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14th Biennial Report on Great Lakes Water Quality

INTERNATIONAL JOINT COMMISSION
Canada and United States

COMMISSION MIXTE INTERNATIONALE
Canada et États-Unis

Fourteenth Biennial Report

Prepared pursuant to the Great Lakes Water Quality Agreement of 1978 for submission to the Governments of the United States and Canada and the State and Provincial Governments of the Great Lakes Basin

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Front cover photos and credits:

The inset photo by Dan Reaume Photography is of the Lou Romano Water Reclamation Plant, Windsor, Ontario. The plant recently underwent a $110 million (CDN) expansion that added secondary treatment technology, including Biological Aerated Filter process and ultraviolet disinfection.

Background photos by Bruce Jamieson are from Singing Sands, Dorcas Bay, Lake Huron, featuring (top photo) the wetland plant water purslane, or marsh seedbox, native to the Great Lakes.

Table of Contents

Executive Summary

Article VII of the Great Lakes Water Quality Agreement (Agreement) requires that the International Joint Commission (Commission) report to the federal, state and provincial governments biennially concerning progress toward achieving the Agreement's general and specific objectives. The Commission's report is also to assess the effectiveness of programs and other measures undertaken pursuant to the Agreement.

For its 14th Biennial Report on Great Lakes Water Quality, the Commission chose to focus on Article VI.1 (a), which calls for programs to abate, control and prevent pollution from municipal sources entering the Great Lakes System. The objective was to survey existing programs aimed at controlling surface-water pollution and to provide an overview of existing conditions.

The economic consequences of polluted discharges of wastewater are substantial. Impacts include increased costs for treating drinking water, decreases in property value, lost productivity from illness, increased health care costs and lost revenue from recreation and tourism.

Pollution from municipal wastewater sources (a combination of household, commercial, some industrial and stormwater) in the U.S. and Canada is managed by a system of sewers, pipes, collecting basins and treatment plants. Municipal wastewater is predominantly collected by either combined sewer systems (CSSs), which carry urban runoff or stormwater with sanitary wastewater, or by separate sanitary sewer systems (SSSs). There are also systems designed to handle only stormwater from municipalities, industries and construction sites.

Wastewater treatment facilities reduce the levels of many contaminants through the use of physical, biological and advanced wastewater treatment technologies. However, even when treated, wastewater can contain harmful levels of microorganisms, such as viruses, parasites or protozoa, and potentially harmful substances that are not always effectively removed.

In preparing this report, the Commission took into account information provided by the governments, examined a sample of dischargers on both sides of the border in the Great Lakes System by commissioning studies in each country and review the situation in the five binational Areas of Concern (AOCs). The Commission's sense is that governments at all levels are undertaking the right actions and that conditions have improved over the years. However, it is still difficult to assess the overall impact and effectiveness of programs to abate, control, and prevent pollution from municipal sources as required by Article VI.1 (a). Discharge quality at some facilities confirms that considerable work is yet to be done before the water quality in receiving waters is suitably protected.

It is in this context that the Commission makes the following recommendations:

1. **Ensure that the economic-stimulus measures now being developed address wastewater system needs in the Great Lakes basin.**

2. **More effectively link watershed management with the permitting process for municipal and industrial dischargers.**

3. **Make use of third-party audits to improve compliance with water-quality standards or objectives in the Great Lakes.**

4. **Encourage the adoption of "green infrastructure" to complement traditional infrastructure investments.**

Introduction

The Agreement has been a cornerstone of U.S.-Canadian cooperative efforts on Great Lakes water quality issues since it was first signed in 1972. Its overarching purpose is to restore and maintain the chemical, physical and biological integrity of the waters of the Great Lakes Basin Ecosystem. Under the Agreement, the two countries committed to, amongst other matters:

- Prohibiting the discharge of toxic substances in toxics amounts and virtually eliminating any or all persistent toxic substances;
- Providing financial assistance through a combination of local, state, provincial and federal resources to construct publicly owned wastewater treatment works;
- Developing and implementing coordinated planning and best management practices for the control of all sources of pollutants by respective jurisdictions.

Article VII of the Agreement requires that the Commission report to the federal, state and provincial governments biennially concerning progress toward achieving the Agreement's general and specific objectives. The Commission's report is also to assess the effectiveness of programs and other measures undertaken pursuant to the Agreement.

For this, its 14th Biennial Report on Great Lakes Water Quality, the Commission chose to focus on Article VI (a), which calls for programs to abate, control and prevent pollution from municipal sources entering the Great Lakes System.[1] The objective was to survey existing programs aimed at controlling surface-water pollution and to provide an overview of the current situation. Accordingly, the Commission asked Environment Canada and the U.S. Environmental Protection Agency (EPA) to provide copies of any formal or informal reports and supporting data produced by or submitted to the federal governments since 2000 on programs and measures with regard to water pollution from municipal and industrial sources.[2]

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1 The specific programs called for by Article VI (a) may be found at http://www.ijc.org/en/activities/consultations/glwqa/agreement.php.

Substantial written documentation was received from Environment Canada, and also from the Province of Ontario's Ministry of Environment (MOE) to which Environment Canada referred the Commission's request. The EPA gave the Commission helpful advice on which documents should be consulted and where to access them. The Commission appreciates the responses from the governments and acknowledges the considerable effort required to collect the information.

In addition to the material provided by governments, the Commission undertook a review using U.S. and Canadian contractors to examine a sample of dischargers on both sides of the border in the Great Lakes System. These reports are available on the Commission's Web site.[3]

Other important documents that informed the Commission's review included Canada's new strategy for managing municipal wastewater effluent, the EPA's assessment of the impacts of climate change on combined sewer overflows and a report by the U.S. Committee on Reducing Stormwater Discharge Contributions to Water Pollution.[4]

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2 Initially, it had been the Commission's intention to review the situation with respect to both municipal and industrial discharges into receiving waters of the Great Lakes basin. However, a variety of considerations led the Commission to devote this report to municipal systems. For one thing, ongoing discussions about the need for large-scale investments in public infrastructure together with the subsequent design of economic stimulus measures made the need to focus on the municipal sector more imperative. For another, the industrial sector is generally regulated and, for the most part, has made investments in pollution controls. In addition, the potential impacts of climate change, particularly on combined sewer overflows, are greatest in the municipal sector. Nevertheless, while this report deals with municipal discharges, the Commission does not mean to imply that issues of serious concern are absent in the industrial sector.

