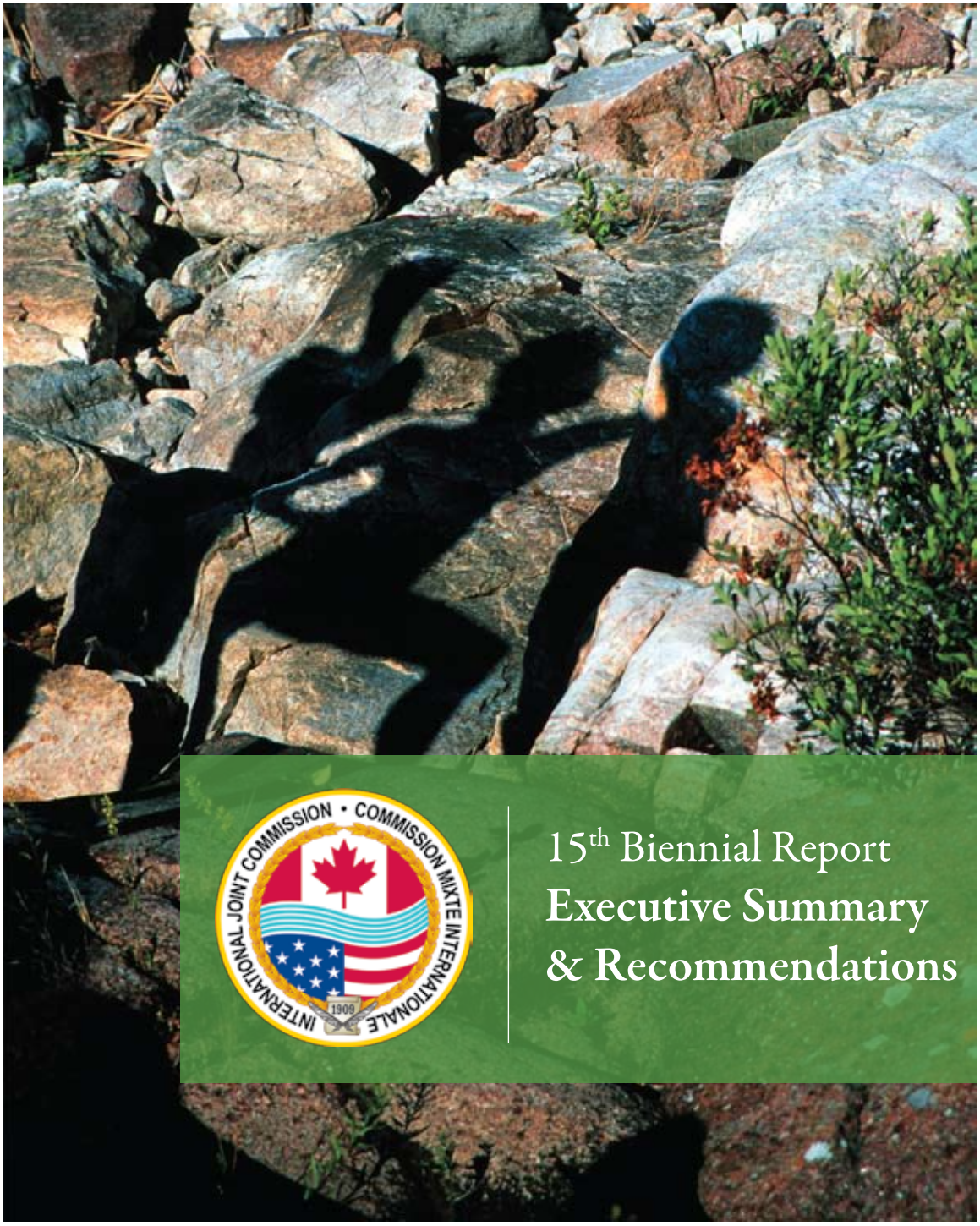

15th Biennial Report
Executive Summary & Recommendations

Fifteenth 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.

Commissioners

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Dear Friend of the Great Lakes:

The United States and Canada are extraordinarily fortunate to share the Great Lakes, a world-class resource containing one-fifth of all the fresh surface-water on earth. The importance of this international treasure was recognized nearly 40 years ago when the United States and Canada first signed the Great Lakes Water Quality Agreement (Agreement) that committed our two countries to restore and maintain the chemical, physical and biological integrity of the waters of the Great Lakes Basin Ecosystem. An updated agreement is now being negotiated, providing a unique opportunity to set new goals that will guide future actions to protect and restore this vital asset.

