Ninth Biennial Report on Great Lakes Water Quality

"There is much work to be done..."

Julian Holenstein
Great Lakes United
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International Joint Commission
Mission Statement

The International Joint Commission prevents and resolves disputes between the United States of America and Canada under the 1909 boundary Waters Treaty and pursues the common good of both countries as an independent and objective advisor to the two governments

In particular, the Commission rules upon applications for approval of projects affecting boundary or transboundary waters and may regulate the operation of these projects; it assists the two countries in the protection of the transboundary environment, including the implementation of the Great Lakes Water Quality Agreement and the improvement of transboundary air quality; and it alerts the govenments to emerging issues along the boundary that may give rise to bilateral disputes.

In order for our vision to become reality, we must take action now. With the concerns for ourselves and future generations, now is the time to set goals for solving the problems that we face today and to prevent new problems from arising.

Vision submitted by the 1997 Great Lakes Student Summit
Buffalo, New York

EXECUTIVE SUMMARY

The Great Lakes Water Quality Agreement commits the U.S. and Canada "to restore and maintain the chemical, physical, and biological integrity of the waters of the Great Lakes Basin Ecosystem." The journey that Great Lakes society has travelled since the first Agreement was signed 26 years ago has been full of success stories and positive signs that the lakes are returning to better health. It clearly reflects public concern over the health and welfare of the environment, as well as the courage and willingness of governments to deal with environmental problems of the Great Lakes.

Despite these tremendous and positive efforts, society has not gone far enough. The journey is not complete and we must persist in our effort to restore and protect the Great

Lakes. The challenge is how to move forward. How do we get from here to there? The advice in this report provides a guide to do just that.

A major focus of the Commission since its *Fifth Biennial Report* in 1990 has been the need to address the issue of persistent toxic substances. It has equally recognized the impact of many other stressors, including land use patterns, shoreline development, habitat modification, biological contamination and nutrient input. All must still be considered as society strives to move from our present situation to the clean and healthy environment in which we all want to live. However, the issue of persistent toxic substances has not been resolved and the Commission again stresses the importance of achieving virtual elimination.

The *Ninth Biennial Report* includes 19 targeted recommendations that, when implemented, will allow the Commission to measure progress toward the Agreement's purpose and help society move from here to there. Committed research, surveillance and monitoring, and the development and application of ecosystem models are essential elements from which to measure and define progress. Focused efforts on dioxins, furans, mercury, polychlorinated biphenyls and radioactivity are a starting point. Air pollution, contaminated sediment and agricultural practices need to be addressed through detailed work plans, schedules and benchmarks toward defined goals. The restoration of Areas of Concern requires a renewed commitment and dedication of resources to overcome specific obstacles to progress.

Making progress requires strong government leadership, coupled with active public awareness and support of environmental issues and the programs in place to address them. Communication, public participation and productive partnerships are key. Our understanding of the concept of governance continues to change and so must institutional structures and society's way of thinking. Transition to a cleaner and more environmentally benign society entails costs and risks and will involve an orderly process along a designed path to move toward sustainable development. This report recognizes that all stakeholders in the Great Lakes basin have roles and responsibilities to ensure that restoration and protection of the Great Lakes become reality.

"The government is . . . reporting on some of the things we're doing, but really it's going to require everybody to work together; these problems don't get easier, they continue to get harder. . . . if we all work together, we can make the job move forward, we can complete the job and we need to do that for our children."

Robert Perciasepe
Assistant Administrator for Water, U.S. Environmental Protection Agency

INTRODUCTION

The Canada-United States Great Lakes Water Quality Agreement provides a foundation for our two nations "to restore and maintain the chemical, physical, and biological integrity of the waters of the Great Lakes Basin Ecosystem." Under the terms of the

Agreement, the two federal governments, referred to as the Parties, agreed "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 and to reduce to the maximum extent practicable the discharge of pollutants into the Great Lakes System." The federal governments report progress through the biennial State of the Lakes Ecosystem Conferences (SOLEC) and biennial reports on programs and policy. Through its biennial reports to federal, state and provincial governments,[1] the International Joint Commission, using data and information provided by governments and others, assesses the adequacy and effectiveness of programs and progress to restore and maintain the health of the Great Lakes.

An agreement has been in place for over 26 years. The Commission believes that the present Agreement is sound, effective and flexible. Review and renegotiation are not necessary. Rather, the Parties need to renew and fulfill their commitments and focus on implementation, enforcement and other actions, including review of institutional arrangements, to achieve the Agreement's purpose.

Biennial Reports -- A Tradition and a Requirement

This biennial report is the ninth submitted to governments under the 1978 Agreement. The Commission's previous reports have stressed the need for the Parties to establish deadlines and timetables and to fulfill their obligations and responsibilities under the Agreement. The Commission has tracked and reported on the Parties' response to degraded Great Lakes conditions and their initiatives to restore and protect them. The Commission has provided advice about contaminant sources and pathways, with particular emphasis on municipal and industrial point sources, land runoff, contaminated sediment and atmospheric pollution. The Commission has strongly advocated support for science and research to underpin the programs developed and the actions taken.

The Commission has provided advice on appropriate institutional arrangements and has pointed out the advantages of an ecosystem approach. For more than a decade, the Commission has stressed the need to focus on geographic Areas of Concern and the advantages of doing so, and has provided advice about Remedial Action Plans as a framework to deal with contaminants from a multimedia, multi-jurisdictional and multi-stakeholder perspective.

Since the Commission's *Fifth Biennial Report*, in 1990, the predominant focus of concern and advice has been toxic and persistent toxic substances, drawing upon the increasing body of evidence of injury to human and ecosystem health. The Commission has encouraged further research to identify the responsible substances, strengthen understanding of the nature and extent of the injury and establish its implications for society.

The Commission identified the need for the Parties to develop a binational strategy to virtually eliminate inputs of persistent toxic substances. The Commission provided detailed advice about the elements of such a strategy and even developed a framework

strategy. Among the principles advocated to guide the strategy are the involvement of all stakeholders; anticipation and prevention; precaution; reverse onus; application to all sources and pathways; and consideration of all places where contaminants reside in the ecosystem, including water, land, sediment, air and biota.

The Commission has heard and conveyed the public's support for the Agreement, as well as people's increasing concern about gaps in its implementation, the lack of progress and demands for government action.

Previous Recommendations

To accompany its evaluation and advice on these and other issues related to Great Lakes water and ecosystem quality, the Commission has sent governments 155 recommendations over a span of 16 years. The Parties have, in turn, provided official responses to each of the Commission's biennial reports.

The Parties have accepted the majority of the Commission's recommendations, and much of its advice has been incorporated into existing or planned programs, including the principles necessary to achieve virtual elimination of pollution. The responses, however, have generally not cited particular programs or actions undertaken by the Parties. This lack of specificity makes it difficult for the Commission -- and the public -- to track and evaluate progress from a program and policy perspective and to conclude whether the Parties have met their commitments. Only a small number of the Commission's recommendations have resulted in specific follow-through by the Parties. Two examples are the Binational Program to Restore and Protect the Lake Superior Basin, adopted in 1990, and The Great Lakes Binational Toxics Strategy, signed on April 7, 1997.

The Commission's 1992 recommendation that "the Parties, in consultation with industry and other affected interests, develop timetables to sunset the use of chlorine and chlorine-containing compounds as industrial feedstocks and that the means of reducing or eliminating other uses be examined," resulted in some controversy. The public in the basin saw it as an inspiration and tended to agree with it. On the other hand, neither federal government supported the recommendation, and industry rejected it outright. This recommendation was not well understood and often misconstrued, particularly by industry. Nevertheless, the recommendation yielded positive results. It stimulated governments to review the use of chlorine in society and helped lay the ground for virtually eliminating the use of elemental chlorine by the pulp and paper industry.[2]

Many objective observers and the Commission itself have commended the tremendous progress made under the Agreement, evidenced by the fact that the Great Lakes and their biota are cleaner now than they have been over the last 50 years. In spite of such obvious progress, much of which was achieved in the early years of the Agreement, the advice and comments received from the public, labour, native Americans and First Nations, and industry during the last two years, have been remarkably similar to those received since 1982. Their concern is not so much with progress to date but, rather, that implementation of programs to achieve further environmental improvement has not been fast enough and

that society still has a long way to go to complete the journey and achieve the purpose of the Agreement.

Why a *Ninth Biennial Report*?

In light of this situation, the Commission has judged it appropriate, in the preparation of this *Ninth Biennial Report*, to reflect on the past in order to see how better to move toward the future. It has done an introspective search by asking whether

- there is a purpose for the biennial reports;
- to make another set of recommendations if all the previous ones have not been implemented;
- society is embarked on such a difficult task that whatever progress has been achieved is overshadowed by both the magnitude of the steps already taken and the immensity of the work still ahead;
- the federal, state and provincial governments have become less assertive in pursuing environmental policies, and have forgotten their responsibility to protect the citizens they represent;
- the players around the basin have become entrenched with their adopted positions to the extent that real dialogue and changes in attitude needed for further action are not possible;
- some institutions have strayed or failed to adapt to changing circumstances;
- the mood around the basin has changed since 1972 to the extent that those who are still genuinely interested in further progress are but a minority; and
- it has become more difficult to motivate people because issues are more subtle and less obvious.

The Commission believes that there are clear answers to these fundamental considerations. Some are encouraging. Others are not. Society needs to face them all.

The Commission is writing this report in the disquieting context of societies all over the world being confronted with two seemingly contradictory challenges. On one hand, some believe that social goals should be concerned with adjusting economies to cope with the requirements of world trade and global competitive markets. Conversely, many now realize that the survival of our societies is more than ever threatened by the impacts of expanding and competing economies, namely global dispersion of toxic chemicals, climate change, and decline in biodiversity -- including the diversity of agricultural products that sustain us all. All these issues are relevant because the Commission believes, and has been told, that the solutions to the problems of the Great Lakes cannot be found without considering actions on a global scale.