3 See *Status of Municipal and Industrial Discharges to the Great Lakes Basin and Compliance Summary Report on Selected Ontario Municipal and Industrial Dischargers in the Great Lakes Basin*, prepared by Environmental Consulting & Technology Inc. and XCG Consultants Ltd., respectively, under *Supporting Documents* at www.ijc.org.

4 *Canada-wide Strategy for the Management of Municipal Wastewater Effluent*, Canadian Council of Ministers of the Environment, http://www.ccme.ca/assets/pdf/cda_wide_strategy_mwwe_final_e.pdf; *A Screening Assessment of the Potential Impacts of Climate Change on Combined Sewer Overflow Mitigation in the Great Lakes and New England Regions*, U.S. EPA, http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=188306; *Urban Stormwater Management in the United States*, National Research Council, http://books.nap.edu/openbook.php?record_id=12465&page=R1.

Overview of Point-Source Pollution in the Great Lakes

The pollution of water from one place in a concentrated manner that is easy to identify – for example, effluent discharge from municipal sewage treatment plants – is described as point- source pollution.[5] (Many industrial wastes are discharged into municipal sewer systems, but most large-scale industrial enterprises do discharge directly into receiving waters.)

Considerable water pollution in the Great Lakes basin comes from point sources. As a result, there is an array of federal, state, provincial and local policies, programs and legislation in both the United States and Canada intended to reduce, control or prevent point-source pollution.

The economic consequences of polluted discharges of wastewater are substantial. Impacts include increased costs for treating drinking water, decreases in property value, lost productivity from illness, increased health care costs and lost revenue from recreation and tourism. For example, the EPA estimates that across the U.S. annual loss of income from beach closings is between $1- $2 billion U.S., and economic losses due to illness from sewage releases is about $28 billion per year.[6] In Canada, health problems related to water pollution in general are estimated to cost $300 million dollars CDN per year.[7]

Pollution from municipal wastewater sources (a combination of household, commercial, some industrial and stormwater) in the U.S. and Canada is managed by a system of sewers, pipes, collecting basins and treatment plants. Municipal wastewater is predominantly collected by either CSSs, which carry urban runoff or stormwater with sanitary wastewater, or by SSSs. There are also systems designed to handle

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5 See *Water Resources Glossary*, Ontario Ministry of Natural Resources at http://www.mnr.gov.on.ca/en/Business/Water/2ColumnSubPage/STEL02_163778.html.

6 *Swimming in Sewage*, Natural Resources Defense Council 2004 at http://www.nrdc.org/water/pollution/sewage/sewage.pdf.

7 *Health and Environment – Partners for Life*. Health Canada 1997, as cited in Municipal Wastewater Effluents in Canada, Environment Canada at www.ec.gc.ca/soer-ree/English/SOER/MWWE.cfm.

only stormwater from municipalities, industries and construction sites. In the U.S., such municipal systems are referred to as municipal separate storm sewer systems (MS4s). An overview of these systems follows below; a fuller description, including pollution impacts, is available in the Commission's forthcoming multi-board report, The Impact of Urban Areas on Great Lakes Water Quality.

Combined Sewer Systems (CSSs)

CSSs were built from the mid-19th century until the early to mid-20th century and are among the oldest wastewater collection systems in use within North America. They combine and convey domestic, commercial and industrial wastewater and stormwater through a single connected pipe system to a treatment works. During various types of wet-weather conditions – periods of heavy rainfall or snowmelt – large flows of sanitary wastewater and stormwater can exceed a CSS's capacity for immediate treatment. This leads to excess volumes being discharged directly to nearby water bodies including rivers, streams, coastal waters or lakes. These discharge events are termed combined-sewer overflows (CSOs).

CSO discharges can contain high concentrations of contaminants. Examples may include pathogens, nutrients, toxics, trash, oxygen-demanding pollutants and pesticides that are flushed down toilets and sinks, or washed from streets, roadside drains, roofs, parks and lawns during heavy precipitation. Such discharges can seriously degrade water quality, impact aquatic ecosystems and threaten human health.[8]

In the U.S., the majority of CSSs are found in the Northeast and within the Great Lakes basin. The Great Lakes states are home to more than 70 percent of the total number of U.S. CSSs. In Ontario, no new combined sewer construction has been allowed since 1985 and only about 20 percent of communities have CSSs; of those communities, only one-third have systems with more than 25 percent combined sewers. Nevertheless, Ontario's Great Lakes urban areas do experience CSO events. For example, a recent report[9] based on information from the Province of Ontario noted that there are approximately 107 known CSSs in Ontario, with 1,544 releases of raw or partially treated sewage in 2006.

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8 *Combined Sewer Overflows Principal Guidance documents*, EPA 2002 at http://cfpub.epa.gov/npdes/cso/guidedocs.cfm. See also *The Great Lakes Sewage Report Card*, Ecojustice 2006 at http://www.ecojustice.ca/publications/reports/the-great-lakes-sewage-report-card.

9 *Green Cities, Great Lakes, Ecojustice 2008*, http://www.ecojustice.ca/publications/reports/the-green-infrastructure-report. See also *Great Lakes Hot Spots*, Ontario Public Advisory Council, http://www.citizensrapinfo.ca/reports/report.pdf.

The impact of storm events on wastewater systems in urban areas can be considerable. In one extreme wet-weather event from September 13-16, 2008, the Chicago region received a record 6.8 inches of rainfall across the metropolitan area. The deluge filled the Metropolitan Water Reclamation District (MWRD) of Greater Chicago's network of storage tunnels and reservoirs. To relieve high-flow conditions and avoid flooding and damage to structures along the waterway, the MWRD was forced to release more than 11 billion gallons of floodwaters to Lake Michigan.[10]

A study of the potential effects of climate change on CSOs in the U.S. portion of the Great Lakes basin examined projected long-term (2060-2099) changes in precipitation. The study suggested that if CSO-mitigation efforts are designed based on historical precipitation values, many wastewater systems could experience increases in the frequency of CSO events. Increases in overflow volumes discharged to receiving waters also could occur. Opportunities for improvement do exist for local governments facing these prospects. Some current CSO mitigation efforts might be expanded to provide an added margin of safety to account both for near-term extreme events and the potential future effects of climate change.[11] In Ontario, the MOE is currently reviewing its stormwater guidelines in light of the predicted impacts of climate change.

