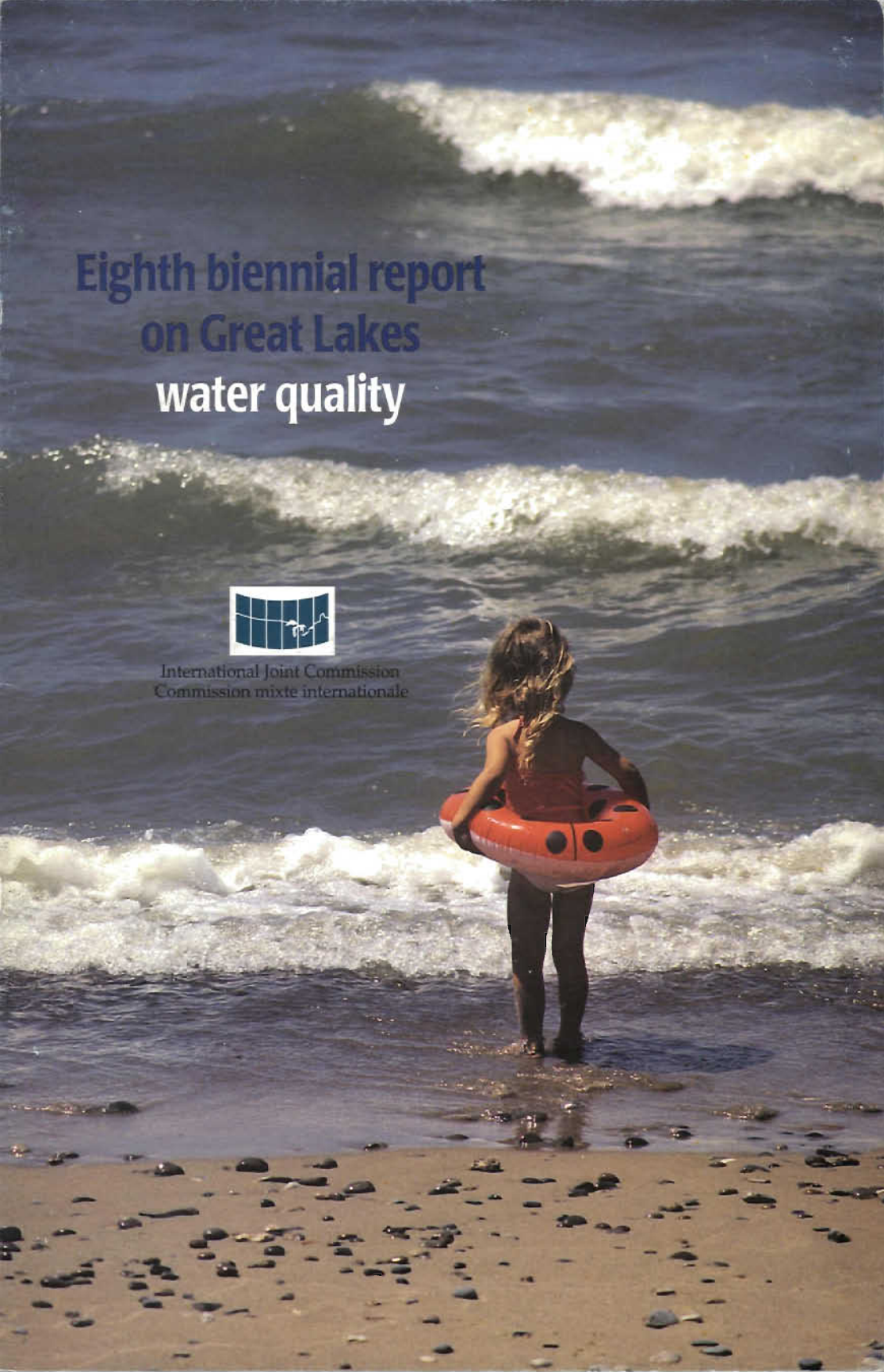
Eighth biennial report on Great Lakes water quality



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ERRATUM: Page 5

The dollar amounts cited in the first paragraph, sentence three, under the Great Lakes Cleanup Fund refer to expenditures on Lake Superior only. The text should read:

As of January 1996, the Canadian Great Lakes Cleanup Fund had provided $14.8 million for habitat restoration and a total of $43 million for all Great Lakes projects; an additional $79 million was provided from other sources.

3iennial Report

Water Quality Agreement of 1978
of the United States and Canada
nd Provincial Governments
Great Lakes Basin

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International Joint Commission, 1996

Eighth Biennial Report on Great Lakes Water Quality

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* When a word is underlined, that term is defined in the glossary.

Executive Summary

Twenty four years ago the Governments of Canada and the United States had the foresight to sign the first Great Lakes Water Quality Agreement. Government actions based on the Agreement's goals, as well as the private sector's significant investments in pollution control and prevention, have significantly restored much of the Great Lakes Basin Ecosystem. Because of the Agreement, the lakes are cleaner than two decades ago. The Agreement has provided a model of cooperative environmental research and ecosystem management for the world. We congratulate both countries for their achievements.

This historic journey teaches us that a strong governmental presence is indispensable to achieve progress on environmental issues. To sustain and build on these achievements, a strong regulatory base that sets common goals is needed, as well as voluntary programs. Further progress and past accomplishments could be jeopardized if cutbacks in environmental legislation, regulation and funding for monitoring, enforcement and research are permitted to occur. Only with our continued commitment to current and future laws and policies, will we achieve adequate progress toward the Agreement's goals.

The virtual elimination of the inputs of persistent toxic substances, agreed to by the Governments in 1978, remains a key challenge. Growing scientific evidence of persistent toxic substances' impacts on the ecosystem and human health provides additional incentive for programs to achieve virtual elimination and zero discharge of these chemicals. These targets are achievable if society has the will.

Pollution must be controlled using four key principles: precaution; prevention; targeting groups of chemicals rather than single ones using a weight of evidence approach; and reverse onus of proof. Adherence to laws and regulations that define the targets, in concert with initiatives by all sectors of society, must lead to new ways to do business, carry out our daily lives, and define our individual and collective responsibility to implement these principles. Governments must lead this deliberate transition towards environmentally and humanly sustainable production and consumption to ensure that future generations have a sustainable future.

Leadership is also needed in several other areas: the large component of Great Lakes pollution entering through the air, from both local and more distant sources in North

America and even the globe; controlling persistent toxic chemicals in world trade; and monitoring and controlling radionuclides. Other issues include climate change, control of ground level ozone, sustaining biological integrity and habitat, and improving environmental health information and training for health professionals.

Recommendations

The Commission recommends to the Governments, and where appropriate, others:

1. a) **Identify and review proposed reductions in regulations, monitoring and enforcement programs and scientific research concerning the Great Lakes Basin Ecosystem, particularly reductions in environmental and natural resource agencies;**
   b) **identify and review all proposed legislative and regulatory initiatives expected to reduce requirements for environmental and natural resource protection within the Great Lakes basin;**
   c) **assess the impacts of these initiatives on the requirements of the Boundary Waters Treaty and Great Lakes Water Quality Agreement; and**
   d) **report to the Commission their findings and specifically whether Agreement-related programs will be reduced below the levels that will achieve the objectives of the Great Lakes Water Quality Agreement.**

2. a) **Continue to target persistent toxic chemicals for virtual elimination from production and commerce;**
   b) **continue enforcing performance requirements or standards for known uses and locations of these substances as minimum interim requirements; and**
   c) **complete and implement a Binational Persistent Toxics Virtual Elimination Strategy that targets all substances meeting the Agreement definitions of persistent and toxic, for zero discharge to the environment of the Great Lakes basin.**

3. Lead targeted discussions among governments at all levels, business, labour and other appropriate organizations in a variety of economic sectors, to identify obstacles to and opportunities concerning the transition from the production and/or use of persistent toxic chemicals to more environmentally and humanly sustainable alternatives.

4. Adopt toxics management strategies that target broad classes of chemicals and contain "reverse onus" provisions that require proponents of the production, use or import of chemicals to demonstrate:
   a) zero discharge for persistent toxic substances deemed essential for use; and
   b) emissions of other materials to the Great Lakes environment at less than toxic amounts.

5. Continue to take a strong leadership role in multinational discussions aimed at preventing, controlling and eliminating persistent toxic chemicals in global production and commerce.

6. Maintain legislative and regulatory baselines and identify goals sufficient to achieve the provisions of the Great Lakes Water Quality Agreement, as well as facilitate and encourage *voluntary* efforts by industries, communities and their own agencies to reduce discharges.

7. Support the restoration of Areas of Concern, help develop local knowledge and capacity for effective action in communities and professions such as education and health care providers, and continue to support the efforts of stakeholders involved in the restoration of Areas of Concern.

8. Join in supporting and adopting common protocols and fully protective health standards as a basis for the declaration of uniform sports fish advisories throughout the Great Lakes basin.

9. Develop a strategy to address the influence of air pollution on the Great Lakes ecosystem, including a

bilateral process to:

a) identify primary and secondary air pollutants transported to the Great Lakes basin from both sides of the Canadian - United States boundary;
b) develop scientific data and criteria on exposure and related effects within the Great Lakes basin;
c) determine common acceptable levels of exposure consistent with emerging scientific knowledge of effects and the precautionary approach to regulation; and
d) agree on control programs consistent with Agreement provisions, including virtual elimination of persistent toxic substances. These programs should include achievable timetables for implementation and prevent increased emissions due to other regulatory decisions governing sources such as transportation and thermal power generation.

10. Address radioactive materials consistent with other substances that meet the Agreement definitions of *toxic* and *persistent*, support the development and maintenance of inventories of radionuclide emissions to the Great Lakes, and ensure the continued reporting of pertinent data from environmental radiation monitoring systems.

Chapter 1

The Commission's Mandate

The Boundary Waters Treaty of 1909 was created to prevent and resolve water resource disputes along the boundary between the United States and Canada, particularly those concerning water resources. The Treaty states that neither country shall pollute boundary waters to the injury of health or property on the other side. This commitment is echoed in the Great Lakes Water Quality Agreement first signed in 1972, which provides a framework for cooperative and coordinated national programs to restore and maintain the chemical, physical and biological integrity of the waters of the Great Lakes Basin Ecosystem. The International Joint Commission (Commission) was asked by the Governments to monitor progress under the Agreement. Among other things, the Commission reviews progress and advises Governments — through biennial reports and other means — on Great Lakes water quality matters.

Recent Commission Biennial reports have emphasized policy and institutional issues rather than localized problems or data-intensive assessments. The Commission is assisted in its responsibilities by advisory boards and committees including two created by the Agreement: the Great Lakes Water Quality and Science Advisory Boards. The Council of Great Lakes Research Managers was established by the Commission to assist in coordinating and reviewing research needs, and a number of subsidiary or *ad hoc* groups have contributed to our work on specific issues. Their analyses, published in *1993-95 Priorities and Progress under the Great Lakes Water Quality Agreement,* have been essential to the preparation of this report.

Another vital component of the Commission's assessment is consultations with various interest groups and with the wider public. In addition, the Biennial Meeting on Great Lakes Water Quality held in Duluth, Minnesota in September 1995 allowed us to hear the views of a range of interests, which we took into account in writing this report.

Chapter 2

Sustaining Progress in Agreement Programs

The purpose of the Parties is to restore and maintain the chemical, physical, and biological integrity of the waters of the Great Lakes Basin Ecosystem. In order to achieve this purpose, the Parties agree to make a maximum effort to develop programs, practices and technology necessary for a better understanding of the Great Lakes Basin Ecosystem and to eliminate or reduce to the maximum extent practicable the discharge of pollutants into the Great Lakes System.

