# MUNICIPAL WASTEWATER TREATMENT IN THE GREAT LAKES BASIN:

## Something Old, Something New

CANADA-ONTARIO AGREEMENT RESPECTING THE GREAT LAKES BASIN ECOSYSTEM

Canada Ontario

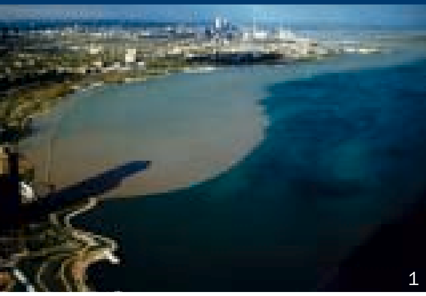
Each day, the urban landscape creeps a little farther across the Great Lakes Basin. The farmlands and woodlots of southern Ontario are being transformed into houses and roads, golf courses and suburban malls. As the population grows the effluents from sewage treatment plants, as well as polluted urban runoff and untreated municipal stormwater have emerged as prime contributors to local water quality problems throughout the basin.

Urban runoff, flowing like a sheet of water off rooftops and over pavement, washes heavy metals, road salt, animal feces, and oil and grease directly into nearby waterways. Stormwater, laden with silt and sediment, muddies streams, suffocates aquatic life and buries fish spawning grounds. And combined sewer overflows (CSOs), swollen with rainwater, flush untreated sewage into local rivers, streams and lakes. Within 24 hours, the warning signs go up and the beaches are closed, again.

The governments of Canada and Ontario and municipal authorities, working under the auspices of the Canada-Ontario Agreement Respecting the Great Lakes Basin Ecosystem (COA), have been developing and evaluating new stormwater control technologies and sewage treatment techniques to resolve these water quality problems. Under the new COA, Canada and Ontario will continue to build on this work, implementing efficient and cost effective projects to reduce the environmental damage of a rapidly expanding urban population.

To reduce the impacts of urbanization on the natural environment a variety of projects have been developed under the Municipal Wastewater Program. Technologies for sewage treatment, CSOs and stormwater management have been developed and demonstrated. The focus is on sharing the information and experience gained from projects, as well as investigating innovative approaches for reducing cost and managing municipal wastewater.

Municipal Wastewater Program partners include, the Ontario Ministry of the Environment and Environment Canada's Wastewater Technology Institute and the National Water Research Centre as well as conservation authorities, Remedial Action Plan committees and municipalities. The coordinating force behind the program is the Government of Canada's Great Lakes Sustainability Fund.



**Cover:** Homeowners can do their bit by disconnecting downspouts from the sewer system and diverting precipitation into rain barrels, gardens and lawns. **Cover inset:** Untreated stormwater can result in beach closures.

**1.** stormwater entering Lake Ontario
**2.** combined sewer overflow (CSO)
**3.** Midland STP

*If the environmental benefits are not sufficient motivation, facility optimization can also save a cash-strapped municipality a substantial amount of money.*

## Getting started on stormwater

Sewers in many older municipalities pull double duty. They often carry both sewage and stormwater through a single or combined pipe to the local sewage treatment plant. When a big storm hits, the huge volume of combined sewage, rainwater and all the contaminants carried along in the flow can overwhelm the plant with the result that wastewater may be dumped untreated into the closest lake or river.

"Treating stormwater and runoff is a relatively new concern," says Sandra Kok, Senior Project Engineer with the Government of Canada's Great Lakes Sustainability Fund. Historically, communities worried more about erosion and flood control. "Only in the last 15 years or so have we started taking a serious look at the environmental effects of stormwater," she says.

The art of stormwater management is evolving rapidly. The Great Lakes Sustainability Fund (GLSF) and the Ontario Ministry of the Environment (MOE) have been helping municipalities assess and test a variety of new techniques for diverting and treating urban runoff and stormwater:

- Various storage systems that hold back stormwater, for hours or days, until the local sewage treatment plant (STP) can handle the extra flow;
- Perforated piping, infiltration trenches and soakaway pits that use the natural attenuation properties of the underlying soil and bypasses the STP altogether;
- Ponds and artificial wetlands that hold runoff until the contaminated sediments settle out and the clear water can be released to local watercourses;
- Cost-effective technologies for better handling of the outflow of CSOs, including chemical treatment and real-time controls, that can save on the cost of storage tanks.