Sanitary Sewer Systems (SSSs)

Early in the 20th century, cities and municipalities in the U.S. and Canada began constructing separate SSSs. These convey everything that goes down the bathtub, toilet, sink and drain from domestic, commercial and industrial facilities – and in some cases smaller amounts of infiltrated groundwater and stormwater – to publicly owned treatment works (POTWs.)

Discharges from SSSs that are untreated or partially treated are referred to as sanitary sewer overflows (SSOs). Such overflows can be caused by problems with operation and maintenance, blockages, breaks in sewer lines (allowing stormwater or groundwater to infiltrate and overload the SSS), poor sewer design or power outages. SSOs can range from small to immense volumes – from one to several million gallons.

10 http://www.mwrd.org/irj/portal/anonymous/overview/Home.
11 Ibid.

Municipal Separate Storm Sewer Systems (MS4s)

Separate storm sewer systems, designed to convey and collect stormwater and snowmelt, consist of pipes, inlets and catch basins, but could include roads, drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels and storm drains. These systems are not designed to collect sanitary wastewater.

Discharges from MS4s are a major concern in urbanized areas due to the volumes released and the concentration of pollutants they contain. Urbanized areas have a considerable percentage of impervious or hardened surfaces, such as city streets, roofs, driveways, parking lots, alleys and sidewalks. Pollutants settle and accumulate until a storm event washes them into nearby storm drains. The most common pollutants found in stormwater systems are pesticides, polycyclic aromatic hydrocarbons (PAHs), nutrients, oils, road salts and bacteria.

Wastewater Treatment

Wastewater treatment facilities reduce the levels of many contaminants through the use of physical, biological, and advanced wastewater treatment technologies.[12] However, even when treated, wastewater can contain harmful levels of microorganisms, such as viruses, parasites or protozoa, and potentially harmful substances[13] that are not always effectively removed.

Table 1 shows the significant beneficial effect of treating wastewater and the range of fecal coliform levels in dry weather SSOs, CSOs, urban stormwater, and treated wastewater. These data, from the EPA, show that fecal coliform levels in treated wastewater are drastically lower than the levels in CSOs or dry weather SSOs.

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12 Sewage treatment is the process of removing contaminants from municipal, commercial and industrial wastewater. It includes processes to remove physical, chemical and biological contaminants. Municipal wastewater treatment technology began with primary treatment, which mainly reduced solids using sediment tanks or clarifiers. Later, some chemical additives were included to reduce phosphorous levels. Today's standards require secondary treatment or equivalent which is designed for the removal of biodegradable organic matter and for further removal of suspended solids. Although pollution is significantly reduced through disinfection, wastewater treatment does not completely reduce all harmful microorganisms and other potentially harmful substances.

13 Such as mercury, polychlorinated biphenyls, toxic chemicals, disinfection byproducts of treatment.

Table 1 [14] **Comparison of Fecal Coliform in SSOs, CSOs, Stormwater and Wastewater**

Fecal Coliform (colonies/100 ml)		
Source	Range	Median
Dry Weather SSOs	1,000,000 – 1,000,000,000	-
CSOs	3 – 40,000,000	215,000
Urban Stormwater	1 -5,000,000	5,000
Treated Wastewater	-	< 200

To track pollutant releases into the environment, including those from wastewater facilities in Canada, Environment Canada has put in place the National Pollutant Release Inventory (NPRI). The NPRI is Canada's legislated, publicly accessible inventory of pollutants released, disposed of and sent for recycling by facilities across the country. A summary of contaminant releases into water reported by municipal wastewater facilities in Ontario in 2006 showed more than 50 million kilograms of contaminants released to water with nitrate ion, ammonia (total) and phosphorus being the major releases contributing 62, 35 and 2 percent, respectively, of the total.[15]

Three levels of sewage treatment technology are used in municipal wastewater treatment facilities. Primary treatment, the most basic technology, separates out solid matter through settling and removes 50 to 70 percent of total suspended solids (TSS) and 25 to 40 percent of Biochemical Oxygen Demand (BOD)[16]. Only a handful of municipal wastewater treatment facilities in the Great Lakes basin still depend on primary treatment technology and need to be upgraded. Most wastewater treatment plants in the basin provide secondary treatment; indeed, secondary treatment or its equivalent is now considered the lowest acceptable level of treatment. Through biological processes, secondary treatment further reduces TSS and BOD in the effluent by 85 to 90 percent. Concentrations of heavy metals and contaminants such as polychlorinated biphenyls are also reduced in the effluent and are removed via sludge from the process. Tertiary treatment involves additional treatment such as activated carbon or sand filtration, which reduces substances such as ammonia, nitrogen and phosphorus.

14 Adapted from *Report to Congress on the Impacts and Control of CSOs and SSOs*, EPA, http://www.epa.gov/npdes/pubs/csossoRTC2004_chapter04.pdf.

15 *2006 National Pollutant Release Inventory*, Environment Canada, http://www.ec.gc.ca/inrp-npri/default.asp?lang=en&n=0EC58C98.

16 Excessive BOD can result in low dissolved oxygen concentrations in receiving waters, thus threatening aquatic life.

Public Notification

Adequate, comprehensive and timely reporting is critical to protect public health and to ensure public trust in responsible agencies. However, Canada and the U.S. lack consistency in the type of information reported, public accessibility of information and timely reporting or notification to the public. In the U.S., the Clean Water Act (CWA) requires public notification of CSOs and their impacts; however, state environmental agencies, which are required and empowered to inform their citizenry, must rely on operators of wastewater treatment plants to undertake public notification. The Metropolitan Water Reclamation District of Greater Chicago has a well-designed CSO notification plan. It maintains a Web page that is updated daily with a color-coded graphic representation of waterways that depicts the occurrence of CSOs and waterway diversions to Lake Michigan. An electronic address book is currently under development, so interested parties can sign up to receive e-mail notification of CSO events.[17]

In Ontario, municipalities are required to report overflows to the provincial government, which does issue annual reports, but there appear to be no Ontario or federal requirements for timely (within 24 hours) notification of the public.[18] In Ontario, information about wastewater discharge exceedances from municipal, industrial, private and commercial facilities is posted annually through the Environmental Compliance Report link on MOE's Web site. These reports provide general information based on the following categories: the industrial and municipal facilities, the type of concern, the facility's remedial action, and the Ministry's response to correct or prevent future exceedances, additional discharge and requirements details, the facility location and some explanations and analyses.[19]

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17 http://www.mwrd.org/irj/portal/anonymous/overview.