The International Joint Commission (Commission) is charged with preparing a report to the federal, state and provincial governments that assesses progress to meet Agreement objectives. Our Fifteenth Biennial Report provides 32 recommendations for action at the federal, state, provincial and local levels of government. In particular, the recommendations focus on the need for the United States and Canada to approve an updated Agreement that addresses threats to water quality in order to prevent or reduce their impact on human and ecological health. These threats are of greatest concern in the nearshore zone where people interact with the lakes and include beach closings, harmful algal growth, contaminated groundwater and alien invasive species.

We believe that the report will also help legislatures ensure that resources are effectively directed to addressing the highest-priority challenges. Highlights of the recommendations follow this letter and a full list is appended to this executive summary. Complete copies of the report are available online at www.ijc.org or may be requested from a Commission office.

Sincerely,

Lana Pollack
U.S. Co-Chair

Joseph Comuzzi
Canadian Co-Chair

15th Biennial Report Highlights of Recommendations

Research and Monitoring

A key concern raised in the report is the resurgence of eutrophication–aquatic plant growth caused by excessive nutrients such as phosphorus. Among many potential causes identified in the report, key factors are believed to be inadequate municipal wastewater and residential septic systems, agricultural run-off, industrial livestock operations and the impacts of climate change, which causes more frequent and intense precipitation and stormwater events. To address this challenge, the report recommends new research and monitoring efforts similar to the Commission's Pollution from Land-use Activities Reference Group (PLUARG) in the 1970s.

The largest ever study of pollution in the Great Lakes from land-use activities such as agriculture and forestry operations, PLUARG research was instrumental in determining the regulatory actions needed to address nonpoint source pollution. PLUARG II would help managers improve their understanding of eutrophication and select the wisest management actions.

The report also cites the impact of nonpoint source pollution on water quality at recreational beaches and recommends federal support into research to improve indicators of threats to human health. Such new indicators, better warning systems for the public, and a binational standardized system of surveillance and monitoring are recommended to protect public health and reduce beach closings. Related recommendations in the report include systematic basin-wide collection of groundwater quality and quantity data, monitoring for chemicals of emerging concern, such as pharmaceuticals and personal care products, and research into their health effects as well as into treatment systems to remove them from drinking water.

Governance

The report notes that while collaboration has improved in recent years, there is a critical need to modify existing governance to strengthen coordination across jurisdictional lines to address ecological challenges in the nearshore. Specifically, the Commission recommends adopting Lakewide Management Plans (LaMPs) as the geographic unit to coordinate, integrate and implement programs to address the impacts of agricultural and urban areas on water quality. Currently, LaMPs include all the governmental, nongovernmental and tribal/first nation units in coordinating ecological restoration projects and also engage the public.

With the Asian Carp threatening to invade the Great Lakes, the report recommends using a revised Great Lakes Water Quality Agreement as a vehicle for the development and deployment of binational protocols for rapid response before invasive species enter the lakes. The report also calls for binational coordination to develop consistent fish consumption advisories.

Regulatory Action and Public Infrastructure

The report recommends that governments institute "no regrets" actions immediately to reduce nonpoint sources of pollution from agricultural and urban sources, especially in phosphorus-sensitive watersheds as well as from point sources, such as sewage treatment plants. In addition, the Commission recommends improved enforcement efforts to prevent contamination of groundwater, establishment of standards and regular inspections for septic systems and more effective regulations of confined animal feeding operations to ensure proper treatment of manure and application of methods to reduce run-off.

Note: The complete report is available at www.ijc.org.

In particular, the recommendations focus on the need for the United States and Canada to approve an updated Great Lakes Water Quality Agreement that addresses threats to water quality in order to prevent or reduce their impact on **human** and **ecological** health.

Executive Summary

Article VII of the Canada-United States Great Lakes Water Quality Agreement (Agreement) requires the International Joint Commission to report biennially to the Parties and to state and provincial governments concerning progress toward achieving Agreement objectives, and the effectiveness of programs pursuant to it. Article VII also directs the Commission to provide advice on any matter related to the quality of the boundary waters of the Great Lakes system.