Unfortunately, the global picture is overwhelming for the majority of citizens, and has led to some sense of hopelessness or disengagement. This trend needs to be reversed, and that can be achieved by showing that further progress can be made. But further progress can be made only if action is dedicated, collective and focused.

In this ninth formal assessment of progress, and in the wake of the 25th anniversary of the Agreement, the Commission has chosen to look back at the Agreement as originally written. It was a commitment "to restore and maintain the chemical, physical, and biological integrity of the waters of the Great Lakes Basin Ecosystem." From a concern about phosphorus in 1972, the focus shifted to a concern about toxic substances in 1978. The first issue has largely been solved. The second has not -- this is the continuing clear message from the Commission's consultation process. The *Ninth Biennial Report* addresses this issue. It includes 19 targeted recommendations to the Parties which, when implemented, will allow the Commission to assess achievement of the purpose of the Agreement. The Commission also suggests ways in which other members of the Great Lakes community can contribute.

The Issue -- Toxic and Persistent Toxic Substances

Persistent toxic substances are responsible for injury in living organisms. In its 1985 report, the Commission's Great Lakes Water Quality Board "institutionalized" a list of 11 Critical Pollutants.[3] These pollutants are the basis for other lists developed nationally and internationally, including, for example, by the United Nations' persistent organic pollutant program. Despite years of effort to stop inputs, clean up contamination and eliminate the use of chemicals that have long been known to cause injury, all remain widespread in the ecosystem and many continue to be used. Through its consultation process, the Commission has heard the question, "Why are we unable to effectively deal with these persistent toxic substances?"

The question becomes more critical as evidence continues to build regarding subtle, insidious effects of these and other chemicals on key body processes, including the endocrine system. Moreover, society now realizes that not only fish and wildlife are affected, but humans as well. The Great Lakes community also knows that the solution to this problem lies partly within and partly outside the boundaries of the basin. The Commission must continue to press its attack. The issue of toxic and persistent toxic substances and the concepts of zero discharge and virtual elimination of inputs are not only essential to the purpose of the Agreement, but provide the necessary focus to rally all stakeholders around a common goal. They also provide a standard against which to objectively measure progress, that is, whether or not society can move from the present situation of a legacy of toxic and persistent toxic substances in water, sediment, fauna and humans, to the clean environment in which we all want to live. The challenge is how. The advice in this report is designed to help show the way.

Commission Consultation -- Other Issues and Background Reports

To develop its advice to governments, the Commission significantly expanded its consultation process in 1996-1997, to more effectively reach out to basin stakeholders and secure advice about achieving the Agreement's goals. The Commission continued to rely on its Water Quality Board, Science Advisory Board, International Air Quality Advisory Board and Council of Great Lakes Research Managers, as well as various task forces. These groups work on Commission priorities and alert the Commission to

emerging issues. In addition, the Commission actively sought advice and perspective through public meetings, workshops on specific Great Lakes issues, focused discussion with various Great Lakes community sectors and written advice solicited from knowledgeable members of the Great Lakes community. The consultation process culminated in the Commission's Agreement Public Forum, held in Niagara Falls, Ontario, on November 12, 1997. Through this process, a number of other issues have been brought to the Commission's attention and numerous supporting reports prepared.

- Appendix A lists the Commission's consultation activities for 199597, leading up to the *Ninth Biennial Report*.
- Appendix B lists supporting reports that have been developed through the consultation process since the Commission's previous biennial report. These provide details in support of the advice contained in the current report. Many are available on the Commission's Web site **http://www.ijc.org**. The Commission encourages the use of the reports by those interested in formulating their own assessment and evaluation of programs and progress under the Agreement.
- Appendix C lists other issues and concerns brought to the Commission's attention by Great Lakes citizens and by the boards. The list includes questions of land use, biological contamination, and nutrient over-enrichment -- stresses which must be alleviated if the Agreement's purpose is to be achieved. Some of these are exclusively within the Commission's mandate under the Agreement and others are of joint interest to the Commission and other Great Lakes institutions. Still other issues were raised because the Commission provides a convenient forum and because there may not be another one available. All are important. The Commission is considering how to effectively convey these issues and concerns to the appropriate authorities within governments at all levels.

COMPLETING THE JOURNEY

The Journey Thus Far

Over the past 50 years, society has adopted a way of life heavily dependent on chemicals. The first evidence of injury by persistent toxic substances also was reported more than 50 years ago. Concern focused on fish and wildlife -- decreased hatching success, metabolic abnormalities, gross birth defects and cancer. As the body of evidence increased, the use of the most insidious persistent toxic substances -- such as DDT and PCBs -- was severely restricted or banned, and initiatives were undertaken to control releases to the environment and to clean up contamination. As a result, contaminant releases decreased significantly and exposure declined.

The Great Lakes environment has improved dramatically over the past quarter century. The biotic community rebounded with increased hatching success among herring gulls, decreased incidence of deformities and return of viable bald eagle populations along the Great Lakes shorelines. Most recently, four species of fish -- young sturgeon, lake trout, lake herring and deep-water sculpin -- have reappeared in Lake Ontario after absences of up to several decades. These successes are positive signs that the lakes are returning to

better health. They clearly reflect the effectiveness of legislation, regulations and programs undertaken in both countries, driven largely by increasing public concern about the health and welfare of the environment and by the courage and willingness of governments to deal with Great Lakes environmental problems.

While these improvements were being recorded, evidence continued to build of subtle, more insidious injury, especially neurobehavioural injury resulting from endocrine disruption during fetal development. In addition to substances already identified, others also may cause injury. Among chemicals widely distributed in our environment and reported to have endocrine-disrupting effects are pesticides such as atrazine, alachlor and methoxychlor as well as industrial chemicals such as phthalates, which are used as plasticizers.[4] Among the effects of endocrine-disrupting chemicals on fish and wildlife are behavioural abnormality, compromised immune system and sex change. Recognizing this concern, the Commission in its *Sixth Biennial Report* recommended a weight-of-evidence approach to identify persistent toxic substances.

Thus, despite improvements, society has not yet gone far enough. Contaminant body-burdens remain a concern -- injury is still occurring. Some believe that actions taken to date are sufficient and that, in time, the ecosystem will respond and contaminant concentrations will decrease further, notwithstanding an equilibrium period approaching two decades. Others contend that the system has established an equilibrium, that levels will not appreciably decrease, that society cannot afford to wait and that additional action is required.[5]

Why We Must Persist

Most disturbing is increasing evidence that persistent toxic substances also injure human beings.[6] The first warning signals of human injury by chemicals at levels present in the ambient environment were raised more than a decade ago, when results were published on a study of women who consumed Lake Michigan fish prior to giving birth. As a result of prenatal exposure to PCBs, the infants of these mothers had lower weight and smaller head circumference at birth, as well as a shorter gestational age and poorer neuromuscular development. As they grew, other injury was identified and reported, primarily related to memory, IQ, attention, and learning and behavioural problems. Other studies continue to provide corroborating evidence of injury to humans in the form of subtle functional deficits. The studies have been published in peer-reviewed literature, and those sponsored by the Agency for Toxic Substances and Disease Registry[7] and by Health Canada have been the subject of intense Commission consideration, in terms of understanding the nature and the extent of injury as well as investigating the policy implications of that injury.

The evidence is overwhelming: certain persistent toxic substances impair human intellectual capacity, change behaviour, damage the immune system and compromise reproductive capacity. The people most at risk are children, pregnant women, women of childbearing age and people who rely on fish and wildlife as a major part of their diet. Particularly at risk are developing embryos and nursing infants. *Injury has occurred in*

the past, is occurring today and, unless society acts now to further reduce the concentration of persistent toxic substances in the environment, injury will continue in the future. The fact that such injury is occurring, coupled with a lack of knowledge about other, as yet unrecognized, effects is a call for action by all basin stakeholders to minimize and eliminate injury.

The Destination

The destination of the journey is the achievement of the Agreement's purpose: "to restore and maintain the chemical, physical, and biological integrity of the waters of the Great Lakes Basin Ecosystem." The public have put it more succinctly and clearly -- they want clean lakes, without persistent toxic substances.

To track progress toward this goal and determine when it has been achieved, the Commission over the past few years has characterized the Agreement's purpose in more quantifiable terms, building on the concepts of virtual elimination of inputs and zero discharge, as well as the beneficial use impairments in the Agreement. The Commission, through its Indicators for Evaluation Task Force, identified nine positive desired outcomes[8] and proposed specific indicators and measurements to quantify each.

Characterization of the Agreement's Purpose

The driving force behind the Agreement was the continuing concern of the Parties "about the impairment of water quality on each side of the boundary to an extent that is causing injury to health and property on the other side"(Preamble). Although governments -- indeed society -- are striving to achieve the Agreement's purpose, two questions can be asked:

- When and how can society conclude that sufficient actions have been undertaken and the Agreement's purpose achieved?
- What is the appropriate framework within which society should take action?

The Agreement states that "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" (Article II). "The intent . . . is to virtually eliminate the input of persistent toxic substances in order to protect human health and to ensure the continued health and productivity of living aquatic resources and human use thereof" and "the philosophy adopted for control of inputs of persistent toxic substances shall be zero discharge" (Annex 12).

In its *Sixth Biennial Report*, the Commission concluded "that persistent toxic substances are too dangerous to the biosphere and to humans to permit their release in *any* quantity." Given the impediments to total elimination of persistent toxic substances from the Great Lakes system, virtual elimination of inputs is a more realistic objective. The Commission was quite emphatic that "zero discharge means just that: halting all inputs from all human

sources and pathways and to prevent any opportunity for persistent toxic substances to enter the environment as a result of human activity."

In its *Seventh Biennial Report*, the Commission adopted the report of its Virtual Elimination Task Force, *A Strategy for Virtual Elimination of Persistent Toxic Substances*, and commended it to governments as a framework for action. The task force's vision for the virtual elimination strategy is "ecosystem integrity, characterized by a clean and healthy Great Lakes Basin Ecosystem and by the absence of injury to living organisms and to society."