In the past, engineers concentrated on how best to handle the huge quantities of stormwater. "Now we are working to improve the design of stormwater ponds and other systems in order to improve the quality of the water discharged," says Tony Ho, a Municipal Water Specialist with the Ontario Ministry of the Environment. "We are looking at wetlands to cut nutrients, and filters to remove grease and sediment, and ultra-violet disinfection to reduce pathogens."

Homeowners are also being encouraged to do their bit by disconnecting downspouts from the sewer system and diverting precipitation into rain barrels and onto gardens and lawns. In Niagara Falls, a joint GLSF-MOE project achieved a voluntary disconnect success rate of 90 percent among the 4,300 homes inspected. "Downspout disconnects won't solve the whole stormwater problem on their own," says Kok, "but they certainly help, especially on a local basis."

Tackling the stormwater problem requires an array of approaches. For example, no single road drainage system is suitable for all situations. Certainly the conventional curbs-and-gutters do not reduce stormwater volumes or remove pollutants. In 1997, the Toronto and Region Conservation Authority (TRCA) and its partners re-evaluated roadside ditches and other related stormwater management practices. "Sometimes you have to go back to your roots," explains Kok. Grassed swales and roadside ditches hold back runoff and even filter out some of the solids.

The selection of the appropriate option for controlling stormwater depends on many factors including soil type, slope, land use patterns, the depth of the water table, and the distance to water bodies. Contractors for TRCA have developed a electronic spreadsheet which takes into account

### Stormwater ponds

A significant amount of contamination, including trace metals, PCBs and pesticides, can settle in the bottom of stormwater detention ponds that are built to collect polluted run-off. The lush green habitat also attracts and supports nesting birds, raccoons, frogs, turtles and other urban wildlife. Studies show that the ponds' contaminants can build up in the eggs of Redwing Blackbirds, and can prove toxic to aquatic invertebrates. More research is needed to determine the environmental risks the ponds pose to wildlife. The Canadian Wildlife Service has prepared a detailed factsheet on the issue that can be downloaded from their website at **www.on.ec.gc.ca/wildlife/intro.html**.

the full set of selection criteria and determines the best road drainage alternative according to the characteristics of the site.

The Municipal Wastewater Program also evaluates innovative stormwater management technologies. These include wet ponds and constructed wetlands, underground storage tanks, flow balancing systems, oil and grit separators, and conveyance exfiltration systems. Each monitoring program looks at rainfall and water flow rates, the quality of water flowing into and out of the plant, sediment particle sizes, and sediment quality in order to test the performance of the various systems.

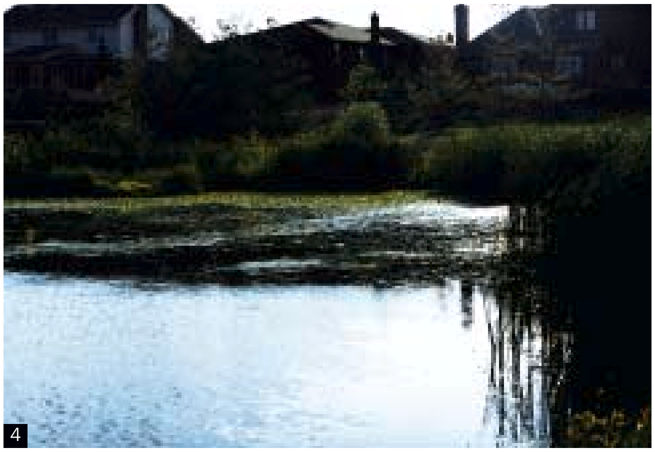
"Operational data just doesn't exist for many of these applications," says Kok. The designs are based on computer simulations. "Once the stormwater facility is constructed you have to recheck what actually happens against the performance that you had predicted," she says.

## Taking a fresh look

While the stormwater control technologies are all relatively new, in Ontario there are more than 150 years worth of experience operating ever more sophisticated sewage treatment plants. But even in the high tech world of STPs, there is still much to learn. Before considering expansion or building new facilities, municipal authorities try to optimize the treatment system that is already in place. "We want operators to take a fresh look at the way they run their plants," says Kok. They can often get a plant operating "at a much higher efficiency than the original design specifications," she says.