In this 15th Biennial Report, the Commission addresses issues that are relevant to government departments and agencies at all levels along with other organizations with environmental responsibilities in the Great Lakes basin. These issues are particularly pertinent given the current negotiations between Canada and the United States to revise the Agreement. This document is based on the reports of work groups established by our advisory boards with additional input provided by commissioners and staff.

The focus of this report is the nearshore zone, the vital ecological link between watersheds, tributaries, wetlands, groundwater, and offshore waters of the Great Lakes. Most people live in the nearshore and get their drinking water from this zone. The nearshore also supports critical habitat for fish, invertebrate and wildlife populations. Beach closings, nuisance algal growth, the establishment of alien invasive species, and habitat loss are just some of the troublesome developments in the nearshore that act as harbingers of future changes in offshore waters. **A revised Agreement should be strengthened with explicit provisions to address threats to nearshore water quality and to prevent or reduce their impact on human and ecological health.**

In a December 2007 letter to governments, the Commission concluded that water quality problems in nearshore areas have binational implications and binational cooperation is required

to solve them. The Commission noted that urban and agricultural nonpoint pollution are key contributors to excessive loadings of phosphorus and need to be reduced; nutrient-control programs need to be funded and implemented; most programs to monitor phosphorus loadings terminated fifteen years ago need to be reinstated; and the significant gaps in understanding linkages between land sources, nearshore, and offshore waters need to be addressed.

The Commission recognizes the need for better accountability measures and integration of services among the many levels of government and government agencies charged with protecting the Great Lakes basin in both countries. Triennial reports, as recommended by the Commission in its 2006 advice to governments about their review of the Agreement, should be mandated to include an evaluation of the policies and programs in both countries that are intended to fulfill the governmental obligations stipulated in the Agreement.

A Nearshore Framework

Proper management of the nearshore requires adaptive management and improved governance along with management and planning at a scale that integrates watersheds with their associated lake. The Commission believes that existing governance structures could be modified to meet these challenges.

For the most part, jurisdictions and institutions are not aligned with the hydrological boundaries of the Great Lakes basin. There are multiple levels of government in two countries, bi-national organizations, and environmental nongovernmental associations with diverse legislative, programmatic, and policy tools–and all are addressing water-quality problems in the Great Lakes. Coordination and collaboration among binational institutions on nearshore zone issues have improved in recent years, but they must be further enhanced.

Greater attention must be devoted to addressing the impacts of agricultural and urban areas on Great Lakes water quality. Because the permitting and budgetary responsibility for urban development and agricultural practices is shared among all orders of government, the Commission recommends using Lakewide Management Plans (LaMPs)[1] as the geographic unit to coordinate, integrate, and implement programs. All levels of government, watershed and other environmental non-governmental organizations should be involved in each LaMP. A binational condition assessment needs to be performed to establish a baseline that roughly coincides with the timing of the revised Agreement. Within watersheds, an assessment of stressors should be undertaken prior to using analytical and diagnostic tools to assess causes of problems and determining management actions.

[1] A Lakewide Management Plan, or "LaMP", is a plan of action to assess, restore, protect and monitor the ecosystem health of a Great Lake. It is used to coordinate the work of all the government, tribal, and non-government partners working to improve the Lake ecosystem. A public consultation process is used to ensure that the LaMP is addressing the public's concerns. (EPA, 2008)

Eutrophication

The Commission is troubled by nearshore eutrophication, aquatic plant growth caused by excessive nutrients, which causes adverse effects on ecosystems, the economy, recreation, and human health. The reemergence of algal blooms is likely due to multiple factors, including inadequate municipal wastewater and residential septic systems; runoff from increased impervious surface areas and agricultural row-crop areas; discharges from tile drainage which result in more dissolved reactive phosphorus loading; industrial livestock operations; ecosystem changes from invasive mussel species; and impacts from climate change which include warmer water and more frequent and intense precipitation and stormwater events.

