare a pollution prevention plan and submit summaries of the plan to the City. A pollution prevention plan is defined as a detailed six-year plan that identifies operations or activities of an owner or operator of commercial, institutional or industrial premises identifying specific pollution prevention methods. The plan must include a description of pollution prevention options for subject pollutants with a list of possible three year and six year targets to reduce or eliminate the discharge of subject pollutants to the City's sewers. The subject pollutants list includes arsenic and heavy metals, and organic chemicals including pesticides.

Best Management Practices (BMPs) Plans

Best Management Practices Plans (BMPs) are used as a qualitative tool for protecting the environment beyond, or in addition to limits contained in sewer use by-laws. They are designed to reduce the impact of accidental spills or the release of contaminants that are associated with, or ancillary to, industrial manufacturing processes and are generally applied to stormwater control.

A Best Management Plan is generally applied to an individual site. Application of BMPs to all sites in a specific industrial group or commercial sectors, or to all dischargers in a municipality is not usually recommended due to site-specific nature of operations.

The essential components of a BMP plan include: identification and assessment of risk; emergency response plans; reporting of incidents; materials compatibility; good housekeeping; preventative maintenance; inspections and records; security; and employee training. Guidance on developing a BMP Plan may be obtained through the Canadian Centre for Pollution Prevention (http://www.c2p2online.com/) or the USEPA (http://www.epa.gov/).

Codes of Management Practice (CMPs)

A Code of Management Practice (CMP) is a management tool for protecting the environment. CMPs provide a framework for identifying activities that a discharger could undertake to prevent the discharge of harmful substances to the environment, (See Part III Case Studies).

CMPs may be applied to specific industrial groups or commercial sectors. Code of Management Practices by design generally cannot be applied to all dischargers in a municipality unless a CMP is available for each industrial group discharging to the municipality's sewer system.

Environmental Management Systems (EMS)

An Environmental Management System is a management framework for corporate-wide implementation of environmental policies resulting in a high level of environmental performance, (see section 4.3).

The implementation of ISO 14000 by a discharger is voluntary and the status and completeness of the ISO 14000 certification at a discharger's site is verified by auditors approved by the International Standards Organization. Municipalities can also become certified under ISO 14000 for various facets of their operation such as water treatment and supply and sewage collection and treatment.

4.6 Linkages to Other Chapters

This chapter provided municipalities with an overview, and information on different approaches available for pollution prevention. Implementation of these approaches requires technical guidance on pollution control measures (e.g. flow reduction measures, source control of pollutants). Part II of this handbook provides fact sheets on pollution prevention at source, flow reduction at lot level, municipal operations measures, and local drainage and inlets. In Part III of the handbook, case studies of Ontario municipalities are highlighted and practical information on implementing a pollution prevention program is provided. In addition, implementation of pollution prevention measures also requires public support. Chapter 5 offers guidance on garnering support to ensure the successful implementation of pollution prevention programs.

5 BUILDING SUPPORT FOR YOUR PROGRAM AND TAKING ACTION

5.1 Public Outreach and Education

Public education has a significant role to play in pollution prevention because an enlightened and concerned public has the power to alter behaviour at all levels. Pollution prevention and stormwater management initiatives must be understood and supported by the public. If they are not clearly understood, such programs may be viewed as an unnecessary extra cost or a restriction of freedom. Public pressure or even apathy may prevent their successful implementation. **Figure 5.1**, outlines the some of the key roles of public education.

Gaining public support is a continuous process and is often the most neglected phase of solving municipal stormwater pollution problems. Few municipalities have good public information or community relations programs as an integral part of their operations, often because of a lack of funding and staff time.

Role of Public Education

Inform the public about:

- issues
- solutions
- regulations
- financing

Involve the public:

- in remedial action
- in cost saving through volunteerism
- to increase political support

Figure 5.1-Role of Public Education

Schools

Long-range pollution prevention goals can be addressed through school programs, which teach the connectivity between the individual, the land, and the health of the local watercourses. Educating future householders from their early years can positively influence future behaviour in household waste disposal, water conservation and responsible neighbourhood stewardship.

