PART III - CASE STUDIES

Part III outlines sample watershed studies, municipally based pollution prevention studies, and flow reduction programs. These 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 Stormwater Retrofit Study;
- Emery Creek Environmental Association;
- City of Belleville Pollution Control Plan – Bay of Quinte Area of Concern;
- Community of Ancaster;
- City of St. Catharines;
- Regional Municipality of Waterloo;
- City of Hamilton;
- City of Toronto; and
- Watershed Infrastructure Ecology Program (WIEP)-Toronto

CENTENNIAL CREEK STORMWATER RETROFIT STUDY

Centennial Creek subwatershed (see **Figure 1.0**):

- Contains one of three major watercourses in Scarborough;
- Drains approximately 740 hectares outletting into Highland Creek just north of Lake Ontario;
- is located in Toronto RAP with the objective to improve near-shore water quality in Lake Ontario;
- has a fully urbanized watershed, predominantly residential;
- is in a state where urbanization has altered the hydrologic cycle and natural ecosystem, however some environmental amenities remain (limited wetlands, relatively continuous stream corridor);
- has no SWM quality facilities;
- is served by separate storm sewers.

What are the Issues and Goals for the Subwatershed?

The objective of this urban retrofit study was to develop a remediation plan for the subwatershed to meet the goal of improved water quality at the outlet of Centennial Creek and environmental conditions along the stream corridor. The stormwater retrofit study was carried out in parallel with the subwatershed study, carried out by independent consultants.

The stormwater quality management goals adopted for the retrofit study were:

A. Ecosystem goals

- Rehabilitate and enhance the existing hydrologic cycle; and
- Rehabilitate and improve the existing runoff quality.

B. Economic goals

- Integrate stormwater quality management strategy with municipal capital works and operation programs; and
- Minimize the cost of stormwater quality management in urbanized areas.

The ecosystem and economic goals were then defined by the following objectives:

1. Reduction of the existing annual runoff volume up to 25%;
2. Reduction of the existing annual total suspended solids loading up to 50%; and
3. Application of proven and cost-effective retrofit stormwater management practices (RSWMPs).

What approach was selected?

The management practices selected included a blend of at-source, conveyance and end-of-pipe controls (i.e., SWM ponds). Controls were to be selected in a hierarchy, with source controls preferred over conveyance controls which in turn were favoured over end-of-pipe controls. This is common to all watershed strategies in that a blend of measures is necessary to provide the most cost-effective approach.

The measures selected in this case are listed as follows:

- Downspout disconnection
- Oil/grit separators
- Stormwater exfiltration systems
- Stormwater quantity pond retrofit for quality control
- Stormwater quality ponds

How were the measures applied?

The facilities were evaluated for effectiveness in water quality protection and stormwater volume reduction. This was based on the removal/reduction efficiency of each measure and the consideration of a number of alternatives.

A combination of strategies can achieve most of the solids loading reduction target - 47% TSS reduction compared to the target of 50%, and all of the volumetric target of 25% flow volume reduction. The recommended strategy, which costs $2.1 million should be implemented as follows:

First 5 years

- Twenty percent of the feasible residential areas will have downspouts disconnected;
- The existing stormwater quantity pond will be retrofitted to provide water quality treatment; and
- A new stormwater quality pond will be constructed on City’s property.

Over 15 years

- Fifty percent of the feasible residential areas will have downspouts disconnected;
- Twenty percent of the feasible commercial areas will be retrofitted with oil/grit separators; and
- Ten percent of the feasible roads/sewers in good condition now will be retrofitted with exfiltration systems as they deteriorate;

Over 25 years

- All the feasible residential areas will have downspouts disconnected;
- Thirty percent of the feasible commercial areas will be retrofitted with oil/grit separators; and

- Twenty percent of the feasible roads/sewers in good condition now will be retrofitted with exfiltration systems as they deteriorate;

Operational controls such as improved street sweeping practices and increased catchbasin sump maintenance and sewer flushing are also recommended to complement the strategy and make up the remaining 3% of the target objective of 50% total suspended solids load reduction.

Currently, most of the municipal capital and operating projects, such as road and sewer reconstruction or rehabilitation, in the Centennial Subwatershed are developed without consideration for stormwater quality improvement.

A sequence of actions the municipality may implement were identified:

1. A new stormwater quality pond on the city-owned site should be investigated. As land is redeveloped in the subwatershed, additional stormwater quality ponds should be considered as part of the redevelopment requirements.
2. As a capital project, the existing quantity pond should be retrofitted to provide a water quality treatment function.
3. All the feasible roads/sewers, which have been currently identified to be in poor condition, should be retrofitted with stormwater exfiltration systems as they are reconstructed or rehabilitated in the next 15 years. In the long term, as more roads/sewers need reconstruction, the stormwater exfiltration systems should be applied.
4. The feasible residential areas should have downspouts disconnected gradually. Ways to achieve a higher percent coverage for downspout disconnection should also be investigated, including combinations of subsidies, regulatory measures and application of additional technologies such as rain barrels and soak-away pits.
5. Where feasible all the roads in the commercial areas should be retrofitted with oil/grit separators as they are reconstructed or rehabilitated. Oil/grit separators can also be considered for retrofit in additional road systems, especially in high traffic areas where there is a higher potential of spills.
6. A methodology for measuring the benefits of the RSWMPs on receiving water should be developed.
7. The recommended stormwater quality management strategy should be reviewed and updated periodically as part of the Capital Budget Process.

References

Macviro Consultants Inc. 1995, *Centennial Creek Subwatershed Study Phase II* Report, City of Scarborough, Ontario, Canada.

J. Li., D. Weatherbe, D. Mack-Mumford, M. D. Andrea, *A Stormwater Retrofit Plan for an Urban Subwatershed, in Advances in Modeling the Management of Stormwater Impact*s – Vol. 6, W. James, Ed. CHI Guelph 1998.

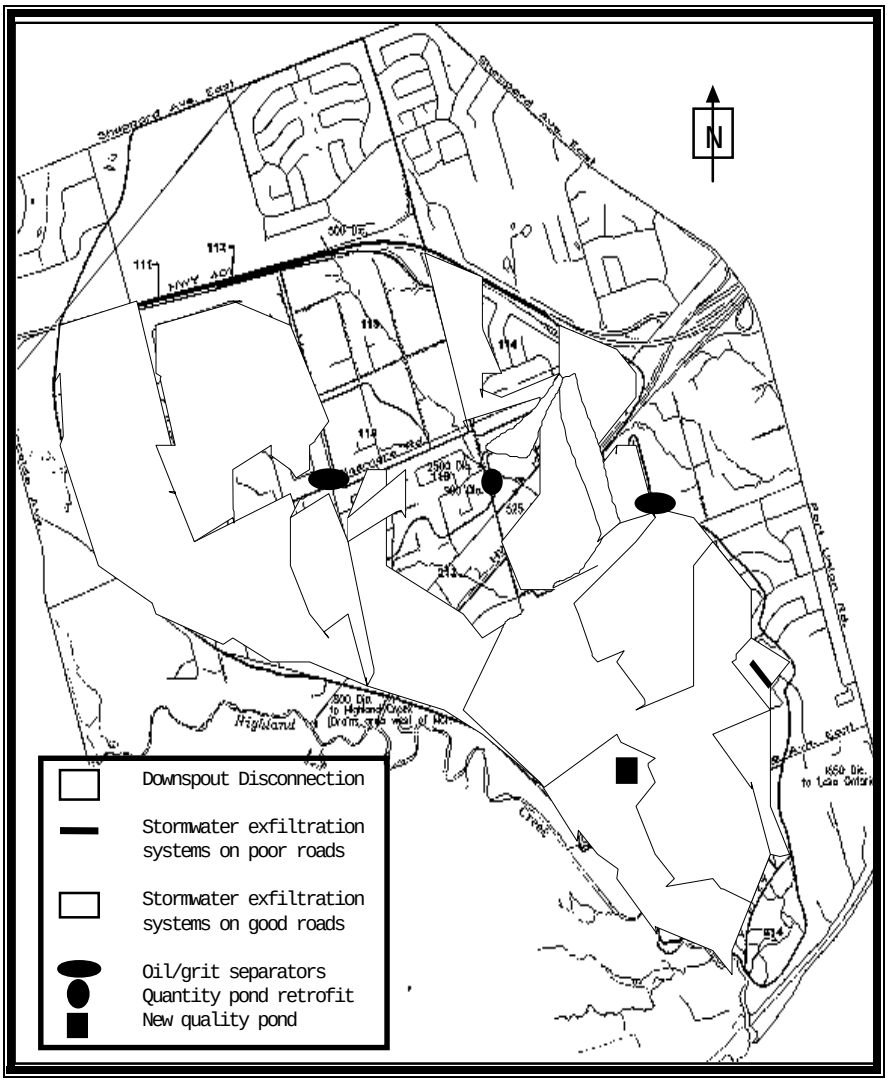

Figure 1.0: Centennial Creek Subwatershed

THE EMERY CREEK ENVIRONMENTAL ASSOCIATION

Emery Creek

- is a tributary to the Humber River draining a mixed industrial-commercial-residential area in Toronto, Ontario.
- was identified as the most polluted creek in the Humber watershed, and one of the worst polluted in Toronto, with high levels of contaminants and frequent chemical spills.
- has a drainage area of 700 hectares with over 3000 industrial and commercial businesses.

An industrial association was formed in 1993 to address watershed concerns.

What are the problems or issues?

Water quality problems in the Humber River were defined in the Toronto Area Watershed Management Strategy (TAWMS) study completed in 1986. Emery Creek was determined to be a primary source of fecal coliforms, heavy metals and phenolic compounds. Frequent spills were reported attributed to industrial and commercial sources. Most of the watercourse is either buried as sewers or converted to concrete channels.

The area has over 3000 industrial and commercial businesses with some residential land use. The businesses include almost every sector including food production, telecommunications, pharmaceuticals, automotive repair and waste management. Company sizes range from small “mom and pop” service businesses to 1000 employee manufacturers.

Enforcement activities of anti-pollution legislation and municipal by-laws was effective for large spills or obvious pollution offences, but could not prevent further spills from the many different companies, and did nothing to stop the polluted runoff from all the activities and sources.

How did they respond?

- The TAWMS study proposed that a stormwater management pond be constructed at the mouth of the creek, to treat all of the dry weather flow and capture spills, and treat part of the wet weather flow. This proposal is the subject of a Class Environmental Assessment study with Toronto as the proponent. EA approval was given in 1998. City Council has directed staff to form a neighbourhood liaison committee and proceed with detailed design.
- The Emery Creek Environmental Association was formed in 1993 to improve water quality in the creek through control at the source - in the industries and commercial businesses in the watershed.

Mission Statement

Emery Creek Environmental Association is a non-profit association of businesses and industries within the Emery Creek watershed. Our mission is to heighten the awareness of environmental responsibility for ourselves and our community, through voluntary participation in activities for pollution abatement. Our aim is that through voluntary participation, the health of this watershed, and consequently the Humber River and Lake Ontario, will improve to provide a sustainable benefit for this association, and all businesses and residents of our community.

Focus of Program

The program focuses on reducing the water and air pollution in the Emery Creek watershed through the promotion and facilitation of pollution prevention to local businesses. This includes identifying practices that lead to contamination of stormwater runoff from land drainage, and activities that could lead to spills into the storm system. It also includes reducing toxic discharges to sanitary systems to reduce contaminants in sewage treatment plant discharges and biosolids. While Emery Creek sewers are not combined, this focus in other systems would also reduce contamination in combined sewer overflows.

Education Program

The focus of the education outreach program has been to educate the business and residential community on the impact of pollution on the environment, and the pathways of pollution in an industrialized watershed, as well as foster and promote an environment where all parties can benefit from pollution prevention at the source.

Components of the outreach program include:

- A storm sewer marking program on business sites with the message “DO NOT DUMP — FLOWS TO CREEK”
- A newsletter with technical articles, pollution prevention tips, advice on ISO 14001, meeting notices, and success stories.
- Technical seminars on related environmental and pollution prevention topics. Often the free seminars cover issues that otherwise would cost several hundred dollars for participants to attend. This removed a major impediment for staff of small businesses to participate. Businesses are encouraged to suggest topics of particular relevance or interest to them, specifically within their environmental management practices.
- The Association supports a Resource Centre that businesses have access to in developing a pollution prevention plan.
- The Association helps companies in receiving recognition for accomplishments through government award programs.
- The Association facilitates networking between business, governments and non-governmental organizations for information sharing, pollution prevention planning and waste exchange.

Newsletter - Up the Creek

Recent issues have included articles on community recycling, energy efficiency, Bell Canada's returned material collection program, by-law enforcement issues, Ontario's pollution prevention program, transportation of dangerous goods information, and carpooling.

The newsletter is distributed to all industries in the watershed and serves as a major notice board and education vehicle for all businesses, including those that don't otherwise participate.

Challenges Addressed

- Raise awareness of the watershed environment - Many businesses do not know that they are part of a watershed with water quality concerns and an aquatic community to protect.
- Correct misconceptions - Storm sewers don't receive treatment and discharges to them can damage the watercourse.
- Identify key individuals in businesses - Change in an organization must be made by decision-makers.
- Be flexible in approach - Smaller businesses need more help and outreach since they generally do not have the time or resources to get involved.

Key Message

The association is selling a product. The "pollution prevention product" is not a cost item. Pollution prevention increases profits, improves production, and fosters a good corporate image while improving the environment.

Advantages of Approach

- The Association is voluntary and is not a government agency. Members are more likely to participate if they don't think they will be prosecuted for practices that may be exposed.
- The Association can respond to needs of the membership with direct support and advice, and tailor education seminars to direct requests and identified needs.
- The Association can take advantage of government support through grants and resources provided through pollution prevention programs.
- The Association membership often provides free advice from larger companies with professional environmental staff that offer consulting and training to smaller companies.

- As an environmental organization with a focus on businesses, the Association is in a unique position to bridge the gap between business and industry and to effectively liaise with both, as well as with the local residents and local organizations.

Guidance Document

A project to create a guidance document for ISO 14001 registration for small businesses has been developed with the participation of Emery Creek businesses, and support from the Ontario Ministry of the Environment, and coordinated by the Canadian Centre for Pollution Prevention. The document contains a model Environmental Management System, a model implementation plan, a checklist for the ISO 14001 standard, documentation of Emery Creek members' experiences, and a list of external resources.

References

This summary is based extensively on *"Up the Creek Without Pollution! Stormwater Pollution Prevention in the Emery Creek Watershed"* by Cheryl Gonsalves, Executive Director, Emery Creek Environmental Association, and Harold Leadlay, Environment Canada.

The Emery Creek Environmental Association may be contacted at 857 Fenmar Drive, Weston, Ontario, M9L 1C8. Tel: (416) 749-6373. E-mail: emery@interlog.com Website: www.interlog.com/~emery

CITY OF BELLEVILLE POLLUTION CONTROL PLAN – BAY OF QUINTE AREA OF CONCERN

The City of Belleville is:

- situated at the mouth of the Moira River, on the Bay of Quinte, Lake Ontario;
- is a primarily urban area in eastern Ontario;
- has a population of 46,000;
- lies within the jurisdiction of the Moira River Conservation Authority;
- is serviced by a separated sewer system;
- is responsible for stormwater management;
- can be contacted through the website http://www.city.belleville.on.ca

What are the problems?

Bacteriological contamination of surface waters in the Bay of Quinte has impaired beneficial use related to recreational activities in the Bay. The bacterial contamination is attributed primarily to stormwater runoff.

The Pollution Control Program for the City of Belleville quantified and located the sources of bacterial contamination under both dry and wet weather. Under dry weather, some of the storm outfalls are occasionally contaminated. However, the level of contamination is quite variable. For those sewers that were consistently contaminated, the source was identified and the problem tributary lines were isolated. Sanitary cross-connections and/or sewer leakages were suspected to be the cause of bacterial contamination in these lines.

During wet weather, bacterial contamination occurs in the receiving waters of the Moira River, increasing by approximately an order of magnitude compared to dry weather periods. These elevated bacterial concentrations lead to contamination of east Bayshore of the Bay of Quinte within the City of Belleville and a beach (Riverside Beach) within the Moira River.

The high levels of bacteria are attributed to wash-off of bacteria-laden sediment from urban surfaces, and suspension and transport of sediments that accumulate within the storm sewers during rain events. For the Riverside Beach, however, pigeons residing under the highway bridge upstream of this location are suspected to be the source of contamination since the contamination occurs during both dry and wet weather.

How did they respond?

A stormwater control plan was developed for the City of Belleville. Core components were:

(1) a source control program;

(2) a centralized stormwater retrofit treatment; and

(3) project-by-project stormwater control and treatment. Recommendations related to source control include street sweeping/catchbasin cleaning, identifying/eliminating sources of dry weather storm sewer contamination (sewer cross-connections), minimizing runoff from existing industrial and commercial properties, pet-litter control, public education, and minimizing runoff volumes as a principle to be applied to new development and to road/sewer reconstruction projects.

For (2), the recommendations consist of installation of end-of-pipe stormwater treatment to treat existing outfalls, where opportunities exist. For the project-by-project stormwater control and treatment, a stormwater control policy was recommended that sets out guidelines and procedures for reviewing the design of drainage systems for all new development and redevelopment projects, as well as road and sewer improvement projects. This policy is intended to ensure that, on each project, all opportunities are utilized to reduce stormwater volumes and stormwater contamination.