As a result, more coordinated and frequent monitoring of algal fouling is needed as is watershed-specific monitoring to test both causal hypotheses and assess management actions. More sophisticated models are needed to capture the interactions of habitat, fish community structure, and nutrient loading and work must be undertaken to understand the linkage of nearshore re- emergence of eutrophication and oligotrophication (nutrient depletion) of the offshore. The Commission recommends accomplishing the necessary monitoring and research actions via a major binational scientific effort similar to the Commission's Pollution from Land Use Activities Reference Group (PLUARG) of the 1970s. PLUARG produced a body of work instrumental in understanding and addressing nonpoint source pollution. A "PLUARG II" would improve the understanding of the resurgence of eutrophication and help managers select the wisest management actions.

In the interim, the Commission recommends that all levels of government implement actions to reduce nonpoint sources from agricultural and urbanized watershed and tributaries. The Commission recommends governments place priority on the protection and restoration of wetlands and forest lands to enhance the quality and resiliency of the Great Lakes ecosystem. These habitats are naturally effective at filtering and reducing some pollutants that affect nearshore water quality. Governments should exercise available options to prevent conversion of existing habitats to uses that could damage water quality or fish and wildlife populations, and restore habitats through conservation easements or public ownership of habitats.

In addition, the Commission recommends actions that mimic natural processes such as buffer strips on agricultural land, rain gardens and green roofs in urban areas, along with reducing urban sprawl and impervious surfaces. All these efforts need to be undertaken in nearshore and in all tributary watersheds. Effective efforts need to be documented

and shared among potential users. In the longer term, there is a need to further develop systems that use phosphorus for desirable outcomes, such as harvesting algal biomass for biofuel.

Beaches and Recreational Water Quality

Beaches and recreational waters are critical to the economic and environmental health of the Great Lakes region and to the quality of life for residents and visitors. They provide recreational opportunities and contribute to ecosystem biodiversity and provide breeding grounds and cover for fish, birds, aquatic invertebrates and other wildlife.

Nonpoint source pollution, in particular urban and agricultural stormwater runoff, poses a much greater threat to recreational water bodies than point source pollution. More frequent and severe storm events, predicted by models of climate change, will have additional impacts.

The presence of *E. coli* bacteria and other pathogens in surface water can serve as an indicator of bacterial contamination. Nevertheless, testing can produce false positive results when fecal indicator bacteria from birds, algae and other natural populations, which have less pathogenic bacteria, are mistaken for human fecal contamination. The Commission recommends the federal governments support research into novel indicators of human fecal contamination to determine rapidly the risk to human health and increase the efficiency of decision-making for beach advisories. The Commission further recommends that governments share information on causes and best practices to improve water quality, enhance warning systems, and reduce the need for beach closings.

An efficient and timely testing method is needed to advise the public about recreational water quality. Current beach testing methodologies take 24 hours or more prior to posting beaches as unsafe for swimming. The Commission recommends that state and local governments improve public communications and issue preemptive advisories where a correlation between rainfall and elevated bacteria levels exist or when sewer overflows or other catastrophic events jeopardize public health.

Under a revised Agreement, there should be binational and nearshore standardized basin-wide surveillance and monitoring protocols along with standardized criteria for beach postings. Further, the Commission recommends that both governments designate a lead agency to establish a binational, systematic, centralized, consistent, and timely way to evaluate and report waterborne illness in the Great Lakes and to facilitate collaboration on best practices at all levels of government.

Groundwater

Groundwater recharges streams and rivers that flow into lakes, contributes to fish habitat, and supports significant ecosystem functions by maintaining stream flows and wetlands during dry periods. Groundwater's contribution to Great Lakes tributaries ranges from 48 percent in the Lake Erie basin to 79 percent in the Lake Michigan basin. In addition, an estimated 8.2 million people, 82 percent of the rural population, rely on groundwater for drinking water. Groundwater in the Great Lakes basin is of generally good quality but is threatened by chemical and biological inputs from point and nonpoint sources.

Annex 16 of the Agreement calls for both federal governments, in cooperation with state and provincial governments, to identify and control the sources groundwater contamination and to issue biennial progress reports to the Commission. This work has not been accomplished.

In 2010, Commission boards published a report describing a range of specific threats to groundwater. The report recommended actions that could be taken by all levels of government, including research, monitoring, regulation, enforcement and economic and tax incentives. Specific threats to groundwater in the basin include: pathogens, toxic chemicals, nutrients, household products, hormones, antibiotics, pharmaceuticals, and road salt. The sources of these threats include: failing septic systems, leaking underground storage tanks, hazardous waste sites, abandoned wells, leaking sanitary sewers, confined animal feeding operations, de-icing practices, landfills, land application of manure, agricultural practices, spills, atmospheric deposition, vehicle fluids, cemeteries, petroleum refineries, and injection wells.