United States and Canada
Great Lakes Water Quality Agreement of 1978
Article II

Laws and initiatives in Canada and the United States have created the building blocks for comprehensive action on environmental concerns. The Agreement has provided a binational framework for these initiatives within an ecosystem approach to environmental management for the Great Lakes. It has served as an outstanding example of what two countries can do with vision and commitment. The Agreement's community of scientists, informed officials and volunteers has become a world-class example of binational cooperation and environmental stewardship.

Investments in sewage treatments, stormwater runoff management, controls on industrial discharges, shipping and dredging, and limited bans on phosphorus and certain pesticides have produced significant results. Other initiatives — including the Lake Superior Binational Program, Remedial Action Plans and rural nonpoint strategies — have focused attention on best management practices and needed local actions. To sustain progress under the Agreement, existing programs must continue, and in some cases be expanded or adapted to meet new challenges and complexities in the ecosystem.

Challenges to Environmental Regulation and Programs

Despite this success, and the need for continued vigilance and effort, the progress of the last quarter century of investments in the Great Lakes is in jeopardy. The

following proposals and actions in both countries place in question their capacity to sustain this progress:

- **proposals to weaken regulatory frameworks that underpin pollution control and other effective programs, including reporting and compliance requirements;**
- **erosion of funding and expertise for research, monitoring and enforcement, and transferred responsibilities to other levels of government without the requisite resources.**

We are concerned that regulatory reviews, revisions and legislative riders may be used to weaken and eliminate environmental laws. Even in cases where existing mandates are not being challenged, a lack of will and resources for implementation, monitoring and enforcement can have a similar effect. Weak enforcement limits action as effectively as weak mandates.

We recognize that Governments are reducing regulatory burdens and their own spending under current financial and political conditions. However, these reductions should not be allowed to sacrifice environmental protection or compromise the ability of Canada and the United States to meet their Agreement commitments. We strongly believe the existing legislative and regulatory base is a required baseline to restore and protect the Great Lakes Basin Ecosystem.

Threatened Programs that Support Agreement Goals

Examples of our concerns include:

- The **U.S. Clean Water Act** is undergoing statutory review. Among proposed revisions are changes in reporting and compliance requirements, including greater reliance on self-audits; transfer of responsibilities to states without the attendant resources, and reduced scope of activities for many remaining federal programs. The **U.S. Clean Air Act** is under similar scrutiny.

- The **Great Lakes Water Quality Initiative** (GLI) is intended to provide a framework for federal uniform water quality criteria and implementing procedures in the U.S. portion of the Great Lakes basin, and a basis for revisions to the Specific Objectives and related protocols with Canada under the Great Lakes Water Quality Agreement.

  The GLI established water quality criteria for 29 pollutants, addressed nonpoint and point sources and established antidegradation policies. It incorporated the concepts of prevention, precaution and weight of evidence and local empowerment, all of which the Commission has encouraged.

The Example of Fish Advisories

Scientists and fisheries managers have long worked to standardize fish advisories among the eight Great Lakes states and Ontario. Consumption of Great Lakes fish is a major source of human exposure to persistent toxic substances, particularly to polychlorinated biphenyls (PCBs). Some fish, especially the larger salmon and lake trout, pose a particular threat to women of childbearing age and their children. Some fish species subject to advisories by one government agency continue to be stocked by others. The Commission has called on the Governments and the Great Lakes jurisdictions to review, strengthen and harmonize their fish consumption advisories, and to reevaluate stocking programs.

Substantial progress has been made in the United States under the auspices of the Council of Great Lakes Governors, the Great Lakes Fishery Commission and other agencies. By March 1996, three states were using the proposed common health protection value of 0.05 μg/kg/day, a level that has been supported, among others, by Michigan's Environmental Science Board. However, the standard's consistent adoption is threatened by the State of Michigan's decision to drop fish advisories for coho and chinook salmon from Lake Michigan while all other surrounding states' advisories for these fish remain. Governments should ensure a consistent, credible and science-based message to Great Lakes residents and others who come to enjoy the substantial sport fishery around the lakes.

While the existing GLI is hampered by its timeliness and scope, such as a limited list of targeted substances and linkages to Canadian programs, it is a major step toward implementing the Agreement in the United States. Attempts to limit its provisions could make the GLI programs too weak or poorly funded to be fully effective.

- The **Joint Great Lakes Five-Year Strategy** commits U.S. EPA and its federal, state and tribal partners to programs to fulfill Agreement goals. It was expected to drive many actions identified in the United States' September 1995 report to the Commission, *Great Lakes Program Progress Report*, including actions to achieve zero discharge and virtual elimination. These programs need to receive further support at all government levels.

- The **Canada-Ontario Agreement** (COA) facilitates federal and provincial cooperation to implement the Great Lakes Water Quality Agreement in Canada. In 1994, joint specific objectives and milestones by the year 2000 were formulated in three broad areas: restoring degraded areas; pollution control and prevention; and conserving and protecting the Great Lakes ecosystem, including human health. The 1995 progress report outlined advancements, but also made clear that much remains to be done.

Areas needing further attention are human health research, water conservation, actual remediation of Areas of Concern, and progress towards zero discharge for most persistent toxic

substances. Programs under COA, such as targets for achievements in Remedial Action Plans and persistent toxic substance reductions, are under stress from government restructuring and resource constraints as well as regulatory review in Ontario.

- Several Canadian federal programs are focused by **Great Lakes 2000**. They include restoring Areas of Concern, preventing and controlling pollution, and conserving human and ecosystem health. Between 1990 and 1995 the **Canadian Great Lakes Cleanup Fund** provided $4.5 million for habitat restoration and environmental projects; an additional $10 million was leveraged from other sources. Several worthwhile projects are underway and essential federal programs are intact, however indications are that some projects will be diverted and extended timetables will compound delays in provincial programs due to fiscal constraints.

- Deregulation and resource cutbacks could also impact controls on exotic species introductions. The **United States and Canadian Coast Guards** must have the resources necessary to provide sound scientific and technical advice, to enforce regulations and/or management practices for ballast water exchange, and to control exotic species in general.

Eroded Support for Great Lakes Science

Funding for and expertise in scientific research and monitoring are also eroding. Some budget proposals go beyond incremental savings to narrow and in some cases eliminate entire programs and laboratories. We call for a review of this situation by Governments and reassurances that the research needed to meet Agreement provisions will be maintained.

Our Council of Great Lakes Research Managers has surveyed major research institutions to determine the status of programs specifically identified in Annex 17 of the Agreement. Responses from 31 organizations represented about $88 million or 80 percent of the total funding listed in the Council's 1991-92 research inventory survey. They projected reductions of 23 to 53 percent of total operating funds, and 31 to 45 percent of salaries by 1997 (see table 1). Proposed reductions in the number of researchers are projected to be 47-62 percent over this period (see table 2). Reductions in research programs on this scale, with some entire laboratories slated for closure, could seriously compromise the governments' ability to achieve Agreement commitments.

Table 1

GREAT LAKES RESEARCH BUDGET FOR 31 SELECTED INSTITUTIONS, 1993 - 1997

Actual and Projected, in $US millions)

	Operating Budget	Salary Budget	Total Budget	% of 1994 Level
1993	53.1	29.6	82.7	93
1994	57.2	31.7	88.9	100
1995	52.3	29.4	81.7	91.8
1996	46.8	25.7	72.5	81.5
1997	26.9-43.9*	17.3-21.8*	44.2-65.7*	49.7-73.9*

*best and worse case projections

Table 2

GREAT LAKES RESEARCH POSITIONS FOR 31 SELECTED INSTITUTIONS, 1993-1997

(Actual and Projected)

	Total # of Researchers	% of 1994 Level
1993	621	87.7
1994	709	100
1995	697	98.3
1996	495	69.9
1997	269-378*	37.9-53.4*

* best & worst case projections

Three examples illustrate the range and effect of resource cuts. The Great Lakes fish tissue specimen bank provides an international sample archive, which has been used by many researchers for retrospective monitoring and to assess the impacts of persistent toxic chemicals on fisheries. This important source of historical information will be permanently lost without consistent funding. It is part of a substantial decrease in fisheries research relevant to the Agreement including substantial elimination of Canada's federal fisheries research on Lake Superior.

According to our International Air Quality Advisory Board, automation and downsizing will also affect the accuracy of estimates required for risk assessments, maintenance of climate records and monitoring networks, and will limit emission inventories of sources contributing to transboundary air pollution and the atmospheric transfer of pollutants to the Great Lakes. There is a continuing need for the development of loading and source data to assess this problem including data on critical pollutants for Lakewide Management Plans (LAMPs). Similarly, we are also concerned about the maintenance of adequate, coordinated radionuclide monitoring within the Great Lakes ecosystem.

Contaminated sediment removal programs in Areas of Concern, habitat restoration and fisheries management would be hindered by insufficient research. Some of these programs have resulted in economic savings by defining optimal remedial and preventive programs. For example, research on the transfer and reduction of contaminated sediments in Green Bay, Wisconsin created a strategy for remediation that restored uses of the waterway and saved $10 million (US). In Hamilton Harbour, Ontario, research on habitat as it affects the harbour's ecosystem allowed $19 million (Cdn) to be leveraged from public and private partners to test various rehabilitation techniques.

Health Effects Research

An important U.S. program directed by the Agency for Toxic Substances and Disease Registry (ATSDR) is also under threat. The ATSDR has recently studied people who consume Great Lakes fish for epidemiological studies. Health Canada is researching the health effects of air pollutants, drinking water and other routes of exposure to contaminants, including specialized studies on high-risk populations such as native people. While not formally linked in a binational program, scientists and officials in the two countries are cooperating and exchanging information as the studies progress.

These studies are critical to understanding health effects of persistent toxic substances. As with other government programs, these studies and agencies are facing severe pressure on available resources. We feel strongly that these programs should continue to receive high priority for funding to meet Governments' responsibilities under the Agreement.

Creating New Concepts and Programs

Rather than withdrawing from or weakening regulations and standards, Governments must strengthen measures to make progress under the Agreement. For example, some provisions that have formed the basis to control *conventional* types of pollution will not be adequate to virtually eliminate *persistent toxic substances*. Governments need to create new concepts and programs to achieve this Agreement objective.

One area that merits increasing support is that of interjurisdictional commitments. International cooperation, within the work of this Commission, other regional organizations and directly among governments, industries, universities and others, has led to significant results. With increased demands on time and limited resources, participants are beginning to view such coordination as a luxury.

Interjurisdictional agreements facilitate progress at the regional, binational and multinational scales, and draw on the strengths and competence of each level of government. Broader coordination will be needed, for example, in international trading of persistent toxic substances and climate change, as discussed later in this report.

Chapter 3

The Legacy of Persistent Toxic Substances

It is the policy of the Parties that...the discharge of toxic substances in toxic amounts be prohibited and the discharge of any or all persistent toxic substances be virtually eliminated.

United States and Canada
Great Lakes Water Quality Agreement of 1978
Article II

The Governments committed themselves to this far-sighted provision to protect human and ecological health in the Great Lakes basin. Canadians and Americans should take comfort in this commitment, and must be assured that it will be accomplished. The elimination of persistent toxic substances is the cornerstone of the Agreement, and must remain an important focus of programs to restore and protect the Great Lakes Basin Ecosystem.