18 See *Sewage Warning! What the Public Doesn't Know About Sewage Dumping in the Great Lakes*, U.S. Public Interest Research Group, 2005, http://static.uspirg.org/reports/sewage-dumping.pdf and *The Great Lakes Sewage Report Card*, Sierra Legal Defense Fund, 2006, http://www.ecojustice.ca/publications/reports/the-great-lakes-sewage-report-card/attachment.

19 MOE provides information on annual exceedances of contaminant discharges from municipal and industrial wastewater facilities online at http://www.ene.gov.on.ca/envision/compliance/compliance.htm#glossary. As of January 2009, Compliance Reports are available for the years 2003 to 2007.

Oversight and Review of Wastewater Treatment Facilities by Federal, State and Provincial Governments

United States

The CWA establishes a foundation to regulate discharges of pollutants into U.S. waters and regulates quality standards for surface waters. A precursor of the CWA, called the Federal Water Pollution Control Act, was enacted in 1948, but it was significantly expanded and reorganized in 1972. The CWA became the Act's common name with amendments in 1977. Under the CWA, water-quality standards have been set for contaminants in surface waters and it was made unlawful to discharge any pollutant from a point source into navigable waters until a permit is obtained.[20]

The National Pollutant Discharge Elimination System (NPDES) permit program controls water pollution by regulating point sources discharging pollutants into waters of the U.S. The eight Great Lakes states have approved state permit programs that administer the NPDES program. NPDES permits set limits on the amount of pollution each facility can discharge into water bodies. Permitted facilities are required to monitor discharged pollutants and report those monitoring results to the responsible state using Discharge Monitoring Reports. The EPA retains an oversight role in the NPDES process and has the authority to take enforcement action against violators if the delegated agency fails to do so.[21]

In 1990, the *Great Lakes Critical Programs Act*[22] amended the CWA, requiring the EPA to publish final guidance for the Great Lakes states on minimum standards to protect water quality. The Critical Programs Act requires states to adopt provisions consistent with these standards.

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20 See http://www.epa.gov/lawsregs/laws/cwa.html.

21 In *Better Enforcement Oversight Needed for Major Facilities with Water Discharge Permits in Long-Term Significant Noncompliance* (U.S. EPA 2007), the Office of the Inspector General concluded that the EPA did not provide effective enforcement oversight of major facilities with NPDES permits in long-term significant noncompliance, and made several recommendations.

22 Public Law 101-596.

In 1995, the EPA issued the Final Water Quality Guidance for the Great Lakes System, better known as the Great Lakes Initiative (GLI).[23] The GLI focuses mainly on toxic pollutants and bioaccumulative chemicals of concern (BCCs). The U.S. Government Accountability Office (GAO) completed reports in 2005 and 2008 that considered the EPA's progress toward ensuring the full and consistent implementation of GLI. The GAO noted that of the nine BCCs for which GLI criteria have been established, only mercury and lindane have EPA-approved methods that will measure below these criteria levels. The GAO documented the increase in the number of permits with mercury limits from 185 in May 2005 to 292 in November 2007 and confirmed that the uptrend trend was expected to continue. As noted by the GAO, EPA and state officials do not know when the GLI criteria will be met.[24] Nonpoint sources including atmospheric deposition are significant sources of mercury and polychlorinated biphenyls (PCBs) to the Great Lakes Basin Ecosystem. Continued fish-consumption advisories for mercury and PCBs are evidence of the need for a stronger emphasis on reducing contributions from these sources.

The EPA and the states use the Permit Compliance System (PCS) for Michigan, Minnesota and Ohio and the modernized Integrated Compliance Information System-National Pollutant Discharge Elimination System (ICIS-NPDES) for Illinois, Indiana, New York, Pennsylvania and Wisconsin to manage and assess compliance and enforcement program information. ICIS-NPDES is gradually replacing PCS. Available data include permit issuance, permit limits, facility monitoring data and enforcement and inspection activity for facilities regulated under the NPDES programs. The public can access the Enforcement and Compliance History Online (ECHO) to search PCS and ICIS-NPDES at http://www.epa-echo.gov/echo/compliance_report_water.html.

The Commission's sponsored survey[25] of dischargers on the U.S. side of the Great Lakes Basin found that the NPDES program provides a useful array of information on the compliance of dischargers with NPDES provisions.[26] Based on available information, the percent of

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23 www.epa.gov/waterscience/standards/gli/.

24 See GAO reports *EPA and States Have Made Progress, But Much Remains to Be Done if Water Quality Goals Are to Be Achieved* and *EPA Needs to Better Ensure the Complete and Consistent Implementation of Water Quality Standards* at www.gao.gov/new.items/d08312t.pdf and www.gao.gov/new.items/do5829.pdf.

25 See *Status of Municipal and Industrial Discharges to the Great Lakes Basin*, op cit.

26 See U.S. EPA *National Pollutant Discharge Elimination System 2007*, http://cfpub.epa.gov/npdes/.

major NPDES permittees in significant noncompliance at any time during the fiscal year ranged from 15 percent to 28 percent within the three EPA Regions comprising the U.S. portion of the Great Lakes basin.[27] The General Pretreatment Regulations establish responsibilities of federal, state and local government, industry and the public and implementation of effective pretreatment programs is a prerequisite toward carrying out the programs specified under Article VI(a)(iv) of the Agreement. EPA and the states conduct inspections and audits of the pretreatment implementation programs of POTWs.[28]

Canada

Municipalities own and operate most of the more than 550 wastewater facilities in Ontario.[29] The facilities are subject to federal and provincial legislation, regulations and standards because various levels of government have certain authorities and powers to protect the environment.