A revised Agreement should strengthen the provisions of Annex 16 by incorporating some of these recommendations to spur implementation. In particular, efforts are needed by all levels of government to address leaking septic tanks and underground storage tanks as well as runoff from confined animal feeding operations.

Chemicals of Emerging Concern

The term "chemicals of emerging concern" refers to the recently recognized risk to human health and ecosystems from some unregulated or inadequately regulated chemicals. These chemicals are found in common household and personal care products, veterinary and human pharmaceuticals, flame retardants, and phthalates used to make plastic flexible. Wastewater treatment plants, one of the leading conveyors of these chemicals to the nearshore, are not designed to remove them.

While the Agreement has annexes that address toxic substances, none mention chemicals of emerging concern. A revised Agreement should include provisions to address this shortcoming. This revision should include the underlying principles and processes by which the Parties would prioritize categories of chemicals to address, rather than compiling a long list of specific chemicals which would rapidly become outdated. There is a need to establish coordinated monitoring programs that will provide exposure and effects information. An easily accessible repository for data also needs to be established by the governments to enable assessment of management options.

In addition, the Commission recommends that the governments provide incentives and educational programs to encourage industry, agriculture, and consumers to develop and use environmentally-friendly alternative products, thereby reducing the production and consumption of chemicals of emerging concern.

Fish Consumption

Most attention to Great Lakes fish consumption is focused on risks because contaminant levels in many species exceed current health standards. Nevertheless, fish consumption is beneficial for health because they provide a dietary source of high-quality protein and omega-3 fatty acids. The risk/benefit tradeoff of Great Lakes fish consumption is further complicated because most assessments of health benefits are based on analyses of marine fish.

Diverse health impacts from some chemicals are well documented. For example, dioxins, polychlorinated biphenyls (PCBs), and chlorinated pesticides may cause cancer, affect sex determination, hormonal functions, suppress immune systems, disrupt thyroid function, and are associated with elevated risk of diabetes and cardiovascular disease. For some chemicals, children (especially at the prenatal stage of development) are more at risk than adults. Chlorinated pesticides impair neurodevelopment in children, and methyl mercury is a potent neurotoxicant to which the developing brain is more susceptible.

Research is needed to improve our understanding of the benefits of Great Lakes fish consumption and on optimum ways to present fish consumption information.

The province and the states need to devote resources for more effective outreach and education campaigns, especially to those populations who traditionally consume larger quantities of fish.

Pending the foregoing activities, the Commission's workgroup has suggested the following text be included with every fish advisory: "When properly prepared, fish provide a diet high in protein and low

Research is needed to improve our understanding of the benefits of Great Lakes fish consumption and on optimum ways to present fish consumption information.

in saturated fats. Many doctors suggest that eating a half-pound of fish each week is helpful in preventing heart disease. Almost any kind of fish may have real health benefits when it replaces a high-fat source of proteinin the diet. You can get the health benefits of fish and reduce contaminants by following this advisory." The Commission also recommends that advisories disclose to women of child-bearing age that frequent fish consumption can affect fetal development and that might have a lifelong impact on intelligence and achievement.

Aquatic Invasive Species (AIS)

AIS are generally defined as introduced aquatic organisms that may cause harmful environmental, health, or economic impacts. More than 180 aquatic non-native species have been detected in the Great Lakes. About 10 percent of them are considered invasive, including sea lamprey, zebra mussel, round goby, spiny waterflea, and Eurasian watermilfoil.

AIS may degrade habitat, cause adverse effects to native species (including threatened and endangered species), disrupt food webs, and facilitate harmful algal blooms. Other impacts include degraded beaches, reduced quality of sport fishery, impaired stocks of native fish f or commercial harvest, disruption to water infrastructure, lower property values, and increased public expenditures for prevention and control measures.

Once they are established, it is virtually impossible to eradicate AIS populations and very difficult to control their spread. As a result, the Commission, first and foremost, supports efforts to prevent invasions from all potential pathways.