The nine desired outcomes developed by the Commission's Indicators for Evaluation Task Force articulate the Agreement's purpose in more quantitative terms. To quantify each, the task force also proposed specific indicators and measurements. Quantitative data and information developed for explicitly stated desired outcomes provide the basis to gauge progress toward the Agreement's purpose and to hold governments accountable for its achievement.

ACHIEVING THE FUTURE -- HOW TO DO IT

Today's attitudes toward the environment are ambivalent. Public opinion polls continually show that people support a clean environment, but governments appear to be less receptive and responsive to advice and to the wishes of their citizens regarding the environment. Opposition to further environmental measures -- indeed to retaining successes to date -- is mounting. Energy and interest are flagging. Funding and resource cutbacks for environmental programs and supporting science have a domino effect on the public's sense of empowerment and mood. Although the environment continues to be important in people's minds, other pressing issues -- such as employment, education and health care -- provide increasing competition for attention. People know what the problems are, and they know that the longer they wait, the worse things may become.

This chapter explores a number of ways which the Commission feels will help the Great Lakes community complete its journey. They focus on the removal of toxic and persistent toxic substances still present in the ecosystem, elimination of continuing inputs, and prevention of future inputs. To reach the end of the road, however, it is necessary first to consider how the community arrived where it is today and to identify the key obstacles that must be overcome. Since the enormity of the task may seem daunting, the solutions are discussed in smaller, more manageable blocks and focus on

- governments -- the regulatory framework, responsibility, voluntary partnerships;
- contaminant sources, pathways and reservoirs -- sediment, air, agriculture;
- geographic Areas of Concern and Lake-wide Management Plans;
- essential support programs -- science and research, science-policy links, models, surveillance and monitoring;
- specific pollutants -- dioxins and furans, mercury, PCBs, radioactivity;
- perspective and orientation -- communication, transition, socioeconomic values; and

- governance -- the role of key basin stakeholders.

Viewing each as part of a strategy, the Commission has endeavoured to present pragmatic advice in the context of "think globally and act locally." Action undertaken in each of these areas will provide tangible and measurable proof of the commitment to the Agreement by the Parties -- and the community.

Successes Thus Far

To date, governments have clearly demonstrated their commitment to reduce and eliminate contaminant loadings and to protect water quality and human health, not only in the Great Lakes basin and throughout the two nations but also on the international stage. They have responded positively to environmental challenges, especially in the light of a deeper understanding of the challenges. They have recognized the interconnectedness of the Great Lakes system and the need to work together. Over the past quarter-century, governments have developed an excellent infrastructure -- policy, laws, regulations, and programs -- that has played and continues to play a significant role in the restoration and protection of the Great Lakes. There is no doubt that the federal, state and provincial environmental and resource management programs have resulted in substantial improvements to the lakes.

Industry also has taken an active role. Of particular note are voluntary actions and co-operative partnerships to reduce contaminant release, restore the environment and protect human and ecosystem health. Programs such as Responsible Care® have demonstrated their success. Such measures are well publicized through corporate annual reports and similar means. The 1997 *Environmental Report* of the Council of Great Lakes Industries reaffirms its commitment and describes its programs and contributions.

In its previous biennial reports, the Commission has recognized the progress achieved and acknowledged the contributions made. Further progress will require different approaches and novel partnerships, and governments must adapt to the change. Increasingly, the emphasis has shifted to embrace not only control of discharges and emissions but also prevention (including bans on production and use of DDT, mirex and other chemicals) and to blend regulation with voluntary, beyond-compliance measures, partnerships and greater flexibility. In addition, common basin-wide standards are required because the Great Lakes system is interconnected. Further, community revitalization and Great Lakes protection now encompass aspects such as brownfields redevelopment and environmental justice. The willingness to explore new approaches bodes well for society's ability to address environmental issues.

The Commission notes key programs and frameworks that governments have developed and within which priorities, targets, and schedules are established and results developed and delivered, consistent with the Agreement's purpose:

- Remedial Action Plans and Lake-wide Management Plans;

- Great Lakes Binational Toxics Strategy -- Canada-United States Strategy for the Virtual Elimination of Persistent Toxic Substances in the Great Lakes;
- Canada-Ontario Agreement Respecting the Great Lakes Basin Ecosystem;
- Canada's Accelerated Reduction/Elimination of Toxics (ARET) Program;
- Ontario's Municipal-Industrial Strategy for Abatement;
- Canada's National Pollutant Release Inventory;
- U.S. Toxics Release Inventory;
- U.S. Great Lakes Water Quality Guidance (GLI), which provides an even regulatory playing field across the eight Great Lakes states, including standards to protect not only human health but also the health of wildlife;
- U.S. tribal environmental agreements; and the
- U.S. Lake Michigan Mass Balance Study/Enhanced Monitoring Program.

This is only a partial list of measures, and others are identified throughout this report. The breadth of these and numerous other initiatives and the successes delivered to date are amply described in recent documents like the *Second Report of Progress Under the Canada-Ontario Agreement Respecting the Great Lakes Basin Ecosystem 1995-1997*, the *United States Great Lakes Program Report on the Great Lakes Water Quality Agreement*, and the *State of the Great Lakes 1997*. These programs and their achievements reflect commitment and strong legislation and regulations, coupled with voluntary, co-operative measures. Progress is also evident through the increasing incorporation of such concepts as anticipation, prevention, precaution, reverse onus and full life-cycle consideration of contaminants in programs and policy.

Are We Unable to Get from Here to There?

Persistent toxic substances remain widespread throughout the Great Lakes ecosystem, and many are still in use. Society struggles to clean up contamination caused by these substances, stop inputs and eliminate their use.

In the advice received through its consultation process, several potentially contributing factors were brought to the Commission's attention. People questioned the soundness of the governments' present framework -- policy, legislation, regulations and programs -- and its ability to deliver. They also expressed concern that institutions are not organized to deal with persistent toxic substances in an integrated way that reflects how contaminants enter and move through the ecosystem. Others questioned the role and application of existing authority and flexible or voluntary approaches. Still others challenged the philosophical commitment to the Agreement's virtual elimination goal and timely motivation to resolve and prevent problems. Some raised the importance of pollution reduction and prevention in relation to social and economic considerations. Technological, data and/or knowledge limitations may also be factors, as are cost and resource limitations.

In examining these concerns, the Commission considered whether the appropriate responses were regulatory reform, greater use of existing authority, more flexible approaches to problem solving, reorganization or better integration, and better

communication of issues. Upon reflection, the Commission views all these factors as contributing to the problem as well as being opportunities to get from here to there.

The Responsibility of Governments

Great Lakes governance is in the midst of a profound and continuing evolution characterized by a shift from an exclusive command-and-control emphasis to voluntary measures, and a move from top-down management to environmental partnerships.

Legislation, Regulations and Programs

The General Accounting Office,[9] Resources for the Future[10] and the World Resources Institute[11] have identified obstacles that put into question the sustainability of the current regulatory approach and philosophy. Among these obstacles are

- state regulators who spend approximately 85 per cent of their technical staff time reviewing permits where few, if any, performance parameters are changed;
- industrial practices and technologies that have changed drastically in relation to statutes and policies conceived 25 years ago. Consequently, imposition of the current regulatory approach is viewed as costly and ineffective because of its inherent inflexibility and inability to embrace innovation and new technology.

Care must be taken to ensure that staff time is used effectively to achieve the Agreement's purpose as well as the basic goals of domestic environmental legislation: for example, to provide technical expertise to small businesses.

The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), amended by the Superfund Amendments and Reauthorization Act of 1986, provides the legislative basis to address the situation relating to contaminated sediment, one of the major challenges to basin restoration. Through CERCLA, notable successes have been achieved at such severely contaminated sites as Waukegan Harbor, Illinois, and the Manistique River, Michigan. CERCLA has been criticized, however, as too bureaucratic and not cost effective -- too many resources go toward legal costs rather than cleanup, resulting in unnecessary delays. Also, CERCLA does not always target the highest priority sites. Without identification of potentially responsible parties, a contaminated site often is not placed on the National Priorities List, and no alternative mechanism is in place to address the many contaminated sites that await action throughout the U.S. portion of the Great Lakes basin. Some jurisdictions have come to rely on CERCLA and similar state programs, and few are willing to contribute their own funds for remediation. "Orphan" sites, such as the Detroit River, which lack obvious potentially responsible parties, fall to the bottom of the federal and jurisdictional restoration priority lists.

Deregulation, Devolution and Downsizing -- "3 D"

Through the Agreement, the two federal governments have committed themselves to restore and maintain Great Lakes water quality. Indeed, governments at all levels have a responsibility to contribute to achieving the goals of the Agreement. The fiscal realities of the 1990s, however, are driving governments to reduce expenditures and debt load, affecting their approach to environmental restoration and protection. In its *Eighth Biennial Report*, the Commission expressed concern about deregulation, devolution and downsizing -- "3 D" -- and it continues to do so.

Governments have reaffirmed their commitment to the Agreement and their intent to meet its obligations. They have identified key priorities and protected associated resources, and they have promoted deregulation, devolution and downsizing as the means to provide local geographic focus and promote stewardship and community involvement. This change in governance focuses attention on those programs and actions that will effect the greatest direct environmental improvement in the Great Lakes, to ensure more efficient use of resources in delivering programs and achieving timely environmental results. This shift also can provide greater opportunities for voluntary compliance and relief from an overly prescriptive regulatory framework. Transfer to local authorities places responsibility and empowerment closer to those who understand local issues; it also may provide opportunities for setting priorities and establishing partnerships.

The Commission welcomes the removal of bureaucratic hurdles and obstacles. Improved efficiency is no doubt possible and the resources saved can be redirected to enhance other programs to restore and protect the Great Lakes. The ability of governments at all levels to deliver, however, is being stressed, and programs to restore and protect the Great Lakes have drastically slowed or halted, especially initiatives for Areas of Concern and those directed toward persistent toxic substances, whose effects are far less visible than water clarity and beach aesthetics. Other examples include Ontario's repeal of a ban on municipal incinerators, the movement away from enforceable standards, and a reduction in enforcement actions. The Commission wonders whether the regulatory framework itself has been compromised and the research infrastructure placed at undue risk. There is also a tendency to redefine the goal for persistent toxic substances to be not virtual elimination through zero discharge but input reduction, a clear shift away from the Agreement's purpose.