Federal Government

Under the *Constitution Act* (1867), the federal government is responsible for protecting and conserving the nation's fisheries resource and its supporting habitats. Federal actions can have implications regarding the wastewater effluent requirements in all jurisdictions, primarily through authorities and regulations under the F*isheries Act* that limit the deposit of deleterious substances in waters. In addition, there are also important provisions under the *Canadian Environmental Protection Act*.

Federal inspection or enforcement regarding municipal point sources can currently take place in the following situations:

- When there is a fish kill or other evident environmental harm.
- When alerted to a deleterious deposit situation through environmental emergency pollution-incident reports, Environment Canada intelligence reports, media reports, tips from informants, complaints from public and/or reports from other levels of government.

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27 U.S. EPA Office of Enforcement and Compliance Assurance data reported on 02/06/2006.

28 Information about pretreatment standards to control pollutants from industrial users is available at http://cfpub.epa.gov/npdes/home.cfm?program_id=3.

29 In some cases, the wastewater facilities are operated on behalf of municipalities by the Ontario Clean Water Agency (a provincial Crown Agency). There are also 74 First Nations wastewater treatment facilities and 20 federal wastewater treatment facilities.

- Extraordinary, critical situations such as spills, leaks, treatment-system failures, system bypasses.

In these situations, Environment Canada invites the province to participate in a joint inspection or investigation. Any measure decided upon by the Environment Canada Fishery Officer or Fishery Inspector to deal with any alleged violation involving the municipal wastewater effluent will be consistent with the *Fisheries Act* Compliance and Enforcement Policy.

Seven such on-site inspections have been conducted since 2000 with one non-compliance situation. Eleven off-site inspections also have been conducted since 2000, all showing compliance.[30]

Ontario Government

In Ontario, wastewater that is discharged directly to the natural environment is regulated under the general terms and conditions of the *Environmental Protection Act* and the *Ontario Water Resources Act*. These Acts also provide the Ministry of Environment (MOE) with extensive powers of inspection and investigation.

Treatment requirements for municipal and private sewage treatment works discharging to surface waters are determined by MOE's F-Series guidelines, and the B-Series guidelines specify effluent requirements. The F-Series deal specifically with aspects of communal sewage works including minimum levels of treatment or secondary treatment or equivalent, effluent quality, monitoring and reporting as well as combined and sanitary sewer overflows. In addition, the B-Series procedures govern the general water-management principles and point-source discharges to receiving waters.[31]

Under the Canada-Ontario Agreement (COA) Respecting the Great Lakes Basin Ecosystem[32], MOE – with cooperation from municipalities – conducted a province-wide survey of the influent, effluent and sludge of 46 sewage treatment facilities (representing approximately 70 percent of Ontario's total treatment capacity) to characterize the incidence and concentrations of harmful pollutants including metals, legacy chemicals like PCBs and dioxins/furans, other industrial chemicals, household chemicals, pesticides and new priority contaminants such as brominated flame retardants in

30 Environment Canada 2008. Personal information.
31 See http://www.ene.gov.on.ca/envision/gp/F5-1.pdf.
32 See Joint Federal-Ontario below.

municipal effluents. Data from this survey will be used to inform the development and/or use of treatment technologies to reduce concentrations of these pollutants in municipal wastewater effluent.

Provincial governments are directly responsible for licensing wastewater facilities and for setting, monitoring and reporting effluent-treatment levels and limits. In Ontario, this is achieved through Certificates of Approval (C of A). The discharge criteria in a C of A for communal facilities are based on receiving water capacity studies, application of provincial water quality objectives and hydrogeological information. Depending on the receiving-water assessment, some C of A contain conditions that are more stringent than policy standards.

The MOE conducts between 500 and 700 municipal (and industrial) wastewater inspections each year to ensure compliance with legal requirements and MOE policy, as well as to audit regularly reported information. When non-compliance is suspected, abatement and enforcement responses can include a range of actions such as education, amending approvals, issuing orders, penalties and undertaking investigations that may result in prosecution. Since 2004, the MOE has used a risk-based inspection program that increases its oversight of operations that have or could have the potential to be of highest risk to human health and the environment, or indicate a poor compliance record.

The Commission's 2008 sponsored survey[33] of dischargers in Ontario indicated that most met the effluent-discharge criteria and requirements of their C of A. However, some compliance issues were identified; and the MOE exercised a variety of powers under the legislation in dealing with these situations. Many of the plants and collection systems experienced bypasses and overflows during wet-weather conditions and were actively pursuing remedial actions. Plant operators recognize that these situations contribute large amounts of untreated or partially treated wastewater to the Great Lakes system and are working with both senior levels of government to correct the situation through sewer-separation programs and the installation of storage reservoirs.

The MOE's own reports indicate that, after a drop from 530 in 2001, the annual number of municipal wastewater exceedances has

33 *Compliance Summary Report on Selected Ontario Municipal and Industrial Dischargers in the Great Lakes Basin*, op cit.

remained relatively steady in the low 400s. Since 2006, inspections have included a focus on bypasses and overflows, ensuring that municipalities with combined sewers and numerous bypasses and overflows have a Pollution Prevention Control Plan (PPCP), which is a long-term strategy to eliminate dry weather overflows and minimize CSOs. Currently 52 percent (24 of the 46) of the Ontario municipalities with combined sewers within the Great Lakes basin have or are developing PPCPs. MOE also is focusing on the remaining municipalities with combined sewers that have no PPCPs and have not been reporting overflows. These municipalities will need to ensure the MOE they have no overflows by completing a sewer characterization study to assess their system and, if necessary, begin a plan. Inspection results for 2006 indicate that 13 percent (40 of 288 inspected facilities) had four or more incidents. Of the 40 with numerous incidents, 68 percent (27 of 40) have combined sewers and 60 percent (24 of 40) have plans or are developing plans to address the incidents.

Joint Federal-Ontario

The federal government and Ontario have long been co-signatories to the COA, respecting the Great Lakes Basin Ecosystem, the objectives of which are ecosystem restoration, protection and conservation.[34] Under COA, the two governments help to identify infrastructure priorities within Great Lakes Areas of Concern by providing written support for municipal funding applications that meet COA objectives, conducting studies to identify infrastructure projects needed to restore environmental impairment and supporting the development of pollution prevention and control plans.

Under the 2007 COA, a number of studies were conducted in order to provide a basis for the reduction of releases of harmful pollutants from municipal wastewater. These included investigating optimization of existing facilities, developing best management practices for sewer use and characterization and treatment of municipal wastewater and sludge.