Reproductive failures, deformities and physiological malfunctions in Great Lakes fish and wildlife, is linked by a growing body of evidence to various pesticides, PCBs, dioxins, furans and similar substances. Managers who closed Great Lakes fisheries in the 1980s because dangerous substances such as mercury and PCBs were found in lake trout and salmon now recognize that the sources of these substances often are not localized. Pesticides found on Isle Royale at concentrations higher than those in the surrounding waters of Lake Superior, as well as similar findings in Florida, the Netherlands and the Arctic, help all of us to realize that persistent toxic substances can affect local and global environments as a result of atmospheric and other methods of transport.

Protracted legal battles to remove DDT from use foreshadowed the continued struggles to reduce environmental contaminants. The time and resources required to document contamination and injury to establish linkages between cause and effect has inhibited action in a public health policy. A comprehensive approach to all persistent toxic chemicals is not only the preferred way to protect the integrity of the ecosystem and public health, but the *only* effective way.

The Agreement's principles of virtual elimination and zero discharge are neither impossible nor impractical as long-term goals. In its last three Biennial Reports, the Commission provided over 50 recommendations that involved toxic and persistent toxic substances. Governments have accepted most of the recommendations in principle and have begun to implement a number of them. Progress has been made in addressing virtual elimination as a concept, as in Lake Superior, and governments and industry are vigorously addressing particular chemicals and processes. Continued efforts by all parties are needed to focus on *eliminating* rather than *reducing* inputs in order to make virtual elimination a reality in the basin.

The Meaning of Virtual Elimination and Zero Discharge

There are various interpretations of virtual elimination and zero discharge. Virtual elimination is not a technical measure but a broad policy goal. This goal will not be reached until all releases of persistent toxic chemicals due to human activity are stopped.

Zero discharge does *not* mean simply less than detectable. It does *not* mean the use of controls based on best available technology or best management practices that continue to allow some release of persistent toxic substances, even though these may be important steps in reaching the goal. Zero discharge means no discharge or nil input of persistent toxic substances resulting from human activity. It is a reasonable and achievable expectation for

Swimmers along Bruce Trail, Lake Huron

The Legacy of Persistent Toxic Substances

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a virtual elimination strategy. The question is no longer *whether* there should be virtual elimination and zero discharge, but *when* and *how* these goals can be achieved.

The Scourge of Persistent Toxic Substances: An Update

Our Science Advisory Board's 1989 Report contained a compelling premise that all persistent toxic substances are intrinsically harmful to the integrity of the environment and should not be allowed to be released. Indeed, this recognition of a serious problem with these substances has grown over the past several years. Resistance to both the concept and practicability of virtual elimination has changed into a growing acceptance of this objective. Despite this broad acceptance and the inherent obligation to virtual elimination, these substances have not yet been virtually eliminated from the Great Lakes and comprehensive programs to this end are still needed.

New studies are continuing to find various effects from exposure to persistent toxic substances on fish, wildlife and humans. Some effects are quite dramatic. Earlier studies are being re-examined based on new evidence. For example, a recent retrospective risk assessment suggested that dioxin in Lake Ontario may have caused complete reproductive failure in native lake trout populations by the early 1940s. This important fishery has required artificial stocking to this day, with mixed results.

Mounting published evidence indicates that harm to humans from persistent toxic substances is similar to that caused in wildlife. Since our last Biennial Report, published studies indicate such harm is being caused, at least in part, by *in utero* exposure to elevated levels of environmental estrogens. A synopsis of research on endocrinal effects conducted in 1994 by the Danish Environmental Protection Agency showed that several aspects of human male reproductive health have declined over the past 30 to 50 years, including dramatic declines in sperm counts in otherwise healthy men to levels where fertility may be impaired. Other cited problems are increased testicular cancer, undescended testis and genital tract disorders. The authors conclude that disorders seen today originated 20 to 40 years ago, during fetal and childhood development. Similarly, chemical influences on male reproductive health in today's babies may not become apparent for decades.

Our Science Advisory Board has studied this phenomenon and concluded that certain chemicals in the environment can cause a range of effects on the endocrine and endocrine-responsive organ systems. The Board's 1995 report identifies several areas where cooperative efforts among governments, academia, industry and others could expand our knowledge about the processes and effects of endocrine modulation due to exposure to these substances. We urge support for this important research to safeguard human health.

In its *Seventh Biennial Report*, the Commission asked whether the increasing incidence of behavioural and cognitive problems in school children might be related to exposure to persistent toxic substances. Again, the emerging picture is not encouraging. The U.S. Agency for Toxic Substances and Disease Registry (ATSDR) is completing studies of potentially at-risk human populations in the Great Lakes region, with fish consumption as the primary route of exposure to chemical contaminants. One study involved human infants in upper New York State whose mothers ate Lake Ontario salmon prior to pregnancy. The findings (preliminarily reported at our 1995 Biennial Meeting) support data of behavioural abnormalities found 15 years ago in progeny of a similar group of mothers who ate Lake Michigan fish. The higher exposed infants in New York State were unable to adapt to mild frustration compared to a less exposed group. These new findings require us to ask again, what is the wisdom of exposing another generation of human infants to such toxins?

The danget to human and ecosystem health from persistent toxic substances is sufficiently clear and being reinforced by new evidence. This evidence justifies concerted and effective action against persistent toxics. While we remain committed to elimination of persistent toxic substances, other evidence is showing that a single exposure at a critical moment in human development may cause significant effects and be dangerous to reproduction.

The Commission's Proposed Strategy

The Commission has long held that controlling the inputs of persistent toxic inputs requires a comprehensive binational strategy. The proposal, on which the Governments have begun to develop, has a fundamental premise consistent with the precautionary principle, that such chemicals are bad for the environment and human exposure unless they are specifically proven safe to use or release. The strategy should prevent the generation and discharge of these chemicals by addressing broad classes of chemicals and then require manufacturers, importers and users to demonstrate that *specific* chemicals within those classes are not persistent and toxic. Those chemicals that cannot meet this test should preferably be removed from manufacture and use altogether through bans, sunsetting provisions or voluntary transitions to other processes and products. At a minimum, it should be demonstrated that the use of such chemicals is both essential and subject to zero discharge.

The Commission's previous reports have outlined proposed actions to implement a binational strategy for virtual elimination. Based in part on the 1993 report of the Commission's Virtual Elimination Task Force, this proposed strategy included:

- adopting the principles of *prevention, precaution, weight of evidence*, and *reverse onus* and the strategy of *sunsetting*

- ensuring that the application of existing legal mandates is not inhibited by conflicting institutional or administrative barriers
- beginning with the eleven critical pollutants first listed a decade ago by the Great Lakes Water Quality Board, including PCBs, DDT and its metabolites, dieldrin, toxaphene, mirex, dioxin, furans, benzopyrene and hexachlorobenzene, lead and mercury
- consulting with industry and other interests to alter production processes and feedstock chemicals to eliminate dioxins, furans and hexachlorobenzene as byproducts and to sunset wherever possible uses of lead and mercury, and
- consulting with industry and other affected interests on timetables to sunset the use of chlorine and chlorine containing compounds as industrial feedstocks.

While the Commission's strategy has been aimed primarily at the Governments, all sectors of society must accept their share of responsibility to protect the integrity of the ecosystem and become partners in this process. The Commission therefore has proposed that all interests, led by Governments, join in a deliberate process of transition to achieve compatible economic, environmental and social goals.

This binational plan could guide national and multinational strategies that virtually eliminate persistent toxic substances in other regions of the world. Relevant mechanisms include the Paris-Oslo Conventions, the Baltic Convention, the Organization for Economic Cooperation and Development (OECD), the Intergovernmental Forum on Chemical Safety and discussions in United Nations groups including the Environment Program (UNEP) and the Commission on Sustainable Development (CSD).

Chapter 4

Making Progress on Persistent Toxic Substances

We must recognize the fundamental impediments to achieving virtual elimination, and move from rhetoric to action.

First, we must recognize the relationship between what we produce and its long-term consequences. We have come to rely on many of these chemicals for our economic and social wellbeing, and it is difficult to change that dependence, for the producer and consumer. We must address this issue now, or we will pay the painful consequences later.

Persistent toxic substances should not be allowed to accumulate in the environment and in humans, for policy and health reasons. Rather than focusing on controlling a particular chemical, we must answer the questions: Can we afford to ignore the evidence? Can we wait until the case is proven undeniably for each and every suspect chemical? Why do we continue to place these chemicals into the environment, knowing the growing risks and effects?

Society — governments, entrepreneurs, labour, scientists and educators — can deal with this problem *without* destroying the lifestyles we enjoy. Society does not want to destroy its economic and social vitality, nor is this necessary. A carefully planned and deliberate process of transition away from the persistent toxic substances we now produce and use to more environmentally and humanly sustainable patterns of production and consumption is needed. The transition should protect the vitality of business, the earning capacity of labour, the integrity of the natural environment, and the potential for our current and future health.

Governments must lead this process of transition.

The overall cost of transition should be treated as an investment over a reasonable time of resources, effort and know-how and as technological and reinvestment opportunities are realized. With a clear long-term strategy and unity of purpose, the Agreement objective to virtually eliminate the inputs of these chemicals to the Great Lakes environment can be accomplished.

Regional, local and sectoral elements of this strategy must involve more than environmental regulations and conservation programs as means to change both our production and consumption patterns. Retraining and retooling can enhance rather than diminish or eliminate employment and earning potential, and protect and assist affected communities. Our Science Advisory Board specifically recommended that transition planning be incorporated in programs to phase out toxic substances such as those contained in the Lake Superior Binational Program and Canada-Ontario Agreement.

Our economic system does not currently shield companies and employees from the impacts of the competitive market system during such changes. New manufacturing processes and other requirements of a major transition to sustainability will involve costs that may not be supported in the short term in highly competitive global markets. For this reason, global transition initiatives will also be important to help create a level playing field for Great Lakes industries, including mechanisms to monitor and eliminate production and trade of certain chemicals, and conscious integration of these needs into international trade agreements.

Specific Impediments to Progress

Prevention vs. Management

Environmental regulations are central to any effective strategy, but they alone will not eliminate persistent toxic substances since conventional regulations tend to "manage" pollution within defined limits. Implicit in regulations is a general acceptance of some level of contaminant discharge. This is not sufficient to meet the goal of virtual elimination of persistent toxic substances. The transition strategy must focus on avoiding or preventing the causes of pollution at their source, while using regulations as an essential underpinning. One component of transition will be to phase out or sunset chemicals and processes that produce compounds of concern.

At a Pollution Prevention Workshop in March 1995, the Commission's Water Quality and Science Advisory Boards focussed on technical, socio-economic and cultural aspects of pollution prevention. Workshop participants concluded that governments should initiate measures to encourage prevention and ensure that regulations in environmental and other policy fields do not unnecessarily inhibit voluntary prevention initiatives. Governments and business should also identify barriers to adopting pollution prevention measures such as lifecycle and materials management approaches.

In the United States, the Pollution Prevention Act of 1990 incorporated the concept

pollution prevention into law. The development of pollution prevention programs in Canada is a joint federal-provincial undertaking. In 1993, the Canadian Council of Ministers of the Environment announced "A National Commitment to Pollution Prevention," and Environment Canada created a pollution prevention information centre and programs. Such government and industry initiatives for voluntary pollution prevention action should be encouraged.