Where prevention has not been successful, the Commission supports binational protocols for rapid response both before the AIS is detected (e.g., the Asian Carp) and if needed after an AIS has penetrated the Great Lakes. The Commission recommends consideration of the Incident Command System (ICS), an organizational structure used successfully to manage major emergencies in such areas as human and animal disease, forest pathogens and insects, invasive plants, fire management, and oil and hazardous material spills.

Many of the building blocks for binational AIS rapid response are available in the Great Lakes basin, with its well-established institutional arrangements, regulatory regimes, and long tradition of cooperation across the boundary. A revised Agreement can serve as the organizing vehicle for the development and deployment of joint protocols for effective rapid response to AIS.

A Note on Protection of Human Health

Each challenge in the nearshore zone discussed in this report has current or potential impacts on human health and enjoyment of the resources of the Great Lakes. In the past, human health concerns addressed by the governments have focused on legacy contaminants such as PCBs. While these materials remain of concern, current and emerging threats to human health include a suite of substances and problems ranging from algal blooms to little-regulated materials often found in consumer products. The Commission believes that in addition to protection of the biological, chemical and physical integrity of the Great Lakes ecosystem, the revised Agreement will be critically flawed unless it also makes explicit the goal of protecting human health.

A Note to the Reader on Recommendations in this Report

The 15th Biennial Report contains 32 recommendations. Recommendations presented with this executive summary are organized immediately below as "Guidance to the Governments for Revisions to the Agreement" and as "Recommendations for Better Implementation of the Agreement"–with the latter to be applied under both the existing and a revised Agreement.

All 32 recommendations are repeated in the body of the full report.

The Commission recognizes that the Great Lakes would benefit from governmental reforms that would assign more definitive responsibilities and timetables to various governmental entities.

Recommendations

Guidance to the Governments for Revisions to the Agreement

Periodic IJC Independent Reviews

• Governments require the Commission to generate triennial reports assessing progress in achieving Agreement objectives that would include an evaluation of the policies and programs in both countries that are intended to fulfill the governmental obligations stipulated in the Agreement.

Nearshore Framework

• Explicitly recognize the importance of the nearshore; define it to include a specific distance or depth offshore and also include a specific coastal distance inland.

• Establish a nearshore framework that encompasses sound science and adaptive management in governmental programs.

• LaMPs should be used to engage a broader array of governments, agencies and programs in managing watersheds, nearshore and offshore waters of the Great Lakes Basin Ecosystem. In doing so, improve the governance linkages between RAPs, LaMPs and watershed planning and program implementation.

• Perform a binational condition assessment of the nearshore waters of the Great Lakes using existing trend data and methods. This assessment should be nested within comprehensive basin-wide programs.

• Human health should be recognized as an additional primary goal of governmental programs designed to protect and restore the biological, physical and chemical integrity of the Great Lakes.

Eutrophication

• Develop new or improved models to improve estimates of phosphorous loadings to the Great Lakes from tributaries and other sources and use the results to establish phosphorous concentration targets for nearshore and offshore waters of the Great Lakes.

• Issue a reference to the Commission for a binational scientific investigation into the causes of the resurgence of nuisance and harmful algal growths in the Great Lakes from land-use activities and to test causal hypotheses of the linkages between land use and algal problems and associated ecosystem changes in the Great Lakes.

Beaches

• Develop standardized binational criteria, monitoring protocols and reporting for issuing and tracking beach postings and for reporting of waterborne illnesses.

Groundwater

• Retain the existing Groundwater Annex and add the following provisions:

o Recognize the importance of groundwater as a source of drinking water in the basin and make a high priority the protection of groundwater through monitoring, wellhead protection, well registration and abandoned well-closure programs to ensure human health.

o Require systematic basin-wide collection of data following standardized protocols for groundwater quantity and quality.

o Maintain water budgets for the basin that include major groundwater withdrawals and consumption uses, and report on trends.

Chemicals of Emerging Concern

• Develop and implement a process to identify chemicals that are a priority for binational action, consistent with national chemicals management programs; establish coordinated monitoring programs that will provide information on exposure and effects of chemicals to enable assessment of management strategies; place more emphasis on gaining knowledge and understanding of human health effects as they pertain to the major categories of chemicals of emerging concern.

• Develop provisions for monitoring chemicals of emerging concern that describe the underlying principles and processes by which the Parties identify substances and establish priorities, rather than compiling lists of substances that rapidly become out-of-date; examine and modify existing regulatory regimes to improve the response to issues posed by newly developed and newly recognized substances; enhance binational communication, coordination, and cooperation on the design and implementation of monitoring programs and set common objectives.