The federal government also has been collaborating with the provinces and territories to develop a harmonized framework to manage effluent discharges. This effort by the Canadian Council of Ministers of the Environment yielded a Canada-wide Strategy for

34 COA was last renewed in 2007. See http://www.on.ec.gc.ca/greatlakes/default.asp?lang=En&n=D11109CB-1.

the Management of Municipal Wastewater Effluent that ensures wastewater facilities will have regulatory clarity in managing effluent. All facilities will be required to achieve minimum national performance standards that address pollutants common to most wastewater discharges. Implementation of risk management activities to reduce the risks associated with sewer overflows is also required. The Strategy recognizes the establishment of a sewer-use bylaw (pretreatment requirement) as a best management practice and it encourages all wastewater-facility owners with appropriate legislative authority to establish sewer-use bylaws.[35]

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35 Canada-wide Strategy for the Management of Municipal Wastewater Effluent, Canadian Council of Ministers of the Environment, op cit.

Assessing Compliance: Some Representative Examples

More than 30 years after the first Agreement took effect, it is still difficult to assess the overall impact and effectiveness of programs designed to achieve the objectives of Article VI. Comprehensive or basin-wide quantitative reports with evaluations are not currently available. While Canada's National Pollutant Release Inventory includes municipal wastewater treatment facilities, the Toxic Release Inventory in the United States addresses certain industries and federal facilities.[36]

The type of analysis that is necessary is beyond the scope of this report. The Commission's sense is that governments at all levels are undertaking the right actions and that conditions have improved over the years. However, the situation at some facilities suggests that considerable work is yet to be done before the water quality in receiving waters is suitably protected.

One example of the challenges and complexity involved is the ongoing effort to implement a basin-wide indicator of wastewater treatment and pollution. In 1994, EPA and Environment Canada hosted the first biennial State of the Lake Ecosystem Conference (SOLEC) to provide a binational forum for exchanging information on the ecological condition of the Great Lakes and surrounding lands. From the outset, SOLEC began to facilitate development of easily understood indicators that would be used to inform the public and report on progress in achieving the purpose of the Agreement.[37]

The SOLEC "Wastewater Treatment and Pollution" indicator is still under development. Its purpose is to: measure the proportion of the population served by municipal sewage treatment facilities; evaluate the level of municipal treatment provided; measure the percent of collected wastewater that is treated; and assess the loadings of phosphorus, biochemical oxygen demand (BOD), ammonia and solids (and

36 See www.epa.gov/TRI/index.htm.

37 "SOLEC conferences are intended to focus on the state of the Great Lakes ecosystem and the major factors impacting it rather than the status of programs needed for its protection and restoration. Evaluation and redirection of programs are addressed through other means." See *State of the Lakes Ecosystem Conference* at http://binational.net/solec/intro_e.html.

organic chemicals and metals, when possible) released by wastewater treatment plants into the water courses of the Great Lakes basin.

The 2007 SOLEC Wastewater Treatment and Pollution indicator report identifies the levels of treatment in the U.S. and Canada (i.e., the population served by treatment plants and statistics on the types of these treatment plants).[38] The report generally discusses the condition of wastewater effluent and pollutant loadings in the U.S. and Canada. However, recent binational data were not available, and the data that were available were too inconsistent. Full development, implementation and analysis of this indicator may be possible in the future.

The Commission does not take issue with this situation. Given the number of collection systems and treatment facilities across the basin, the differences between Canadian and U.S. regulatory regimes, the ongoing investments in upgrades, uneven populations and changes in socio-economic conditions, it is an enormous task to assess the current situation. For this reason, evaluations must rely on representative examples in both countries.

To this end, as noted earlier in this report, the Commission sponsored two reviews of dischargers in the United States and Canada.[39] In addition, the Commission selected 10 facilities, five in each country, and considered their performance in terms of compliance data drawn directly from the EPA and the Ontario MOE.

Compliance information of wastewater treatment plants located in the five binational AOCs was examined. These locations are the St. Marys River, the St. Clair River, the Detroit River, the Niagara River and the St. Lawrence River AOCs. Table 2 summarizes available information on environmental compliance.

A wide range of environmental performance is noted for facilities in Ontario with two locations having no exceedances in either 2006 or 2007 and one facility with 22 exceedances reported in 2007. Similarly, in the U.S. performance ranged from one facility with one quarter in noncompliance in the past three years to three facilities with noncompliance in every quarter of the previous three years. Noncompliance in a quarter can be due to one violation of an NPDES permit or because of numerous violations. Clearly, there is an opportunity to improve the environmental performance of these lesser-performing facilities.

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38 *State of the Great Lakes 2007 Report* at http://binational.net/solec/sogl2007_e.html.

39 See *Status of Municipal and Industrial Discharges to the Great Lakes Basin and Compliance Summary Report on Selected Ontario Municipal and Industrial Dischargers in the Great Lakes Basin*, op cit.

Table 2 Environmental Compliance of Wastewater Treatment Plants in the Binational Areas of Concern

Area of Concern	Treatment Plant	Compliance[40]	Parameters of Concern
St. Mary's River	Sault Ste. Marie, ON East End Plant (NPRI ID 11467)	One exceedance (2007)	pH
	Sault Ste. Marie, MI WWTP (MI0024058)	Nine quarters of non-compliance	BOD, suspended solids
St. Clair River	Sarnia, ON WWTP (NPRI ID 4779)	22 exceedances (2007)	ammonia, *E. coli*, phosphorus, suspended solids
	Port Huron, MI-WWTP (MI0023833)	one quarter of noncompliance	
Detroit River	Windsor, ON Lou Romano Water Reclamation Plant (NPRI ID 495)	No exceedances reported	
	Detroit, MI WWTP (MI0022802)	12 quarters in noncompliance	pH, total residual chlorine, cyanide, fecal coliform
Niagara River	Niagara Falls, ON WWTP (NPRI ID 3677)	No exceedances reported	
	Niagara Fall, NY Wastewater Treatment Facility (NY0026336)	12 quarters of noncompliance	fecal coliform, hexachlorobenzene, total phosphorus
St. Lawrence River	Cornwall, ON Water Pollution Control Plant (NPRI ID 10304)[41]	One exceedance (2006)	BOD
	Massena, NY WWTP (NY00311194)	12 quarters of noncompliance	BOD, fecal coliform, flow, suspended solids

One possible tool to improve the environmental performance of wastewater treatment plants is implementing an Environmental Management System (EMS) that follows the ISO 14001 standard.[42] EPA's Office of Water has designated 11 organizations in the U.S. as EMS Local Resource Centers to educate and support EMS understanding and adoption by local governments.[43] A starting point in this process is a gap analysis that identifies the "gaps" in existing environmental policies and procedures compared to the ISO 14001 standard.