The "3 D" approach transfers environmental stewardship to those closer to local issues but without transferring the accountability. Furthermore, local authorities are not parties to the Agreement and therefore bear no obligation to fulfill its purpose. Moreover, the resource pie to be shared is smaller, adversely affecting the ability to monitor and clean up. The "3-D" approach also results in the loss of the broader perspective required to understand issues and meet goals, objectives and requirements on a basin-wide or international scale.

The consequence has been described as a lack of leadership and vision, characterized by a lack of commitment and political will to protect the environment on the part of the higher levels of government and the regulatory agencies. There is a clear detachment between environmental priorities and those of an economic, social and political nature.

The Commission again reminds the Parties of their commitments and calls upon them to provide a detailed accounting (considering both human and financial resources) of program cuts and delivery on Agreement commitments. Of particular note, the Commission met with representatives of Canada and Ontario in October 1996 and requested information about the impacts of cuts on their ability to meet Agreement obligations. No response was received. The Commission's Great Lakes Water Quality Board is now assembling relevant information for all Great Lakes jurisdictions. This review is particularly relevant in view of the magnitude of the program and policy changes that governments have implemented or may implement.

The Commission believes that a strong legislative framework is in place in both countries to protect human and environmental health, a framework that strongly motivates environmental management programs in the business community and provides a level playing field. The challenge is to ensure that programs which control and eliminate contaminant inputs will continue, along with the science needed to characterize problems and develop solutions and a rationalized surveillance and monitoring scheme to track progress. Laws and accompanying regulations, policies, programs and enforcement must not be compromised for the sake of fiscal austerity. Long-term capital investment, the infrastructure and the goals of environmental restoration and protection must not be sacrificed for short-term gains.

Governments must continue to provide leadership and demonstrate flexibility. As environmental issues become more fully understood, policy considerations evolve as society strives to better protect human and ecosystem health. Periodic review is appropriate to ensure that the institutional and legal framework for Great Lakes protection and management remains properly integrated, flexible and fully capable of addressing the issues.

Voluntary Measures and Partnerships

Voluntary measures and partnerships provide opportunities for governments to move away from bureaucratic command-and-control management and for participants to work together co-operatively. Voluntary measures complement the more traditional enforcement. The Common Sense Initiative (CSI), the Excellence and Leadership Program (Project XL), the 33/50 Program, and the Accelerated Reduction/Elimination of Toxics (ARET) Program are four initiatives to foster understanding, co-operation and partnership. Such programs offer opportunities for voluntary action above and beyond regulatory requirements, improve cost effectiveness and provide flexibility to explore innovative solutions. They are also the proving ground for the development of approaches that, if successful, can then be applied more broadly and, when appropriate, with the backing of regulation and enforcement.

- The U.S. CSI, for example, includes representatives of government, industry, environmental non-government organizations and community groups in an effort to design "cleaner, cheaper, smarter approaches to environmental protection."

- Brownfield cleanup and redevelopment is a cost-effective voluntary initiative with strong incentives to restore urban properties with low-level contamination to income- and tax-producing uses, yielding both economic and environmental benefits. Many provide a high rate of investment return, as evidenced by redevelopment interest. Several insurance companies now offer coverage to protect against unforeseen remediation costs.
- Canada's ARET Program and the U.S. 33/50 Program focus on reducing pollutant loadings to the environment from existing industrial sources.

Notable successes have been achieved, but these programs have not realized their full potential. For example, some members of the public criticize ARET and the 33/50 Program, as voluntary or co-operative initiatives that

- lack accountability and report unverified load reductions or achievements;
- focus on reduction of releases rather than on substance use;
- forestall more substantive action to prevent or reduce pollution;
- focus on only a small portion of the total inventory of contaminants; and
- do not target small business.

Governments continue to operate in a highly structured, stifling and expensive regulatory mode. Time is required to relinquish personal agendas and build trust to overcome outmoded ways of thinking, such as inflexible command and control. Governments must continue to build upon mutual and complementary interests and nurture actions by the Great Lakes community. The Commission fully supports voluntary measures and partnerships that complement necessary measures such as water quality standards and urges development of means and incentives to encourage and adopt cost-effective change while maintaining desirable aspects of the existing regulatory framework.

On April 7, 1997, the Parties signed The Great Lakes Binational Toxics Strategy, which considers both land-based sources and atmospheric transport of contaminants. Specific implementation measures are being developed and involve a cross section of basin stakeholders through a number of chemical-specific work groups. As is often the case, such initiatives hold much promise. The Commission is closely tracking developments and will provide an assessment in its *Tenth Biennial Report.*

Investing in the Future -- Implementing Change

Corporate business priorities and decision-making structures can pose formidable barriers to voluntary pollution prevention. In one case study,[12] pollution prevention strategies were identified that would have saved a company more than $1 million per year (about 10-20 per cent of the facility's existing environmental expenditures), eliminated 500,000 pounds of waste, and allowed shut-down of a hazardous waste incinerator.

The voluntary measures were *not* implemented because benefits were insufficient to outweigh other corporate priorities and potential loss of future business related to incinerator shut-down. Pollution prevention measures were considered in the same way

as other business opportunities and needed to be more attractive than other capital investment options.

The apparent lack of corporate will to implement measures that would voluntarily reduce pollution and save on existing environmental expenditures is perplexing. Such barriers to environmental restoration and protection must be explored and overcome. Voluntary measures ultimately will work well only where economic opportunities and choices are measured against the common standard of a pollution-free, sustainable development policy, rather than the usual playing field in which options are considered as equivalent business opportunities in a traditional sense.

Contaminant Sources, Pathways and Reservoirs

To resolve the toxic and persistent toxic substances issue, society must address the substances already in the environment, particularly in sediment; their movement, especially through the air; and their use, such as in agriculture. These aptly illustrate the challenges involved in cleaning up and protecting the Great Lakes environment.

Contaminated Sediment

All 42 Areas of Concern (AOCs) are plagued with contaminated sediment, a major cause of environmental problems and a key factor in restoring 11 of the 14 beneficial use impairments identified in the Agreement. Because bioaccumulative contaminants can become incorporated into the food chain, contaminated sediments must be addressed before they are transported into the lakes proper where cleanup is virtually impossible.

Over the past ten years, approximately $500 million has been spent on 24 sediment remediation projects in 14 AOCs.[13] Substantially greater resources also have been spent on pollution prevention and pollution control as prerequisites to sediment remediation. For many other AOCs, the nature and extent of the contaminated sediment problem has been established, and there are no technological barriers prohibiting remediation and restoration. However, in 31 AOCs, the problem is still under assessment and management decisions regarding intervention are still required (Figure 1).

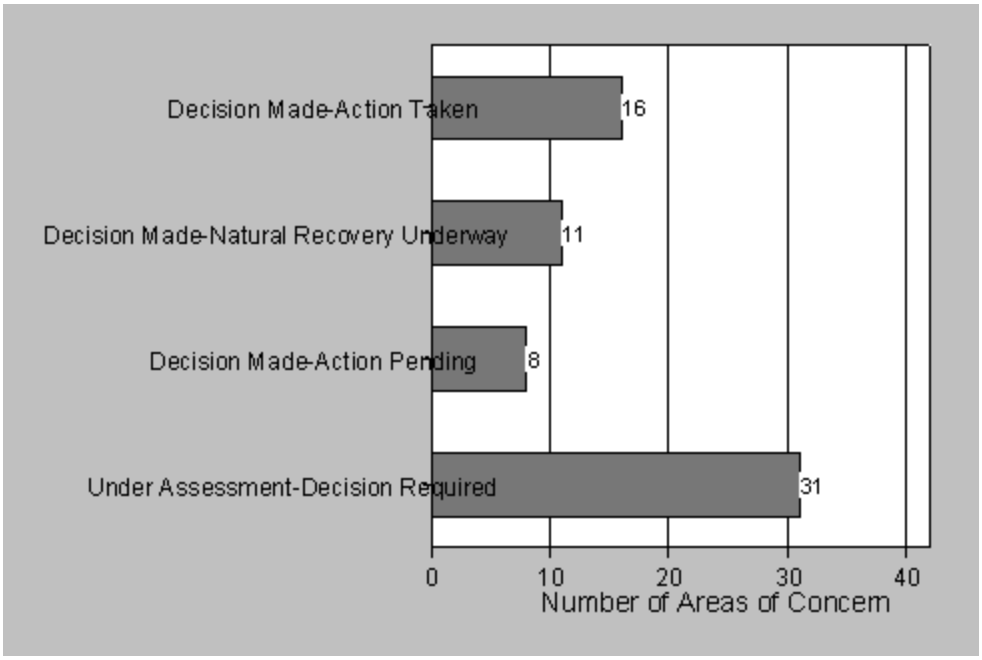

Figure 1. Contaminated Sediment Management Actions in Great Lakes Areas of Concern. Summary status, reported by the Water Quality Board's Sediment Priority Action Committee. Note that an Area of Concern can be listed in more than one category. For example, even though sediment remedial actions have been taken at two sites on the Rouge River, Michigan, a numbe of other areas of that river are under assessment and a decision is required.

A variety of sediment management strategies are available, ranging from source control to full-scale remediation, depending on the severity of the problem. Inadequate knowledge about many contaminated areas -- indeed, the inability to define the magnitude of the problem -- and uncertainty whether remediation will make any difference are major considerations.

A 1997 white paper,[13] prepared by the Water Quality Board's Sediment Priority Action Committee, identified six major obstacles to sediment remediation:

- limited funding and resources;
- regulatory complexity;
- lack of a decision-making framework;
- limited corporate involvement;
- insufficient research and technology development; and
- limited public and local support.