Disinfection, using ultraviolet irradiation, was recommended for consideration, only for those areas of high recreational use. Other recommended control measures included:

a) continued surveillance of the storm sewer system for bacterial sources,

b) following the recommended stormwater control policy,

c) construction of end-of-pipe stormwater quantity/quality ponds for specific outfalls, and

d) implementing a bird control program (at the Highway 401 bridge) for reducing/eliminating the pigeon population, and a public information program to discourage feeding of gulls and waterfowl.

Estimated cost of the control measures was $3.18 million.

THE COMMUNITY OF ANCASTER

The Community of Ancaster (former Town of Ancaster)

- is a primarily urban area of 174.55 km² in the New City of Hamilton (former Regional Municipality of Hamilton-Wentworth);
- lies partly within the jurisdiction of the Niagara Escarpment Commission;
- drains partly to the Grand River and partly to creeks of the drainage system of Hamilton Harbour;
- has a fast growing population of 23,403 (1996 figures);
- is responsible for stormwater management;
- is serviced by an 85% separated storm and sanitary sewer system and 15% septic systems alone;
- will provide information through Richard Tupholme, Director of Engineering, at the Town of Ancaster Offices, 300 Wilson Street East, Ancaster, Ontario. L9G 2B9.
  Phone: (905) 648-4405. Fax: (905) 648-3557.

What are the problems?

Water quality in Ancaster Creek and other local water bodies is impacted by stormwater drainage from a rapidly urbanizing area. Some creeks have an easement for City staff to perform maintenance, while some lie completely within private property. There has been some difficulty meeting environmental regulations and goals with neighbourhood resistance in some areas.

How did they respond?

The main focus of the pollution prevention efforts is through new commercial development and redevelopment designs and a strong partnership between the developers, the Town staff and neighbourhood representatives, and the Hamilton Region Conservation Authority.

Pollution Prevention Programs

- A new large commercial development is taking place in Ancaster. As part of the development process, roof water can be directed untreated to the storm sewers, but drainage from parking areas must be treated by the use of oil/grit, or other environmental engineering solutions. It is the responsibility of the owner to provide a maintenance plan and to carry out the necessary actions. Town staff have an easement on the new development which can be used to deal with reported problems.
- The use of filter strips, oil and grit separators, grassy swales, infiltration control and the use of existing ponds to control water volumes is encouraged with redevelopment.

- The Town's use of road salt, fertilizers, herbicides and pesticides has been reduced over the past several years. Road salting now is done successfully with a mix of 85% sand and 15% salt.
- Roads are ploughed quickly after snow events and there are few steep grades in the urbanized core. Pesticides and herbicides have not been used on Town properties for several years.
- An "Adopt a Road" project is being considered as part of a public anti-littering program.

Background Studies and Planning

In 1995, 60 municipalities were asked to comment on the draft Town of Ancaster stormwater management policy. Comments were studied and some of the recommendations already implemented.

Some progress is being made towards getting a common stormwater management policy for the City of Hamilton.

Staff Commitment

Because of limited staff and funding, environmental education and public outreach is built into the daily activities of the Town staff.

Public Education and Outreach

- **A neighbourhood representative** is included as an important part of the Committee dealing with the new commercial development. Stewardship and partnership is advocated and encouraged.
- **Information was provided by letter to residents with properties adjacent to Ancaster Creek**. This stressed the importance of the natural environment of the area and the negative impacts on the creek of some human activities. A repeat letter is being planned for the near future.
- **A Hazardous Waste program** is in effect in partnership with the municipalities of Flamborough and Stoney Creek. Monthly bulk waste pickups are made in all three communities. Residents are provided with information about disposal of household hazardous waste at a Hamilton depot.
- **A yearly calendar** is provided to all residents of Ancaster. This lists the dates of all Town garbage and recycling collection, leaf and Christmas tree pickups, community events, recreation registration and useful environmental information and phone numbers.
- **Environmental brochures and leaflets** from a variety of sources are available at the Town offices.
- **Yellow Fish Road Program.** Permission was given to a local group to carry out storm drain marking, but has not yet been implemented by the group.

THE CITY OF ST. CATHARINES

The City of St. Catharines:

- is situated along 25 kms of the south shore of Lake Ontario, and bounded on the south by the Niagara Escarpment;
- has a population of 130,000 in an area of 100 km²;
- encompasses two major watercourses and over 25 urban creeks;
- is predominantly urban development;
- is responsible for local water supply and wastewater collection;
- is serviced with about 40% fully combined, 30% partially combined and 30% fully separated sewer areas;
- provides information and contacts at the website www.city.stcatharines.on.ca

What are the problems?

The older areas of St. Catharines have combined storm and sanitary sewer systems. During rainstorms, overflow points allow the excess water and dilute sewage to escape into local creeks causing bacterial pollution in the creeks and eventually impacting the City's four Lake Ontario beaches.

Basement flooding was also a chronic problem in combined and partially combined sewer areas because of this overloading.

There was an operational efficiency impact at the Water Pollution Control Plants as well as the added cost of treating large volumes of "clean" rainwater along with household wastes.

How did they respond?

Pollution Prevention Programs

Background Studies and Planning

The St. Catharines Area Pollution Control Plan (SCAPCP) was initiated in 1986 after a series of water quality discussions with the (then) Ontario Ministry of the Environment and Energy

(MOEE). Study management was broad-based and included most government agencies with jurisdictional responsibilities regarding the area's nearshore water quality. This included the MOEE, the Cities of St. Catharines and Thorold, the Region of Niagara and the Niagara Peninsula Conservation Authority. A major public consultation component was included.

The study area encompassed the linked combined, sanitary and storm sewer systems of the Cities of St. Catharines and Thorold. Jurisdiction is split with the Region of Niagara operating two Water Pollution Control Plants sited near the lakeshore, pumping stations and large inter-municipal trunk sewers. The two municipalities of St. Catharines and Thorold manage the remaining collection system. Land use, sewer servicing and pollutant loadings were evaluated. All surface waters in the study area were considered, and the four beaches were also assessed.

Between 1986 and 1990, the plan was formulated to manage water quality concerns and pollutant sources with a focus on controlling combined sewer overflows within the study area. SCAPCP was completed in June 1990 when the City Councils endorsed the recommendations of the Pollution Control Strategy.

The Strategy provides recommendations for almost $100 million of major pollution control capital works and prioritized implementation over twenty years. A Five Year Initiation Plan (FYIP) outlined annual programs for dry weather seepage abatement, water quality monitoring, downspout disconnection, water conservation, enhanced pet litter control and public education. The FYIP also included direction to carry out sewer infrastructure needs assessments in several high priority combined sewer catchment areas followed by construction of combined sewer overflow control facilities in lakefront areas.

In 1998, all of the annual programs were well established and the majority of recommended capital works are complete and operational. Three CSO retention facilities are in place. The costs for these facilities totalled about $6 million and funding partners included the Ministry of the Environment, the Region of Niagara, St. Catharines and Great Lakes 2000 Cleanup Fund (now Great Lakes sustainability Fund). Ongoing programs include:

- Dry Weather Seepage Pollution Abatement. A field survey in 1984 identified sixteen sewer pipes with dry weather effluent concerns. Problems related to minimal freeboard under dry weather conditions, trash rack maintenance for CSO drop-through grates, and residential cross-connections. The Cities of St. Catharines and Thorold undertook corrective actions.
- A field survey program was initiated in 1986 as part of pollution control planning to provide information on the quality and quantity of dry weather discharges from the area's outfalls. The program was initiated to identify outfalls receiving flows contaminated by illegal cross-connections of sanitary to storm sewers, commercial or industrial discharges, improper residential sanitary connections, septic tank overflows, or improperly functioning CSO regulators. The implementation of an annual program was recommended within the Strategy and an annual summer program was established in 1990. Immediate benefits were realized with eight significant dry weather pollutant sources eliminated for an estimated loading reduction of 13,000 fecal coliforms per second.

- The program continues each year to update the computer database and investigate priority outfalls. The program's benefits were greater initially since the solutions for identified problems were more obvious. Investigations now produce steady progress but remedial measures take longer to define and implement since the problems are usually complex, i.e., source identification in large catchment areas, grade incompatibilities between laterals and sanitary sewers, etc. A budget of $20,000 has been allocated in the past for remedial works. This has now been reduced since the pace of the investigations limits the spending of the budget. Some works require budget allocations and engineering and design in the following year.

Regulations and By-Laws

- City of St. Catharines By-Law 91-364 prohibits the direct connection and discharge of roof water into the municipal sanitary or combined sewer system.
- By-Law 83-80 requires dog owners to remove waste left by their dog on public or private property. There is a "passive" enforcement program to encourage citizens to act responsibility and clean up after their pet.

Staff Commitment

A Pollution Control Plan Section was created within the City of St. Catharines' Engineering Department. Three contract staff became permanent, and temporary and student staff is used to address periods of peak "work load" (e.g., up to 8 summer students). Participation in college/university/high school co-op or internship programs supplements staff without additional costs. In 1999, the permanent staff complement was increased by two positions.

Public Education and Outreach

A well-developed public education program focuses on promoting sound environmental practices by the homeowner. Typical presentations cover water conservation, household hazardous waste disposal, responsible pet litter disposal and overall environmental awareness. Public outreach programs include the following:

- **A City day** was held in 1997 and 1998, when City Hall was opened to the public on a Saturday. All the annual programs noted in this case study were represented at a staffed display seen by over 500 residents. Mall and library displays are held about five times each summer using student and other staff to present information on BMPs. No-cost advertising of public education events are aired on local radio stations during their community event listings. Display materials are periodically updated but otherwise materials are well stored and organized and are used for each session.
- **An annual beach and waterfront "clean up" day** is held to promote environmental awareness. This involves up to 300 school children and is organized by the City and the Niagara Peninsula Conservation Authority. The event is usually co-ordinated by a co-op student working from either office who provides teacher's information such as details on proper dress, safety issues and supervision requirements.
- **Information displays** are provided at two popular beaches. Informative, material on all of the Pollution Control Section activities is rotated throughout the summer season.

- **Environmental resource expertise** is provided by staff persons to the local community. For example, Niagara College has formed a committee of local technical advisors to assist with the development of environmental courses such as watershed management and aquatic habitat restoration. City staff provides a base of volunteer lecturers in relevant subjects. College and university mentorship is becoming an increasingly important component in the initial development of environmental projects.
- **School presentations** include both water conservation and pollution prevention topics. From 1996 to 2001, co-op students, sometimes federally or provincially funded, gave presentations to about 15,000 school children. Use is made of many educational materials available through municipal, provincial, federal, and technical associations as well as other sources. Brochures have been produced using the Environment Canada customized brochure software. Promotional materials used include pencils, magnets, stickers, posters and pamphlets.
- **Downspout Disconnection Program.** This has been one of the most successful and cost effective, pollution control programs. It focuses on education and enforcement to ensure that homeowners with downspouts discharging directly to combined or sanitary sewers disconnect and redirect them for discharge on their property. Based on earlier experience, it was not deemed cost effective to pay homeowners to disconnect downspouts and the success of voluntary disconnection was questionable. Prior to active enforcement of the City's sewer use by-law, an intensive public education campaign was carried out in 1991. Funding of $10,000 was received from the Clean Sweeps Program through the Ontario Ministry of the Environment.

  Preparations included:

  - A brochure, distributed to over 30,000 homes in combined or partially combined sewer areas.
  - A comprehensive display including a video and sample disconnection materials.
  - Mall displays presenting information and advice to interested citizens.
  - Printed materials such as community newsletters and inclusions in recreation program guides.
  - Media messages through the local newspaper and radio.

  The program began in 1992, with well-trained summer or temporary staff making "door-to-door" contact with residents in defined high priority sewer areas. Staff provided disconnection advice and available options, supplying information on swales, soakaway pits and rain barrels. Disconnection is not voluntary or optional, and no exceptions were made. Homeowners received three follow-up inspections before being referred for legal action. Legal action has not yet been taken in any instances given the consistently high compliance. A recent Ontario Court of Appeal decision, Oosthoeck v. Thunder Bay (1996) O. R. (2^{nd}) 323, awarded damages to a plaintiff because the municipality did not enforce its 'downspout disconnection' by-law. This highlights the need for not only a by-law but also a downspout disconnection program.

Work on private property is not subsidized or supported in any other way than in an advisory capacity. Program costs are equivalent to a person per year, however the summer component usually involves two students that generally receive wage subsidies from provincial or federal sources. In 1998, over 11,500 homes were inspected and compliance was over 95% after the third inspection. A database contains information on all aspects of compliance and notification. An update for March 1999 shows 93.2% compliance for 14,757 records.

The program is labour intensive with hundreds of phone calls and kilometres logged. It has proven very effective and provides an educational opportunity at the grassroots level. Public support is positive and City Council continues to support the program despite several challenges.

The "theoretical" success of the program is gauged periodically by calculating the annual savings in terms of reduced sewage treatment cost based on the amount of rainfall diverted from direct discharge of roof water to the sanitary sewers. The biggest impact of the program is to "shave" the peak from sewer system response to intense rainstorms that will serve to reduce CSOs and alleviate basement flooding. Flow monitoring shows this is achievable, particularly in small catchments. In large catchments the results are not so apparent because of sewer system complexities and the impact of other inflow sources.

- **Flood Alleviation Project (FLAP).** A flow reduction program, started in 1991, is aimed at residents with basement flooding problems. Prerequisite for assistance is downspout disconnection and chronic flooding problems. A $150 fee must accompany each application and this is rebated once the FLAP measures are completed. A grant of $2,500 per applicant provides homeowners with basement flooding protection. This is achieved through the installation of backwater valves and disconnection of foundation drains from the combined/sanitary sewer system for discharge to the surface via sump pump. A provision for backup power supply is included as an eligible cost within the grant allocation. Work is carried out by local contractors in accordance with the Plumbing and Building Codes. The homeowner is also required to sign a waiver precluding municipal liability should any further basement flooding occur.
- Public education is a strong component of this program. Demonstration materials are taken to homes as requested. Follow-up visits are made to ensure commitment to the program. The program helps relieve localized sewer constraints and somewhat reduces the CSOs through the decrease in extraneous flows. In 1996, a year-round contract person was hired to oversee the program as part of their duties.
- Since 1994, FLAP has been funded solely by the City and has increased its budget allocation. From 1995 to 2001, about 270 residents have taken advantage of the program for a cost of about $600,000. The 1996 budget was exceeded with the occurrence of a 100-year storm. The 1998 budget was about $75,000 to accommodate 30 installations, which is expected to be sufficient unless there is another major flood. By March 1999, over two hundred homeowners had taken advantage of FLAP.
- **Pet Litter Program.** A "stoop and scoop" program has been operating, on and off, depending on funding and budget constraints. 1n 1992, 1994 and 1995, a summer student was dedicated to implementation at costs ranging from fully funded to about $3,000. The program is now incorporated into general summer student duties since it is fairly well researched and can be implemented satisfactorily without a dedicated co-ordinator.

- "Stoop and Scoop" bag dispensers and receptacles are provided to promote responsible pet care at the City's beaches, parks and walkways. A student stocks the dispensers weekly and conducts surveys of park users and dog walkers to determine the impact and support of the program. The annual budget allocation for the purchase of promotional materials and signs remains at $2,500.

  Dispoza-Scoops were also provided to area veterinarians and animal clinics in 1994 for distribution and their reaction was positive. Sponsorship for the scoop dispensers has been considered but the level of effort to initiate and maintain any arrangements was not considered cost effective in terms of the resultant reduction in pollutant loadings to local waters.

Policy Review and Recommendations

Financial Considerations and Support

The St. Catharines Area Pollution Control Plan Study costs totalled about $1.1 million, with the MOE contributing about 70% and the remaining funding contributed by St. Catharines, the Region of Niagara and Thorold.

Partnership and cost sharing efforts of the City and the Region of Niagara ($72,400) supported a computer modelling/flow monitoring assessment within the entire drainage catchment for one of the Water Pollution Control Plants. The study used 11 temporary sewer flow monitoring sites supplemented with 16 permanent regional sites throughout St. Catharines/Thorold, and $100,000 worth of flow monitoring equipment for permanent City sites. The premise for municipal support was alleviation of basement flooding.

Funding of $10,000 was received from the Clean Sweeps Program through the Ontario Ministry of the Environment for the Downspout Disconnection Program.

Municipal staff is focusing on developing partnerships, possibly on the private side to promote a type of "adopt a sewer" concept. A business development component will be an integral part of the Strategy to generate both funds and support from the community for continued implementation of Strategy recommendations. The municipality also implemented a 20% sewer surcharge in November 1996, based on water consumption. This surcharge is separate from the General Levy, and is used for water infrastructure management.

Monitoring and Evaluation

There are documented water quality improvements related to the St. Catharines lakefront beach area. Before 1994, the beaches were permanently posted with placards indicating swimming related health risks. Since 1994, the beaches have been are placarded between 50% to 70% of the summer season. Section staff sample five beach locations seven days per week. A database is maintained to track posted water quality, hazard notices on the beaches and to assess water quality. As well, sampling of the major watercourses continues with time of travel and water quality assessment carried out each year. Other monitoring programs are built into the Section budgets as required.