Aerial view of steel plant, Sault Ste. Marie, Ontario

The Chemical-by-Chemical Approach

The practice of addressing one chemical at a time is a lengthy and resource-intensive process. The analysis, debate and negotiation over the risks, impacts and the restrictions for each chemical has effectively blocked regulation for years. This has been the case for dioxin, PCBs, DDT, various pesticides and a number of other chemicals.

The Chemical-by-Chemical Approach

As a society, we cannot continue protracted debate while the actual or even suspected injury to living species continues to occur. Yet, this is precisely what occurs and will continue to occur until Governments address classes of chemicals rather than a few specific chemicals at a time.

A framework is needed for addressing the large number of toxic chemicals at the same time. Governments need to develop broader and less onerous provisions to prevent the use and discharge of such chemicals. Society cannot continue protracted debate while the actual or even suspected injury to living species continues to occur. Yet, this situation will continue until Governments address classes of chemicals rather than a few specific chemicals at a time. Others in the chemical debate, including some members of industry, have expressed the need to change from the chemical-by-chemical approach, but this change has yet to occur.

U.S. Toxic Substances Control Act

The U.S. Toxic Substances Control Act (TSCA) was designed to prevent additional toxic contaminants from entering the environment and to address the risks posed by existing chemicals. Approximately 72,000 chemicals are on U.S. EPA's TSCA chemicals list, but regulations have been issued to control only nine new chemicals

in 20 years, and the Act's provisions have not been used to control any existing substances other than PCBs. According to U.S. EPA, creating a test rule for a single chemical can take as long as 2½ years and costs 68 to 234 thousand dollars. The requirement to consider social and economic impacts has provided the opening for successful litigation against proposed controls for several existing substances. In 1993, our Water Quality Board stated that this provision had rendered the act ineffective to control existing chemicals and that its effectiveness should be improved.

Canadian Environmental Protection Act

Similarly, the Canadian Environmental Protection Act (CEPA) has effectively created federal-provincial cooperation and partnerships. While several regulations have been considered and promulgated, CEPA does not provide an effective mechanism to assess and control chemicals.

The Act has been under extensive review, and proposed revisions would significantly improve its stance on pollution prevention. They would also provide a broader suite of options, including economic incentives and more flexible use of enforcement powers, to reach compliance with environmental objectives. Along with the federal government's Toxics Substances Management Policy — developed partially in response to our reports but applied nationally — the proposal recognizes the special dangers of bioaccumulative, anthropogenic persistent toxic substances and creates a management regime for them. A specific action plan also is included for chlorinated substances of concern.

While proposed changes to the Act are promising, the most restrictive procedures would be applied to a relatively small number of listed substances, based in part on risk assessment rather than their inherent toxicity. The chemical-by-chemical approach would remain the basic methodology. It is not clear what standards of risk and scientific proof of harm would be required before action is taken against specific chemicals or whether all persistent toxic chemicals, as defined under the Agreement, will be dealt with expeditiously.

Ontario Municipal-Industrial Strategy for Abatement

The principal operating framework for pollution control in Ontario is the Municipal-Industrial Strategy for Abatement (MISA), which aims to control contaminants in municipal and industrial discharges, and has used an industry-based approach. Since mid-1993, final clean water regulations have been prepared in consultation with industry for nine sectors, including petroleum, pulp and paper, and chemical manufacturing. The planned pulp and papet requirements, in particular, are consistent with the Commission's approach on chlorinated and other toxic compounds. MISA

has provided a good approach to water pollution control although such programs have not been applied to air emissions or solid wastes. The Ontario government is reviewing its regulations and related efforts. We urge Ontario to maintain MISA and related programs to ensure compliance with the Agreement.

Reverse Onus

The burden of proof of potential risk or proven harm to health or environment has been the responsibility of environmental management agencies — agencies with limited resources. Reversing the onus, whereby the proponent manufacturer, importer or user would have to prove that suspected persistent toxic substances are not and will not be harmful, is a more reasonable and logical approach.

Some provisions already place the responsibility on proponents for new chemicals. The proposed amendments to the Canadian Environmental Protection Act, the Toxics Substances Management Strategy and the Chlorine Action Plan intend to incorporate the concept of reverse onus for existing chemicals and classes of chemicals. A weight of evidence approach should be used to trigger the reverse onus procedures and restrictive controls more readily than do existing procedures.

Misuse of Science

Valid scientific information is important to informed policymaking. Scientific arguments and their lack of absolute proof can also be used as an excuse for inaction. The phrase "good science" has been used to block change through demands for more rigorous proof. It is also ironic that statements about a lack of "sound science" in current policy discussions about toxic chemicals are heard concurrently with calls for financial cutbacks to the very programs that could provide additional, credible scientific information and contribute to responsible public policy in such areas as human health and persistent toxic substances.

The principles of epidemiology and toxicology are central to conventional cause-effect science but may inhibit early action on environmental and health concerns. The potentially large scale and uncertain outcomes of these issues cannot be dealt with solely by traditional scientific and regulatory models. Our Science Advisory Board considered this issue and recommended that a multilayered approach be created that melds available scientific evidence with existing uncertainties to obtain a range of management options. This process requires that legal, socio-economic, equity and community values and goals also be considered to choose acceptable policy options that minimize risks to human health.

Examples for Furthering Progress

The most potent impediment to action is the claim that it is impossible to address major categories of chemicals, such as chlorinated organics, comprehensively. This position prevents a collective consideration of opportunities and difficulties. How can we initiate a discussion on the parameters and implications of such a strategy? Two examples of shared experiences could help our nations break this blockage and point the way to accomplishing the virtual elimination of all persistent toxic substances.

Producers in North America have committed to ending production of ozone-destroying chlorofluorocarbons (CFCs). This definitive action against a group of chlorinated chemicals responded to a multilateral agreement, the Montreal Protocol. The process lasted a generation and the debate progressed through each stage of a now familiar tableau of assertions: CFCs are irreplaceable; curtailing their use deprives us of our current standard of living; there are no available substitutes; the available science is incomplete or constituted "bad science"; it is unfair to developing countries; it will cost thousands of jobs. With a sufficient degree of public and political concern, the collective will to act and the development of technical alternatives, governments around the world agreed on a common course of action.

Contrary to original predictions, recent studies indicate that levels of the precursor chemicals are diminishing in the upper atmosphere, and thus the Montreal Protocol is indeed effective. The schedule for curtailing and phasing out the use of CFCs has been met, and accelerated. Developing nations, initially sceptical of the effect a phaseout of CFCs would have on their potential, are supportive of the phaseout and agreed to comply by the year 2015. Costs are much lower than original projections, and in some cases the transition has resulted in additional profits rather than costs. Substitutes have been developed and manufacturers are ready to develop replacement products.

United States and Canadian action on acid rain provides another example. The U.S. Clean Air Act amendments of 1990 established a plan to curb acid rain and its precursors, which led to the United States/Canada Air Quality Agreement. Draconian predictions also flowed: jobs would be lost; we would become more dependent on foreign sources for energy; the costs would be burdensome for consumers.

The Air Quality Agreement has curbed emissions of acid rain precursors, and resulting benefits far outweigh the financial impact. Estimates in a 1995 U.S. EPA report on human health state that the 1990 reductions under the Clean Air Act are yielding benefits that will reach 12 to 40 billion dollars annually by 2010. These figures do not include substantially reduced damages to buildings, forests, lakes and streams. Another EPA draft report on the benefits and costs of other provisions of

Clean Air Act states that the actual monetized benefits (including various health costs and other economic savings) had a central estimate of 6.8 trillion dollars over the period 1970-90, approximately 15 times the costs of compliance.

What do these two substantial success stories have in common? First, both solutions allowed industry the flexibility to do what it does best, and placed government in the role it should assume. Industry sources were given clear targets to meet and they proceeded to determine how best to achieve them. Governments were catalysts for the discussion and set the targets, with a tacit assumption that if industry did not devise its own solutions, government would revert to the more traditional regulatory route.

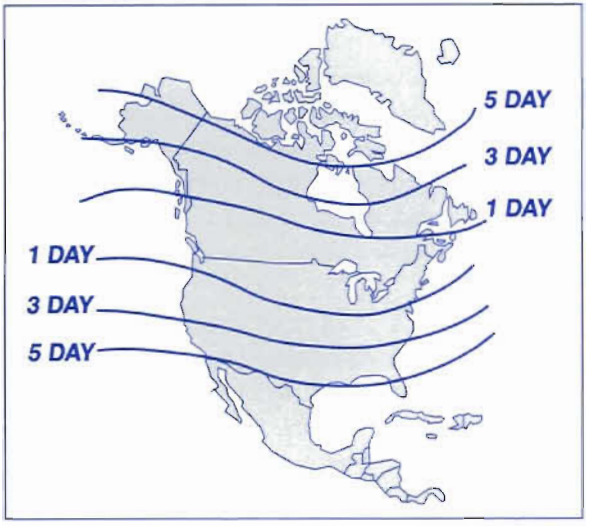
The arguments against strong, concerted action on classes of persistent toxic chemicals are similar to those made during the CFC and acid rain debates. The stakes in allowing these arguments to justify inaction are even higher and the evidence at least as compelling. Again, too much is at stake to justify delaying the beginning of a process of transition that, in all likelihood, will proceed faster than we can envision at this time.

Atmospheric Deposition: A Major Pathway of Pollution

We are increasingly recognizing that a variety of pollutants emitted to and transported by the air have become the major pathway of pollution to the Great Lakes. These pollutants may come from direct sources, such as industrial and municipal discharges, from distant sources in North America and beyond, or directly from the lakes themselves through recirculation of previously deposited pollutants. A recent report of the Canadian Chemical Producers' Association, *Reducing Emissions*, illustrates that from 1992 to 1994 total Canadian water emissions by member companies were halved, but the proportion of air emissions almost doubled. In Ontario, almost 99 percent of Association members' emissions — including all of the major chemical producers — are now reported to be to the air.

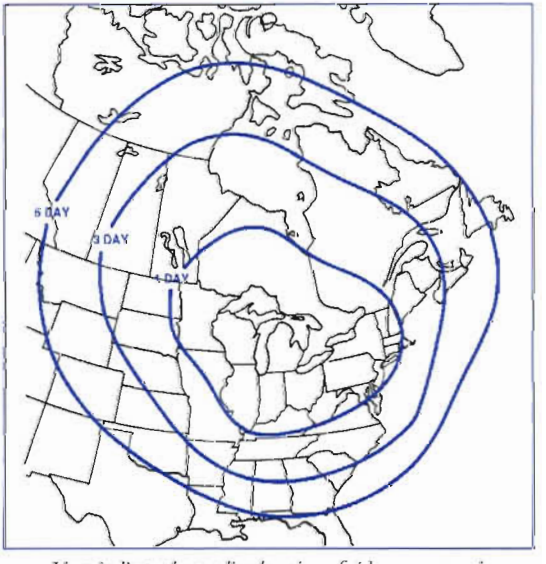
These data are consistent with Environment Canada's evaluation of the Canadian National Pollutant Release Inventory and the U.S. Toxics Release Inventory, which states that 73 percent of total releases from manufacturing in the Great Lakes basin was emitted to the air. This figure increases to 85 percent when manufacturing emissions within the "one-day airshed" are included (roughly corresponding to the eight Great Lakes states, Ontario, western Quebec, Vermont and most of West Virginia). This amount could increase if emissions from electric power utilities and municipal incinerators were reflected in these total loading figures. As the U.S. EPA's first report to Congress under the Great Waters Program pointed out, the relative contributions of these deposition sources are not well understood. However, they

Atmospheric Deposition: A Major Pathway of Pollution



Lines indicate the average length of time needed for airborne contaminants to arrive at the southern U.S. - Canadian border, which runs through the Great Lakes basin.