Curriculum-based classroom programs are usually welcomed by local school boards, and may also be designed with the cooperation of local educators.

Community

Short-term goals may be achieved through community outreach programs designed for the general public. These can include projects such as reducing stormwater volumes through downspout disconnection, and the reduction of household chemicals, pet wastes and other pollutants entering storm sewers. Neighbourhood or environmental groups looking for community improvement projects can often provide valuable support. Opportunities arising from news media coverage and publicity of local events can also be used to advantage. Pollution Prevention Best Management Practices displays and presentations can be included as part of municipal events such as the St. Catharines City Open House or beach Clean-Up days.

Business

The commercial sector is a large and diffuse group in many municipalities. Both the business owners/managers and their staff need to be included in any communication activity. Methods of communication may include news announcements in the local press, mailed news items, individual contact and follow-up contacts to answer questions and educate new employees. Public education can also benefit from failures reported in the local press, such as violation of regulations, which results in a citation or fine. This not only informs the reader about regulations but also provides an incentive for the regulations to be followed. An ongoing industrial pollution prevention program is an important part of the Region of Waterloo's Groundwater Protection Strategy, with the focus on active involvement and leadership from the commercial sector itself.

Public officials, governmental institutions and municipal departments should also be informed of pollution prevention programs and their implications. Examples include road, sanitation and parks departments, and workers at public institutions such as hospitals and prisons.

References

Yes In My Backyard (1992). Laurie Fretz. While primarily a guide to rehabilitating urban streams, this manual provides a layman's overview of the issues and problems of urban stormwater management and the impact of pollution on local waterways. Contact the Conservation Council of Ontario. Suite 506, 489 College Street, Toronto, ON M6G 1A5.

Recipes for Clean Water – A Homeowner's Stormwater Survival Guide (1999). William and Judy Beaudrou. Brule Publishing, P. O. Box 641, 3010 Hennepin Ave. S., Minneapolis, MN 55408.

Further information on describing the stormwater management program to the public can be found in *Designing an Effective Communication Program: A Blueprint for Success* (Beech and Dake 1992), and *Urban Runoff Management Information/Education Products* (EPA 1993).

Key Messages for Public Pollution Prevention Programs

In 1998, the Water Environment Research Foundation produced a report, *Residential and Commercial Source Control Programs to Meet Water Quality Goals (Project 95-IRM-1),* summarizing a literature assessment of wastewater and stormwater pollution prevention and public education programs to address non-industrial sources. The study was specific to the United States,

using information from the ten regions of the United States Environmental Protection Agency. In their Final Report on Source Control some important observations are made that are also appropriate to Canadian communities and reinforce material and information reviewed during the preparation of this manual.

The Report states that typical programs and public education material focussed on educating the public that, as individuals, *they* are the non-point sources contributing daily to significant water pollution problems. The authors note that materials usually stressed that protection and future enjoyment of local water bodies depend on individual effort to reduce their share of the pollutant load. Most educational materials listed activities that people could do to reduce pollutants. The most exciting materials key into local interests and use regionally appropriate graphics.

The Report summarizes the key public education messages as follows:

- Stormwater and urban runoff are not generally treated; therefore, as these surface flows reach local bodies of water, they contain all of the pollutants that accumulate from everyday living and commerce.
- By making changes in daily habits, individuals can protect the health of local creeks, streams, rivers, lakes, bays and oceans.

The Report notes that messages addressing specific sources of stormwater pollution include:

- Educating the public that specific sources of stormwater pollution include automobile products, vehicle maintenance operations, litter, pet wastes, pesticides, fertilizer, erosion from construction sites and illegal sewer connections.
- These pollutants enter the storm drain as water from rainfall, overwatering or cleaning operations washes over outdoor surfaces.
- Specific outreach messages to business and/or groups typically revolve around encouraging the business to implement BMPs for their particular activity.