Both the Region of Niagara (16 sites) and the City of St. Catharines (8 sites in 1998; 4 sites in 1999) have established permanent telemetered flow monitoring within the City.

Water Efficiency Programs

Background Studies and Planning

The implementation of a water conservation program was not considered within the Strategy, however, an annual summer program was established for the residential sector in 1993. Water efficiency is built into the overall public outreach program. The goal of the program is to optimize the operation of the combined and sanitary sewer systems' operations by reducing the clean water flows from the private side.

Staff Commitment

In 1993, the first summertime program began with an Environmental Youth Corp (EYC) funded student. Initially a research component was included to provide the basis to develop a program.

Public Education and Outreach

- Educational programs are carried out by summer students and EYC participants in summer camps and in the fall, in local schools. These include:
  - An initial contact with the school curriculum services department.
  - Classroom presentations on the hydrologic cycle, water conservation, wastewater treatment, the use and installation of water saving devices, and reinforcing puzzles and games.
  - A see-through toilet demonstration.
  - Distribution of 100 water conservation kits as demonstration material and prizes during presentation.
  - Distribution of magnets, posters, stickers or pogs for teachers and students.

  Each year program co-ordinators are required to document procedures, text for presentations, contacts, and recommendations for next year's program. Students are hired more for "people skills" than technical knowledge.
- Through public education efforts, homeowners are provided with information to enable them to lower their water and hydro bill (by reducing the amount of hot water used). Although this results in lost municipal revenue, the benefit is achieved by reducing pressures on the water treatment, distribution, sanitary and wastewater systems and the potential of prolonging the life of the infrastructure.

Financial Considerations and Support

The cost for the 1996 school and summer camp education program was about $14,500 for partially subsidized staff and $1,500 for promotional materials. Since fall 1998, the program has been run year round with co-op students (fall and winter) and summer students.

A Port Dalhousie CSO Abatement Study was carried out in 1999, and cost-shared between the City and the Region of Niagara. This will refine the recommendations of the 1990 Pollution Control Strategy.

THE REGIONAL MUNICIPALITY OF WATERLOO

The Regional Municipality of Waterloo:

- includes the Cities of Cambridge, Kitchener and Waterloo and the Townships of North Dumfries, Wellesley, Wilmot and Woolwich;
- is responsible for water supply, wastewater operations and waste management;
- has a total population of 426,700 (1997 figures);
- is 1,382 sq. km in area with 14% urban and 86 % rural land use;
- is part of the drainage area of the Grand River watershed;
- is serviced with separate storm and sanitary sewers systems apart from some areas in Woolwich Township;
- provides information and contacts through the website www.region.waterloo.on.ca

What are the problems?

Municipal water supply is provided by an integrated system of 90% groundwater and 10 % surface water. The long-term sustainability of the Region's water resources depends on the quality and quantity of the recharge to the groundwater aquifers and the Grand River. Concerns include the potential of the present water resources to accommodate future population growth in the Region and the impacts of rural and urban point and non-point source pollution on the water supply.

The Region of Waterloo promotes water conservation and water efficiency programs as a supplementary means of conserving and sustaining the vital groundwater supplies of the area.

How did they respond?

Pollution Prevention Programs

Background Studies and Planning

- A comprehensive Water Resources Protection Strategy was implemented in 1994, with the objective of limiting risk to water resources from historic, current and future land uses. A series of tasks and programs are being implemented over a ten-year period. These include:

- Regional scale hydrogeologic studies to provide the technical basis for detailed studies to determine the capture zones for individual wellfields.
- A Preliminary Capture Zone Study for some of the 55 wellfields with a time period of six years to complete detailed studies of other wellfields.
- A Reconnaissance Inventory of Potential Contaminant Sources used existing data to establish relative risk on a broad scale to water resources from potential sources of contamination.
- A Detailed Inventory at the Middleton Street Wellfield provided a list of businesses within the capture zone that may be potential sources of contamination.

- A Draft Groundwater Protection Awareness and Education Program for the Industrial, Commercial and Institutional Sector Plan was prepared in 1998 for incorporation into the Water Resource Protection Plan. This sector is considered to be the main contributor to existing urban water pollution. The plan objectives are:

    a) increase industry/business awareness and understanding of water as a resource,

    b) facilitate and encourage individual/collective action to protect water resources.

Regulations and By-Laws

A Regional Sewer Use By-Law (1-90) mandates levels of toxic material in sewer discharges. The biggest problem with industrial, commercial and institutional users is sewer pipe maintenance. Site inspectors test regularly for enforcement and there are heavy fines for non-compliance.

Staff Commitment

Since 1994, the Program has been implemented with full time commitment of a manager, three hydrogeologists, and one hydrogeological technician. Summer students and university co-op students are used on occasion for some very focussed projects.

Public Education and Outreach

- **A Water Resource Protection Liaison Committee** was formed in 1994. Members of this umbrella group include representatives from regional staff (Planning, Engineering and Health), regional councillors, business, environmental and agricultural interests.

  Working groups were formed for the following areas:

  - Future Urban Point Sources (FUPS)
  - Current Urban Point Sources (CUPS)
  - Rural Non-Point Sources

  The Future Urban Point Source group focuses on the Region's authority to influence future development in a proactive manner to prevent groundwater quality problems. *(see Policy Review and Recommendations).*

  The Current Urban Point Source group focuses on increasing public awareness of the Region's water resources and promoting voluntary resource protection in urban businesses and industries. Activities include the following pilot projects:

1) The preparation and distribution of a survey to one wellfield area's businesses to prepare an inventory of potential contaminant sources. Co-op students distributed the survey, with personal visits, follow-up phone calls and an excellent 85% response rate. These responses provide a future base for contact and may be used to monitor the effectiveness of the approach.
2) BMP fact sheets for individual industries. Draft sheets are being prepared for two industries (metal fabricating and veterinary) in two city wellfield areas.
3) An information package for area businesses. This will include a poster for a communal work area, information on pollution control and BMPs.
4) Policy review (see Policy Review and Recommendations).

Rural Non-Point Sources. The Rural Water Quality Program initiative began in April 1998 and ends December 31, 2002. Financial assistance up to $25,000 is available to qualified rural landowners in the Region to share the cost of implementing selected BMPs that improve water quality. Financial assistance ranges from 50% to 75% depending on the project. Cost share grants are available for milkhouse waste, manure handling and chemical storage improvements, restricting livestock access to watercourses, improvements to water wells, and control of field erosion.

A preliminary survey for the Rural Water Quality Initiative was undertaken in 1997 as a pilot project. An information kit was first sent to 200 rural homes followed by a questionnaire to determine if the information about water quality improvements had been read and if any of the recommendations were implemented. The response rate was 25%, which may have been somewhat higher if scheduled during a less busy time for farmers.

Waterloo Region committed $1.5 million from user rates to the program. Additional funds are supplied by the National Soil and Water Conservation Program and the Grand River Conservation Authority. The program is delivered by staff from the Grand River Conservation Authority and was developed with consultation with many agricultural associations and the Stewardship Network.

- **Environmental Business Source**. This networking group was developed through the Ontario Centre for Environmental Technology Advancement. The Region is sponsoring the set-up of the program and will step back once it is developed and functioning well. The focus is on information sharing, networking and contacts that will assist small business by providing no-cost expertise.
- **Groundwater Guardian Communities**. Woolwich, Cambridge and Wilmot are participating with full council and some staff support.
- **Household Hazardous Waste** awareness programs and Hazardous Waste disposal schedules at the Regional Waste Management Facility. Publications include *Environews*, a newsletter about many facets of waste reduction, hazardous waste disposal and conservation practices. Other publications include brochures on household and garden practices, pesticide use, etc., and children's environmental colouring books.

Policy Review and Recommendations

The following policy reviews are being carried out by the Future Urban Point Source group:

- Develop Regional Official Plan amendments to establish Wellhead Protection Areas and identify acceptable and unacceptable land uses in these areas.

- Work with Area Municipalities to implement Regional Official Policies Plan policies through appropriate means such as zoning by-laws and development approvals.
- Evaluate existing Provincial, Regional or Area Municipal regulations as a mechanism for regulating future land use activities (including the use of specific chemicals).

The following policy reviews are being carried out by the Current Urban Point Source group.

- Evaluation of current Provincial, Regional and area municipal regulations which might provide a regulatory basis to require the use of BMPs in Wellhead Protection Areas, similar to the Regional sewer use by-law or health regulations.
- Evaluation of the need for financial incentives to encourage businesses to implement BMPs.
- Develop a plan to target household hazardous waste collection (depots and/or advertising).
- If necessary, advocate the development of new Provincial or Regional regulations to ensure adequate groundwater protection.

Financial Considerations and Support

The estimated costs presented in **Table 1,** are sufficient to fund identified projects but the Implementation Plan does not include funds for financial incentives which may be required to implement protection policies and programs. The types of and need for financial incentives was evaluated from 1996-1998. The 10-year capital forecast is reviewed annually and revised if necessary to incorporate new information and changing priorities.

Table 1.0: Water Resource Protection Costs for the Regional Municipality of Waterloo

Water Resource Protection Costs from 1996 and a Ten Year Forecast		
Year	**Current Capital Budget** **(includes a small portion of expenses funded by Wastewater)**	**Percentage of Total** **Water Supply Budget. (excluding debt charges)**
1996	$1,587,000	4.3%
1997	$ 915,000	2.7%
1998	$ 915,000	2.6%
1999	$ 915,000	3.5%
2000	$ 765,000	3.1%
2001	$ 315,000	1.3%
2002	$ 215,000	.6%
2003	$ 215,000	.6%
2004	$ 215,000	.6%
2005	$ 215,000	.7%

Monitoring and Evaluation

No formal monitoring program was undertaken in 1998. Monitoring will be a component incorporated into the draft Groundwater Protection Awareness and Education Program for the Industrial, Commercial and Institutional Sector.

Water Efficiency Programs

Background Studies and Planning

A Master Plan for Water Efficiency was developed by regional staff with input from a Water Efficiency Advisory Committee. The Master Plan sets water reduction targets for ten years and determines what programs will be used. The programs must be feasible, economically viable and environmentally beneficial. The Plan was completed in September, 1998 and includes the following components:

- projected water demands,
- climate and rainfall statistics,
- water consumption,
- capital expansion and needs,
- water efficiency measure in use and planned,
- education and public input.

Staff Commitment

Dedicated full-time staff time includes a manager and a water efficiency co-ordinator. A co-op student during the winter and a summer student provide extra staffing. A proposal to add a full-time program assistant is being considered this year.

Public outreach staff are chosen for their proven communication skills. Conferences (Ontario Water Works Association, American Water Works Association, and the Conserve Conference) are regarded as valuable areas to gain information about new technology, approaches and solutions. Committee liaisons, for example the Water Efficiency Committee, are also regarded as valuable.

Public Education and Outreach

- **A Water Efficiency Advisory Committee** provides input to the Master Plan and program development. Members include university, political, industrial and community (neighbourhood) representation. An economist advises on budget needs.
- **An information phone line** is available for public queries and concerns. Many brochures, information leaflets, refrigerator magnets and publications about house and garden water-saving techniques have been produced and distributed. Recommended water saving practices include rainbarrel installation, downspout direction to lawns and gardens, naturescaping or xeriscaping, and household water conservation with showers, laundry and other BMPs. Media coverage and relations has been positive. Speakers are provided to community groups on request.

- **School programs** are used to educate future residents. These include curriculum-based projects with two school boards, from K1 to Grade 8. Teacher's kits, materials, video and a class visit by a speaker are available on request. The curriculum is developed and updated on an ongoing basis.

  School children take home water saving devices such as shower head adapters, toilet dams and shower timers. This program is most effective when there is a follow up required as homework to monitor the actual placement and use of the devices.

- **A Toilet Replacement Program** was used twice with differing rates of success. The initial program took place several years ago in two smaller rural communities (St. Jacobs and Elmira) and was not considered a success. There was little preplanning, no open houses or demonstration sites, and no information brochures. Community resources such as plumbers and hardware suppliers were not used and there was little fixture choice. On the positive side, some monitoring was done through water bill records as the communities are 100% metered. It was found that the toilet replacement program achieved a 20% to 30% reduction in water use and was a long-term benefit, while reduction devices achieved only a 0% to 9% reduction rate.

- A more successful on-going program uses a rebate incentive of $50 per household toilet replacement, with local contractors supplying the new low-flush toilets. Regional staff inspect the installments for conformance to the water saving criteria and pick up the old toilets for recycling. The rebate is then mailed to the householder.

  The program is aimed only at retrofitting as the Ontario Building Code specifies low-flush toilets in new developments. Each year 7,000 toilets are replaced, and it is expected that in ten years only low flush toilets will be in use.

- **An Industrial Water Audit Kit** was produced and is available under licence to other municipalities. The "Saving Water" kit was completed in 1992 and updated in 1996. The kit recommends the development of an employees' committee to carry out the audit, a technique that produces more support from the staff. A one-day workshop can be added with consultant guidance and set up. Kits have already been sold to London, the City of Toronto, Greater Vancouver District and the City of Vancouver. There is also an annual mailing on water efficiency in the workplace.

Financial Considerations and Support

A budget of approximately $520,000 is allocated from 1999 to 2008 for the Water Efficiency Program.

Monitoring and Evaluation

The Region of Waterloo is participating in the American Water Association Research Foundation end user study. In July 1997, twelve communities in North America put data loggers on 100 homes for summer and winter periods. The areas logged in the Region are Cambridge and Waterloo. Data is analysed to give information on residential water use. The preliminary results are already useful, and the final data was ready in the summer of 1998. Preliminary results show that toilets are the heaviest year round water users, and water softeners are also large water users.

Long Term Planning

The Water Resource Protection Strategy implemented in 1994 will continue to provide directions for the following ten-year period. Financial commitments will be reviewed annually and revised to accommodate new information and changing priorities.

The Master Plan for Water Efficiency will provide guidance and direction from 1998 for a ten-year period. Other future considerations include water-pricing changes. At present, water is wholesaled by the Region to the municipalities of Kitchener, Waterloo, Cambridge, North Dumfries, Woolwich, Wilmot and Wellesley. All seven areas have different pricing rates and billing systems. The Region will try to involve the municipalities in an overall water rate plan reviewing facets of each system and seasonal differentials. A group choice may then be made or the billing can be incorporated into the wholesale costs.

Monitoring and Evaluation

Reduction of sewage flows is not expected to be significant at this time since water conservation practices involve lifestyle and behaviour changes and the target group is the next generation.

THE CITY OF HAMILTON

The City of Hamilton:

- is situated at the west end of Lake Ontario, with Hamilton Harbour forming a major part of its waterfront;
- includes the communities of Hamilton and Stoney Creek, Towns of Ancaster, Dundas and Flamborough, and Township of Glanbrook;
- has a population of 460,000 and an area of 1,120 sq. km;
- includes the City of Hamilton which has mostly combined sewers discharging to streams and Hamilton Harbour; other municipalities have separate systems;
- can be contacted through the website at http://www.city.hamilton.on.ca/

What are the problems or issues?

Water and sediment quality degradation in local streams and Hamilton Harbour. Hamilton Harbour is an Area of Concern and a Remedial Action Plan has been developed.

Concern about toxic contaminants in the water, air and soils.

Mandate to develop a sustainable community.

Interest in pollution prevention and better management of the environment.

How did they respond?

- Pollution Control Plan
- Pollution Prevention Plan
- Environmental Management System

1. Pollution Control Plan for the City of Hamilton

Primarily directed at the combined sewer overflow problem in the City of Hamilton. The study, completed in 1991, recommended a combination of improvements including storage tanks, and increased interceptor capacity for in-line storage. Flow reduction using downspout disconnection was analysed with a predicted reduction of storage requirements of 5%. Several large storage tanks have been constructed that have reduced overflows. A demonstration project has been completed to evaluate the use of real-time control operation of the system to further reduce overflows and avoid construction of some additional tanks.

References

Pollution Control Plan for the Regional Municipality of Hamilton-Wentworth, Paul Theil Associates and Beak Consultants, December, 1991.

2. Comprehensive Pollution Prevention Plan (CPPP)

The CPPP was initiated in 1993 jointly with the former Regional Municipality of Hamilton-Wentworth, Environment Canada and the Ontario Ministry of the Environment and Energy. The project was considered the first of its kind and was established to demonstrate how pollution prevention programs could be incorporated into municipal government operations and programs.

The goals of the project were to:

- look at the Region's internal operations to ensure that its own house was in order;
- encourage local residents, communities and businesses to practise pollution prevention through leadership and the Region's ability to regulate and influence certain activities;
- share results with other communities.

The benefits of this approach of incorporating pollution prevention programs into a municipality's programs are as follows:

- Environmental - Combining environmental issues with business decisions is a proactive approach to environmental protection;
- Fiscal - Costs are reduced through efficient use of resources;
- Reduced Risk and liability - Changing to products which are less harmful to the environment reduces risk to workers and the environment;
- Improved Corporate Image - Relations with stakeholders and staff are improved;
- Impact on Other Sectors - Ability to influence businesses, suppliers, and the community to adopt pollution prevention.

Steps in Developing a Pollution Prevention Plan

This figure indicates the recommended steps to be followed in developing a PP plan in a cycle of continuous improvement. The steps are detailed below:

Step 1 - Getting Started - What is needed to initiate a Pollution Prevention Plan process.