Fish Consumption

• Monitor levels of omega-3 fatty acids in fish species of concern in conjunction with their ongoing monitoring of contaminant levels.

Aquatic Invasive Species

• Explicitly address the aquatic invasive species issue in a separate annex that includes improved understanding of their impacts, with provisions for, among other initiatives, a binational rapid response program.

Recommendations for Better Implementation of the Agreement

Nearshore Framework

• Ensure that the various orders of government address impacts of urban and rural areas on nearshore water and ecosystem quality, including the development of appropriate goals, targets and indictors, infrastructure improvements, and research and monitoring to track progress in sustainable land use that is protective of Great Lakes receiving waters.

Eutrophication

• Institute "no regrets" actions–measures that would be justified under all plausible future scenarios–using adaptive management to improve retention of nutrients and sediment on the land, especially in watersheds with high phosphorus loadings.

• Promote the implementation of successful "no regrets" management actions by developing, maintaining, and sharing an inventory of effective techniques and programs.

Beaches

• Conduct research on novel techniques such as microbial source tracking which would help distinguish between the various potential factors which contribute to contamination of recreation waters.

• In consultation with various orders of governments, develop testing methods to improve the scientific basis for advisory and closure decisions at Great Lakes beaches; improve early-warning communication to the public about beach advisories and closures.

Groundwater

• Designate a lead agency with responsibility for compiling and regularly reporting to the Commission on relevant research, monitoring and program information on key groundwater issues because of the importance of groundwater quality to human and ecosystem health.

• Improve training, inspection and enforcement efforts and cost-sharing of clean-up expenses from various sources, including leaking underground storage tanks, spills and leaks from oil pipelines and vehicle fluids, de-icing practices and petroleum refineries.

• Establish standards for septic systems, have them inspected periodically and require owners of them to be in compliance. Tax incentives should be provided to maintain, repair, or replace faulty systems.

• Implement and enforce more effective regulations on confined animal feeding operations to ensure proper treatment of manure and application of methods to reduce run-off and infiltration into groundwater.

• Consider grants or incentive programs as a means of ensuring maintenance and proper decommissioning of abandoned wells.

Chemicals of Emerging Concern

• Invest in communication and outreach efforts that educate consumers and provide economic incentives that encourage them to purchase more environmentally-friendly (greener) products and services, and practice safer disposal of products that contain chemicals of emerging concern.

• Provide tax, economic incentives, and educational support to encourage industry and agriculture to use and develop more environmentally-friendly and green chemistry products and reduce the design, production, and consumption of chemicals of emerging concern.

• Develop wastewater treatment technologies that improve the detection, control and removal or destruction of chemicals of emerging concern.

Fish Consumption

• Conduct research to improve the understanding of human health effects from the various chemicals found in Great Lakes fish, both singly and as a mixture of chemicals. Information on emerging chemicals of concern is of particular importance.

• Develop consistent standards for issuing fish consumption advisories that are based on consideration of both the benefits of omega-3 fatty acid consumption and the hazards from the mixture of contaminants found in Great Lakes fish.

• Improve the communication of fish consumption guidance, especially for reaching sensitive and vulnerable populations.

Aquatic Invasive Species

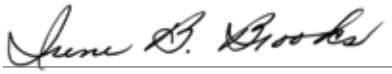
• Institute a consistent, coordinated approach for aquatic invasive species rapid response planning tailored to the binational dimensions of the Great Lakes-St. Lawrence River system.

• Better align research efforts with rapid response needs; establish a “technology transfer” process to convert research findings into practical application; provide for on-site scientific advice, and ensure that early detection and monitoring programs are responsive to emerging needs and feature the latest technology.

Signed this seventh day of January, 2011 as the Fifteenth Biennial Report of the International Joint Commission pursuant to the Great Lakes Water Quality Agreement of 1978.

Lana Pollack
U.S. Co-Chair

Joseph Comuzzi
Canadian Co-Chair



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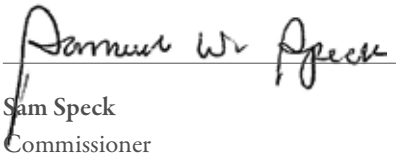

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