Atmospheric Regions of Influence for the Great Lakes



Lines indicate the median location of airborne contaminants originating 1, 3 and 5 days before their arrival in the Great Lakes hydrological basin.

have been identified as major human sources of pollutants in the region, including mercury.

This evidence leads us to conclude that part of our focus must be on atmospheric emissions. This should not, of course, lessen the resolve to control point and other land-based sources in the basin. Also, our traditional concept of the geographic area that impacts the Great Lakes basin must be expanded. The scale should at least encompass most of North America, and for some purposes the globe. Persistent toxic substances must be eliminated wherever they exist. Air quality standards and guidelines should be consistent among jurisdictions to recognize the long-range transport and effects of these pollutants. The U.S. and Canada need to develop a strategy that will be consistent with Agreement objectives, identify transboundary pollutants, develop data on exposure, and result in a bilaterally coordinated control program.

Municipal, industrial and medical incinerators are believed to contribute significant emissions. Current waste management programs allow or even encourage incineration. Ontario has recently joined other jurisdictions by rescinding a ban on new and expanded incinerators and issuing emission guidelines. Governments approving new incinerators or renewing licences must ensure that

the best state-of-the-art technology is installed and operated effectively, both in their own jurisdictions and internationally. Emissions should be carefully monitored with timely public access to these data and provisions for remedial action if limits are exceeded. The burden of inputs delivered to these facilities can be reduced by waste management and reuse programs, and by removing organochlorines and other persistent substances in the material to be incinerated.

Thermal power production is another major source of harmful emissions or their precursors. It is a major contributor to atmospheric emissions of mercury which, in turn, are the most significant source of human inputs to the Great Lakes. Our International Air Quality Advisory Board recently pointed out that increased electrical generation by coal-fired utilities, if it occurs without mitigation as a result of pending U.S. regulatory decisions, should lead to concern about an increase in emissions of mercury transported to the Great Lakes basin. Mercury is identified in the Agreement as a persistent toxic substance and one of the eleven critical pollutants. The Board also has pointed out that a number of other sources, including automobiles and other modes of transportation, contribute heavy metals, volatile organic compounds and other hazardous pollutants to the atmosphere. Canada and the United States should ensure that such regulatory and other economic decisions do not lead to increased loadings of persistent toxic substances to the Great Lakes.

Global Action

The use of chemicals in the global economy and their movement through the biosphere require multilateral action as well as local, regional and binational programs. Several initiatives are being considered which seek to virtually eliminate the inputs of various substances to the biosphere.

The International Experts Meeting on Persistent Organic Pollutants, held in Vancouver in June 1995 and jointly sponsored by the Governments of Canada and the Philippines, concluded that there is sufficient scientific evidence to warrant cooperative global action on persistent organic pollutants (POPs), including bans, phaseouts and other restrictions for certain POPs. At the United Nations Environment Programme POPs conference in Washington, D.C. later in 1995, more than one hundred nations signed a declaration to control these chemicals. The United States and Canada should exercise leadership towards international action to support the POPs initiative.

Another area of concern is the ability to restrict chemicals and products from entering the Great Lakes ecosystem from other countries. Globalization, liberalization of international trade, and free trade areas create pressures for harmonization of rules that affect competitive economic advantage and the free movement of goods,

services and capital. Without consistent standards among them, the lowest common denominator may dictate. It is important that goals of harmonization, at the binational or international levels, not be allowed to become a justification for accepting the lowest common environmental standard. Harmonization should not prevent individual jurisdictions from imposing environmental standards more stringent than an intetnational norm to implement domestic and binational programs such as the Great Lakes Water Quality Agreement.

Chapter 5

Binational Responses to Persistent Toxic Substances

Governments have announced national and regional programs that focus on eliminating the sources and discharges of persistent toxic substances. These binational initiatives are an important step to accomplish the Agreement's goals. They reflect an acceptance of the concept of virtual elimination, and to a lesser degree of zero discharge.

Binational Virtual Elimination Strategy

In February 1995, Prime Minister Chrétien and President Clinton announced an agreement to develop a binational strategy for the virtual elimination of persistent toxic substances in the Great Lakes basin. This represents a significant step forward to create coordinated common goals, priorities and information sharing between the two countries.

Canada and the United States presented a draft strategy in August 1995 at a Stakeholders Workshop in Windsor, Ontario. Target chemicals were presented in two tiers or lists, based on the level of action proposed, with provision to include additional chemicals. The emphasis on partnerships and specific products involving state, provincial and local governments as well as other basin stakeholders, helps to ensure ecosystem thinking and improvements. The strategy should also emphasize links to other programs such as the Lake Superior Binational Program and Lakewide Management Plans.

Zero discharge, reverse onus and weight of evidence were not clearly reflected in the draft strategy, which proposed goals and actions aimed at *reduction, management* and *control* of chemicals to specified levels. While we understand that Governments and their partners need to focus on achievable, measurable targets as part of their strategy to reach virtual elimination, we encourage Governments to ascertain what subsequent steps will be needed to achieve this goal for all persistent toxic chemicals, once the interim targets have been met. We also encourage specific tracking of progress under the binational strategy as part of the State of the Lakes program.

Lake Superior Binational Program

The Lake Superior Binational Program responds to the recommendation in the Commission's *Fifth Biennial Report* (1990) that "the Parties designate Lake Superior as a demonstration area where no point source discharge of any persistent toxic substance would be permitted." At the 1991 Biennial Meeting in Traverse City, the two federal governments, in cooperation with Ontario, Michigan, Minnesota and Wisconsin, accepted that challenge and announced the *Binational Program to Restore and Protect Lake Superior.* The plan emphasized specially designated areas, pollution prevention, enhanced regulatory programs and a multi-media approach.

A multistakeholder Lake Superior Forum has successfully focused attention on Lake Superior. The forum helps to break down barriers among diverse and often opposing interests. As a result, reduction schedules have been developed for nine critical pollutants, embodied in the draft Stage Two Lakewide Management Plan, and the groundwork has been laid to address other problems.

The Lake Superior Programs Office, established prior to the Binational Program, also deserves mention as a promising and creative means for coordination of Canadian programs, including those related to the binational program, Remedial Action Plans, the Lake Superior LAMP and the Great Lakes Cleanup Fund. The office has been helpful in developing consensus on these programs and could serve as a model for other jurisdictions.

While several other initiatives are consistent with the plan and further actions are expected, actual progress in achieving the program's goals has been limited to date. Reductions in point source discharges are mainly attributable to pre-existing rather than new or enhanced programs and mechanisms. A comprehensive effort is still needed to virtually eliminate or even prohibit new and increased inputs of persistent toxic substances. Firm program schedules are needed that move beyond planning into action, such as a specific date after which no point source releases will be permitted. Pollution prevention should be fostered and can be accomplished, as demonstrated by the achievement of zero discharge for mercury by the Western Lake Superior Sanitary District municipal wastewater treatment plant in Duluth, Minnesota.

Public awareness, education and involvement are also important to success. However, the Forum reports these as weak links in the binational program's pollution prevention activity. The Governments should also recognize the value of the proposed Special Protection Designations for Lake Superior, which the Commission has recommended.

Lakewide Management Plans

The preparation and implementaton of Lakewide Management Plans (LAMPs) could be essential for framing and implementing regional virtual elimination strategies. While considerable discussion and cooperation has occurred to develop initial phases of these plans, progress has been limited. After almost a decade we have received one draft of a first-stage LAMP, for Lake Superior. LAMPs offer a key opportunity to develop comprehensive lists of critical pollutants to be reduced to restore degraded beneficial uses in each of the Great Lakes, and subsequent priorities for phased action. LAMPs should also ensure that all sources of pollutants of concern are addressed through an integrated, ecosystem strategy.

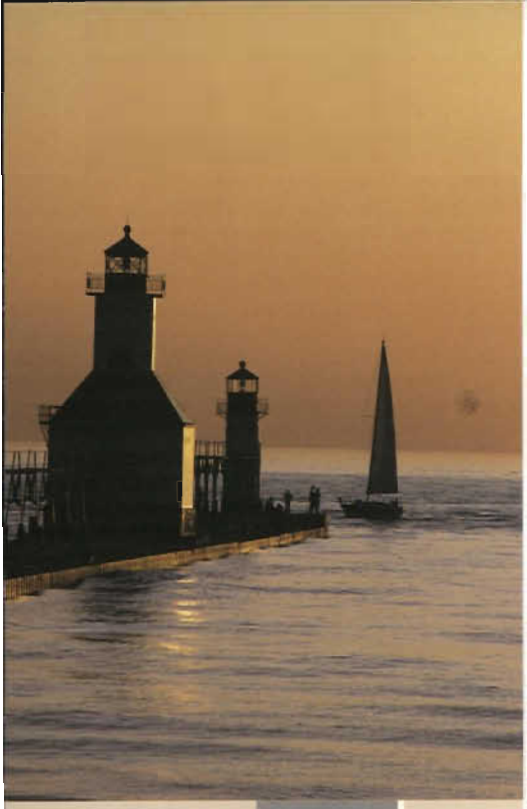
Areas of Concern

A great deal of attention has been focused by the Commission, Governments and the public on designated Areas of Concern. Their primary purpose is to plan and implement programs to restore beneficial uses in local areas. They are also expected to contribute to the achievement of LAMPs and other Agreement objectives.

The process has generated an immense amount of planning, reporting and public discussion. Some plans have progressed well, particularly in areas where active and committed multistakeholder groups form the core of the activity such as Hamilton Harbour, Green Bay-Fox River and Ashtabula. The effort and commitment of resources have been marshalled in Collingwood, Ontario to restore beneficial uses and be the first "delisted" Area of Concern.

While efforts continue among governments, private interests and the voluntary sector in locations such as the St. Louis River in Duluth, Minnesota, in other places the process seems to be slowly coming to a halt. Government leadership is essential to sustain the costs of planning and remediation, but is lacking in some Areas of Concern. Several jurisdictions, including those with the largest number of Areas of Concern, have indicated they are reducing their active involvement in the process. Funding and human resources on the scale needed to restore beneficial uses are simply not being made available.

This leaves the Commission in a difficult position, since it has long been and remains a champion of restoring Areas of Concern. As well as reviewing the plans in a formal sense, our resources have for a decade nurtured the process through direct local contacts, providing educational materials, and guidelines and advice. Several Commission-sponsored forums have helped personnel from the 43 Areas of Concern share their understanding of common issues and have facilitated information



North pier, St. Joseph, Michigan

Areas of Concern

The successful Area of Concern initiatives are those with strong local institutional structures and government support to drive broad and meaningful public participation, implementation and monitoring, and to demand accountability for progress . . .

. . . Efforts to share success stories among Area of Concern groups to this end should be encouraged, and we urge the jurisdictions to support progress to restore Areas of Concern in this and other ways.

exchange on technology, creative financing, publicity and public involvement, and institutional arrangements.