The three most commonly used messages related to wastewater pollution prevention inside homes and businesses are:

1. To protect local bodies of water, it is important to avoid pouring toxic chemicals down drains leading to the sanitary and storm sewer system.
2. Alternative products can readily replace household products that are toxic to the environment.
3. There are properly designed and controlled facilities to safely dispose of household hazardous waste in most areas of the country. The public is usually provided with telephone numbers and other information necessary to make arrangements to properly dispose of common toxic wastes.

Developing a Public Education Program

Figure 5.2, illustrates the major steps in developing a public education program and are further discussed below.

STEPS TO A PUBLIC EDUCATION PROGRAM

1. **Define the issues**
2. **Set objectives**
3. **Identify resources**
4. **Outline tasks and conduct activities**
5. **Evaluate the results**

Figure 5.2: Steps to a Public Education Program

1. **Define the issues**. The public must be aware of the problem in terms of its ecosystem impact, the individual community's responsibility and role as the source of concern, and the regulatory and financial issues involved. The education program must tell the public and clearly outline the options open to the municipality to address the specific issues and how much each costs. Public concerns and questions can be identified through surveys, interviews and public meetings and addressed appropriately.
2. **Set objectives**. The objectives of the public education program are to inform and educate the stakeholders and the public at large about a specific issue. It is important to seek input and involve them in the establishment of a citizen task force. Consensus and support for a stormwater management program is an important goal for the public education program, as well as monitoring the effectiveness of the public outreach through follow-up surveys and other means.
3. **Identify resources.** Available resources can include public, staff, a citizen's task force, educational institutions, partnerships with government agencies and community associations.
4. **Outline tasks and conduct activities**. Important elements of some successful public education programs include:

    - Involving a citizen's task force early in the program.
    - Developing appropriate promotional materials such as brochures and flyers.
    - Providing a telephone 'hot line' or website to provide specific information and respond to queries.
    - Conducting surveys.
    - Producing newsletters.
    - Working with the media.
    - Developing presentation materials, i.e., slide shows, displays, videos, and demonstrations.
    - Making community presentations, including neighbourhood associations and business groups.
    - Sponsoring special events.
    - Holding public hearings.
    - Keeping records of public complaints and concerns.

5. **Evaluate results**. Unfortunately there is often no quantified measure or documented record of the direct improvement achieved by public education and it is difficult, if not impossible, to evaluate the effect of school programs on the behaviour of future citizens. However, there is little question of the value of public education in pollution prevention and stormwater management programs.

   Records of the number of individuals participating in a specific program such as Downspout Disconnection provide a measure of the success of an outreach program. A monitoring program or some form of evaluation should be included in the program design if this is feasible. Progress towards or achievement of targets will indicate success in the implementation of remediation measures.

   Monitoring the effectiveness of the promotional material in reaching the desired target groups may be achieved though informal surveys, possibly conducted by students or volunteers, using a “have you heard of?” approach. A “hot line” can also be used to help measure the success of an outreach program.

Developing Best Management Practices for the Public

Development and promotion of Best Management Practices for householders, businesses or schools makes it easier for individuals to take positive and clearly defined actions that have a beneficial impact on their environment. BMP promotion literature can be regional in appeal or focus on specific sites such as the house, garden or neighbourhood, and specific actions such as proper hazardous waste disposal, reduction of garden chemical use or rainwater management.

The information material should provide not only an explanation of the connectivity of the individual’s actions with the source of pollution, but a workable remedy for the situation. BMP and explanatory materials can be effectively distributed in neighbourhoods where initiatives such as Stormwater Drain Marking (Yellow Fish Road), Stoop and Scoop pet waste programs, are taking place. For reference see Fact Sheets S.P. 8, and 9, and the City of St. Catharines Case Study.

5.2 What is Social Marketing?

Community-based social marketing is the strategic influencing of ideas and permanent behaviour in a community or a chosen target group. Using methods based on those of commercial marketers, a demand is created for the idea and for the solution to the problem which benefits the target group and society in general.

Social marketing includes:

- creating awareness in the community of the problem and the attainable solution;
- developing community interest in the project;
- promoting the desire to participate; and
- sparking action in the target group or in key representatives of that group.