Participants at a Commission workshop[14] confirmed the obstacles and identified how the Commission -- in collaboration with governments -- could overcome the obstacles by

- compiling and disseminating information on the economic and environmental benefits of sediment remediation; and

- convening a binational workshop to develop guidance for making decisions regarding management of contaminated sediment.

Program managers require scientific information to ensure that the right decisions are reached and action taken -- from assessment of the severity and scope of the contaminated sediment problem, to selection of remedial action, to measurement of recovery. Decision-making requires certainty where high-risk, high-cost programs are involved. In addition to environmental benefits, the social and economic benefits of potential remedial options must be evaluated. Sediment remediation is expensive. Any short-term financial saving offered by a particular option must not be at the expense of long-term social, economic and health consequences.

The Commission supports research to reduce operating costs while still pursuing restoration goals. Practical, relevant research will, for example, help establish the relationship between a remedial action and the degree of restoration. Since selection of the right course of action is currently an uncertain exercise, the Commission supports studies to evaluate and improve the ability to treat contaminated sediment and to evaluate the success of actions taken.

Annex 14 of the Agreement requires the Parties to report biennially on progress to address contaminated sediment. The Commission recognizes the obstacles to and the opportunities for sediment remediation and recommends the following:

1. **Governments provide detailed work plans, schedules and benchmarks to complete sediment remediation projects in the eight Areas of Concern for which remediation decisions have been made but action is pending.**
2. **Governments make sediment remediation and management decisions for the 31 Areas of Concern that remain under assessment, and provide detailed work plans, schedules and benchmarks to initiate and complete sediment remediation.**

The Commission requests that these work plans, schedules and benchmarks against which to measure progress be incorporated into the Parties' programs and constitute part of their 1999 report of programs and progress under the Agreement.

Sediment remediation must be taken in the broader context of ecosystem-based plans that address other considerations essential to restoring beneficial uses in AOCs. Most important, governments must provide the human and financial resources necessary to ensure that sediment remediation is completed in a timely manner.

Air Pollution

More than 20 years ago, the Commission reported that the atmosphere is a significant pathway for contaminant input to the Great Lakes.[15] The second report to Congress under the U.S. Great Waters Program[16] reinforces concerns about continued atmospheric contaminant deposition. The U.S. Toxics Release Inventory and Canada's National

Pollutant Release Inventory quantify contaminant releases to the air from industrial sources. Both countries are developing atmospheric emission inventories such as the Great Lakes Regional Air Toxics Emissions Inventory. Significant sources include municipal and medical incinerators, coal-fired electric power plants and cars, trucks and other transportation sources. Some contaminants are transported only short distances, but others are carried continent wide or globally, moving the air pollution issue squarely onto the international stage.

The Great Lakes Binational Toxics Strategy[17] renewed and extended the Parties' commitment to manage and control toxic and persistent toxic substances, including the 11 Critical Pollutants. Reduction targets have been set for alkyl lead, PCBs, mercury and other contaminants. Other initiatives to reduce and eliminate air pollution are also under way in both countries. These include, for instance, emissions from medical waste incinerators, the chemical manufacturing sector and internal combustion engines for cars and trucks. Regulations to reduce ambient ozone concentrations and fine particulate matter also will help reduce the threat to human and ecosystem health. The Commission, however, draws attention to a number of exacerbating factors:

- The fate and impact of many contaminants is complicated by the grasshopper effect. After deposition in one location, contaminants become mobile again, are transported through the air and deposited in another location. The result is a complex picture of contaminant deposition into and transport from the waters of the Great Lakes, with possible contaminant remobilization from the sediment as the lakes strive to maintain chemical equilibrium.
- Deregulation of the electric power generation industry, already under way in the U.S., and the recent reconfiguration of the industry in Ontario, may contribute to possible increases in mercury, particulate matter and sulphur and nitrogen oxides, thereby also helping to increase acid rain and ozone.
- With a growing population, the number of vehicles powered by fossil fuels is projected to rise, contributing to an increase in emissions of toxic substances and acid rain and global warming gases.

Given the resultant impact on human and ecosystem health from increased contaminant releases to the atmosphere, the Commission wonders whether society should not rethink its attitude toward growth and energy demand, as well as its strategies for generating electrical power and transporting people and goods. Such reviews might provide interesting case studies for identifying the types of thinking and action required in a transition process to resolve the air pollution problem.

Research also will continue to play a key role in assessing the contribution of contaminant sources, transport, deposition and remobilization, thereby linking sources to receptor regions like the Great Lakes basin. Existing programs and databases must be refined and co-ordinated across the many jurisdictions within and external to the basin. A commitment must be made to compatible, long-term monitoring, which is crucial for assuring that data are available to identify, characterize and quantify not only emission sources but also deposition loadings and loading trends. This information will gauge the

effectiveness of and response to source controls. Modelling will continue to help link sources, transport and deposition.

Toxic and persistent toxic substances released into the air from industrial sources, incinerators and fossil fuel combustion, particularly from electric power generation and vehicles, continue to threaten human and ecosystem health. Considerable effort is now being expended regionally, continentally and globally to reduce and eliminate contaminant emissions to the atmosphere. The governments' commitment to national programs through the Great Lakes Binational Toxics Strategy is welcome.

Annex 15 of the Agreement requires the Parties to report biennially on progress to address airborne toxic substances. The Commission recommends the following:

3. **Governments accelerate development of integrated, binational programs, including common benchmarks and schedules, to reduce and eliminate specific sources of toxic and persistent toxic substances to the atmosphere, including sources outside the Great Lakes basin.**

The Commission requests that benchmarks and schedules be incorporated into the Parties' programs and strategies and constitute part of their 1999 report of programs and progress under the Agreement.

The Commission will continue to track progress to develop alternative transportation and power generation technology. The Commission recommends the following:

4. **Governments develop and communicate to the public, by December 31, 2000, a comprehensive strategy for altering established energy production and use patterns to achieve reductions in mercury and nitrogen oxide emissions.**

Agricultural Practices

Agricultural land use accounts for 35 per cent of the land area of the Great Lakes basin and dominates the southern portion of the basin. Agricultural lands serve as a major source of sediment and nutrients to the lakes. Agriculture is a major user of pesticides, with 26,000 tonnes used annually in the basin.[18] Row-crop herbicides comprise the highest-use chemicals by weight. As a result, the more persistent herbicides currently in use are present in the surface and ground waters of the basin. For 1993, it was estimated that 478 tonnes of atrazine were present in the Great Lakes.[19] Annex 13 of the Agreement delineates programs and measures to reduce non-point inputs from land-use activities.

The Commission has found that agricultural practices such as buffer strips and conservation tillage are cost-effective ways to reduce non-point contaminant loads to water bodies.[20] Field studies have demonstrated that environmental benefits and cost-sharing initiatives have enhanced adoption by the agricultural community. The success of those who adopted innovative practices early on has helped promote broader acceptance.

More widespread application of innovative measures, such as buffer strips to reduce herbicide delivery to water bodies and global positioning to increase the accuracy of delivery to specific areas in fields, could reduce loadings by more than 50 per cent.[21] While practices such as conservation tillage have been widely accepted over the past 15 years, others that are more capital-intensive are considered and adopted much more slowly.

Co-operative partnerships among government agencies, researchers, agricultural chemical companies and the farming community would greatly facilitate promotion and adoption of innovative practices. The Commission found a need for enhanced communication among these sectors and a requirement to display the leadership necessary to establish effective partnerships.[22]

Among the agricultural and land-use programs in the Great Lakes basin, the Commission acknowledges the work of the Great Lakes Commission (GLC) to develop an agricultural profile of the basin;[23] the U.S. Environmental Protection Agency's (EPA) 1991 Pesticides and Ground Water Strategy; the continued U.S. EPA-U.S. Department of Agriculture (USDA) promotion of conservation tillage; the joint GLC, U.S. EPA and USDA grant program to control erosion and demonstrate innovative conservation; and the 1998 U.S. Clean Water Action Plan: Restoring and Protecting America's Waters, which sets nationwide goals for conservation buffers.

Annex 13 of the Agreement requires the Parties to report biennially on progress in developing specific watershed management plans and implementing programs and measures to control non-point sources of pollution. To protect agricultural watersheds and Great Lakes water quality, the Commission recommends the following:

5. **Governments adopt the following agricultural and land-use goals and targets:**
    - **to place at least 55 per cent of the Great Lakes basin row-crop acreage into conservation tillage by 2002;**
    - **to increase buffer-strip mileage in the Great Lakes basin by at least 30 per cent by 2002; and**
    - **to reduce herbicide loads to the Great Lakes by at least 30 per cent by 2005.**

The row-crop acreage should be on an annual basis, and the buffer-strip mileage and herbicide loads should use 1998 as the base year. Assuming continued implementation of the initiatives identified above, the Commission believes that the targets and dates are achievable. The Commission requests that the status of the Parties' agricultural and land-use planning programs and progress to achieve the targets constitute part of their 1999 report of programs and progress under the Agreement.

Areas of Concern and Lake-wide Management Plans

A geographic approach offers distinct opportunities to address environmental issues. Remedial Action Plans (RAPs) and Lake-wide Management Plans (LaMPs) provide community-based opportunities to identify and solve environmental problems, restore beneficial uses and achieve the Agreement's purpose. They provide a framework to focus human and financial resources; establish benchmarks, goals and timetables; and conduct actions and programs. Pursuit of this commitment represents a fiscal obligation of billions of dollars. Since the Water Quality Board introduced the concept of RAPs in 1984, and particularly during the decade after the Parties' 1987 commitment in the Agreement, governments and other members of the Great Lakes community have invested considerable time and effort.

RAP and LaMP development has been slow. Some success has been achieved, as reported by the Commission.[24] Restoration, however, is far from complete. Recent staff reductions and budget cutbacks in many jurisdictions give, at the least, the appearance of a reduced commitment to RAPs and LaMPs and, hence, to the Agreement. Many of these developments have occurred with little advance notice, little discussion and no publicity.

Against this backdrop, the Commission has closely examined the governments' efforts to restore beneficial uses in Areas of Concern (AOCs) and open-lake waters, and the Commission has designed a revised status assessment process. The Commission's findings are detailed in nine reports[25] and are summarized below. The boards' 1995-97 priorities report[26] provides a more extensive summary.