The successful Atea of Concern initiatives are those with strong local institutional structures and government support to drive broad and meaningful public participation, implementation and monitoring, and to demand accountability for progress. Also needed are mechanisms to secure financial commitments. One option is the development of local, nonprofit organizations to focus action plans, funding strategies, public participation and political support. Excellent examples exist of innovative ways to develop this capacity in the Great Lakes basin. These include the experience of the Waterfront Regeneration Trust — whose mandate was originally focused on the Toronto region and now spreads across much of the Canadian shore of Lake Ontario — and the development of a nonprofit foundation at Ashtabula, Ohio. Capacity building was identified in Agenda 21, a product of the 1992 United Nations Conference on Environment and Development, as an essential element of sustainable development. Efforts to share success stories among Area of Concern groups to this end should be encouraged, and we urge the jurisdictions to support progress to restore Areas of Concern in this and other ways.

We will continue to nurture the restoration of Areas of Concern within the limits of our resources. Our strategy has shifted from technical reviews to a broader assessment of progress in individual Areas of Concern over time, including visits to

those sites and an assessment of their progress and potential activity. We hope these site assessments and consultations with relevant governments and other stakeholders will help move this important program ahead effectively in times of limited government resources.

Report on the State of the Great Lakes Ecosystem

A significant binational initiative in the past two years has been to implement a Commission recommendation to develop a report on the state of the Great Lakes. In 1994, the Governments held their first State of the Lakes Ecosystem Conference (SOLEC) in Dearborn, Michigan and developed a *State of the Great Lakes Report*, released in 1995.

We congratulate the Governments for bringing together a large, interdisciplinary group of scientists, managers and other experts to focus their attention on the Great Lakes ecosystem and to develop new methodologies and understandings. The resulting report serves as one basis for the Commission, the public and governments to assess progress in the ecosystem. We encourage the Governments to include broader representation from interest groups outside of government, including labour, business and nongovernment organizations, in future SOLEC conferences.

The SOLEC documents focus on indicators to describe the state of the Great Lakes as a measure of Agreement progress, not the status or quality of programs to address environmental and other ecosystem issues. The governments have taken a first step to create a comprehensive set of indicators and a clear model to integrate these indicators into an ecosystem analysis. The report ranks most habitat issues in the lowest or most degraded category, and most others are improving or, in the case of nutrients, good or restored. While the report's discussion section points to serious issues for aquatic and human health, most health and contaminant risk indicators need more data. Several other indicator assessments are at least partly qualitative, since data weaknesses also exist.

Although much has been accomplished to address various dimensions of the Great Lakes aquatic ecosystem, innovative measures are needed to continue progress in these categories. For example:

- **Phosphorus** indicators show improvement, due largely to sewage treatment plant investments. The remaining challenge is demonstrated by the number of Areas of Concern that still require treatment plant upgrades and nonpoint programs. The report indicates that little is planned to correct these problems as a result of fiscal constraints. Governments should identify the means to provide for infrastructure renovation and extension to avoid having the phosphorus problem resurface.

- **Contaminant** indicators are mixed/improving (total loadings of certain chemicals and residues have reduced over time). The human health section points to long-term human health risks from persistent toxic chemicals, even if it stops short of definite conclusions.
- **Economic** indicators suggest improvement in social attitudes and actions, but major changes in environmental programs and practices are still needed.

The SOLEC report is a major step forward in addressing the ecosystem issues and approaches. The report is strongest in the most traditional data sets, such as chemical and biological status, and the challenge remains for Governments to provide consistent trend data for large segments of this framework. The report's highlighted concern for socio-economic issues recognizes, for the firsr time in an Agreement context, that "the strength of the economy provides the resources and potential to restore and maintain the integrity of the ecosystem" and thus, by extension, is a vital part of a healthy ecosystem. This non-traditional approach is an important dimension of reporting since we must be aware of the economic dimensions of our strategies as we attempt to move toward a sustainable culture.

Private Sector Initiatives to Accomplish Agreement Goals

Although governments champion and protect the environment and public health, business, labour, the nonprofit sector and individuals must address these issues and move away from the use and production of persistent toxic substances. A major element of the business response to addressing the Agreement's goals has included voluntary action to stop or prevent actions that compromise our environment and health. Taking some of the burden from the public sector to force action, voluntary programs allow manufacturers and other generators of contaminants to find the most efficient means available to reduce the creation and use of these substances. Progressive companies such as EB Eddy, the Chrysler Corporation and the 3M Company are at the vanguard of change and should be examples to all industry.

However laudable, voluntary programs are only as strong as the incentives to create and maintain the commitment. Economic factors and legal requirements generally drive the extent of such activity. Taxation and other economic policies can also have a significant impact on the attractiveness of environmentally appropriate actions by business. Governments must continue to provide the vision, leadership, incentives and minimum targets as set out in regulatory instruments. Voluntary programs should focus on the best means to achieve and surpass the targets. At the same time, the public sector, including the educational system, public utilities and municipal works departments can also play a significant leadership and educational role through their practices, including purchasing decisions.

National Programs to Promote Voluntary Action

Government-led efforts to mobilize voluntary commitments beyond current regulatory requirements have been helpful in both countries. The U.S. **Common Sense Initiative** and the Ontario **Pollution Prevention Pledge Program** are both designed to engage multistakeholder teams in specific industrial sectors and have had initial success.

The Common Sense Initiative brings together representatives from federal, state and local governments, industry, labour, community-based and national citizen organizations and environmental justice groups to examine the environmental requirements affecting six industries: automobile manufacturing; computers and electronics; iron and steel; metal finishing; petroleum refining; and printing. It offers opportunities for collective work on shared goals to create strategies that are cleaner for the environment, and cheaper for industry and the taxpayers, consistent with the Commission's transition proposal.

Other initiatives in the United States include the U.S. EPA-sponsored **33/50 Program** for 17 high priority chemicals and **Project XL** for voluntary reductions of some 117 substances. Launched in 1991, the 33/50 Program aimed to achieve voluntary reductions of releases and offsite transfers by 50 percent at the end of 1995. It was a key component of U.S. EPA's pollution prevention strategy and has been reported to be close to being met or even exceeded, although attribution of the reductions to this specific program has been under debate. An independent program evaluation and specific monitoring of voluntary pollution prevention achievements would be desirable to demonstrate its effectiveness.

A noteworthy Canadian program is the **Accelerated Reduction and Elimination of Toxics (ARET)** program, which mobilizes participating companies and government agencies to act on specific chemicals and targets. ARET participants, including most member companies of the Canadian Chemical Producers Association (CCPA), have agreed to virtually eliminate emissions of 14 persistent, bioaccumulative and toxic substances, with a 90 percent reduction by the year 2000. Emissions of 87 less hazardous substances are to be reduced to levels that are "insufficient to cause harm," with a short-term goal of a 50 percent reduction by the year 2000.

By the end of 1995 some 270 entities had joined the ARET program, including 164 companies with action plans, and progress reports are being issued periodically. Actual emission reductions have occurred and further reductions are promised as current participants identify further opportunities for action and other participants are added. ARET should be encouraged to provide a systematic strategy to virtually eliminate and achieve zero discharge of all persistent toxics.

Some Specific Industry Responses

In the past, the **pulp and paper industry** has been a major source of chlorinated effluents, other pollutants and consequent impacts on Great Lakes aquatic communities. Encouraged by regulatory measures and their own research, pulp and paper industries in both countries are converting to elemental chlorine-free technology and secondary effluent treatment, resulting in a significant reduction in adsorbable

organic halogen (AOX) effluents and approaching the virtual elimination of dioxin and furans. The industry also is developing an aqueous-effluent free technology, as adopted in the Avenor Inc. plant at Thunder Bay, Ontario. These are positive advances, provided they are made within an ecosystemic context to avoid creating other environmental problems.

The **automobile industry** has reduced the use and dispersal of several chlorinated and other toxic chemicals in solvents and similar products. Process changes at the Chrysler truck plant in Windsor, Ontario is one early example. The **Automotive Pollution Prevention Project** is a voluntary program in partnership with Governments to identify and reduce use of 65 persistent toxic substances. Perhaps most important is the growing acceptance, reflected in the U.S. industry's report on pollution prevention initiatives, of the principle of addressing environmental concerns at the design stage for vehicles and their components so that substances of concern are eliminated from production and use. Governments should continue to facilitate such programs and to urge their extension to further products, companies, chemicals and target reductions.

Bike messenger in city traffic

The Automotive Pollution Prevention Project

. . . Most important is the growing acceptance, reflected in the U.S. industry's report on pollution prevention initiatives, of the principle of addressing environmental concerns at the design stage for vehicles and their components so that substances of concern are eliminated from production and use. Governments should continue to facilitate such programs and to urge their extension to further products, companies, chemicals and target reductions.

One of the key industries is the **chemical industry** which uses, produces and markets many persistent toxic substances used in other production processes. Most regulations are chemical-specific and address only a fraction of the total number of chemicals in existence. While the industry's voluntary initiatives acknowledge the need for action, the industry generally has encouraged a focus on a few specific chemicals for rigorous control or phaseout. Industry leaders and associations should encourage commitments from all companies, such as DuPont Canada's publicly stated aim to eliminate all potentially toxic emissions and to render such emissions harmless, mainly by converting to cleaner materials and technology by detailed reporting, and training and accountability throughout the management structure.

Another initiative by the chemical industry is **Responsible Care**, a trademark procedure to manage chemicals throughout their lifecycle. Segments of Canadian industry have committed to the Government's toxics management strategy. Available data from the Canadian Chemical Producers' Association show that overall loadings of all emissions by its members have diminished significantly during the 1990s.

Manufacturers of **vinyl** and **vinyl products** are major consumers of chlorine. A large and increasing amount of polyvinyl chloride (PVC) is manufactured and used in the Great Lakes basin. The industry states that its production and use is harmless and even environmentally beneficial, that PVC is a stable product and its manufacture does not cause pollution. We are concerned about the growing use of this material and the need to address its eventual disposal and destruction, through incineration or the open environment. We encourage industry and Governments to address these issues within a full lifecycle and cost-accounting framework and continue research to develop more environmentally benign alternatives.

Environmental liability and restrictions on the reuse of old sites, also known as "brownfields," is plaguing large and small business. This area is in urgent need of environmentally appropriate but economically sensible policy initiatives. The **Iron and Steel Sector's Brownfields Redevelopment Project,** which will focus on northwest Indiana as one of two test sites, aims to develop environment-economy linkages and partnerships to restore land for economic redevelopment. Its guiding principles include many elements of the strategy and transition process discussed in this report. We see promise in this initiative.

Small business and the commercial sector can contribute significantly to pollution prevention and control. Like nonpoint sources, these small production units may make an insignificant contribution to loadings individually, but an immense one cumulatively. Yet, these businesses are often missed by government programs and the trade associations. The **dry cleaning** industry, for example, uses solvents that pose a hazard to the environment, to customers and employees. U.S. EPA and Environment Canada have supported experimental programs to adopt nonsolvent processes as well as implement codes of environmental practice and training courses. The new technology has not only proven effective technically but has had a positive customer reaction.

The **Great Printers Project** in the United States has led to the adoption of pollution prevention principles and technologies in the printing and graphic arts industry, including advances in equipment, chemical use and other practices. Similar efforts are underway in Canada. As a basic principle, corporate purchasing and marketing should promote environmentally benign products whenever possible, including the active development of such products in competitive markets.

A host of other small businesses have many opportunities to prevent pollution and avoid products and processes that rely on persistent toxic chemicals. Many were mentioned at the 1995 Biennial Meeting on Great Lakes Water Quality, including automotive products, auto body repair, floor coverings, photography labs and machine components. It is often difficult, however, for small local owners such as dry cleaners and auto repair shops to retrofit their operations due to the capital costs. Small businesses can be supported through appropriate incentives, cooperative regulations, and support for innovation and appropriate purchasing strategies that encourage change by their smaller suppliers.