- Identify funding sources and get support from management and council.
- Assemble a team including a senior management "champion".
- Develop a flexible work plan.
- Set an environmental policy.
- Begin informing and involving the players.

The City of Hamilton Corporate Environmental Policy:

We believe that a healthy environment is an essential component of becoming a sustainable community and will strive to be exemplary in our environmental performance. Our commitment is:

- To meet and exceed all environmental standards and legal requirements, and the reasonable expectations of Regional taxpayers in the management of Regional Operations and services.
- To address environmental implications of all activities, decisions, and expenditures in concert with economic and social considerations.
- To promote environmental conservation and protection in all our internal operations.
- To encourage all employees to be conscious of environmental considerations and be protective of the environment in their work and personal lives.
- To give highest priority to actions that result in the elimination or reduction of waste at the source (pollution prevention).
- To conduct an annual evaluation of our progress in implementing our environmental goals and policy and report on the results at the Annual Sustainable Community Day.
- To re-evaluate and improve approaches, as required based on the annual evaluation of progress.
- To work with the community, area municipalities, businesses, suppliers, contractors, and other partners to encourage environmentally sound practices and activities.

Step 2 - Taking Inventory

- Evaluate current status of environmental impacts.
- Develop strategy to collect information.
- Complete inventory of selected areas to establish a baseline to measure the results of changes.

Step 3 - Identifying Opportunities

- Set goals and objectives for the pollution prevention.
- Set priority areas using inventory information.
- Identify opportunities to reduce or eliminate water at the source.
- Screen and evaluate options.

Step 4 - Turning Your Plan into Action

- Select opportunities for implementation with targets and timelines.
- Assign responsibilities.
- Document plan and get approvals.
- Train educate and motivate staff.

- Take action.

Step 5 - Monitoring and Evaluation

- Keep track of progress.
- Communicate results.
- Evaluate performance.
- Repeat process.

Lessons Learned

The reference provides good advice for other municipalities embarking on the same course. Some of these are:

- support from all levels is critical to success, especially senior staff;
- understand the position of those being asked to change - their perspective on environmental protection whether environmental, budgetary, planning, or operations affects how they interpret the pollution prevention message;
- use the inventory to generate ideas to act upon quickly;
- use less traditional approaches to make limited resources go as far as possible, eg. Forming a partnership with the federal and provincial governments, and the introduction of pollution prevention as a tool to achieve compliance with the Regional Sewer Use By-Law;

It was noted in the report that there is no formal management plan that links pollution prevention with other business aspects of the Region. This could be addressed through an Environmental Management System, which incorporates pollution prevention.

An extensive reference and resources list is provided in the primary reference - A Guide to Pollution Prevention for Municipalities, Regional Municipality of Hamilton-Wentworth, 1996, available from: The Canadian Centre for Pollution Prevention, 265 Front St. Suite 112, Sarnia, Ont., N7T 7X1. E-mail info@c2p2online.com

Environmental Management System for the Regional Environment Department

The Region Environmental Department (RED) in 1997 initiated development of an Environmental Management System using the ISO 14001 approach.

The RED mandate includes five core businesses:

- Treatment and distribution of potable water.
- Collection and treatment of wastewater.
- Collection of stormwater in the City of Hamilton (includes the combined sewer system).
- Management of solid waste.
- Management and development of growth.

The purpose of the EMS development was to:

- sustain existing environmental management processes;
- improve the corporate image;
- strengthen environmental compliance;

- identify opportunities and enhance environmental awareness.

Steps being followed in developing the EMS include getting started, in which the Regional Environmental Policy stated above was augmented by a Mission Statement (see box) for the RED.

Environmental Mission Statement

The Regional Environmental Department is committed to working toward the goals of VISION 2020 and Regional Council's Environmental Policy. We will continually improve our environmental performance to sustain and protect our human and natural community by strengthening positive effects and reducing negative ones as we deliver our services to the community. Signed January 1998.

Key to the startup was a Communication Program for staff which included newsletters, open houses, site visits with operations crews, meetings with staff, unions and Regional councillors, and the formation of working groups to address issues. A Gap Analysis was performed to identify environmental issues (or aspects, using ISO 14001 terminology). A highly interactive process with staff was used to perform the gap analysis in order to define significant gaps where legal or other requirements were not being met. The procedure first identifies activities, services and operations of the RED in carrying out its mandate. Environmental aspects and impacts are then identified from each, and also the defined legal and other requirements that must be met. Significant gaps were defined as "Any issue of non-conformance with the Department's legal and other requirements".

From the defined significant gaps, an EMS Action Plan was developed. This included creating an information management system, setting short term objectives and targets, and initiating pilot plans for contract management of solid wastes; water-main break and repair; valve inspection; and EMS manual. The pilot plans would assist in applying the EMS approach to the remainder of the department.

The EMS took 2½ years to complete as certification and was completed in 1999. Some of the lessons learned in developing the EMS this far are:

- keep it simple - make sure the scope is manageable and flexible;
- get senior management on the same page, i.e., agreeing on the scope and direction of the EMS;
- break down barriers immediately with ongoing communication and training;
- designate or identify champions sooner.

It was also recognized early on that products of the gap analysis and priority setting can be used immediately in the discussion of budget priorities and work planning. In other words, benefits can be derived from the process before the EMS itself is completed.

THE CITY OF TORONTO

The City of Toronto:

- is a densely populated urban area located on the north shore of Lake Ontario;
- had a land area of 97 km² prior to 1998 and a population of 653,378 (1995 figures*);
- was amalgamated in January 1998 with the municipalities of East York, North York, Scarborough, York and Metro Toronto to form the new City of Toronto with a combined population of 2.4 million;
- is part of the watersheds of the Don and Humber Rivers, and Highland and Mimico Creeks;
- is responsible for water supply and wastewater removal;
- services 75,000 properties with combined building drains, and 56,000 properties with separated building drains;
- provides information on the website www.city.toronto.on.ca

**All figures are applicable to the area before amalgamation in 1998.*

What are the problems?

Water quality in the Don and Humber Rivers and in Lake Ontario is being impacted by sewer overflow discharges during heavy rainstorms. The majority of homes, schools and businesses in the City, (75,000 properties) have roof areas which drain directly to the Toronto, Scarborough and East York neighbourhood's combined sewers through a single combined drain. During rainfall events, the roof areas contribute approximately 95% of the flow entering the combined drain, which may range from 20 to 30 times the amount of dry weather flow. This significant increase in flow is a major contributor to combined sewer overflows. Basement flooding due to backup of combined sewers is also a problem in some areas of the City.

How did they respond?

The City of Toronto embarked on a program to separate road storm sewers from sanitary sewers. The program has resulted in the partial separation of 70% of the total combined sewer drainage area. As redevelopment occurs in the area, new developments are required to completely separate the private drainage system.

A major Downspout Disconnection Program was implemented in 1996 to reduce the frequency of combined storm sewer overflows and basement flooding. Other responses to the problems include active water efficiency and water use reduction programs to reduce the volume of water entering the sewers and the wastewater treatment plants, and eastern and western storage tunnel construction.

Pollution Prevention Programs

Background Studies and Planning

A Sewer System Master Plan was developed by City staff, with a recommendation that a Downspout Disconnection Program be implemented over a period of 20 years. A pilot project in 1992 involved 93 homes and achieved disconnections on 51% of the eligible properties (8 homes were already disconnected and 39 volunteered to participate). A high rate of participation is believed due to the direct benefit derived by homeowners in this area who have experienced basement flooding.

Another pilot project achieved a lower rate of participation with 61 out of 1,090 homeowners signing participation agreements. Residents in both pilot areas demonstrated an interest on the part of the homeowners to help reduce the storm sewer overflows and improve water quality.

Based on experience and soil and site considerations it was estimated initially that about 20% to 30% of property owners might participate.

Regulations and By-Laws

An amendment to By-Law 78-91 was made to require the infiltration of stormwater run-off into the ground in the case of all new buildings and re-developments, except in cases where soil or site conditions are unsuitable for infiltration. Disconnection became legal with the provision that if water hazards resulted on streets and driveways, there may be reconnection.

Staff Commitment

The Downspout Disconnection program is delivered with a full time staff equivalent of 9.5 persons. Partnerships with community organizations and volunteer assistance have been used at times with the program.

Public Education and Outreach

A Downspout Disconnection Program was promoted on a voluntary basis. The program started in East Toronto as a response to complaints about basement flooding. Program publicity included the distribution of flyers, a Home Depot exhibition, and posters and presentations. A glossy handout with a recognizable symbol proved useful at exhibitions while a more detailed information package provided a better response during door-to-door promotions. It was felt that the original glossy handout did not provide enough information for the householder.

The disconnection program includes a property permeability assessment by City agents. A City contractor performs the disconnection at no cost to the homeowner and installs a rain barrel at the homeowner’s request. Rain barrels initially cost $75 for a 214-litre size, and $120 for a 565-litre rain barrel. A “do-it-yourself” option is provided, with disconnection being performed by the homeowner who receives a 565-litre rain barrel free of charge. Approximately 2,000 properties are disconnected each year.

A permission agreement is signed before work is carried out. The agreement includes the following provisions:

- An acknowledgement on the part of the owner that water may run overland and the owner will be responsible for maintaining safe sidewalk conditions. The City may also, at its expense, require the homeowner to reconnect the downspouts.
- An agreement that the City will carry out any remedial work such as remedying wet basement walls and/or icy conditions which are necessary in the opinion of the Commissioner of City Works Services, as a result of the initial work. This agreement remains in force for a period of two years after the disconnection.

Financial Considerations and Support

The Downspout Disconnection program budget is $1.5 million annually. In 1996 and 1997, a fee-for-service contract for inspections was made with the Greensaver organization with provisions of funding of $100 for every agreement signed. The total contract was $156,000.

An estimated 6,500 properties are to be included in the program each year. The predicted participation rate is 30% (2,000 properties) with an average cost per disconnection, including soak-away pits installations where necessary, of $580 per property.

Budget details included:

Property disconnection costs at 2,000 x $580 =	$1,160,000
Estimated administrative =	$1,160,000
Public Awareness Campaign =	$20,000

A Non-Structural Working Group (later renamed the Stormwater Group) was appointed by City Council in 1996 as a response to a directive from the Ministry of the Environment and Energy as a condition for rescinding the requirement for a full Environmental Assessment for the proposed Western Beaches Storage Tunnel. The group includes members of the public and agencies, and their mandate includes the following:

- identify areas of the City where implementation of natural systems rainwater management is possible;
- identify alternative methods for stormwater management and combined sewer overflow and water pollution alleviation;

The Stormwater Group reviews current City policies and programs, and assists in the review of options for techniques, policy options and implementation sites in conjunction with City staff.

The Stormwater Group, in its first formal report to Toronto City Council (May 1997), recommended the initiation of three projects to determine opportunities and feasibility of source control SWM. In February 1998, three different groups of consultants were chosen to examine options for new programming and policies based on three test neighbourhoods.

- North Bloor West Village
- Moore Park/North Rosedale
- Garrison Creek

The three test neighbourhoods were evaluated by a consultant team and a Steering Committee, which included local citizens. Each study team completed an assessment of the area including public and private land use, biophysical characteristics, population demographics and stormwater flow modeling. Each team carried out an extensive public consultation.

The three consultant groups reported in February 1999 with recommendations for revisions to the Downspout Disconnection program, new initiatives for each neighbourhood and citywide policy recommendations. The Stormwater Group will establish a work plan to implement selected projects from the three reports. A more detailed analysis of findings follows.

Demonstration Site Findings

North Bloor/West Village

The study area included approximately 4,000 single-family dwellings, with a mix of institutional, single, and multi-family dwellings, and a population of approximately 23,000. A high percentage of roof leaders were already disconnected (21%).

Barriers to Action

Through focus groups and a telephone survey of 150 residents, the key barriers to adoption of stormwater reduction techniques were identified as physical (94 mentions). These included lack of space, inappropriate site conditions including shared driveways.

Financial considerations were the next most frequently mentioned barrier. Cost was perceived to be a significant consideration in replacement of paved surfaces and installation of soak-away pits, and less, although still important, for the installation of rain barrels.

Other barriers included perceived problems such as concerns regarding flooding, ice accumulation, odours and mosquito breeding. Twenty respondents felt that a lack of knowledge, tools or physical ability was a barrier. Appearance was a concern for 16 respondents, and level of effort required was a barrier for 12 respondents.

Awareness of Stormwater Issues

- 85% were highly aware that stormwater pollution affects Lake Ontario.
- Most residents (91%) believe that water conservation is good for the environment.

Willingness to Act

- 71% have already implemented at least one method of reducing stormwater pollution and many are willing to do more.
- 63% are willing to disconnect downspouts, and 57% to install rain barrels.
- 86% participate in water conservation actions.

Moore Park/North Rosedale

Public consultation methods and information used included two public meetings/workshops (presentations, discussion, questionnaires); phone surveys; consultation with appropriate environmental groups; detailed socioeconomic data obtained from Statistics Canada; personal contact with area residents; and the results of the “Downspout Disconnection Program – Delivery Strategy Report”.

Audience

Well-educated, professional families in a high-income neighbourhood. There was strong pride in home ownership, a well-developed sense of community and high community standards.

Willingness to participate

HIGH-rated SWM measures, based on resident's willingness to implement, were tree planting, rain barrels, porous paving, lawn aeration, and water metering.

MEDIUM-rated: backyard ponds, grassed swales, and infiltration trenches.

LOW-rated: below ground cisterns, rooftop gardens, and shallow marshes.

- The majority (76%) said the Downspout Disconnection (DD) Program should be incentive-based.
- 50% said the incentives should be financially based.
- 37% said that more information, advice and assistance would make them act.
- 75% felt that public lands, (parks etc.) should be used to demonstrate "lesser known" stormwater management practices.
- Many are bewildered by the current DD program and lack an overall understanding of SWM context and an understanding of program limitations.

Media and Messages

- 88% said public education is important or very important to SWM issues.
- 94% felt that these issues should be integrated into the school curriculum.
- The top 5 media selected by respondents:
    - personal letter by mail (88%),
    - flyer or brochure by mail (66%),
    - insert in tax or water bill (63%),
    - personal phone call with follow up (63%),
    - community newspaper ad (38%), and
    - The lowest ranked included the City website, in store video, and the daily paper.

Modelling/Engineering Simulation Results (Potential Conditions)

- A 25% disconnection (1 in 4) of existing downspouts within the Sighthill Avenue combined sewer area would reduce the average number of CSOs by almost 50%.
- The Moore Park area is partially separated with road storm sewers installed for approximately 75% of the system. Consequently, roofs are the main source of runoff to the combined sewer. With this partial control, combined sewer outflows occur an average of 9 times per year.
- While disconnecting 2/3 of the remaining downspouts would increase the annual stormwater runoff to the Yellow Creek ravine by approximately 1%, the annual CSO volumes would be reduced by more than 15 times.

- The more each area is partially separated with road storm sewers installed for approximately 75% of the system. Consewuently, roofs are the main source of runoff to the combined sewer. With two partial control, CSOs occur on average 9 times per year.

Surface Infiltration Rates

- Field measurements on typical residential lawns have shown that surface infiltration rates can be doubled if the surface is aerated. On an annual basis, such increase in infiltration rates would reduce the surface runoff volumes by approximately 4%.

Benefits of SWM Methods on CSOs

- The use of rain barrels has little effect in reducing the number of annual CSOs unless the overflow from the rain barrels is directed to a grass area.

  Benefits of using rain barrels are:

  i. source of water for watering lawns and flowers, and

  ii. reduction of 65% to 70% in the occurrence of roof runoff going directly to lawns.

- Underground storage tanks or subsurface infiltration trenches can, if properly sized, significantly reduce the annual number of CSOs. For example, if a $1m^3$ of storage per 35 m^2 of roof area could be provided within the Sighthill Avenue combined sewer system, annual CSOs could be reduced by 64% - to less than 3 per year.

Garrison Creek

By looking at a series of connecting rainwater strategies, starting with the single house, park, street and schoolyard, to a connected stormwater community of blocks, schoolyards and open spaces, an overall reduction of stormwater runoff of 43% can be achieved across this demonstration site.

Water Efficiency Programs

Policy Review and Recommendations

Water Conservation Standards and Policies for new development are being implemented including the development of guidelines for preparation of the Water Conservation Plan. This involved the submission of a water conservation plan by the building owner as part of the development review and permit approval process.

Staff Commitment

The Water Efficiency/Conservation Program has a full time staff equivalent of four people.

Public Outreach and Education

Water efficiency programs undertaken by the City of Toronto include:

- **Water saving retrofit kits** were distributed to approximately 50,000 homes having a water meter installed and to condominiums that ensure the kits will be installed within a stated time period.