The Commission found that leadership is required from senior levels of government. The Detroit River AOC illustrates the point: although local governments remain committed, representatives of the responsible federal, state and provincial agencies themselves confirmed the leadership void. A further threat throughout the Great Lakes basin is agency cutbacks to all RAP and LaMP activities.

The Parties must set priorities between and within RAPs and LaMPs. To date, the setting of priorities among remedial options and AOCs appears to have been ad hoc. Although all AOCs remain important, the Commission believes that a higher priority for resources must be assigned to those AOCs, particularly binational AOCs, which are substantial sources of persistent toxic substances to downstream waters. Because of the impact of these chemicals, human health must be a prominent element of RAPs and LaMPs.

In its review of the Lake Superior Stage 1 LaMP, the Commission confirmed that higher priority must be assigned to human health and atmospheric loadings of Critical Pollutants (listed in note 3). The same consideration should be given the other LaMPs as well. Since completion of its review a year and a half ago, the Parties have adopted the Great Lakes Binational Toxics Strategy, which provides a means to address atmospheric considerations. Although one LaMP requirement is to define the threat to human health posed by Critical Pollutants, in the more than six years of LaMP development this generally has not yet occurred. In fact, the debate among LaMP participants is whether LaMPs should even address human health issues directly.

The Detroit River status assessment stated that "Local partnerships and financing provided by various sectors of the community should only be supplementary sources of funding and not substitutes for a strong financial commitment by the U.S. and Canadian federal, state and provincial governments." The status assessment recommended that "Federal, state and provincial governments . . . demonstrate commitment to . . . [the] Agreement by providing sufficient financial and human resources." Local RAP and LaMP public advisory groups can pursue additional resources, since the full potential to tap local financial resources has not been reached. Local resources, however, are clearly inadequate to provide the massive resources required for restoration.

Priority planning and implementation must include public outreach, to consult with and inform citizens. Clearly defined priorities and initiatives developed with substantive community involvement will help ensure support from elected officials and private citizens, provide leverage to increase the resource commitment and stimulate the timetable to undertake and complete restoration.

Public-private partnerships are one mechanism to cope with reduced resources. RAPs provide opportunities for creative funding arrangements that bring into the process those private sector interests that will benefit from cleanup, interests such as real estate, recreation and new industrial/commercial initiatives. The benefits of partnerships have been demonstrated in several AOCs and their use should be expanded to others.

Measuring and celebrating incremental progress through RAPs and LaMPs will be essential to sustain momentum and the necessary long-term commitments required to restore beneficial uses. As noted in the Water Quality Board's report from its 1997 public meeting in Thunder Bay,[42] greater emphasis must be placed on reporting on both process milestones (such as securing funding for implementation, the number of permits/control orders issued) and ecosystem milestones (environmental and ecosystem results as defined in Annex 2 of the GLWQA) to help build a record of success.

Annex 2 of the Agreement requires the Parties to report biennially on progress in developing and implementing RAPs and LaMPs and in restoring beneficial uses. To advance remediation in Areas of Concern, the Commission recommends the following:

6. **Governments implement the eight recommendations presented in the Commission's report, *Beacons of Light*, that deal with human health, public-private partnerships, funding and staffing, public participation, information transfer, quantification of environmental benefits and public advisory council funding.**

The Commission requests that the status of actions taken to implement the eight recommendations be incorporated into the Parties' 1999 report of programs and progress under the Agreement.

On April 17, 1998, the U.S. Environmental Protection Agency, Environment Canada, the Michigan Department of Environmental Quality and the Ontario Ministry of

Environment signed the Letter of Commitment which provides a framework of roles and responsibilities for the implementation of shared RAPs for the Detroit, St. Clair and St. Marys rivers. The letter recognizes that each agency is accountable to its citizens for continued environmental improvement and protection, acknowledges their collective responsibility to ensure public and stakeholder involvement and recognizes that their leadership will be an important factor in the cleanup of these shared AOCs. The Commission commends the four agencies for reaffirming their commitment to restore these three binational rivers.

For more than ten years, the Commission has expressed its concern about environmental conditions in Lake St. Clair (Michigan-Ontario) and the St. Joseph River (Indiana-Michigan). The U.S. EPA recently published a report[27] that identified both as "areas of probable concern," based on the potential adverse effects of sediment contamination. Concern relates to levels of persistent toxic substances such as mercury, PCBs and banned pesticides. Recent work, for example U.S. EPA's Lake Michigan Mass Balance Project, has confirmed that the St. Joseph River is a primary source of atrazine to the lake. Current fish consumption advisories and research into the human health effects of persistent toxic substances contribute to the weight of evidence that supports listing Lake St. Clair and the St. Joseph River as AOCs. The Commission concludes that both have the attributes of "Areas of Concern" as described in Annex 2 of the Agreement. The Commission recommends the following:

7. **Governments review the current environmental status and programs in place to address environmental issues in the Lake St. Clair and the St. Joseph River areas, and report this information to the Commission, so that the Commission may direct the Great Lakes Water Quality Board to advise on their possible designation as Areas of Concern under the Agreement.**

The Commission requests that the Parties advise the Commission no later than their 1999 report of programs and progress under the Agreement.

Fundamental Supporting Programs

Restoration and protection of the Great Lakes basin ecosystem require strong underpinnings of essential programs -- science-policy links, models and surveillance and monitoring.

Science and Research

Science and research must provide information that assists society to act on what is in the best interest of the Great Lakes. Science and research are essential, and investment is crucial to achieve both short- and long-term environmental, social and economic benefits. They provide a basis to identify, understand and solve environmental problems. Annex 17 of the Agreement "delineates research needs to support achievement of the goals" of the Agreement.

To ensure that research supports Great Lakes issues, the Commission's Council of Great Lakes Research Managers is evaluating Great Lakes research programs in the light of the Commission's 1997-99 priorities. The Commission supports dedicated, long-term funding for key research programs, such as research to reduce and eliminate atmospheric releases of toxic and persistent toxic substances, and to develop alternative industrial manufacturing processes to ensure that these chemicals are removed from production and use and, therefore, will never pose a threat to humans.

The Commission supports studies to determine the nature and extent of injury to human and ecosystem health caused by persistent toxic substances, including investigation of endocrine-disrupting chemicals that can contribute to adverse reproductive, developmental, immunological and behavioural consequences as a result of prenatal and neonatal exposure. The Commission particularly supports the work of U.S. EPA's Endocrine Disruptor Screening and Testing Advisory Committee, which is composed of stakeholders drawn from industry, academia, government agencies, and public interest and environmental organizations. The Commission also supports the U.S. initiative to establish six federal research centres as part of the National Agenda to Protect Children's Health from Environmental Threats. This program is expected to focus on possible environmental causes for a range of childhood illnesses and disorders (including respiratory disease), intellectual development and growth.

The U.S. EPA must meet an August 1998 deadline to present to Congress a program for screening and testing the 70,000 chemicals in commercial use in the United States for endocrine disruption. The Commission seeks assurances that other key considerations related to endocrine-disrupting chemicals are addressed in a timely manner. Further, the impact of these chemicals is not limited to the Great Lakes basin or, indeed, the United States and Canada. The Commission recommends the following:

8. **Public and private sectors**
    - **fund research that expands understanding about the incidence of endocrine disruption in humans and wildlife;**
    - **conduct programs to measure and establish the concentration of endocrine-disrupting chemicals in human tissues and fluids; and**
    - **investigate endocrine-disrupting capability of chemical mixtures.**

The Commission requests that the status of endocrine-disruption research be incorporated into the Parties' 1999 report of programs and progress under the Agreement.

The Commission reiterates its understanding of "good science." The Commission agrees that environmental policy, decisions and action must be underpinned by high-quality science that is free from intense political pressure. There is a difference, however, between "good" science and "certain" science. Science is continually evolving and its conclusions are not necessarily invalid just because they are provisional or uncertain. It may be difficult or impossible to distinguish a strong correlation between levels of exposure and resulting health damage, but that does *not* mean there is *no* link, only that the mechanisms remain obscure. The Commission remains fully confident that its weight-

of-evidence approach and the call to virtually eliminate persistent toxic substances, based on the information now at hand, is appropriate and justified. The call for unequivocal evidence of injury to humans is inappropriate and must not preclude corrective and preventive action.

Communication of Scientific Information -- Linking Science and Policy

Science and research must provide information in a manner that is understandable and defensible to those who fund restoration and prevention. To restore and protect the Great Lakes, the general public, elected officials and decision-makers must work with scientists and research managers to understand environmental issues, identify needed research, set priorities, agree on the schedule to carry out studies and develop information, and recognize what current science can deliver.

The Commission perceives a continuing gap between the research undertaken by the scientific community and the information required by decision-makers to strengthen and underpin actions to evaluate, restore and maintain the Great Lakes. In addition, scientists are often not connected to the regulatory, policy and jurisdictional arenas. The State of the Lakes Ecosystem Conferences were created, in part, to help improve communication. Decision-makers are invited to participate to more clearly understand the "state of the science" so as to assist them in decision-making. Information is also disseminated over the Internet. To help bridge the gap, the Commission's Council of Great Lakes Research Managers, in co-operation with the Great Lakes Regional Office, has established a Communications Task Force to identify and communicate research needs, gaps, priorities and findings. To improve the link between science and policy, the Commission recommends the following:

9. **Governments actively participate in the work of the Communications Task Force under the Council of Great Lakes Research Managers.**

Ecosystem Models -- Contributions to Problem Definition and Resolution

Ecosystem models help the Great Lakes community to evaluate management strategies and to make informed decisions. Models help in understanding the transport and fate of persistent toxic substances, leading to more informed decisions about their control and management. Models continue to prove their worth for the evaluation of remediation alternatives in support of RAPs and LaMPs, particularly contaminated sediment and non-point sources, indicators, biodiversity and habitat. The Lake Michigan Mass Balance Study is one example that demonstrates the successful application of an ecosystem model.