Environmental Reporting

The Commission's *Seventh Biennial Report* recommended annual reporting by companies of their environmental stewardship policies, practices and progress. We are pleased to note increased environmental reporting by industry associations and individual corporations, in some cases as a part of their overall annual reports and in others through separate environmental publications. A sample includes reports of the Automotive Pollution Prevention Project, the Council of Great Lakes Industries, the Canadian Chemical Producers' Association, Dow Chemical Inc., Shell, Ontario Hydro, DOFASCO (steel), Noranda (paper and mining) and EB Eddy Paper. These reports provide public accountability and often include observable targets, such as that by DuPont to cease the discharge of toxic chemicals. The reports the Commission has reviewed indicate actual reductions in pollutants with emphasis on toxics, solid waste, recycling and air emissions. Expanded reporting by more companies is desirable, and corporate executives should ensure that their reports include clear, empirical indicators of progress that demonstrate verifiable results.

The Role of Labour

Labour representatives have brought their views clearly and impressively to Commissioners in recent biennial meetings and on other occasions. Labour wants to support broad environmental programs that protect society in general and workers in particular, but not at the expense of the workers' employment and earning capacity. They are concerned about the perceived tendency to eradicate or downgrade jobs and earnings when change occurs, and they feel an orderly transition process is needed at the societal, specific industry and individual plant levels. This approach is generally consistent with the Commission's vision of a societal transition process, and we continue to encourage governments, business and unions to include transition planning in collective bargaining and other initiatives.

The Voluntary Sector

The voluntary sector — often termed nongovermental organizations but actually broader in scope, and including all of us as individuals — has made a major contribution to the Agreement's goals by raising public concern. Although the recent economic and policy conditions have reduced the number of organizations, their membership and funding, this sector is an important component in society's process for addressing environmental issues.

Some projects led by voluntary organizations are supported by private funding bodies such as the Great Lakes Protection Fund. Its **Green Thumb** project, for example, funds pilot studies on urban fertilizer use and conservation. Other bodies, such as Trinity Theatre Toronto and the Great Lakes Beach Sweep as part of the Coastal Cleanup program in the U.S., bring together the energy of volunteers, with support from corporate and governmental sponsors, to reach out to the public and young people to instill a Great Lakes environmental ethic. These programs have tremendous benefits. They are at great risk from government and corporate cutbacks. We encourage a long-term view of the benefits that these programs provide when such funding decisions are considered.

Chapter 7

Other Issues of Concern

Understanding Human Health Issues

We have only begun to understand the long-term and often subtle effects of environmental exposure to low levels of toxic chemicals on humans. Special focus is needed on critical "at risk" populations that consume a disproportionate amount of Great Lakes fish, including the urban poor, native peoples and immigrant populations. Children and pregnant women who consume these fish are also at higher than average risk.

Health care practitioners need to become aware of environmental medicine. Commission roundtables and workshops have explored this subject and raised its profile among some health practitioners with support from the Canadian Great Lakes Health Effects Program and the U.S. Agency for Toxic Substances and Disease Registry (ATSDR). We created a Health Professionals Task Force in 1995 to advise us on current issues in environmental health developments and to provide a binational platform for consultation.

The Task Force's initial recommendations address how information is provided to practicing health professionals and educational institutions. They urged continued support for agencies that have been critical to health professionals' education to date, including several federally supported U.S. agencies and institutes, Health Canada's health effects programs and provincial Ministry of Health programs. Programs that support local initiatives and information centres, and that develop and disseminate new environmental health resources, are particularly vital. Increased faculty support and funding, including environmental health chairs, in professional schools of health sciences is needed. Training in environmental health is still limited, although some centres of excellence are developing. This area would benefit from cooperative work and funding among universities, governments, corporations and foundations.

Other Atmospheric Issues

Ozone issues are critical to the Great Lakes basin at near-ground as well as stratospheric levels. Ground-level ozone contributes to photochemical smog within and downwind from urban centres, largely due to emissions from vehicles and other combustion processes. This signficiant local and transboundary issue imposes human health, economic and environmental costs, including direct crop damage and stress to other vegetation. We are concerned about inadequate corrective programs for such emissions in both countries. Without proper controls, trends to deregulate electric power utilities may increase loadings of ozone precursors. We encourage consistent binational programs to address this problem.

Both our Science Advisory Board and Internarional Air Quality Advisory Board have monitored **climate change** discussions, particularly by the Intergovernmental Panel on Climate Change, from a Great Lakes perspective. Scientists now generally agree that the problem is real and growing, but are uncertain about how effects will vary from region to region. Some models suggest the Great Lakes climate will become warmer and drier, resulting in decreased water levels, runoff and other hydrological changes, and reduced areas of boreal forest and wetlands. Types of aquatic and terrestrial species will change, with an increase in exotic species of fish, animals and plants and a reduction of native species. Increased attention to water conservation will also be required, as the region is currently one of the highest per capita consumers of water in the world.

Since climate change issues are largely created by high energy consumption, the Governments could do more to encourage energy conservation and use of susrainable energy sources that build on agreements forged at the national, binational and multilateral levels. We concur with our Science Advisory Boatd's recommendation that the Parties support the completion of the timely binational implementation plan, hold periodic symposia and make a long-term commitment to climate change research under Annex 17 of the Great Lakes Water Quality Agreement.

Radioactive Substances

The Commission receives the public's concerns about the production, use and storage of radioactive materials and nuclear wastes. This issue should be addressed under the Great Lakes Water Quality Agreement in a similar way to persistent toxic chemicals. The Governments did not agree with the Commission's *Seventh Biennial Report* which included a recommendation that radionuclides be subject to this approach.We continue to believe, however, that the consideration of radionuclides under the Agreement is important and cannot be ignored, particularly with new proposals to reprocess radioactive material in the Great Lakes basin.

The Governments should address the treatment of radioactive materials discharged to the Great Lakes as they have approached other persistent toxic substances. Many radionuclides fit the Agreement's definition of persistent toxic substances because they are persistent and toxic. We will continue to analyze the degree of risk to the Great Lakes ecosystem, and the capacity for governments and private interests to protect the integrity of the Great Lakes basin from radioactive contaminants.

A comprehensive inventory of radionuclide releases in and around the Great Lakes basin does not exist. Existing monitoring programs for individual nuclear sites are not necessarily compatible or integratible, and are generally limited to a few radionuclides. The Environmental Radiation Monitoring System (ERAMS) gives a Great Lakes overview and a link to global programs; this and similar programs should be maintained and adapted to changing information needs.

Our concerns about nuclear waste disposal and decommissioned nuclear plants continues. The Canadian Auditor General's 1995 report indicated that substantial funds have been expended in Canada to develop strategies for the disposal of high-level radioactive waste and to ensure funding arrangements to meet future financial requirements, but there is no solution or consideration of alternative approaches for after 1997.

Biological Integrity Issues

Habitat

The physical environment plays a critical role in sustaining the biological, chemical and physical integrity of the Great Lakes. Wetlands and nearshore areas provide essential habitat to meet spawning and feeding needs of biota, help sustain a healthy aquatic ecosystem, and are instrumental in moving nutrients through the ecosystem. They are also particularly vulnerable to human-induced stresses.

Government programs and cooperative initiatives to inventory wetlands and to conserve and restore habitat include the North American Wildlife Management Plan, the Fish and Wildlife Restoration Project in Hamilton Harbour, and Partners for Wildlife in the United States. Several recent initiatives have focussed on Great Lakes habitat issues, such as the 1994 HabCARES (Habitat Conservation and Restoration Strategies in the Great Lakes) Workshop and the 1995 Aquatic Habitat Rehabilitation and Conservation Technology Transfer Session, cosponsored by the International Joint Commission, the Great Lakes Fishery Commission, various government agencies and the academic community. Local initiatives such as the Global Rivers Environmental Education Network and River/Lake Watch foster

Aerial view of Presque Isle, Erie, Pennsylvania

Biodiversity

The U.S. Fish and Wildlife Service has listed 22 endangered and/or threatened species in the Great Lakes that are affected by water quality. According to Environment Canada reports, the entire shoreline of lakes Ontario, Erie and southern Lake Huron are at high risk for sustaining biodiversity, as a result of extensive development, and numerous species are at risk from pesticide use by agriculture.

community awareness and education, and some Area of Concern initiatives include provisions to restore habitat as part of urban redevelopment efforts.

These programs will not save enough critical habitat to offset increasing wetland and nearshore losses due to shoreline development and pollution. Unfortunately, the public does not appreciate the value of wetlands and nearshore areas to ecosystem integrity; detailed information does not exist to quantify and characterize habitat; existing habitat enhancement and protection initiatives are detached from other management activities; and some land use policies seem to encourage wetland loss.

The technology exists to restore and conserve habitat, but more targeted scientific and management programs and public education are needed. Governments should also preserve areas that are not yet degraded by the designation of Areas of Quality and more rigorous preservation of protected areas such as parks, wilderness reserves, nature conservancies and wildlife reserves. These areas not only have intrinsic value by protecting species and natural processes, they also serve as sentinels for what is happening to the ecosystem. Governments should resist the growing temptation to relax existing standards for habitat protection.

Biodiversity

Loss of biodiversity has become a major global concern due to the high rate of species extinction and the importance of this indicator to a healthy ecosystem. This is also a significant concern in the Great Lakes. The U.S. Fish and Wildlife Service has listed 22 endangered and/or threatened species in the Great Lakes that are affected by water quality. According to Environment Canada reports, the entire shoreline of lakes Ontario, Erie and southern Lake Huron are at high risk for sustaining biodiversity, as a result of extensive development, and numerous species are at risk from pesticide use by agriculture. Better practices in pesticide use and integrated pest management are needed to maintain biological diversity.

Exotic Species and Biological Contamination

During the past century, about 140 non-native or exotic species have become established in the Great Lakes. They include the sea lamprey, alewife, smelt, zebra and quagga mussels, river ruffe, round goby and purple loosestrife. Since the St. Lawrence Seaway was opened, all 41 of the new introductions into the Great Lakes are believed to have entered through either shipping activities or other unintentional releases.

Biological contamination affects the Great Lakes aquatic community's structure and vitality. The zebra mussel, for example, caused the extinction of native Unionid clams in Lake Erie in less than a decade, and appear to be contributing to population declines in smelt, yellow and white perch. Significant costs to the sport and commercial fishery and to clear water intakes have been attributed to zebra mussels. The sea lamprey is another, well-known invader that has resulted in substantial negative impacts on the fishery and continues to necessitate a costly control effort.

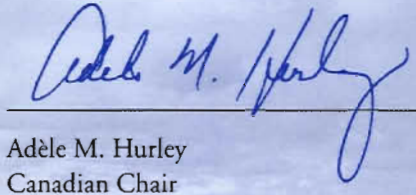
In 1990, the Commission pointed out the need for ballast water controls and urged stronger measures against further species introductions. A special report, *Exotic Species and the Shipping Industry: The Great Lakes-St. Lawrence Ecosystem at Risk*, by this Commission and the Great Lakes Fishery Commission recommended mid-ocean exchange of ballast water for all ocean-going vessels or an environmentally acceptable alternative. The U.S. and Canada have responded with such regulations and guidelines, respectively. Compliance is now greater than 90 percent for vessels entering the Great Lakes, but only 50 percent for ocean-going vessels bound for ports along the lower St. Lawrence River. There is significant potential for colonization of the lower St. Lawrence River by exotic species and their indirect migration into the Great Lakes.