- **A Universal Metering Program** provides for the installation of approximately 4,000 water meters. This includes metering of new construction or buildings where the water service is repaired or replaced, and voluntary residential metering.
- **Metering Sizing and Replacement Programs** involve data base analysis of accounts to identify improperly sized meters, followed by on-site monitoring and replacement. This reduces previously unaccounted water use and increases City revenues.
- **Water Conservation Curriculum Supplements** have been developed and made available for school grades 4-6 and K-3, with approximately 5,000 students participating each year. This program includes the following elements:
    - Water Saving Kits were distributed to students;
    - Classroom presentations, water activity days and tours of water and waste management facilities;
    - Provision of teacher's workshops and development of a Leader's Guide.
- **A Water Efficiency Training Manual** for City of Toronto Schools was developed including conducting training workshops for plumbers and caretakers. Training manuals were also developed for City plumbing staff and swimming pool operators.
- **A Water Efficiency in the Workplace Manual** was developed jointly with the Region of Waterloo for the industrial, commercial and institutional sectors. This includes guidelines on how to conduct water audits and develop employee involvement programs.
- **Media and transit shelter advertising**, press releases and bill stuffers to encourage metering.
- **A Water Efficiency Display** was produced with working models of a toilet and shower for use at malls, schools and environmental events.
- **Videos and slide presentations** relating to water efficiency, downspout disconnection, etc., are available to renovators, community groups, and public information forums.
- **Brochures and information leaflets** are available on a wide variety of topics including Wise Lawn Care.

Monitoring and Evaluation

A survey was undertaken of door-to-door water saving kit distribution customers (previously metered) versus newly metered customers to determine the use and effectiveness of the kits.

TORONTO WATERSHED INFRASTRUCTURE ECOLOGY PROGRAM (WIEP)

The Watershed Infrastructure Ecology Program (WIEP)—Toronto, Ontario.

WIEP is a part of the City of Toronto's Task Force initiatives to improve water quality in the Don River.

- The City of Toronto is a densely populated urban area located on the north shore of Lake Ontario and is part of the watersheds of the Don and Humber Rivers, and Highland and Mimico Creeks. The City is responsible for water supply and wastewater removal, and services 75,000 properties with combined building drains, and 56,000 properties with separated building drains.
- WIEP can be contacted at (416) 392-1983, www.riversides@riversides.org or www.h2info.org

The Watershed Infrastructure Ecology Program (WIEP) was developed in 1995 as part of the City of Toronto Task Force To Bring Back The Don. The residential campaign, *Five Things You Can Do For The Don*, consisted of more than five municipal and non-profit programs but was characterized as such because of its emphasis on five principles: disconnect, clean, create, conserve, and call.

The program incorporated residential, commercial and institutional components. These include the City of Toronto downspout disconnection and rain barrel program; the City of Toronto water metering and conservation; and the Toronto Environmental Alliance household toxics self-audit. Each initiative was delivered free of charge or at minimal cost.

Residential Project

A Water Quality Canvass was used to increase program participation; educate the public; and raise awareness of lot level retrofit source control measures and non-point source pollution prevention BMPs. The canvass was designed by Kevin Mercer, Environmental Equity Consultants, and Elizabeth Bruckmann of the Task Force. Social marketing techniques were used to provide diverse organizational components that highlighted the importance of NPS pollution prevention. Canvassers provided crucial links between the programs and the health of the river, the cost of municipal infrastructure, and residential stewardship. A community presence was built through community events, media articles, posters and signs, preliminary pamphlet drops, and a comprehensive campaign brochure.

The Water Quality Canvass also acted as a data collection process that cross-correlated with the monitoring of flow management. All contact and sign-up data were collected in a single database reflecting the householder response form filled out by canvassers.

Monitoring and Evaluation

The Watershed Infrastructure Ecology Program (WIEP) evaluated the response rate to the voluntary downspout disconnection program in specified areas in 1996 and 1997. The first two seasons of the Water Quality Canvass achieved a higher than anticipated response rate. A total of 6,257 residents were canvassed, with the greatest numbers participating through the downspout disconnect program.

A total of 1,098 expressions of interest were generated. Of these, 983 were inspected and 491 disconnection agreements were sent to owners of suitable properties. WIEP estimates that at least 100 households undertook self-disconnection prior to city inspection. There is no calculation for the number of houses that self-disconnected after being rejected as unsuitable by city inspection.

The results of the WIEP canvas include:

- The Rain Barrel component shifted focus dramatically during the campaign. Of the households requesting downspout disconnections, roughly 75% requested a rain barrel. Initially, barrels were charged for as an add-on to the Downspout Disconnection program. Rain barrel design and purpose underwent a major shift during the program, as did public acceptance and expectations. The early barrel design was replaced with a more suitable barrel that did not require winter maintenance. Canvassers found that householders were more receptive to rain barrels than to downspout disconnections *per se*.
- Water metering was a hard sell for most householders not already metered due to the long term cost implications. WIEP created a handout describing the cost savings for a family of four from metering as compared to flat rate. A toilet tank bank incentive was offered to all canvassed households in addition to the estimated 250 water-metering installations and conservation kits.
- The staff easily addressed barriers to comprehension, although a lack of discretionary authority hampered the flexibility of staff where questions were raised about program implementation.
- The major barrier to participation for the downspout disconnection program was the permeability criteria used by city inspectors to determine whether or not a house could be disconnected. The city's prohibition against run-off to sidewalks considerably reduced the acceptable number of disconnects, and some residents disagreed with the recommended disconnect route or method.
- It is difficult to compare the effectiveness of the canvass in directly raising awareness through participation because of changes to the program over the period of the canvass. For example, rain barrels changed from being an option to an integral program component. Rain barrels changed in cost, size, shape and colour, and inspections criteria varied with the nature of the neighbourhood.
- Voluntary programs, while extremely appealing on a number of grounds, do not guarantee high levels of environmental protection. A mandatory program might secure disconnections on an additional 20,000 to 70,000 properties, depending on physical feasibility and cost effectiveness.
- Initially, a participation rate of 30% was predicted, while an actual participation rate of 8% has been generated through contact with over 100,000 homeowners since the program was introduced.
- "In person" initial contact was more successful than mailings in generating participation.

- The importance of clear messages in brochures and written communications is stressed with the key hurdles being product awareness and understanding. Information materials should reinforce the recognition of the public and private benefits accrued to homeowners.

Sewershed Flow Monitoring was used by the City of Toronto, with six flow monitors placed in the three sewersheds being canvassed. The Riverdale/Playter Estates monitors were fine tuned to capture a specific sub-sewershed with the intention of illustrating detailed flow reductions from a specific site. The gauges were installed for a two-year period with the objective of capturing the base flow and comparing its changes over time with the sign-up rate of the canvass. These goals were unfulfilled after it was discovered that the monitoring required either a very large area with a correspondingly large participation rate for disconnections, or a more detailed monitoring method to account for the finer changes that the system in place could not handle.

Among the difficulties encountered with the flow monitoring regime were the variable meteorological conditions of the years measured. Whereas 1996 had some of the largest rain events ever recorded for a summer, 1997 and 1998 were drier than usual. Monitors installed in September 1996 missed the majority of the large 1996 rain events. Nonetheless, the sign-ups and inspection process required more than a six-month period to process the backlog of inspections requests. It could not be determined whether the reduced flow was a result of the completion of the canvass disconnection sign-ups or from other factors. Monitors were pulled before the completion of the program to use in the base-flow monitoring program for the Stormwater Group demonstration study areas.

GLOSSARY OF WATER RELATED TERMS

Anaerobic - Describes an organism or metabolic process that functions in the absence of air, or, more precisely, in the absence of molecular oxygen.

Aquifer – A porous water bearing geologic formation generally restricted to materials capable of yielding an appreciable supply of water

Backfill - Earth used to fill a trench or an excavation.

Backwashing - Reversing the flow of water back through the filter media to remove the entrapped solids.

Baffles - Fin-like devices installed vertically on the inside walls of liquid waste transport vehicles that are used to reduce the movement of the waste inside the tank.

Bankfull Flow - The condition where streamflow fills a stream channel to the top of the bank and at a point where the water begins to overflow onto a floodplain.

Barrel - The closed conduit used to convey water under or through an embankment; part of the principal spillway.

Base flow - The portion of stream flow that is not due to storm runoff, and is supported by groundwater seepage into a channel.

Bedload - The sediment in a stream channel that mainly moves by jumping, sliding or rolling on or very near the bottom.

Benthos - In freshwater and marine ecosystems, the collection of organisms attached to or resting on the bottom sediments, and those which bore or burrow into the sediments.

Berm - An earthen mound used to direct the flow of runoff around or through a structure.

Best Management Practice **(BMP)** – A structural or non-structural device designed to temporarily store or treat stormwater runoff in order to mitigate flooding, reduce pollution and provide other amenities.

Bioaccumulation - A process where chemicals are retained in fatty body tissue and increase in concentration over time. The accumulation of chemicals in the tissue of species higher in the natural food chain increases as contaminated food species are eaten.

Biochemical oxygen demand (BOD) – The quantity of oxygen consumed during the biochemical oxidation of matter over a specified period of time (see also COD).

Biodegradable - The ability to break down or decompose under natural conditions and processes.

Biofilters - A collection of living organisms (bacteria), growing on small particles or substrates which give a very large surface area. Biofilters are used as a watertreatment and waterquality method. The biofilter has requirements that must be met if the bacteria are to survive and function.

Biomass - The total quantity or weight of organisms (living matter) in a given area or volume.

Bioretention - A water quality practice that utilizes landscaping and soils to treat urban stormwater runoff by collecting it in shallow depressions before filtering through a fabricated planting soil media.

Bioretention Areas - Area to mimic the functions of wooded wetlands removed by land development

Biosolids - The nutrient-rich organic materials resulting from the treatment of sewage sludge.

Bioventing - The process of inserting air into the soil matrix due to withdrawing soil gas from the recovery well.

Brownfield Sites - Existing development areas, primarily commercial and industrial. Can also refer to a way of redevelopment. May include existing residential areas as well as infilling, depending on the context. This item is generally used in the discussion of providing stormwater management, best management practices, or site remediation cleanup to control runoff from older uncontrolled "brownfield" areas.

Buffer Strip or Zone - Strips of grass or other erosion-resistant vegetation between a waterway and an area of more intensive land use.

Calibration - A check of the precision and accuracy of measuring equipment.

Catchbasin - Box-like underground concrete structure with openings in curbs and gutters designed to collect runoff from streets and pavement.

Catchment Area - Also referred to as drainage basin, a catchment area is an area drained by a stream or other body of water. The limits of a given catchment area are the heights of land-often called drainage divides, or watersheds-separating it from neighboring drainage systems. The amount of water reaching the river, reservoir, or lake from its catchment area depends on the size of the area, the amount of precipitation, and the loss through evaporation (determined by temperature, winds, and other factors and varying with the season) and through absorption by the earth or by vegetation; absorption is greater when the soil or rock is permeable than when it is impermeable. A permeable layer over an impermeable layer may act as a natural reservoir, supplying the river or lake in very dry seasons. The catchment area is one of the primary considerations in the planning of a reservoir for water-supply purposes.

Cementitious Coatings - A coating of cement (portland cement by-products or calcium aluminates) that can be used to prevent leaks on defective manholes.

Channel - A natural stream that conveys water; a ditch or channel excavated for the flow of water.

Channel erosion - The widening, deepening, and headward cutting of small channels and waterways, due to erosion caused by moderate to large floods.

Channel Stabilization - Erosion prevention and stabilization of velocity distribution in a channel using jetties, drops, revetments, structural linings, vegetation and other measures.

Check dam - (a) A log or gabion structure placed perpendicular to a stream to enhance aquatic habitat. (b) An earthen or log structure, used in grass swales to reduce water velocities, promote sediment deposition, and enhance infiltration.

Chemical oxygen demand (COD) – A monitoring test that measures all the oxidizable matter found in a runoff sample, a portion of which could deplete dissolved oxygen in

Chlorinated Hydrocarbons - Recognized as carcinogens and mutagens, and contribute to global warming and ozone depletion. Includes trichloroethylene, perchloroethylene and methylene chloride.

Cistern - A tank for storing water.

Clarifier - A large circular or rectangular tank or basin in which water is held for a period of time, during which the heavier suspended solids settle to the bottom. Clarifiers are also called settling basins and sedimentation basins.

Compaction (SOILS) - Any process by which the soil grains are rearranged to decrease void space and bring them in closer contact with one another, thereby increasing the weight of solid material per unit of volume, increasing the shear and bearing strength and reducing permeability.

Conduit - Any channel intended for the conveyance of water, whether open or closed.

Contaminant - Constituents of the air, water or soil which render them unsuitable for their intended use. Such agents may be chemicl or biological in anture and may result from natural forces, life processes of other species, or our own acitivies.

Conveyance – Any natural or manmade channel or pipe in which concentrated water flows.

Corrosion – The dissolving and wearing away of metal caused by a chemical reaction such as between water and the pipes that the water contacts, chemicals touching a metal surface, or contact between two metals.

Culvert - A covered channel or a large-diameter pipe that directs water flow below the ground level.

Curbs - Concrete barriers on the edges of streets used to direct stormwater runoff to an inlet or storm drain and to protect lawns and sidewalks from vehicles.

Dam - A barrier to confine or raise water for storage or diversion, to create a hydraulic head, to prevent gully erosion, retention of soil, sediment or other debris.

Dechlorination - The deliberate removal of chlorine from water. The partial or complete reduction of residual chlorine by any chemical or physical process.

Denitrification - Bacterial reduction of nitrite to gaseous nitrogen under anaerobic conditions.

Design storm - A rainfall event of specific size, intensity, and return frequency (e.g.,. the 1-year storm) that is used to calculate runoff volume and peak discharge rate.

Detention - The temporary storage of stormwater to control discharge rates, allow for infiltration, and improve water quality.

Detention Structure – A permanent structure for the temporary storage of runoff that is designed to temporarily pool water.

Detention time - The amount of time a parcel of water actually is present in a BMP. Theoretical detention time for a runoff event is the average time parcels of water reside in the basin over the period of release from the BMP.

Dethatching - Involves the removal of the matted layer of dead and decaying plant material between growing grass and the soil.

Dewatering - A process for removing excess water from solids to lessen the overall weight of the wastes**.**

Dike - An embankment to confine or control water, for example, one built along the banks of a river to prevent overflow to lowlands; a levee.

Discharge - A release or flow of storm water or other substance from a conveyance or storage container.

Diversion - A channel with a supporting ridge on the lower side constructed across the slope to divert water to areas where it can be used or disposed of safely. Diversions differ from terraces in that they are individually designed.

Downspout - A pipe which carries rainwater from a roof to a drain or to ground level.

Draft EA - A document which a proponent can opt to submit, before submission of a formal EA document to the Minister, so that issues or concerns respecting the documentation can be resolved between the proponent and the reviewers before the formal submission.

Drainage - 1. The removal of excess surface water or ground water from land by means of surface or subsurface drains. 2. Soil characteristics that affect natural drainage.

Drainage Area (Watershed) – That area contributing runoff to a single point measured in a horizontal plane, which is enclosed by a ridge line.

Ecosystem - A community of plants and animals within a particular physical environment which is linked by a flow of materials through the non-living as well as the living sections of the system.

Emission – Pollution discharged into the atmosphere from smokestacks, other vents, and surface areas of commercial or industrial facilities and from motor vehicle, locomotive, or aircraft exhausts.

Environment - Environment means: (i) air, land or water; (ii) plant and animal life, including man; (iii) the social, economic and cultural conditions that influence the life of man or a community; (iv) any building, structure, machine or other device or thing made by man; (v) any solid, liquid, gas odour, heat, sound, vibration or radiation resulting directly or indirectly from the activities of man, or; (vi) any part or combination of the foregoing and the interrelationships between any two or more of them.

Enviro Whirl - a dry vacuum sweeper exhausted through cartridge filters, and various other street sweeping machines

Erosion - 1. The process by which the land surface is worn away by the action of water, wind,ice, or gravity. 2. Detachment and movement of soil or rock fragments by water, wind, ice or gravity. The following terms are used to describe different types of water erosion:

Erosion Gully - The erosion process whereby water accumulates in narrow channels and removes the soil from this narrow area to considerable depths ranging from 1 or 2 feet to as much as 75 to 100 feet.

Erosion Rill - An erosion process in which numerous small channels only several inches deep are formed. See rill.

Erosion Sheet - The spattering of small soil particles caused by the impact of raindrops on wet soils. The loosened and spattered particles may or may not subsequently be removed by surface runoff.

Evapotranspiration - The loss of water from the soil both by evaporation and by transpiration from the plants growing in the soil.

Excavation – The process of removing earth, stone, or other materials.

Exfiltration - The downward movement of water through the soil; the downward flow of runoff from the bottom of an infiltration BMP into the soil.

Extended Detention - A stormwater design feature that provides for the gradual release of a volume of water in order to increase settling of pollutants and protect downstream channels from frequent storm events

Facility - Is a collection of industrial process discharging storm water associated with industrial activity within the property boundary or operational unit.

Fecal coliform bacteria - Minute living organisms associated with human or animal feces that are used as an indirect indicator of the presence of other disease causing bacteria.

Fertilizer – Materials such as nitrogen and phosphorus that provide nutrients for plants. Commercially sold fertilizers may contain other chemicals or may be in the form of processed sewage sludge.

Filter Fabric – Textile of relatively small mesh or pore size that is used to (a) allow water to pass through while keeping sediment out (permeable), or lb) prevent both runoff and sediment from passing through (impermeable).

Filter Strip – Usually long, relatively narrow area of undisturbed or planted vegetation used to retard or collect sediment for the protection of watercourses, reservoirs, or adjacent properties.

First Flush - The delivery of a disproportionately large load of pollutants during the early part of storms due to the rapid runoff of accumulated pollutants. The first flush of runoff has been defined several ways.