Models use scientific information to link ecosystem characteristics and conditions to stressors and provide a means to predict ecosystem response to a change in stress. They help scientists evaluate hypotheses about how the ecosystem functions and help identify research needs and monitoring requirements. To fulfill their role as predictive tools,

models must be calibrated with data and information from monitoring and other programs.

Models must remain focused on important management issues. The Commission continues to support Great Lakes modelling. Its Council of Great Lakes Research Managers will bring modellers and managers together at Great Lakes modelling summits to be held at the State of the Lakes Ecosystem Conference (SOLEC '98) and the meeting of the International Association for Great Lakes Research (IAGLR '99). The Commission recommends the following:

10. **Governments support the development and application of models to assist in the testing, evaluation and implementation of ecosystem indicators, monitoring strategies, and management strategies for water quality, contaminants, fisheries and other ecosystem issues.**

Surveillance and Monitoring

Program development

Surveillance and monitoring provide information about the status of the Great Lakes environment and progress toward achieving the Agreement's purpose. It is the basic tool that informs decision-making. These programs provide data and information that identify problems, describe the present status of the Great Lakes basin ecosystem and track progress to restore and protect beneficial uses. Surveillance and monitoring provide the evidence of success or failure of a completed cleanup effort.

Well-informed management requires a considerable body of data and information, and especially data that are comparable and compatible across the basin. The Commission is fully aware of the resources required for surveillance and monitoring, coupled with today's fiscal realities. For this reason, the Commission has endeavoured to determine what information it needs to assess progress under the Agreement. The Commission has adopted nine specific desired outcomes (listed in note 8) and proposed specific indicators and measurements to characterize and facilitate interpretation of each. Achieving these desired outcomes, which encompass the Agreement's 14 beneficial use impairments, is a measure of achieving the Agreement's purpose.

At present, the Commission does not have the surveillance and monitoring data and information necessary to track environmental change, conduct an evaluation or formulate relevant policy advice. To address these considerations, the Commission is working with governments through two complementary and reinforcing activities. First, through its Indicators Implementation Task Force, the Commission is working with governments to establish, through deliberation and consensus, which data and information are necessary and sufficient to characterize the lakes and evaluate progress toward restoration and protection. Co-operatively and mutually agreed indicators and measurements will influence Great Lakes surveillance and monitoring programs.

The Commission is also working with governments through the Parties' SOLEC initiative, which provides a forum for governments to report on and provide an accounting about the state of the lakes. Through SOLEC, data and information can be presented to answer the perennial questions about fishable, swimable and drinkable water, along with the other desired outcomes. As SOLEC '98 will focus on indicators, the Commission wants to ensure that substantive, detailed and quantitative information is provided to describe and evaluate progress under the Agreement.

Effects of budget cuts on monitoring

Recent budget cuts have resulted in wholesale elimination of surveillance and monitoring programs, especially tributary programs in several major watersheds. Consequently, it is impossible to make load estimates, even for phosphorus, suspended solids and other contaminants.

- Tributary monitoring has not been conducted in Michigan since March 1994. Low-flow sampling of 20 river stations and event-based sampling for two major tributaries (on a rotating basis) have been proposed but not yet implemented.[28]
- Tributary sampling in New York has been reduced to four times per year for four Great Lakes streams.[29] The state's Rotating Intensive Basin Studies program calls for intensive sampling of selected tributaries for two out of every six years, but none were selected during 1993-97.
- Although Wisconsin had been involved in recent intensive studies of tributaries to Lake Michigan and Green Bay, four tributaries to Lake Superior have a three-year gap (1994-97) in their sampling record.
- Ontario and Ohio continue event-based sampling, but some parameters are not measured with sufficient accuracy to allow detection in all samples.

Monitoring for persistent toxic substances warrants particular mention. Whatever the complicated relationships between persistent toxic substances in compartments of the environment -- air, water column, sediment and biota -- it is important that monitoring for these substances in biota be continued and improved. Not only do biota give the primary indication of the effects of these substances, in the case of fish they are the principal route of human exposure. If indeed there is no downward trend or the trend is so small as to be undetectable, then a shift in programs could be warranted.

The Commission recommends the following:

11. **Governments identify surveillance and monitoring programs essential to track contaminant loadings to and concentration trends for each of the Great Lakes; provide assurances to the Commission and the public that these programs will be maintained; and provide on a timely basis data and information to quantify load reductions and ecosystem improvements.**

The Commission requests that essential surveillance and monitoring be conducted as part of the Parties' programs. The Commission further requests that a description of essential

programs, along with assurances for timely provision of data and information, constitute part of the Parties' 1999 report of programs and progress under the Agreement.

Specific Persistent Toxic Substances

The Commission reiterates from its *Sixth Biennial Report* that, under the Agreement, "the overall strategy or aim regarding persistent toxic substances is virtual elimination, and the tactic or method to be used to achieve that aim is through zero input or discharge of those substances created as a result of human activity." This is both necessary and reasonable. "Persistent toxic substances are too dangerous to the biosphere and to humans to permit their release in *any* quantity." Furthermore, a framework is needed that can address the large number of toxic chemicals. That framework should adopt a precautionary approach and require manufacturers, importers and users to prove that suspected substances are not and will not be harmful before they can generate, use or acquire them.

Despite sustained effort, resolution of the problems posed by persistent toxic substances has continued to elude society for more than a quarter-century. To illustrate opportunities, the Commission briefly reviews the status of programs and measures to resolve problems posed by dioxins and furans, mercury, PCBs and radioactivity.

Dioxin-like substances

The Commission commends the Parties for the start that has been made on the preparation and implementation of the Great Lakes Binational Virtual Elimination Strategy. The strategy focuses on the prevention of pollution, particularly by persistent toxic substances, and in this way will be a significant means by which industry and governments will contribute to attaining a part of the purpose of the Agreement in maintaining water quality in the Great Lakes. There is a need, within the context of the Strategy, to also fulfill the purpose of restoring water quality in the Great Lakes.

There is general agreement within the scientific community that the substances that have caused the most injury to health and resources are those with dioxin-like activity. There are many substances that have such activity, including the planar polychlorinated biphenyls, and certain polychlorinated dibenzo-*p*-dioxins, and dibenzofurans (PCDD/F) that are substituted in the 2, 3, 7 and 8 positions. The Commission believes that the incidence of injury to health and property can be significantly decreased by reducing exposures to dioxin-like substances. In the short-term, this can be achieved through reducing consumption of foods, such as Great Lakes fish, contaminated with very high levels of dioxin-like substances in the Great Lakes environment. In the long term, there is a priority need to reduce the amounts od dioxin-like substances in the Great Lakes environment.

These substances have been, and still are released into the environment -- both air and water -- primarily as a result of human activity. The legacy of the past is scattered in sediment and dumps across the Great Lakes basin. Currently, the burning of waste in its various forms -- municipal, medical and hazardous -- as well as certain industrial

processes are the most significant sources. The atmosphere links distant sources of PCDD/F such as incinerators in the southwestern U.S.[30] to Great Lakes contamination. Global transport is probable. Ontario emissions of PCDD/F (measured as 2,3,7,8-tetrachlorodibenzo-*p*-dioxin equivalents) were estimated to be 220 grams per year; total U.S. emissions in 1990 were 5.5 kilograms per year, with about 4 kilograms from point sources and the balance from sources such as wood and residential combustion.

Control efforts in recent years have substantially lowered emissions and discharges. To further protect the Great Lakes, however, continent-wide efforts must continue in order to eliminate atmospheric sources, through a combination of improved control technology and preventive and alternative waste management options.[31] Non-atmospheric sources, particularly hazardous waste sites, require active and extensive remediation and control. The Commission summarizes the status of knowledge and selected initiatives to identify and eliminate PCDD/F sources.

- Medical waste incinerators are being controlled or phased out in both countries, and lower emission limits are under development for hazardous waste incinerators in the U.S.
- U.S. EPA regulations and initiatives in Canadian jurisdictions have reduced and will continue to reduce emissions from municipal waste incinerators. Control technology, however, must be further improved and more consideration given to waste reduction and management technology. For example, substitution of an intensive recycling system for the present incineration of municipal solid waste could save over $500 million US annually in the Great Lakes region, while eliminating PCDD/F emissions.[32]
- Lake Ontario, the lake most heavily contaminated by PCDD/F, currently receives about 90 per cent of these contaminants from sources within its basin; obvious candidates are contaminated sediment transported by the Niagara River and leachate from dumps adjacent to the river.[33] Northern Lake Michigan receives about 60 per cent of its PCDD/F input from local sources such as contaminated sediment in the Fox River and Upper Green Bay.
- Historically, Lake Superior received about 20 per cent of its PCDD/F load from industrial sources in the basin. Today, their contribution is negligible. Much of the reduction is attributable to improvements in pulp and paper operations. European research, however, primarily in the Netherlands, indicates that other industrial sectors are significant sources, in particular metal production processes such as sintering.[34] Local iron sintering plants may account for 21 per cent of the atmospheric deposition of PCDD/F to Lake Michigan (see note 32). Recently, the EPA has also identified secondary aluminium smelters as a significant dioxin source.

Therefore, in order to virtually eliminate dioxin input from human activities into the Great Lakes, the Commission recommends the following:

> **Governments adopt a three-part strategy relating to: existing commercial operations, including manufacture, import, use and release into the**

environment; present day combustion facilities; and the legacy of dioxin-like substances from past human activities. Further, Governments adopt and report on a schedule outlining appropriate measures to be taken.

The Commission has identified the following measures that would reduce human, fish and wildlife exposures to dioxin-like substances on a priority basis:

- The removal of sediments, contaminated with dioxin-like substances, from bays, rivers and harbours;
- The assessment and remediation of chemical landfill sites that contain and release substances with dioxin-like activity;
- The assessment and remediation of emissions containing dioxin-like substances from iron sintering plants and secondary aluminium smelters;
- Increased recycling of solid waste to reduce precursors of dioxin-like substances to all types of incinerators;
- Phasing out and retrofitting of existing incinerators, particularly those for medical wastes, with best available technology to prevent formation and release of dioxin-like substances;
- The implementation of uniform standards for the combustion of hazardous wastes, not only in hazardous facilities, but also in cement kilns.