Specific information on community-based social marketing techniques can be found in the publication *Promoting a Sustainable Future: An Introduction to Community-Based Social Marketing* by Douglas McKenzie-Mohr, published by the National Round Table on the Environment and the Economy.

Social Marketing and Pollution Prevention

Social marketing is used by municipalities to promote stormwater pollution prevention actions. These include actions such as the mandatory downspout disconnection program in St. Catharines and the voluntary disconnection program in the City of Toronto. Mandatory programs are more readily accepted and supported by the public if the social and private benefits, the process and the costs are clearly presented and understood. Some municipalities, such as the Region of Waterloo, use social marketing as a means of public education to influence behaviour in such areas as the use and disposal of household chemicals, or vehicle use reduction (e.g., Bike to Work Day civic promotions).

Steps to Successful Social Marketing

Follow the leader

A committed leader is a key component of a successful program. All the case studies reviewed for this manual indicate that a crucial element for success is strong municipal support and dedicated, long-term staff time. Volunteers may provide co-ordination and leadership in some areas but burnout is common and involvement is generally on a part time or short-term basis.

Know your audience

Identifying and learning about the group you seek to influence is an important step. Your target may be a whole community or just one segment of that community. Community profiles are useful tools to develop for many municipal initiatives. Profiles include population demographics, favoured media, influential community leaders and groups, and popular venues like malls and libraries. St. Catharines' city staff indicated that a previously completed community profile provided an invaluable tool during the development of their stormwater management programs, especially for guidance in the most useful venues for communication.

Strong community support is essential for the successful adoption of a voluntary program. Interviews, focus groups and questionnaires can be used to identify the perceptions of a target group regarding the value of the product or idea, the benefits of behaviour change, the amount of effort needed to participate and the physical or social barriers to implementing the program.

Do not reinvent the wheel

Researching and adapting available studies and materials saves time and money. A great deal of relevant material is already available from university libraries, government agencies, local non-profit organizations, river networks and the Internet.

Other communities with similar problems or demographics may be able to provide information on program design, public acceptance and participation. See Appendix C.

Power through partnerships

Where possible seek out partners or community groups with a similar agenda. Universities or high schools often have resources and students that can be helpful for research, surveys, implementation or monitoring of projects. Monitoring or research projects are best developed by approaching local educators with a clear outline of the project, the research needed, time constraints and the assistance or training already available. School schedules and term commitments should be accommodated by providing this information in time to prepare well ahead of the start of the term or even the school year. Even primary or junior school children can be valuable partners in some projects.

Designing the Marketing Strategy

A successful design includes these elements:

- Product or desired behaviour change. The desired results and the most practical method of reaching them (the tools) should be defined from the start.
- Pricing plan. Pricing considerations include the willingness or ability of the target group to pay all or some of the costs. Is it essential to recover all or some of the costs? Will the product be made freely available or will the transaction be dignified with a nominal fee? How much effort must the target individuals expend to participate?
- Place or agents for distribution. What are the distribution channels and who is responsible? What time period and facilities (storage and working space) will be needed for distribution?
- Promotion. How, when and where will the program be promoted? What materials such as flyers, brochures and demonstrations will be needed? What is the cost of the promotion? What media contacts, meetings or interviews will take place?
- Partnerships. Who can provide support and resources? Who will set a strong community example or play a leadership role? Are there linkages that can be made with other programs?
- Process for evaluation. It is not always practical to directly assess the impact of a proactive environmental program. It may be possible to monitor the community acceptance of the program and evaluate the success of the methods used. Direct monitoring, if feasible, should be built into the overall strategy and co-ordinated with other initiatives where possible to avoid repetition and wasted effort.

5.3 Promoting Behavioural Change

Communicate effectively

Program participants must understand the problem and the solution must be seen as attainable. Apathy is the natural reaction of individuals faced with overwhelming problems and complex solutions. Target groups must feel that they can make a difference to the problem with some reasonable activity.