Floodplain - Areas adjacent to a stream or river that are subject to flooding or inundation during a storm event that occurs, on average, once every 100 years (or has a likelihood of occurrence of 1/100 in any given year).

Fluorometric - a unit of measurement when undertaking dye testing.

Forebay - Storage space located near a stormwater BMP inlet that serves to trap incoming coarse sediments before they accumulate in the main treatment area.

Geology - The study of the earth: its origin, history, structure, composition, and the natural process acting on it.

Geosynthetic Liners - Synthetic fibers that are made into a flexible, porous fabric for separation, reinforcement, filtration, drainage or a moisture barrier.

Grading - The cutting and/or filling of the land surface to a desired slope or elevation.

Greenway - A linear open space; a corridor composed of natural vegetation. Greenways can be used to create connected networks of open space that include traditional parks and natural areas.

Ground Cover - Plants which are low-growing and provide a thick growth which protects the soil.

Groundwater - Water stored underground in the pore spaces between soil particles or rock fractures.

Gully - A channel or miniature valley cut by concentrated runoff through which water commonly flows during and immediately after heavy rains or snow melt. The distinction between gully and rill is one of depth. A gully is sufficiently deep such that it would not be obliterated by normal tillage operations, whereas a rill is of lesser depth and would be smoothed by ordinary farm tillage or grading activities.

Habitat - An area or type of area that supports plant or animal life.

Halogenated VOCs - Volatile Organic Chemicals (VOCs) that are chemically composed of chlorine, bromine, or iodine. VOCs evaporate readily to the atmosphere and contributes to photochemical smog production and certain health problems.

Hazardous Substance - 1. Any material that poses a threat to human health and/or the environment. Hazardous substances can be toxic, corrosive, ignitable, explosive, or chemically reactive.

Hazardous Waste - By-products of human activities that can pose a substantial or potential hazard to human health or the environment when improperly managed. Possesses at least one of four characteristics (ignitability, corrosivity, reactivity, or toxicity), or appears on special EPA lists.

Herbicide - A pesticide toxic to plants, used to kill weeds or other unwanted vegetation.

Heterogeneities - Soil that is varying in structure or composition at different locations in the area.

Hydrocarbon - A chemical compound that consists entirely of carbon and hydrogen.

Hydrogeology - The branch of geology dealing with underground and surface water.

Hydrology - The science dealing with the waters of the earth, their distribution on the surface and underground, and the cycle involving evaporation, precipitation, flow to the seas, etc.

Illicit Connection - Any discharge to a municipal separate storm sewer that is not composed entirely of storm water except discharges authorized by an NPDES permit (other than the NPDES permit for discharges from the municipal separate storm sewer) and discharges resulting from fire fighting activities.

Impervious Area - A hard surface area (e.g., parking lot or rooftop) that prevents or retards the entry of water into the soil, thus causing water to run off the surface in greater quantities and at an increased rate of flow.

Infiltration - 1. The penetration of water through the ground surface into sub-surface soil or the penetration of water from the soil into sewer or other pipes through defective joints, connections, or manhole walls. 2. A land application technique where large volumes of wastewater are applied to land, allowed to penetrate the surface and percolate through the underlying soil.

Infiltration Rate (f) - The rate at which stormwater percolates into the subsoil measured in inches per hour.

Inflow - The water (other than wastewater from sanitary sewers) entering the sanitary or combined sewer system from the surface through downspouts, catchbasin maintenance hole covers, and cross connections to storm sewers.

Inlet - An entrance into a ditch, storm sewer, or other waterway.

Interevent Time - Dry period between storms.

Irrigation - Human application of water to agricultural or recreational land for watering purposes.

Lagoon - A shallow pond where sunlight, bacterial action, and oxygen work to purify wastewater.

Landfills - An area of land or an excavation in which wastes are placed for permanent disposal, and which is not a land application unit, surface impoundment, injection well, or waste pile.

Leaching - The process by which soluble constituents are dissolved in a solvent such as water and carried down through the soil.

Level Spreader - A device used to spread out storm water runoff uniformly over the ground surface as sheetflow (i.e., not through channels) to prevent concentrated, erosive flows from occurring and to enhance infiltration.

Liner - 1. A relatively impermeable barrier designed to prevent leachate from leaking from a landfill. Liner materials include plastic and dense clay. 2. Insert or sleeve pipes to prevent leakage or infiltration.

Live Fascines - A bank protection measure consisting of bound and staked rolls of live willow and dogwood cuttings which are laid in trenches that run along the tops of stream banks. The vegetative cuttings grow quickly to establish a shrubby riparian edge that helps to shade the creek and resist bank erosion. The new riparian vegetation also provides habitat for a variety of wildlife.

Live Crib Walls - A bank protection structure in which logs are spiked together and backfilled with soil. Live stakes are planted between the logs. The logs act to retain the soil which when compacted provides a moderate mass for retaining steep slopes. The vegetative cuttings provide shade and erosion protection. These walls are used where habitat is essential at areas of severe slope.

Low flow channel - An incised or paved channel from inlet to outlet in a dry basin which is designed to carry low runoff flows and/or baseflow, directly to the outlet without detention.

Master Plans - Master Plans are long range plans, integrating infrastructure requirements for present and future land use with environmental planning principles. These plans examine the whole infrastructure system in order to outline a framework for planning for subsequent projects and/or developments.

Material Storage Areas - Onsite locations where raw materials, products, final products, byproducts, or waste materials are stored.

Methanogenic - The formation of methane by certain anaerobic bacteria during the process of anaerobic fermentation.

Microclimate - The climate of those parts of the lower atmosphere directly and immediately affected by the features of the earth's surface.

Mitigation - The activities carried out, or proposed, by a proponent of an undertaking to minimize or ameliorate the environmental effects of the undertaking.

Monitoring - The activities carried out by the proponent after approval of an undertaking to determine the environmental effects of the undertaking ("effects monitoring"). Monitoring can also refer to those activities carried out by the MOE in ensuring that a proponent complies with the EA as accepted and the terms and conditions of the approval of the undertaking ("compliance monitoring"). "Effectiveness monitoring" is a third type of monitoring in which a proponent evaluates how effectively its class EA parent document or proposal, plan or program EA is working in the planning and implementation of its class EA projects or constituent undertaking, respectively.

Municipal Act - Provides municipalities with the authority to enact by-laws for "prohibiting, regulating and inspecting the discharge of any gaseous, liquid or solid mattter 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 industrrial wastes or both, whether connected to a treatment works or not.

Naturalization - Involves working with natural materials such as live vegetation and natural flow deflectors (strategically placed rock or root wads from old trees that are placed along the band) to create a self-repairing bank.

Naturescaping - Naturescaping is a way of inviting wildlife into your backyard by using native plants that provide shelter, food, and water for our urban wildlife neighbors

Nitrification - The biochemical transformation of ammonium nitrogen to nitrate nitrogen.

Nonpoint Source Pollution - Pollution that does not come from a point source. Nonpoint source pollution originates from aerial diffuse sources that are mostly related to land use.

Off-Line - A management system designed to control a storm event by diverting a percentage of stormwater events from a stream or storm drainage system.

Oil and Grease Traps - Devices which collect oil and grease, removing them from water flows.

On-Line - A management system designed to control stormwater in its original stream or drainage channel.

Open Space - Land set aside for public or private use within a development that is not built upon.

Organic Solvents - Liquid organic compounds capable of dissolving solids, gases, or liquids.

Outfall -The point, location, or structure where wastewater or drainage discharges from a sewer pipe, ditch, or other conveyance to a receiving body of water.

Outlet - The point at which water discharges from such things as a stream, river, lake, tidal basin, pipe, channel or drainage area.

Ozonation - The application of ozone to water for disinfection or for

taste and odor control.

Pan Lysimeters - Collect soil water as it percolates down via gravity through saturated soils. This device only gathers fluids under saturated gravity flows. A lysimeter is a device for collecting water from the pore spaces of soils and for determining the soluble constituents removed in the drainage.

Particulate - The solid/liquid particals which are in the air and are usually made up of the chemicals or materials from the original source.

Permeability - The quality of a soil that enables water or air to move through it. Usually expressed in inches/hour or inches/day.

Permeable - Soil or other material that allows the infiltration or passage of water or other liquids.

Permit - An authorization, license, or equivalent control document issued by EPA or an approved State agency to implement the requirements of an environmental regulation; e.g., a permit to operate a wastewater treatment plant or to operate a facility that may generate harmful emissions.

Pesticide -a natural or synthetic agrochemical used to kill organisms that are harmful to cultivated plants or animals.

Phenolic - Compounds with at least one hydroxyl-substituted aromatic ring system.

Phytoremediation - the use of trees and plants to help clean up toxic waste sites

Point Source - Any discernible, confined, and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged. This term does not include return flows from irrigated agriculture or agricultural storm water runoff.

Pollutant - Any dredged spoil, solid waste, incinerator residue, filter backwash, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discharged equipment, rock, sand, cellar dirt, and industrial, municipal, and agricultural waste discharged into water.

Polyureas - A non-corrosive coating that provides a infiltration barrier.

Porous Pavement - A human-made surface that will allow water to penetrate through and percolate into soil (as in porous asphalt pavement or concrete). Porous asphalt pavement is comprised of irregular shaped crush rock precoated with asphalt binder. Water seeps through into lower layers of gravel for temporary storage, then filters naturally into the soil.

Precipitation - Any form of rain or snow.

Proposal, Plan Or Program EA - An EA for a group of related undertakings and/or initiatives which are proposed collectively to achieve the same purpose.

PVC (Polyvinyl Chloride) - A plastic used in pipes because of its strength; does not dissolve in most organic solvents.

Rain Barrels - Barrels designed to collect and store rooftop runoff.

Recharge Rate - Annual amount of rainfall which contributes to groundwater as a function of hydrologic soil group.

Reclaim (water reclamation) - Planned use of treated effluent that would otherwise be discharged without being put to direct use.

Recycle - The process of minimizing the generation of waste by recovering usable products that might otherwise become waste. Examples are the recycling of aluminum cans, wastepaper, and bottles.

Redevelopment - Any construction, alteration, or improvement exceeding five thousand square feet of land disturbance performed on sites where existing land use is commercial, industrial, institutional, or multifamily residential.

Rehabilitation - To restore to good or normal condition

Remedial - Fix a problem. i.e. remedial action on a stream to improve erosion conditions.

Remediation - Cleanup or other methods used to remove or contain a toxic spill or hazardous materials from a (Superfund) site.

Residual - Amount of pollutant remaining in the environment after a natural or technological process has taken place, e.g., the sludge remaining after initial wastewater treatment, or particulates remaining in air after the air passes through a scrubbing or other pollutant removal process.

Retention - The amount of precipitation on a drainage area that does not escape as runoff. It is the difference between total precipitation and total runoff.

Retrofit - The modification of storm water management systems in developed areas through the construction of wet ponds, infiltration systems, wetland plantings, stream bank stabilization, and other BMP techniques for improving water quality. A retrofit can consist of the construction of a new BMP in the developed area, the enhancement of an older storm water management structure, or a combination of improvement and new construction.

Return interval - A statistical term for the average time of expected interval that an event of some kind will equal or exceed given conditions (e.g., a stormwater flow that occurs every 2 years).

Reuse (water reuse) - (see Reclaim)

Riparian - A relatively narrow strip of land that borders a stream or river, often coincides with the maximum water surface elevation of the 100 year storm.

Riparian Area - Vegetated ecosystems along a waterbody through which energy, materials, and water pass. Riparian areas characteristically have a high water table and are subject to periodic flooding.

Riparian Habitat - Areas adjacent to rivers and streams that have a high density, diversity, and productivity of plant and animal species relative to nearby uplands.

Roughness Coefficient (Hydraulics) - A factor in velocity and discharge formulas representing the effect of channel roughness on energy losses in flowing water. Manning's "n" is a commonly used roughness coefficient.

Runoff - That part of precipitation, snow melt, or irrigation water that runs off the land into streams or other surface water. It can carry pollutants from the air and land into the receiving waters.

Sanitary Sewer - A system of underground pipes that carries sanitary waste or process wastewater to a treatment plant.

Sanitary Waste - Domestic sewage.

Secondary Containment - Structures, usually dikes or berms, surrounding tanks or other storage containers and designed to catch spilled material from the storage containers.

Sediment Trap - A device for removing sediment from water flows; usually installed at outfall points.

Sedimentation - The process of depositing soil particles, clays, sands, or other sediments that were picked up by flowing water.

Sediments - Soil, sand, and minerals washed from land into water, usually after rain. They pile up in reservoirs, rivers, and harbors, destroying fish-nesting areas and holes of water animals and cloud the water so that needed sunlight might not reach aquatic plants. Careless farming, mining, and building activities will expose sediment materials, allowing the rain to wash them off the land.

Sheet Flow - Water, usually storm runoff, flowing in a thin layer over the ground surface.

Slide Gate - A device to control the flow of water through storm water conveyances.

Sludge - A semi-solid residue from any of a number of air or water treatment processes. Sludge can be a hazardous waste.

Slurry - A pasty liquid containing solid in suspension.

Soil - The unconsolidated mineral and organic material on the immediate surface of the earth that serves as a natural medium for the growth of plants.

Soakaway Pit - A pit into which liquids may flow and then percolate slowly into the subsoil.

Source Control - A practice or structural measure to prevent pollutants from entering storm water runoff or other environmental media.

Stakeholder - Any person, agency or group who has a direct interest in the purpose of a proposed undertaking.

Stopcock Valve - A small valve for stopping or controlling the flow of water or other liquid through a pipe

Stormceptor - Manufacturer of stormwater quality treatment devices.

Storm Drain - A slotted opening leading to an underground pipe or an open ditch for carrying surface runoff.

Storm Water – Storm water runoff. snow melt runoff. surface runoff. and drainage. It excludes infiltration.

Stormwater Ponds - A land depression or impoundment created for the detention or retention of stormwater runoff.

Stormwater Wetlands - Shallow, constructed pools that capture stormwater and allow for the growth of characteristic wetland vegetation.

Stratigraphy - The order and relative position of strata, which is a layer or set of successive layers of any deposited substance.

Streamflow - Water flowing in a natural channel, above ground.

Sump - A pit or tank that catches liquid runoff for drainage or disposal.

Superfund Sites - In the United States, sites under remediation or clean-up invoked by the CERCLA (Comprehensive Environmental Response Compensation and Liability Act, Superfund Act) and/or SARA. The "cradle to grave law" is applied holding that the generator of waste is responsible for proper waste disposal and provides for any cleanup of the contaminated sites by the government, with the cost of cleanup being charged to the responsible parties. Basically a generator becomes responsible for waste from it's inception until it has been destroyed.

Surface Capping - A layer of clay, or other impermeable material installed over contaminated soil to prevent the entry of rainwater, eliminate direct exposure to contaminated soils, and minimize leachate and the emission of soil gases.

Surface Water - All water naturally open to the atmosphere (rivers, lakes, reservoirs, streams, wetlands impoundments, seas, estuaries, etc.); also refers to springs, wells, or other collectors which are directly influenced by surface water.

Suspended Solids - The portion of total solids retained by a filter.

Swale - An elongated depression in the land surface that is at least seasonally wet, is usually heavily vegetated, and is normally without flowing water. Swales direct storm water flows into primary drainage channels and allow some of the storm water to infiltrate into the ground.

Thalweg - Line joining the lowest points of successive cross-sections, either along a river channel or, more generally, along the valley that it occupies. More specifically, a thalweg is the line of the fastest flow along the course of a river. This usually crosses and recrosses the stream channel.

Topography - The physical features of a surface area including relative elevations and the position of natural and human-made features.

Total Phosphorus (TP) – The total amount of phosphorus that is contained within the water column.

Total Suspended Solids (TSS) - The total amount of particulate matter that is suspended in the water column.

Toxin - A poison produced by an organism.

Treatment - The act of applying a procedure or chemicals to a substance to remove undesirable pollutants.

Tributary - A river or stream that flows into a larger river or stream.

Turbidity - Describes the ability of light to pass through water. The cloudy appearance of water caused by suspended and colloidal matter (particles).

Two-Year Storm - The 24 hour storm event which exceeds bankfull capacity and occurs on average once every two years (or has a likelihood of occurrence of 1/2 in a given year).

Underground Storage Tanks (USTs) - Storage tanks with at least 1 0 percent or more of its storage capacity underground.

Urbanization - Changing land use from rural characteristics to urban (city-like) characteristics.

Ultrafiltration - The process in which hydrostatic pressure causes water and small dissolved molecules and ions to move across a membrane against a concentration gradient.

U.V. Disinfection - A process of disinfecting that involves subjecting the item, object, or instrument to ultraviolet radiation.

Volatize - To cause to pass off in vapour.

Waste - Unwanted materials left over from a manufacturing or other process.

Water Surface Profile - The longitudinal profile assumed by the surface of a stream flowing in an open channel; the hydraulic grade line.

Water Table - The upper surface or top of the saturated portion of the soil or bedrock layer, indicates the uppermost extent of groundwater.

Watershed - The topographic boundary within which water drains into a particular river, stream, wetland, or body of water.

Waterway - A channel for the passage or flow of water.

Wet pond - A stormwater management pond designed to detain urban runoff and always contain water.

Wet Well - A chamber used to collect water or other liquid and to which a pump is attached.