Not all existing ballast water can be pumped out of ships prior to entering the Great Lakes system. Some ships take on ballast within the system and discharge it elsewhere in the lakes. The mixing of residual and new ballast water allows biological species in the old ballast to be released, which is how two species — young flounder and mitten crabs — are believed to have been introduced in 1994 to Thunder Bay and Lake Erie.

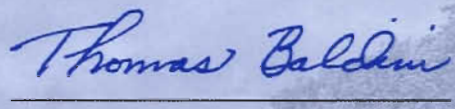
Aquaculture is another and potentially increasing route for exotic species to reach the Great Lakes. The potential for release from fish farms is considered high and safeguards are urgently needed to address this problem. It is believed that whirling disease and striped bass were introduced in this manner. Legislative and regulatory efforts must consider all mechanisms by which exotic species may gain access to the Great Lakes basin. This problem may well be exacerbated by climate change. A basinwide, binational strategy should be developed to prevent further introductions by any route of potentially harmful species.

Progress to restore the Great Lakes over the past quarter century has been too valuable and significant for governments, the private sector and countless dedicated individuals to sacrifice now to short-term economic and political needs. The environmental gains must be safeguarded, and remaining challenges faced. Only then will the objectives of the Great Lakes Water Quality Agreement be achieved and the noble vision the Governments set in 1972 and 1978 be realized. We urge Governments and others influencing the integrity of the Great Lakes Basin Ecosystem to consider our recommendations, in this and previous reports, as part of a prescription for a healthy ecosystem in the coming decades.

Signed this 6th day of June 1996 as the Eighth Biennial Report of the International Joint Commission pursuant to the Great Lakes Water Quality Agreement of 1978.



Adèle M. Hurley
Canadian Chair



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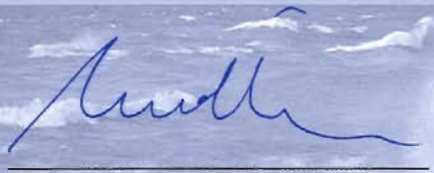
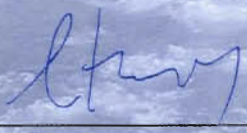
United States Chair



Dr. Pierre Béland
Commissioner

Susan B. Bayh
Commissioner



Francis Murphy
Commissioner

Alice Chamberlin
Commissioner

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Glossary

The page number where the term first appears is listed after each word.

Adsorbable organic halogens (AOX) (30): A noncompound-specific measure of the organic halogen content of a water or wastewater sample. The halogen-containing material is extracted by activated carbon, burned, and the halogen content of the gases measured. All halogens detected are assumed to have been associated with organic material. The procedure is widely used in the pulp and paper industry.

Acid rain/precipitation (18): Occurs when sulfur dioxide and nitrogen oxide emissions, created when fossil fuels are burned, are transformed by chemical processes in the atmosphere and return to earth in rain, fog or snow in higher acidic levels than normal water (acid rain), acidic gases or particulates. Collectively called acid precipitation.

Anthropogenic (16): Created by human activity.

Antidegradation policies (3): Programs and policies to prevent further environmental damage, particularly in areas that have high environmental quality.

Areas of Concern (4): Geographic areas that do not meet the General or Specific Objectives of the Agreement, where such failure impairs or is likely to impair beneficial uses or the area's ability to support aquatic life. Such areas are designated in Annex 2 in the Agreement.

Areas of Quality (38): Geographic areas with high environmental quality and that, because of their location and ecological significance, are identified as deserving special attention under antidegradation programs.

Bioaccumulative (16): A process in which long-lasting chemicals accumulate in various species, particularly in fatty body tissue, and increase in concentration over time.

Biodiversity (39): A measure of the number and variety of different organisms in ecosystems, which may be used to identify the ecosystem's health.

Biosphere (21): The part of the earth and atmosphere inhabited or affecting living organisms.

Boundary Waters Treaty (1): A treaty between the United States and Canada in 1909 to prevent and resolve disputes concerning primarily water quality and quantity along the boundary. The treaty established the International Joint Commission.

Chlorinated organics (18): Organic compounds that contain chlorine, including many pesticides and industrial chemicals such as PCBs, DDT, chlorinated dioxins and furans, dieldrin and hexachlorobenzene. Also called organochlorines.

Chlorofluorocarbons (CFCs) (18): A class of chemicals historically used as a coolant for refrigeration and air conditioning and in aerosol propellants and solvents, which drift into the upper atmosphere and lead to the destruction of the ozone layer.

Climate change (vi): Changes in global weather patterns, including predicted warmer average temperatures, caused by buildup of gases in the atmosphere from human activity. These gases trap the sun's heat within the earth's atmosphere.

Contaminated sediment (7): Material on the bottom of rivers and lakes that contain elevated levels of metals or organic chemicals, deposited into the lake from human activities.

Critical pollutants (12): Persistent toxic substances identified by the Commission's Great Lakes Water Quality Board for focus of zero discharge and virtual elimination efforts.

Despite regulatory controls and reductions in ecosystem concentrations for many, all 11 persist at unacceptable levels. They include PCBs, DDT and its components such as DDE, dieldrin, toxaphene, 2,3,7,8-tetracholordibenzo-p-dioxin (TCDD), 2,3,7,8-tetrachlorodibenzofuran (TCDF), mirex, mercury, alkylated lead, benzo(a)pyrene, and hexachlorobenzene (HCB).

DDT (dichlorodiphenyltrichloroethane) (8): A chlorinated organic chemical used as a pesticide, particularly for mosquito control. Now banned in the U.S. and Canada, DDT was one of the first chemicals to be identified as a persistent toxic substance and deleteriously affecting wildlife.

Dioxins (8): Dioxin includes a family of 75 chlorinated organic compounds that are used in herbicides, and is also created as a byproduct of various industrial and combustion processes, including papermaking, garbage incineration, and burning fossil fuels. Some dioxin compounds are known to be among the most toxic of chemicals.

Ecosystem (v): An intetactive system of biological communities, their nonliving components, and their associated activities. As used by the International Joint Commission, ecosystems include humans, their activities and institutions.

Environmental estrogens (10): Estrogens are naturally occurring substances that affect hormones, which control an organism's functioning at critical stages of development. An environmental estrogen is a synthetic chemical that is known or believed to affect the endocrinal system in living species exposed to them.

Epidemiology (17): The study of the incidence, distribution and control of disease in a population.

Exotic species (5): Species that are not native to an ecosystem, and are usually introduced by purposeful or inadvertent human action.

Furans (8): A class of chemicals similar to dioxins, which are created at elevated temperatures such as incineration of PCBs and other organic wastes containing chlorine. Also known as dibenzofurans, there are no commercial uses for these chemicals.

Great Lakes Basin Ecosystem (v): The interacting components of air, land, water and living species, including humans, within the drainage basin of the Great Lakes and the St. Lawrence River, at or upstream from the point at which this river becomes the international boundary between the United States and Canada.

Great Lakes Water Quality Agreement (v): An Agreement between Canada and the United States signed in 1972 and revised in 1978 and 1987 to restore and maintain the chemical, physical and biological integrity of the waters of the Great Lakes Basin Ecosystem.

Inherent toxicity (16): The natural properties or characteristics of a chemical that cause them to injure a living organism.

Integrity (37): When the physical, chemical and biological components of the waters of the Great Lakes Basin Ecosystem are maintained and restored to an unimpaired condition.

Lake Superior Binational Program (2): A program announced by the Governments of Canada and the United States to create and implement measures to achieve zero discharge of persistent toxic substances from point sources discharging to Lake Superior.

Lakewide management plans (LAMPs) (6): Plans to be developed to reduce loadings of critical pollutants to the open waters of the Great Lakes in order to restore beneficial uses.

Monetized (19): The conversion of benefits or costs of an action into economic value, based on the measured impact and estimates of nonmarket values.

Nonpoint sources (3): Pollution entering the environment where the sources cannot be traced to a single, identifiable point. Examples include atmospheric deposition, erosion, and runoff from parking lots, farms and streets.

Ozone (vi): A pollutant formed in the lower atmosphere by the reaction of nitrogen oxides and hydrocarbons in sunlight, commonly called smog. Ozone is also found naturally in the upper atmosphere called the stratosphere, where it acts as a protective filter, screening out ultraviolet rays.

Persistent toxic substances (v): Chemicals that can cause death, disease, behavioural abnormalities, cancer, genetic mutations, physiological or reptoductive or physical deformities in any living species or its offspring. Also, those chemicals that can become poisonous after concentration in the food chain or in combination with other substances, and which have a half-life in water of more than eight weeks. Also known as **persistent organic pollutants** (21).

Pesticides (2): A product used to control unwanted organisms, such as weeds, insects and fungi.

Phosphorus (2): An element that is often a component of various organic and inorganic compounds that tend to act as nutrients for biological production, and can lead to the overenrichment or excessive growth of algae in aquatic systems.

Point sources (3): Pollution from a distinct, identifiable source, such as a pipe, smokestack or car exhaust.

Polychlorinated biphenyls (PCBs) (4): A group of over 200 nonflammable compounds used in heating and cooling equipment, electrical insulation, hydraulic and lubricating fluids, and various inks, adhesives and paints. These compounds are highly toxic and persistent, and bioaccumulate in living organisms. PCBs are also suspected carcinogens, and have been linked to infant development problems.

Polyvinyl chloride (PVC) (32): A chlorinated substance commonly used in manufacturing of plastics for electrical cable insulation, pipes, packaging, flooring, siding, toys and furniture.

Precaution (v): A principle of taking a cautious, environmentally conservative approach ro avoid and prevent pollution, according to threats of serious or irreversible damage, even with a lack of full scientific certainty.

Prevention (v): A principle to eliminate the formation and/or use of persistent toxic substances, as opposed to taking remedial action once damage occurs.

Radionuclides (vi): An element that can spontaneously emit an alpha particle, beta rays and/or gamma rays upon disintegration of its atomic nucleus, emitting radiation or fast atomic particles.

Remedial Action Plans (RAPs) (2): Plans to be developed to restore beneficial uses such as a healthy aquatic life, and human activities such as fishing, swimming and drinking, to identified Areas of Concern.

Reverse onus (v): A concept to require the producer, user or discharger of a substance to demonstrate that neither the substance nor its degradation products or byproducts are likely to pose a threat to the ecosystem. The more conventional practice is to require governments or opponents of the use of the substance to prove that harm is occurring or would occur without restrictions.

Sunsetting (11): A comprehensive process to restrict, phase out and eventually ban the manufacture, generation, use, transport, storage, discharge and disposal of a persistent toxic substance.

Toxicology (17): The study of poisons and their effects on living species.

Transition (v): A process lead by governments and involving all economic sectors to plan and implement a strategy to modify production and consumption practices at individual, societal and global scales over a reasonable time period, in order to achieve a more environmentally and humanly sustainable economy.

Virtual elimination (v): An Agreement commitment by Canada and the United States to virtually eliminate the input of persistent toxic substances, in order to protect human health and to ensure the continued health of the Great Lakes Basin Ecosystem.

Weight of evidence (v): A decisionmaking approach that takes into account the cumulative body of evidence, scientific and otherwise, with the extent of potential consequences, to reach a conclusion on the need for action against environmental contaminants.

Zero discharge (v):The Agreement philosophy committed to by Canada and the United States to control inputs of persistent toxic substances that will lead to virtual elimination.