The most successful way to reach participants is by personal contact, with trained representatives visiting households after making initial contact by phone or letter. It was observed in the St. Catharines and Toronto case studies that the most effective communication was that undertaken on a house-to-house basis by summer students. It was felt that the students were perceived by the householder as presenting a less “official” manner and possibly engendered some sympathy with their youth or friendly approach.

Printed materials such as flyers, brochures must be attractive and easy to read, and if necessary, in more than one language. An easy to remember tag line, word or symbol is a valuable marketing tool but it is important to ensure that any symbols used really convey the key message to the audience. A useful maxim is “write not only to be understood, but so that you cannot be misunderstood”.

Printed materials are usually targeted to a specific audience, i.e., neighbourhoods, schools, industries or interest groups, and should be distributed carefully to gain maximum exposure. The literature must present sufficient information to enable the recipients to make an informed choice about responding to a program or changing behaviour. The City of Toronto found that a detailed information package about their Downspout Disconnection program provided a good response during door-to-door promotions. A recognizable symbol on handout material can be useful in identifying a program, but this should be carefully designed to convey the desired message in a clear unambiguous manner.

Remove barriers

Barriers to successful communication and implementation of a program include language difficulties, social constraints and prohibitive costs. Physical problems such as the structure of older buildings and lots, and the age and infirmity of target residents must be considered. Personal visits, provision of advice, and work with strong neighbourhood associations can identify and assist in removing barriers or misconceptions. Extension of outreach working hours to include evenings and weekends may also contribute to encouraging participation in neighbourhood programs.

Promote commitment

A prior commitment by a participant is much more likely to result in sustained behaviour changes. Commitment strategies include eliciting a verbal or written agreement to participate before a home visit to finalise the participation. Publicly visible commitments, such as identifying “blue box” stickers, window or lawn signs, or lists of willing participants in a community newspaper, are important in producing continued participation and sustained behaviour change.

Reminders or prompts are also useful tools to help promote and reinforce actions such as proper waste disposal, recycling, water saving or composting. The prompts are placed where they will be most likely to remind participants of their commitment. Prompts include the ‘Yellow Fish’ symbols placed on storm drains as reminders of the connectivity of the drains and the watercourses. There is added value in this program because of the participation of community children, with the implied support of their parents and neighbours. Many householders also do not understand the value of street cleaning apart from æsthetics, and may be less inclined to allow pet waste and garden refuse to accumulate in roadways if the connectivity of storm drains with local waterways was better understood.

Reminders or prompts in the form of refrigerator magnets or other materials can be distributed or used as “prizes” for classroom presentations. These may provide reinforcement at home for desired pollution prevention or water use reduction behaviours, especially if the teacher assigns “follow up” homework activity.

Set good examples

Respected community leaders can have a strong influence on the behaviour of others in the community and the acceptance of the program. Community groups can help neighbours by setting a positive example, by sharing information and assisting with physical changes. Municipal activities should also provide good examples of desired community behaviour such as waste reduction, pollution prevention, water conservation and xeriscaping in local parks. Municipal operations can set an example by using good housekeeping practices, such as proper dust and waste material management during sidewalk repair programs, etc.

5.4 Developing and Implementing Action Plans

What should your plan include?

Your plan should include these features:

- an objective or goal to be reached;
- a defined target group or geographic area;
- an action or set of actions that will elicit the desired response;
- limiting factors such as costs and timing of other linked programs;
- the time frame within which the actions and responses must take place;
- a marketing, distribution and follow-up protocol;
- a clear understanding of the roles of all participants, staff and partners;
- a reporting and evaluating mechanism.

Figure 5.3 summarizes the three steps to a successful public outreach program, including preparation of a program, and design and implementation of the plan.

Testing and evaluating your plan

Test the action plan first with a focus group or through a pilot project in an area that can be easily monitored. The response can be monitored and the plan refined or changed if necessary before implementing the full community program. Good records should be kept of community responses, problems and recommended future changes. Final evaluation of the results at the completion of the program may not always be possible in proactive environmental initiatives but monitoring should be implemented where possible. Apart from improving future program delivery, the knowledge gained may prove useful for other communities.

Figure 5.3: Steps to a Successful Public Outreach Program