40 Compliance was examined for a twelve-quarter period ending in Dec 2008 for U.S. facilities and a two-year period covering 2006 and 2007 for Ontario facilities.

41 Primary technology water pollution control plant.

42 See information provided by the International Organization for Standardization at www.iso.org/iso/home.htm.

43 See information available at www.epa.gov/ems/resources/index.htm.

Discussion and Recommendations

Since the early 1970s, the level of treatment to reduce pollution from wastewater discharges to the Great Lakes has improved considerably. This is a result of significant expenditures to date on both infrastructure and technology, and robust regulatory systems that have proven to be, on the whole, quite effective. Largely as a result of the 1972 *Clean Water Act*, municipal facilities in the U.S. portion of the Great Lakes all maintain a minimum of secondary or tertiary levels of treatment. In Ontario, more than $4 billion CDN has been spent over the last three decades to upgrade sewage treatment facilities to secondary treatment or equivalent; yet there remain five facilities of particular interest to the Commission that still have primary treatment.[44]

Remedial Action Plans (RAPs) in each of the 40 Areas of Concern (AOCs) across the basin detail the accomplishments at these specific locations and also identify remaining issues that are currently being or are yet to be addressed.[45] Despite the daunting challenges still ahead, there are stories of success across the Great Lakes basin, and the Commission is pleased to highlight two in this report.

Toronto, Ontario [46]

In 2003, the Toronto City Council adopted the Wet Weather Flow Master Plan (WWFMP) and a 25-year implementation plan to address management of excessive wet-weather flows. The WWFMP was adopted to reduce the adverse effects of wet-weather flow. As of 2007, Toronto had 79 combined sewer outfalls and 2,600 storm sewer outfalls, and of these 33 and 70, respectively, discharged directly into Lake Ontario. Implementation costs over the 25-year period

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44 Primary technology wastewater treatment plants remain at the Town of Nipigon and Township of Red Rock, both discharging to Nipigon Bay in Lake Superior; City of Cornwall and Village of Iroquois (Township of South Dundas), both discharging to the St. Lawrence River; and City of Owen Sound, discharging to Georgian Bay in Lake Huron.

45 See *Areas of Concern*, Environment Canada at http://www.ec.gc.ca/raps-pas/default.asp?lang=En&n=A0270A32-1 and *Areas of Concern*, EPA at http://www.epa.gov/glnpo/aoc/index.html.

46 See http://www.toronto.ca/water/protecting_quality/wwfmmp/index.htm.

are expected to exceed $1 billion. The WWFMP was developed with recognition that managing wet-weather flows would require management on a watershed basis with the adoption of a hierarchy of management practices and controls, starting with "at source," followed by "conveyance" and finally "end-of-pipe" controls. Implementation of this plan is expected to address priorities including:

- Protecting health and safety by reducing CSOs and providing swimmable water at beaches;
- Meeting provincial policy standards to minimize CSOs;
- Upgrading systems and eliminating dry weather discharges from storm and combined sewer outfalls.

Typical source controls that have been implemented include downspout disconnections and porous pavers; conveyance measures used include roadside swales and infiltration and exfiltration systems; and end-of-pipe treatments include practices such as use of underground infiltration basins, constructed wetlands or underground storage tanks. Wet-weather flow guidelines are also now detailed in the City of Toronto's *Green Development Standard*, which requires that new developments provide on-site controls.[47]

Milwaukee, Wisconsin[48]

The Milwaukee Metropolitan Sewerage District (MMSD), serving 1.1 million customers in 28 communities, has spent over $2.3 billion thus far on its wastewater treatment facilities including construction of a deep-tunnel system. The tunnel system, 300 feet below ground, with a storage capacity of about 521 million gallons, is designed to minimize backups into basements and sewer overflows. From 1994 through January 2009, the tunnel captured more than 78 billion gallons of wastewater, which otherwise would have overflowed directly into Lake Michigan. Through 2010, a total of U.S. $3.3 billion will be expended on the MMSD's plans. Recognizing that additional efforts are required to achieve the desired level of control, the MMSD undertook a watershed-based water quality initiative involving a land area of over 1,120 square miles. Having achieved considerable control of CSOs in the Milwaukee area, urban and rural nonpoint source runoff now results in a greater percentage of the fecal-coliform annual loadings than before the significant reductions in

47 See http://www.toronto.ca/planning/greendevelopment.htm.
48 See http://v3.mmsd.com/DeepTunnel.aspx.

overflows were achieved. Similar to Toronto, MMSD has advanced efforts to encourage installation of rain barrels, green roofs, rain gardens and other best practices for stormwater management.

Successes like the Toronto and Milwaukee examples demonstrate the need for well-designed, long-term plans. Such efforts have contributed to the downward trend in the volume of SSOs and CSOs across the basin. Nevertheless, serious incidences of untreated or partially treated discharges continue and are of concern. And despite the large investments that have been made to this point, it is clear that much more funding is required. In both Canada and the U.S., aging systems are failing and massive sums will be required to repair and replace infrastructure and to better manage discharges. A recent report rated wastewater systems in the United States as D-, the worst of any infrastructure category.[49]

Environment Canada estimates municipal wastewater-infrastructure funding needs in AOCs at approximately $2.6 billion CDN, including $1 billion CDN in the City of Toronto alone. On the U.S. side, the City of Detroit needs between $2 and $2.5 billion U.S. for CSO-control investments[50] — this in a city where one five-day storm event in June 2008 resulted in the release of over two billion gallons of diluted and partially treated sewage into the Detroit and Rouge rivers. Unfortunately, similar challenges are replicated in many other communities. Moreover, forecasts of the impacts of climate change suggest that the situation could worsen if sewer systems and treatment plants are overwhelmed by the predicted increases in frequency of severe-weather events.[51]

It is in this context that the Commission makes the following recommendations:

1. Ensure that the economic-stimulus measures now being developed address wastewater system needs in the Great Lakes basin.