Wetlands - An area that is regularly saturated by surface or ground water and subsequently is characterized by a prevalence of vegetation that is adapted for life in saturated soil conditions. Examples include: swamps, bogs, fens, marshes, and estuaries.

Wind Break -Any device designed to block wind flow and intended for protection against any ill effects of wind.

Xeriscaping - a method of landscaping using rock gardens, cacti, and other plants that thrive in dry environments as a means to conserve water.

GLOSSARY

APPENDICES

APPENDIX A – ONTARIO CSO CONTROL PROCEDURE

PROCEDURE F-5-5

DETERMINATION OF TREATMENT REQUIREMENTS FOR MUNICIPAL AND PRIVATE COMBINED AND PARTIALLY SEPARATED SEWER SYSTEMS

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1. RATIONALE

Procedure F-5-5 is a supporting document for Guideline F-5 "Levels of Treatment for Municipal and Private Sewage Treatment Works Discharging to Surface Waters".

A Combined Sewer System (CSS) is a wastewater collection system designed to convey both sanitary wastewater and stormwater runoff through a single-pipe system to a sewage treatment works. During dry weather, it conveys sanitary wastewater. During a precipitation event (rainfall or snowmelt) the capacity of the CSS and/or treatment facility may be exceeded by the total wastewater flow. This results in the occurrence of a combined sewer overflow (CSO) which is an untreated mixture often containing high levels of floatables, pathogenic microorganisms, suspended solids, oxygen-demanding organic compounds, nutrients, oil and grease, toxic contaminants and other pollutants. The CSOs represent a potential health hazard and can have adverse effects on aquatic life, recreational uses and water supplies. The goals of this Procedure are to:

(a) eliminate the occurrence of dry weather overflows

(b) minimize the potential for impacts on human health and aquatic life resulting from CSOs

(c) achieve as a minimum, compliance with body contact recreational water quality objectives (Provincial Water Quality Objectives (PWQO) for Escherichia coli (E. coli)) at beaches impacted by CSOs for at least 95% of the four-month period (June 1 to September 30) for an average year.

2. DEFINITIONS

A "combined sewer system (CSS)" is a wastewater collection system which conveys sanitary wastewaters (domestic, commercial and industrial wastewaters) and stormwater runoff through a single-pipe system to a Sewage Treatment Plant (STP) or treatment works. Combined sewer systems which have been partially separated and in which roof leaders or foundation drains contribute stormwater inflow to the sewer system conveying sanitary flows are still defined as combined sewer systems in this Procedure.

APPENDIX A

A "combined sewer overflow (CSO)" is a discharge to the environment from a combined sewer system that usually occurs as a result of a precipitation event when the capacity of the combined sewer is exceeded. It consists of a mixture of sanitary wastewater and stormwater runoff and often contains high levels of floatables, pathogenic microorganisms, suspended solids, oxygen-demanding organic compounds, nutrients, oil and grease, toxic contaminants and other pollutants.

An "overflow event" occurs when there is one or more CSOs from a combined sewer system, resulting from a precipitation event. An intervening time of twelve hours or greater separating a CSO from the last prior CSO at the same location is considered to separate one overflow event from another.

"Dry weather flow" is sewage flow resulting from both:

(i) Sanitary wastewater (combined input of industrial, domestic and commercial flows); and

(ii) Infiltration and inflows from foundation drains or other drains occurring during periods with an absence of rainfall or snowmelt.

"Wet weather flow" is the combined sewage flow resulting from:

(i) Sanitary wastewater; and

(ii) Infiltration and inflows from foundation drains or other drains resulting from rainfall or snowmelt; and

(iii) Stormwater runoff generated by either rainfall or snowmelt that enters the combined sewer system.

A "regulator" is any structure that in dry weather permits the passage of all flows to treatment and in wet weather permits discharge to an outfall or relief sewer of all flows in excess of some specific flowrate.

An "average year" refers to:

(i) the long term average of flow based on using simulation of at least twenty years of rainfall data and/or

(ii) a year in which the rainfall pattern (e.g. intensity, volume and frequency) is consistent with the long-term mean of the area; and/or

(iii) a year in which the runoff pattern resulting from the rainfall (e.g. rate, volume and frequency) is consistent with the long-term mean of the area.

A "swimming and bathing beach" is a strip of shoreline with the physiographic, climatic, access, and ownership attributes necessary to accommodate significant water contact and non-contact recreation under favourable aquatic conditions.

3. SEPARATE VERSUS COMBINED SEWERS

The Ministry "Guidelines for the Design of Sanitary Sewage Systems, July 1985" states that

"All new sewer construction within the Province of Ontario should be of the 'separate' type, with all forms of storm and groundwater flow being excluded to the greatest possible extent. New 'combined' sewer systems will not be approved."

However, existing combined sewers may undergo rehabilitation or be replaced by new combined sewers provided the municipality or operating authority has met the Ministry requirements as set out in this document.

4. MINISTRY REQUIREMENTS FOR MUNICIPAL & PRIVATE COMBINED SEWER SYSTEMS

To meet the goals of this Procedure each municipality or operating authority of a combined sewer system will be expected to:

(a) develop a Pollution Prevention and Control Plan (PPCP) as outlined in Section 5;
(b) meet minimum CSO controls as outlined in Section 6; and
(c) provide additional controls
- for beaches impaired by CSOs where water quality is not meeting the PWQO for E. coli as outlined in Section 9
- where required by receiving water quality conditions as specified in Procedure B_1_1 "Water Management - Policies, Guidelines, Provincial Water Quality Objectives of the Ministry of Environment and Energy, July 1994".

The site-specific nature and impacts of CSOs are recognized in this Procedure. There is flexibility for selecting controls for local situations.

5. POLLUTION PREVENTION AND CONTROL PLAN (PPCP)

A Pollution Prevention and Control Plan (PPCP) should be developed to meet the goals of the Procedure by:

- outlining the nature, cause and extent of pollution problems;
- examining alternatives and proposing remedial measures; and,
- recommending an implementation program.

Water quality problems may be caused primarily by combined sewer overflows or by a combination of sources including CSOs. Where the pollution problem is due to a combination of sources, the discharges will be investigated and prioritized based on the relevant significance of the various discharges. In some cases the receiving water quality and pollutant transport mechanisms will be assessed in the PPCP.

To address the impact of CSOs the components of the PPCP shall include:

(a) characterization of the combined sewer system (CSS);

- Monitoring, modelling and other appropriate means shall be used to characterize the CSS and the response of the CSS to precipitation events. The characterization shall include the determination of the location, frequency and volume of the CSOs as well as the concentrations and mass of pollutants resulting from CSOs. Through this process the existence and severity of suspected deficiencies will be confirmed. Records shall be kept for combined sewer systems including the following:

    - location and physical description of CSO outfalls in the collection system, emergency overflows at pumping stations, and bypass locations at STPs;
    - location and identification of receiving water bodies for all combined sewer outfalls;
    - combined sewer system flow and STP treatment capacities; present and future expected peak flow rates during dry weather and wet weather;
    - capacity of all regulators; and
    - location of cross-connections.

- Operational procedures shall be developed for combined sewer systems including the following:

    - combined sewer maintenance programs; and,
    - regulator inspection and maintenance programs.

(b) an examination of non-structural and structural CSO control alternatives that may include:

- source control;
- inflow/infiltration reduction;
- operation and maintenance improvements;
- control structure improvements;
- collection system improvements;
- storage technologies;
- treatment technologies;
- sewer separation.

(c) an implementation plan with cost estimates and schedule of all practical measures to eliminate dry weather overflows and minimize wet weather overflows.

- The implementation plan should show how the minimum CSO prevention and control requirements and other criteria in this Procedure are being achieved.

6. MINIMUM COMBINED SEWER OVERFLOW (CSO) CONTROLS

The minimum CSO controls consist of the following :

(a) Eliminate CSOs during dry-weather periods except under emergency conditions.

- Each municipality shall demonstrate that the combined sewer system, including the regulators, and associated treatment facilities are adequate for the transmission and treatment of all peak dry weather flows from the service area.
- An emergency condition would exist when e.g. basement flooding, damage to equipment at treatment works or pumping stations, or treatment process washout was occurring or was imminent.

(b) 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 on 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.

(c) Establish and implement proper operation and regular inspection and maintenance programs for the combined sewer system in order to ensure continued proper system operation.

(d) Establish and implement a floatables control program to control coarse solids and floatable materials e.g. by reducing the amount of street litter that enters the catchbasins and the CSS; by removing debris from CSOs at the outfalls using measures such as trash racks and screens; and by removing floatables from the surface of the receiving water after a CSO occurs.

(e) Maximize the use of the collection system for the storage of wet weather flows which are conveyed to the Sewage Treatment Plant for treatment when capacity is available e.g. by adjusting regulator settings.

(f) Maximize the flow to the Sewage Treatment Plant for the treatment of wet weather flows e.g. by removing obstructions to flow.

- The secondary treatment capacity should be utilized as much as possible for treating wet weather flows with the balance of flows being subject to primary treatment. Measures to increase the wet weather hydraulic capacity at the Sewage Treatment Plant (e.g. Step Feed operation) should be investigated.

(g) During a seven-month period commencing within 15 days of April 1, capture and treat for an average year all the dry weather flow plus 90% of the volume resulting from wet weather flow that is above the dry weather flow. The volumetric control criterion is applied to the flows collected by the sewer system immediately above each overflow location unless it can be shown through modelling and on-going monitoring that the criterion is being achieved on a system-wide basis. No increases in CSO volumes above existing levels at each outfall will be allowed except where the increase is due to the elimination of upstream CSO outfalls. During the remainder of the year, at least the same storage and treatment capacity should be maintained for treating wet weather flow. The treatment level for the controlled volume is described in Section 7.

7. LEVEL OF TREATMENT

The treatment processes of the sewage treatment plants should be optimized to minimize the pollutant loadings under wet weather conditions. The Pollution Prevention and Control Planning study should evaluate the operation of the Sewage Treatment Plant under wet weather conditions in consultation with Ministry Regional staff. This may lead to wet weather-specific operating conditions which may produce lower overall pollutant loadings.

During wet weather, the minimum level of treatment required for flows above the dry weather flow (as specified in sections 6 and 9) from combined sewer systems is primary treatment or equivalent. The effluent guideline for primary treatment is 30% carbonaceous biochemical oxygen demand (BOD_5) removal and 50% total suspended solids (TSS) removal for an average year during the seven month period as specified in section 6(g). The baseline for the calculation of the average pollutant removal is the influent passing the headworks of the treatment facility under wet weather conditions.

The dry weather flow from combined sewer systems is subject to the process effluent concentration criteria of the STP whether they are primary treatment plants or secondary treatment plants. During wet weather, for secondary treatment plants, the flows through the secondary treatment capacity will be subject to the process effluent concentration criteria of the STP. The flows in the STP which bypass the secondary treatment will be subject to a minimum level of primary treatment.

The treatment of wet weather flows from combined sewer systems may occur at the central Sewage Treatment Plant or at other locations such as satellite treatment facilities. Satellite treatment facilities may be built to treat wet weather flows where there are space limitations or limited capacity in the collection system to get the wet weather flows to the STP. There are a number of satellite treatment technologies some examples of which are vortex separators, high-rate sedimentation, dissolved air flotation and high-rate filtration. Satellite treatment facilities when used to treat wet weather flows from combined sewer systems are subject to the minimum level of primary treatment requirements specified above. In addition, for satellite treatment facilities the effluent concentration for total suspended solids should not exceed 90 mg/l for more than 50 % of the time for an average year during the seven-month period as specified in section 6(g).

8. EFFLUENT DISINFECTION

Effluent disinfection is required where the effluent affects swimming and bathing beaches and other areas where there are public health concerns. The local Medical Officer of Health identifies public health concerns such as e.g. whether recreational beaches are safe for swimming.

The interim effluent quality criterion for disinfected combined sewage during wet weather is a monthly geometric mean not exceeding 1000 E. coli per 100 ml. This criterion may be modified by the Regional staff of the Ministry on a case-by-case basis due to site-specific conditions.

In cases where chlorination is used as the disinfection process, subsequent dechlorination of the sewage works effluents shall be used to minimize the adverse effects of chlorine residuals on public health and the aquatic environment where necessary.

All bypasses at the Sewage Treatment Plant should be subjected to the disinfection process where available in order to reduce the bacterial loadings at discharge.

9. BEACH PROTECTION

Additional controls above the minimum CSO controls (section 6) are required for swimming and bathing beaches affected by CSOs and consist of the following :

(a) There should be no violation of the body contact recreational water quality objective (Provincial Water Quality Objectives (PWQO)) for E. coli of 100 E. coli per 100 ml. based on a geometric mean at swimming and bathing beaches as a result of CSOs for at least 95% of the four-month season (June 1 to September 30) for an average year.

(b) Controlling to not more than two overflow events per season (June 1 to September 30) for an average year in a combined sewer system with the combined total duration of the CSOs at any single CSO location being less than 48 hours and ensuring that the controlled combined sewage which does not overflow receives a level of treatment (as specified in section 7) plus disinfection (as

specified in section 8) is deemed to satisfy section 9(a). An additional overflow event per season may be allowed if the proponent can demonstrate that section 9(a) will still be satisfied and the combined total duration of the CSOs at any single CSO location will be less than 48 hours.

10. MONITORING

Monitoring of wastewater flows and overflows should be undertaken at locations within the sewer system for the purposes of assessing upgrading requirements and determining compliance with Ministry requirements. The responsibility for providing monitoring shall rest with the municipality or operating authority of the combined sewer system.

11. NEW SANITARY CONNECTIONS TO COMBINED SEWER SYSTEMS

When and where significant combined sewer system deficiencies exist, the Regional Office of the Ministry shall require that the provision of sanitary servicing for additional development tributary to the deficient system be curtailed to prevent aggravation of the problem until the necessary upgrading, as outlined by a Pollution Prevention and Control Plan is carried out in keeping with the requirements of this Procedure. Some development is allowed as upgrading proceeds, conditional upon its progress. The staged upgrading should at a minimum provide for the transmission and treatment of all flows from the additional development.

This provision applies to significant development i.e. not to simple, one lot infill cases.

12. NEW STORM CONNECTIONS TO COMBINED SEWER SYSTEMS

New storm drainage systems shall not be permitted to connect to existing combined systems if that increases the gross area serviced by the combined sewer system except where evaluations indicate that circumstances allow no other practical alternative. The evaluations must be documented as part of a Pollution Prevention and Control Plan.

"Piece-meal" construction on existing combined sewer systems will be permitted only with overriding justification such as for the purpose of relocation (e.g., to accommodate underground utilities, subway structures, new buildings and pedestrian tunnels, etc.) or for the purpose of capacity improvement (e.g., to relieve basement flooding or to provide emergency additional conveyance capacity to treatment works to reduce overflows) or for rehabilitating deteriorated sewer conditions.

13. ENFORCEMENT

Procedure F-5-5 will be used to:

(a) review applications for approval to ensure that the proponent is in compliance with the Procedure prior to the issuance of a Certificate of Approval.

(b) assist regional staff in setting minimum requirements in preparing Control Orders to bring systems into compliance with the Procedure.

(c) assist enforcement staff in evaluating a combined sewer system operator's due diligence when investigating violations of the Environmental Protection Act and/or the Ontario Water Resources Act.

Any deviation or relaxation from this Procedure should be reviewed by the Regional Director and the Director, Program Development Branch.

APPENDIX A

APPENDIX B – DISPOSAL ALTERNATIVES

DISCHARGE/ACTIVITY	BUSINESS/COMMERCIAL		RESIDENTIAL
	Disposal Priorities	Approval	Disposal Priorities
General Construction and Painting			
Excess paint (oil based)	1. Recycle/reuse. 2. Dispose as hazardous waste.		1. Recycle/reuse. 2. Take to HHW drop-off.
Excess paint (water-based)	1. Recycle/reuse. 2. Dry residue in cans, dispose as trash. 3. If volume is too much to dry, dispose of as hazardous waste.		1. Recycle/reuse. 2. Dry residue in cans, dispose as trash. 3. If volume is too much to dry, take to HHW drop-off.
Paint clean-up (oil based)	Wipe paint out of brushes, then : 1. Filter & reuse thinners and solvents. 2. Dispose as hazardous waste.		Wipe paint out of brushes, then: 1. Filter & reuse thinners and solvents. 2. Take to HHW drop-off.
Paint clean-up (water based)	Wipe paint out of brushes, then: 1. Rinse to sanitary sewer.		Wipe paint out of brushes, then: 1. Rinse to sanitary sewer.
Building exterior cleaning (high-pressure water)	1. Prevent entry into storm drain and remove off site.Wash onto dirt area, spade into soil.Collect (e.g. mop up) and discharge to sanitary sewer.	Waste Water Treatment Plant	

DISCHARGE/ACTIVITY	BUSINESS/COMMERCIAL		RESIDENTIAL
	Disposal Priorities	Approval	Disposal Priorities
General Construction and Painting continued			
Cleaning of building exteriors which have **HAZARDOUS MATERIALS** (e.g. mercury, lead) in paints	1. Use dry cleaning methods. 2. Contain and dispose washwater as hazardous waste (Suggestion: dry material first to reduce volume).		
Non-hazardous paint scraping/sand blasting	1. Dry sweep, dispose as trash.		1. Dry sweep, dispose as trash.
HAZARDOUS paint scraping/sand blasting (e.g. marine paints or paints containing lead or tributyl tin)	1. Dry sweep, dispose as hazardous waste.		1. Dry sweep, take to HHW drop-off.