STP experts will "troubleshoot those plants that aren't meeting the province's effluent quality limits, looking for design deficiencies, process bottlenecks and operator problems," says Ho. There are often opportunities for improving flow distribution or modifying chemical dosages or fine-tuning sludge recirculation rates in order to increase efficiency.

If the environmental benefits are not sufficient motivation, facility optimization can also save a cash-strapped municipality a substantial amount of money. Instead of opting for the conventional and more expensive technical fix, installing a new filter for instance, finely tuned STPs are treating higher volumes and generating cleaner effluents for a fraction of the cost. "Its taken ten years, but these optimization techniques are now becoming standard operating procedure," says Kok.



**4.** stormwater pond

## The Canada–Ontario Infrastructure Program

The cost of replacing aging infrastructure and the need to expand overworked treatment works represent an overwhelming financial burden for municipalities. The Canada-Ontario Infrastructure Program was announced in 2000 and makes available $680.7 million in federal support and $1.4 billion in provincial support targeted towards urban and rural infrastructure, with a strong emphasis on water, wastewater and waste management projects. An additional $1.5 billion, shared equally between the governments of Canada, Ontario, and City of Toronto, is directed towards the Toronto waterfront regeneration project.

The STP Optimization Program, funded by the governments of Canada and Ontario, and the participating municipalities, has been applied to some 25 Ontario facilities, saving municipalities in Collingwood, Severn Sound, the Bay of Quinte, Detroit River and Hamilton Harbour a total of $66 million to date.

A review conducted for the Village of Coldwater helped it achieve its phosphorus removal target while deferring a $500,000 expansion of its STP, all for a $33,000 investment in staff training and equipment upgrades. And in Burlington, operational changes and minor system modifications reduced phosphorus and nitrogen discharges. This saved the Region of Halton $20-million as extra treatment capacity was found as a result of the optimization.

**5.** Tillsonberg STP
**6.** vortex separator used in CSO treatment

The program helps STPs that need to expand capacity in order to accommodate local growth, or meet tougher effluent limits because of the condition of the receiving water. "We help them optimize operations," says Ho, "and change their system to handle higher flows or operate more efficiently without resorting to major construction." A municipality must field test its revamped STP, and MOE has developed a protocol that supports the use and approval of innovative STP design and operating systems.

Once the existing plants are running at top efficiency, the next stage is to ensure that any new or expanded facility is going to be cost effective and efficient. The cities of Windsor and Thunder Bay both have plans to upgrade their STPs, from primary to secondary treatment standards. Pilot projects in Windsor, funded by the MOE, identified millions in potential cost savings associated with space reductions and reduced use of chemicals. Sault Ste. Marie is now reviewing the use of similar technology in a pre-engineering study prior to upgrading its East End STP.

The governments of Canada and Ontario play a key role in funding and supporting these kinds of pilot programs. "We try to play a leadership role," says Ho. "We will pair up with a municipality to see how a European or United States treatment process might work here." These demonstration projects help evaluate and promote new designs and treatment processes to determine whether they might find wide application in Ontario.

The optimization of existing systems and the evaluation of new technologies, that began under the 1994 COA, will continue under the new agreement. Through COA, municipalities will have access to the tools, technologies and the information they need to control pollutant discharges from storm sewers, municipal STPs and combined sewer outflows.

## Users pay for sewer upgrades

In 1990, Thunder Bay's water pollution control plant provided only primary treatment, a major portion of the city was served by an antiquated combined sewer and, when it rained, homeowners regularly complained about basement flooding. The Ontario Ministry of the Environment estimated the cost of the system upgrades could be in the $50 to $80 million range.

In 1993, with the assistance of the governments of Canada and Ontario, and municipal governments, a comprehensive Pollution Prevention and Control Plan was initiated to better manage the storm and sanitary sewer systems, upgrade CSOs, and add secondary sewage treatment facilities. Instead of relying on property taxes and provincial grants and loans, the city imposed a sewer rate – currently pegged at 65 percent of the water rate – to finance the plan. By 1999, the user-pay system was able to cover all the capital and operating costs of the sanitary sewage collection and treatment works, and municipal politicians were able to balance to the city's budget without raising property taxes.

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Canada-Ontario Agreement
Respecting the Great Lakes Basin Ecosystem

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