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49 *2009 Report Card for America's Infrastructure*, American Society of Civil Engineers, http://www.asce.org/reportcard/2009/grades.cfm.

50 *CSO and SSO 2007 Annual Report*, Michigan Department of Environmental Quality at http://www.michigan.gov/deq/0,1607,7-135-3313_3682_3715---,00.html.

51 See *A Screening Assessment of the Potential Impacts of Climate Change on Combined Sewer Overflow Mitigation in the Great Lakes and New England Regions*, op cit. MOE recently published new *Design Guidelines for Sewage Works (2008)*, which also includes the control and treatment of CSOs and is intended to be used with the *Stormwater Management Planning and Design Manual* (2003). See http://www.ene.gov.on.ca/publications/6879e.pdf and http://www.ene.gov.on.ca/envision/gp/4329eindex.htm. MOE is currently reviewing its stormwater policies in light of climate change.

Usually, times of economic difficulty do not lend themselves to the scale of financial investments that are required for wastewater treatment systems across the basin. But the severity of the current global economic crisis has led governments, including those of Canada and the U.S., to develop economic-stimulus strategies that feature huge expenditures dwarfing anything in recent times. These plans include large-scale expenditures on infrastructure, some of which are targeted to wastewater systems. In this sense, the global economic crisis constitutes an unparalleled opportunity for timely and substantial investments that will have positive impacts on the health of the waters of the Great Lakes basin. The Commission urges that these plans be followed through and that funds are allocated primarily on the basis of highest need rather than extraneous considerations.

2. More effectively link watershed management with the permitting process for municipal and industrial dischargers.

Watersheds almost never match political boundaries, but nearly all permits are issued within defined jurisdictions. Issuance of discharge permits based on watershed boundaries instead of political boundaries has been recognized as action most likely to reduce degradation of aquatic resources.[52] This approach provides a means for considering all stressors within a hydrologically defined drainage basin, rather than addressing individual pollutant sources on a discharge-by-discharge basis. For more than a decade, EPA has supported and encouraged a watershed approach to addressing water quality problems and it has recommended steps for watershed-based permitting implementation under the NPDES permit program.[53] While no such comprehensive approach is currently used in the Great Lakes basin, some jurisdictions are beginning to adopt watershed-based approaches to the restoration and protection of water quality. In Ontario, the 2006 Clean Water Act established a program by which local communities are protecting their drinking water through source protection plans on a watershed basis. Under the Act, municipal (and industrial) discharges to the Great Lakes could be identified as significant drinking-water threats and trigger mandatory action to mitigate or eliminate them. In the Milwaukee area, the Southeastern Wisconsin Watersheds Trust (SWWT) is a collaborative effort to achieve healthy and sustainable water resources throughout the greater Milwaukee watersheds. Among the primary purposes of the SWWT is achieving

52 *Urban Stormwater Management in the United States*, op cit.

53 See *Watershed-based National Pollutant Discharge Elimination System (NPDES) Permitting Technical Guidance* at www.epa.gov/npdes/pubs/watershed_techguidance.pdf

clean water, conservation and ecological function through innovation and sustainable practices and to improve water quality to support a healthy regional economy.[54]

3. Make use of third-party audits to improve compliance with water-quality standards or objectives in the Great Lakes.

ISO 14001, a standard of the International Organization for Standardization, is an approach to environmental management that can be translated into a reliable system to ensure ongoing compliance, detect failures quickly and facilitate corrective actions, thereby assisting an organization to move beyond environmental compliance.[55] Two important features of ISO 14001 are the goal of continuous improvement in environmental performance and the use of third-party audits. While numerous major industrial dischargers within the Great Lakes Basin are registered to ISO 14001, very few municipal wastewater treatment plants in North America have demonstrated this level of commitment to environmental protection and continuous improvement. However, such an approach for the Great Lakes could be feasible if modeled on the work of other large North American cities. For example, wastewater facilities in Edmonton and San Diego are notable for their ISO 14001 registrations.[56]

4. Encourage the adoption of "green infrastructure" to complement traditional infrastructure investments.

The use of green infrastructure appears to hold some promise for improving water quality.[57] This concept includes water conservation practices designed to "keep it out of the pipe"— reducing the overall volume of stormwater and wastewater in a watershed plus more slowly releasing or infiltrating excess water — to reduce the amount of flow into municipal sewer systems.[58] Measures can include planting trees or "swales," installing rain-collecting barrels and roof gardens, constructing infiltration systems, disconnecting downspouts and using permeable paving. However, estimates of the potential gains are not yet well documented and may not be as significant as some would hope. Additional research is needed in this area.

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54 See http://www.swwtwater.org/home/about_swwt.cfm.

55 Information on ISO 14001 is available at http://www.iso.org/iso/home.htm.

56 See ISO 14001 information at www.edmonton.ca/environmental/enviso_iso14001/benefits-of-enviso-iso-14001.aspx and www.sandiego.gov/mwwd/initiatives/iso14001.shtml.

57 *Green Cities, Great Lakes*, op cit.

58 See *Southeast Michigan Council of Governments' Low Impact Development Manual for Michigan: A Design Guide for Implementers and Reviewers* at www.semcog.org/LowImpactDevelopment.aspx.

At the end of this first decade of the 21st century, the Commission remains hopeful that the progress made in Canada and the United States to improve Great Lakes water quality through investments to improve municipal wastewater-treatment facilities continues and indeed strengthens. Continued vigilance is essential to ensure that the governments meet their obligations under the Agreement to improve the integrity of the Great Lakes Basin Ecosystem.

Signed this fifth day of August, 2009
as the Fourteenth Biennial Report of the
International Joint Commission pursuant to
the Great Lakes Water Quality Agreement of 1978

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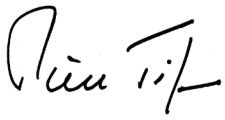

Pierre Trépanier
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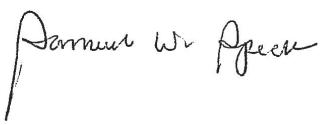

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