DISCHARGE/ACTIVITY	BUSINESS/COMMERCIAL		RESIDENTIAL
	Disposal Priorities	Approval	Disposal Priorities
General Construction and Painting; Street and Utility Maintenance			
Soil from excavations during periods when storms are forecast.	1. Should not be placed in street or on paved areas. 2. Remove from site or backfill by end of day. 3. Cover with tarpaulin or surround with silt fence. 4. Place filter cloth over catchbasin. Note: Thoroughly sweep following removal of dirt in all four alternatives.		
Soil from excavations placed on paved surfaces during periods when storms are not forecast.	1. Keep material out of storm conveyance systems.		
Cleaning streets in construction areas.	1. Dry sweep and minimize tracking of mud. 2. Use silt ponds and/or similar pollutant reduction techniques when flushing pavement.		
Soil erosion, sediments	1. Cover disturbed soils, use erosion controls, filter flows into storm drain. 2. Revegetate immediately.		

DISCHARGE/ACTIVITY	BUSINESS/COMMERCIAL		RESIDENTIAL
	Disposal Priorities	Approval	Disposal Priorities
General Construction and Painting; Street and Utility Maintenance continued			
Fresh cement, grout, mortar.	1. Use/reuse excess. 2. Dispose to trash.		1. Use/reuse excess. 2. Dispose to trash.
Washwater from concrete/mortar (etc.) cleanup.	1. Wash onto dirt area and spade in. 2. Pump and remove to appropriate disposal area. 3. Settle, pump water to sanitary sewer.	Waste Water Treatment Plant	1. Wash onto dirt area and spade in. 2. Pump and remove to appropriate disposal area. 3. Settle, pump water to sanitary sewer.
Aggregate wash from driveway/patio construction.	1. Wash onto dirt area, spade in. 2. Pump and remove to appropriate disposal area 3. Settle, pump water to sanitary sewer.	Waste Water Treatment Plant	1. Wash onto dirt area and spade in. 2. Pump and remove to appropriate disposal area. 3. Settle, pump water to sanitary sewer.
Rinsewater from concrete mixing trucks.	1. Return truck to yard for rinsing into pond or dirt area. 2. At construction site, wash into dirt area.		
Non-hazardous demolition and construction debris.	1. Recycle/reuse (concrete, wood, etc.) 2. Dispose as trash.		1. Recycle/reuse (concrete, wood, etc.) 2. Dispose as trash.

DISCHARGE/ACTIVITY	BUSINESS/COMMERCIAL		RESIDENTIAL
	Disposal Priorities	Approval	Disposal Priorities
General Construction and Painting; Street and Utility Maintenance continued			
Hazardous demolition and construction debris (e.g. asbestos).	1. Dispose as hazardous waste.		1. Do not attempt to remove yourself. Contact an asbestos removal service for safe removal and disposal.
Saw-cut slurry.	1. Use dry cutting technique and sweep up residue. 2. Vacuum slurry and dispose off-site. Block storm drain or berm with low weir as necessary to allow most solids to settle. Shovel out gutters; dispose of residue to dirt area or landfill.		

DISCHARGE/ACTIVITY	BUSINESS/COMMERCIAL		RESIDENTIAL
	Disposal Priorities	Approval	Disposal Priorities
General Construction and Painting; Street and Utility Maintenance continued			
Construction dewatering (Non turbid, uncontaminated groundwater).	1. Recycle/reuse. 2. Discharge to storm sewer.		
Construction dewatering (Other than non turbid, uncontaminated groundwater).	1. Recycle/reuse. 2. Discharge to sanitary sewer. 3. As appropriate, treat prior to discharge to storm sewer.	Waster Water Treatment Plant	
Portable toilet waste.	1. Leasing company shall dispose to sanitary sewer.	Waste Water Treatment Plant	
Leaks from garbage dumpsters.	1. Collect, contain leaking material. Eliminate leak, keep covered, return to leasing company for repair. 2. If dumpster is used for liquid waste, use plastic liner.		
Potable water-line flushing . Hydrant testing.	1. Deactivate chlorine by maximizing time water travel before reaching waterbodies.		
Super -chlorinated (above 1 ppm) water from line flushing.	1. Discharge to sanitary sewer. 2. Complete dechlorination required before discharge to storm drain.		

DISCHARGE/ACTIVITY	BUSINESS/COMMERCIAL Disposal Priorities	Approval	RESIDENTIAL Disposal Priorities
Landscape/Garden Maintenance			
Pesticides	1. Use up. Rinse containers; use rinsewater as product. Dispose rinsed containers as trash. 2. Dispose unused pesticide as hazardous waste.		1. Use up. Rinse containers; use rinsewater as product. Dispose rinsed containers as trash. 2. Take unused pesticide to HHW drop-off.
Garden clippings	1. Compost. 2. Take to Landfill.		1. Compost. 2. Dispose as trash, separate as yard waste if a separate service is offered.
Tree Trimming	1. Chip if necessary, before composting or recycling.		1. Chip if necessary, before composting or recycling.
Swimming pool, spa, fountain water (emptying)	1. Do not use metal-based algaecides (i.e. Copper Sulphate). 2. Recycle/reuse (e.g. irrigation). 3. Determine chlorine residual = 0, wait 24 hours then discharge to storm drain.		1. Do not use metal-based algaecides (i.e. Copper Sulphate). 2. Recycle/reuse (e.g. irrigation). 3. Determine chlorine residual = 0, wait 24 hours then discharge to storm drain.
Acid or other pool/spa/fountain cleaning	1. Neutralize and discharge to sanitary sewer.	Waste Water Treatment Plant	
Backwash from swimming pool, spa filter	1. Reuse for irrigation. 2. Dispose to dirt area. 3. Settle, dispose to sanitary sewer.		1. Use for landscape irrigation. 2. Dispose on dirt area. Settle, dispose to sanitary sewer.

DISCHARGE/ACTIVITY	BUSINESS/COMMERCIAL		RESIDENTIAL
	Disposal Priorities	Approval	Disposal Priorities
Vehicle Wastes			
Used motor oil	1. Use secondary containment while storing. 2. Send to recycler.		1. Put out for curbside recycling pickup where available. 2. Take to Recycling Facility or auto service facility with recycling program. 3. Take to HHW events accepting motor oil.
Antifreeze	1. Use secondary containment while storing, send to recycler.		1. Take to Recycling Facility.
Other vehicle fluids and solvents	1. Dispose as hazardous waste.		1. Take to HHW event.
Automobile batteries	1. Send to auto battery recycler. 2. Take to Recycling Center.		1. Exchange at retail outlet. 2. Take to Recycling Facility of HHW event where batteries are accepted.
Motor home/construction trailer waste	1. Use holding tank. Dispose to sanitary sewer.		1. Use holding tank. Dispose to sanitary sewer.
Vehicle leaks at Vehicle Repair Facilities	Follow this 3-step process. 1. Clean up leaks with rags or absorbents. 2. Sweep, using granular absorbent material (cat litter). 3. Mop and dispose of mopwater to sanitary sewer.		

DISCHARGE/ACTIVITY	BUSINESS/COMMERCIAL		RESIDENTIAL
	Disposal Priorities	Approval	Disposal Priorities
Other Wastes			
Carpet cleaning solutions and other mobile washing services	1. Dispose to sanitary sewer.	Waste Water Treatment Plant	1. Dispose to sanitary sewer.
Roof drains	1. If roof is contaminated with industrial waste products, discharge to sanitary sewer. 2. If no contamination is present discharge to infiltration trenches or storm sewer.		
Cooling water Air conditioning condensate	1. Recycle/.reuse. 2. Discharge to sanitary sewer.	Waste Water Treatment Plant	
Pumped groundwater, infiltration/ foundation drainage (contaminated)	1. Recycle/reuse (landscaping, etc.). 2. Treat if necessary; discharge to sanitary sewer. 3. Treat and discharge to storm drain.	Waste Water Treatment Plant	
Kitchen Grease	1. Provide secondary containment, collect, send to recycler.		1. Collect, solidify, dispose as trash.
Clean-up wastewater from sewer back-up	1. Follow this procedure. Block storm drain, contain, collect, and return spilled material to the sanitary sewer.		

APPENDIX B

APPENDIX C - AVAILABLE PUBLIC OUTREACH MATERIALS

This summary includes materials provided at the start up of the project and new materials collected.

AGENCY	CONTACT	DESCRIPTION OF MATERIAL	FOCUS OF PROGRAM OR MATERIAL		
			FLOW REDUCTION	POLLUTION PREVENTION	WATER CONSERVATION
American Water Resources Association	950 Herndon Parkway, Suite 300 Herndon, Virginia 2207-5528, USA Phone: (703) 904-1225 Fax: (703) 904-1228	**Poster** How do we treat our wastewater?		X	
American Water Works Association	(303) 794-7711	**Brochures and booklets -** pocket size *Water Conservation at Home (1996)* *25 Things You Can do to Prevent Water Waste (1989)*	X		X
Barrie Public Utilities Commission	(705) 739-4254	**Water Conservation Program** Reduced costs or rebates for low flow toilets, aerators and showerheads. 1997 Lawn watering restrictions	X		X
Burlington, City of	City of Burlington, Ontario, Engineering Department (905) 335-7694	**Brochure** *Healthy Creeks - A shared responsibility*		X	

Cambridge, City	Cambridge City Green Strategy. (519) 740-4650, ext. 4526.	**Rain Barrel promotion.** Rain Barrels, benefits, essentials, etc. Information brochure about rain barrel purchase. **Brochure:** *Alternatives to Pesticides for Health's Sake*- lawn care, pesticide alternatives.	X	X	X
Canadian Parks Service. Friends of Fort George.	Friends of Fort George P. O. Box 1283 Niagara-on-the-Lake ON L0S 1J0	**Sewage Waste Amendment Marsh Process (SWAMP)** *Brochure. A green way to treat sewage: Let cattails do it!*		X	
Center for Watershed Protection	(410) 461-8323	**Bulletin, quarterly** Watershed Protection Techniques	X	X	X
CMHC's Healthy House, Toronto	(416) 218-3343	**Healthy House Project 1996** Handout describing the drinkable water and waste water management project.	X	X	X

Cornwall, City of	City of Cornwall Environmental Services Department (613) 937-1777	**Booklet** *Enviropedia - A guide to solid waste management, alternative cleaners, water and energy conservation.*	X	X	X
Credit Valley Conservation	Credit Valley C.A. (905) 670-1615 or 1-800-668-5557.	**Brochure:** *Your Water: What you should know* -A guide for Orangeville residents.	X	X	X
Environment Canada	Enquiry Centre (819) 997-2800 or 1-800-668-6767	**Freshwater Series.** Several comprehensive booklets on many aspects of water and environmental citizenship. **Booklet** What We Can Do for Our Environment (Green Plan) **Book** *A Primer on Fresh Water*	X	X	X
Etobicoke, City of	Rob Klimas, Manager Storm Drainage (416) 394-8379	**Rain Barrel Pilot Project (1994)** Summary of project, survey and distributed household flyers.	X		X

Green Thumb Project	Lake Ontario area contact: Lois Corbett or Janet May. (416) 348-0660	**Green Thumb Project** (Education project for schools, parks and homeowners. **Handout** - turf management concerns, pesticide use, & importance to the Great Lakes.		X	
City of Hamilton (Former Hamilton – Wentworth Region)	Hamilton General Inquiries (905) 546-4417	**Booklet** *Enviro-Guide. For students and residents of Hamilton Wentwork 1996* **Brochures** *Green Venture information of home green up.* *Spills* *Yellow Fish Road Storm Drain Awareness Program* *Recycling just got easier in Hamilton-Wentworth* **Misc** Pogs - *Never Lose Focus*		X	X

Toronto Region Conservation Authority	Toronto Region CA Customer Service (416) 661-6600 for Brochure listing models and displays available for loan to non-profit groups. www.trca.on.ca	**Panel displays:** *Caring for Water (urban)* *After the Rain* - hydrologic cycle, stormwater management. **Factsheets:** *After the Rain* series. *Where Does the Rain Go?* *What is Stormwater Management?* *Managing Stormwater: Constructed Wetlands.* *Meet a Wetlands Plants.* **Models:** *Caring for Water* illustrating flow pathways and water-management do's and don'ts. *Groundwater Simulation Model* hydrogeological concepts.	X	X	X
Natural System Group	(416) 977-5079	**Foldout:** Pictorial depiction of alternative at-source pollution, volume control measures, drawbacks to Western Beaches Storage Tunnel.	X	X	

New York State Water Resources Institute	Centre for Environmental Research, Cornell University.	**Bulletins** *#1 - What is groundwater?* *#2 - Groundwater contamination* *#3 - Aquifers*		X	
Niagara Falls, City of	Brad Simpson Municipal Works Office (905) 356-7521, ext. 4102	**Downspout disconnection program** posters, door knob hangers. *Water Conservation Program information booklet.*	X		
Project Green, Windsor, Ontario	(519) 25-GREEN	**Water Saver** Flyer with advantages and purchasing information for rain barrels. Products and services brochure and price list.	X		X

St. Catharines, City of	Cindy Toth, Pollution Control Plan Coordinator. (905) 688-5600 ext. 693	**Brochures** *Downspout disconnection information.* *What's the connection between downspouts and St. Catharines beach closings?* *St. Catharines is a Beach Front Property* *Use Water Wisely - Water Saving Devices* *Water Wise Tips for Kitchen and Laundry* *Water Wise Tips for the Summer Season* *Water Audit - Water Wise Tips for Bathrooms* **Posters** The 3 r's of Water Conservation Our Waterways are for people to enjoy. **Misc.** Buttons - It's Worth It! waste reduction, recycling Stickers - Be Water Wise Refrigerator magnets - Be Water Wise	X	X	X

Toronto Environmental Alliance.	(416) 596-0660	**Handout:** *Green Lawns - A Guide to Environmentally Sound Lawn Care.* *Non-Toxic White Grub Control* *Toxic Challenge - Home Toxics Audit.* *Healthy Home Pledge* *Detox newsletter*		X	
Toronto, City of	City Works Service (416) 392-1807	**Downspout disconnection & rainbarrel program.** Handouts: *Recycle Your Rain* - Information flyer. *Recycle Your Rain* - Postcard for information on the downspout disconnection program. *Cleaner beaches through downspout disconnection* (multilingual) *Tap into a good thing* - Water meter program information	X		X

Toronto, Metro Works	Environmental Promotion and Consultation Branch (416) 397-7100	**Booklets and handouts:** *Get a great lawn with all the trimmings* *Newsletters: Waste Watch, Water Watch* *Seasonal Information handouts - xeriscaping, groundcovers, grass seeding.* *Household Hazardous Waste - non hazardous alternatives.* *Guide to Hazardous Waste in the Home.* *Commercial and Industrial Waste Reduction. several handouts with checklists and information.* *Be Good to Your Garden - Compost.* *Why you should make and use compost* *Worm your way into composting (vermiculture)* *Composting handouts: the value of compost; composting with worms; community composting; pestproofing your compost bin; vermiculture; odour control; composting resources.*	X	X	X
Water Environment Federation, Virginia USA	601 Wythe Street Alexandria, VA 22314-1994 (703) 684-2438 (703) 684-2400	**Brochure** *Household Hazardous Waste - What you should and shouldn't do*. *Non-point Source Pollution. You are the key to the cleanup.* **Resource guides for students and teachers**		C	

Waterloo, Regional Municipality	Water Efficiency Section (519) 575-4423	*Water Resources Protection Strategy Groundwater Protection Options* (Mike Murray, discussion paper) *Water Resources Protection Strategy Implementation Plan Long Term Water Strategy - Executive Summary Phase I Report* *Groundwater Protection Areas Policy Discussion Paper (1996)* *Sewer Use By-Law* *Water Quality Data Report for the Region's Municipal Water Supply System., Oct 95 to Dec. 96.* *Water Supply - Treatment, distribution, integration.* Residential Toilet Replacement Program - registration details and program information. **Brochures:** *Facts about Waterloo Region's Drinking Water Quality* *40 Ways to be water wise* *A Guide to Water Softeners* *Water - Ours to Protect* *Healthy Lawns and Gardens with Less Water* *Don't Trash Your Grass* *Alternatives to Pesticides - Naturally* *Naturescaping*	X	X	X

Waterloo, Regional Municipality con't		*Plant and Mulch Guide Plant Guide for the Greenbrook Demonstration Gardens* *Composting - the natural choice.* *Where can I buy a rain barrel?* *Residential Toilet Replacement Program $50 Rebate* *Hazardous Waste Days Schedule* *Where does it all go? Waste Management Division* *Take care of your land - Best Management Practices* *Take care of your land - Well and home water protection.* *Water Pollution Prevention Fact Sheets (draft 1998)* **Newsletter** ***Environews & Industrial Perspectives newsletter*** **Children's material** *Be a Friend to Your Planet Earth - household hazardous waste activity and colouring book.* **Other** Shower timer Toilet tank leak detector Drip Disk Outdoor Water Saver			
United States. Environmental Protection Agency	Email: public-access@epa.gov	Teachers and students education kits			