The Commission requests that the status of elimination of dioxin-like substances constitute part of the Parties' 1999 report of programs and progress under the Agreement.

Mercury

The release of mercury from mercury-cell chlor-alkali plants and other sources contributed to the closure of the lower lakes fishery in 1970. Today, only one mercury-cell facility is still in operation in the Great Lakes basin. Present-day fish consumption advisories are a reminder that elevated mercury concentrations continue to pose a threat to human health. The U.S. EPA reference dose is currently 0.1 micrograms per kilogram of body weight per day. The reference dose is the amount of methyl mercury ingested daily over a lifetime that is anticipated to be without adverse health effects to humans, including sensitive sub-populations. Recent studies have spurred a review of this reference level,[35] and the Agency for Toxic Substances and Disease Registry has proposed a five-fold increase to 0.5 micrograms per kilogram per day. The Commission will track the status of this proposal and also focus on further prevention and control to minimize human exposure.

Mercury occurs naturally, is found throughout the environment and, once released as a result of human activity, is easily transported, particularly through the atmosphere, demonstrating the impact of sources worldwide. The average concentration in the air, measured over oceans, is 1.6 nanograms per cubic metre, a two- to five-fold increase since the start of the industrial revolution, a direct result of human activity. The half-life of mercury in the air is more than one year.

The U.S. releases approximately 144 tonnes of mercury per year, with combustion sources -- including municipal and medical incineration -- accounting for 87 per cent of the total.[36] The largest U.S. source sector is coal-fired power plants (47 tonnes). In Canada, emissions from human activity are approximately 21 tonnes per year, with metallurgical processing accounting for about 55 per cent of the total.[37]

Numerous control and prevention initiatives are under way in Canada, the United States and worldwide to identify and quantify specific uses of mercury and to develop co-operative, incentive-based approaches to eliminate these uses, and thereby lower the regional and global environmental burden of mercury. Among the initiatives are the U.S. EPA mercury study,[38] the U.S. EPA report on electric utility emissions,[39] the Commission for Environmental Co-operation Regional Action Plan for Mercury, and the New England Governors-Eastern Canadian Premiers Action Plan for Mercury. Among the range of findings are the following:

- Regulations to address municipal and medical incinerators in the U.S. should reduce mercury emissions from these sectors further, as will changes in handling and disposal of medical waste in Canada.
- No demonstrated efficient and cost-effective control technology for eliminating mercury emissions currently exists for coal-fired power plants. A switch to natural gas would reduce emissions of mercury and a number of other contaminants. Notwithstanding costs, pollution control action must be taken.
- The damming of river systems in eastern Canada and subsequent flooding of vast tracts of land have resulted in the release of substantial quantities of mercury into the water column. Although described by some as "natural," the release is a direct result of human activity.
- Measures to remove mercury from the waste stream through product alteration and targeted waste collection have reduced releases. For example, Michigan recovered and properly disposed of 590 kilograms of mercury from dental offices in 1996. Other states and both federal governments have efforts aimed at batteries, fluorescent lights, hospital products and paints. A comprehensive compilation of total reductions in the Great Lakes basin is not available at present.
- Nearly 10 tons of mercury is used per year by the North American auto industry, almost nine tons in convenience lighting switches. Through the Mercury Pollution Prevention Task Force, a joint Michigan-industry initiative, the Big Three automakers are actively pursuing the voluntary removal of mercury from auto production.
- The Commission has advised the U.S. government not to proceed with the sale of mercury from its Department of Defense strategic stockpile, so as not to contribute further to the total burden.[26]

Mercury is one of the target chemicals of the Great Lakes Binational Toxics Strategy. Among the considerations are life-cycle and policy analysis, including incentives to eliminate mercury use. The Commission recommends the following:

13. **Governments and business apply incentive-based approaches to identify and eliminate specific uses of mercury.**

The Commission requests that a tabulation of uses and the quantities of mercury involved, along with a detailed schedule with measurable benchmarks to eliminate each use, be incorporated into the Parties' 1999 report of programs and progress under the Agreement.

Polychlorinated Biphenyls

The adverse impact of PCBs on fish, wildlife and humans was first recognized in the 1960s. Some injury is obvious; other effects, especially on future generations, are more subtle and insidious. PCBs were manufactured in the U.S. between 1929 and 1977. Although production ceased more than two decades ago, PCBs are still used in a variety of applications in the U.S. and Canada, and manufacture continues today in Russia, Ukraine and possibly elsewhere.

Because of their persistence, PCBs released years ago remain present in Great Lakes sediment, fish and air, especially downwind of urban centres. PCBs continue to enter the environment from insecure landfills, contaminated urban soil, spills from electrical transformers, improper or illegal disposal practices and long-range transport from sources outside the basin.

When ambient PCB levels are reduced, biological communities show marked reductions in body burdens. For example, at Waukegan Harbor, Illinois, removal of approximately 300,000 pounds of PCBs from a boat slip and the upper portion of the harbour, plus an estimated 700,000 pounds from adjacent upland areas resulted in reduction of PCBs in local alewives from 10 to less than 0.5 parts per million.

The initial strategies to resolve the PCB issue focused on eliminating major uses of and avoiding release of what had already been manufactured. These measures were quite successful, but only addressed part of the problem. The challenge is to terminate remaining uses, destroy existing stocks and remove what was released to the environment. Strategies must be formulated to capture, contain and ultimately destroy the material. The Commission is tracking the governments' PCB work through the Great Lakes Binational Toxics Strategy. The following observations are made:

- The political will must be found and financial resources allocated to dredge and remove contaminated sediment.
- Removal of remaining uses of PCBs is not considered cost effective, given the low PCB concentrations in electrical and other equipment.
- Although available for quite some years, application of destruction technology at times has been precluded by regulations prohibiting transport across jurisdictional boundaries, as well as public perception and attitudes against use of the technology. PCB stocks stored in one location are inaccessible to treatment and disposal facilities at another.

The Commission recommends the following:

14. **Governments develop a detailed program, including benchmarks and schedules, for the systematic destruction of PCBs in storage, in use and in the Great Lakes environment.**

Details should be incorporated into the Parties' 1999 report of programs and progress under the Agreement. As a baseline, the program should quantify the amount of PCBs still in use, stored in landfills and other containments, and available in the ambient environment, including sediment. The program should include provision to track quantities taken out of use, removed from the ambient environment, destroyed or shipped out of the basin and entering the basin through air transport.

Radioactivity

The Commission's Nuclear Task Force has released a detailed report[40] on the status of radioactivity in the Great Lakes basin. A summary is presented in the Commission's 1995-97 priorities report.[26] The management of radionuclides, including the temporary and long-term storage of nuclear wastes, is a matter of public concern, and the public repeatedly raised the radioactivity issue during the Commission's consultation process. The recent unplanned releases of radioactivity from nuclear generating stations in Ontario further heightened concern.

Based on the work of its Nuclear Task Force, the Commission believes that there is a strong need for a comprehensive review of all monitoring activities at nuclear facilities in Canada and the United States with a view to making monitoring more accommodating to the needs of the Agreement. Since there are policy and fiscal implications to any expansion or adjustment of monitoring efforts, the Commission calls upon the relevant atomic energy and environmental agencies in each country to explore the kind of monitoring needed and the changes required to current protocols.

At present, the primary goal of monitoring at a nuclear facility is to show compliance with the health, safety and environmental requirements of the facility licence. In turn the health, safety and environmental requirements in the licence are dictated by the atomic energy legislation of each country. The legislation prescribes a maximum annual allowable human exposure to radiation as the basis for setting the environmental monitoring requirements for each individual radionuclide. The use of dose assessment models translates this exposure criterion into allowable discharges of specific radionuclides and types of energy.

The Task Force concluded that the models used to derive the allowable discharges have a limited relationship to the ecological cycling of radionuclides. The models make assumptions about the distribution of the activity of a given radionuclide in different environmental compartments and the fraction of that radionuclide's activity taken up by biota and assimilated and retained, as opposed to taken up and then excreted or otherwise removed. The models also make specific assumptions about the transfer of radioactivity

from radionuclides in other biological compartments and the movement of radionuclides through food webs. This includes direct uptake by humans through drinking water or through uptake and bioaccumulation through food consumption.

The Commission believes that the ecosystem impact of toxic chemicals must include monitoring for those used in large quantities at nuclear power plants in the Great Lakes basin. Monitoring should also include radioactive forms of toxic chemicals.

Based on the work of its task force, the Commission believes that the radionuclides tritium, carbon-14, iodine-129, isotopes of plutonium and radium-226 merit separate studies and further reports because of use and discharge patterns; physical, chemical and biological properties; and the special monitoring needs of lakes as opposed to estuaries, oceans and rivers. These radionuclides have long half-lives, arise from both natural sources and some aspect of the nuclear fuel cycle, and present long-term toxicological and ecological problems. Only carbon-14 and iodine-129 are routinely monitored in the Great Lakes.

Other radionuclides of potential concern are technetium 99, -99m; phosphorus-32; chromium-51; cesium-134, -137; cerium-141, -144; strontium-89, -90; iodine-125, -131; and cobalt-60. These can occur in various components of the nuclear fuel cycle as well as in discharges from sources other than nuclear power plants. They may merit special monitoring under conditions of large-scale emission or abundance.

The Commission recommends the following:

15. **Governments comprehensively review all monitoring at nuclear facilities in the Great Lakes basin with a view to making the monitoring more accommodating to the needs of the Agreement.**
16. **Governments monitor toxic chemicals used in large quantities at nuclear power plants, identify radioactive forms of the toxic chemicals and analyze their impact on the Great Lakes ecosystem.**
17. **Governments investigate and report toxicological and ecological problems associated with tritium, carbon-14, iodine-129, isotopes of plutonium and radium-226.**

Perspective and Orientation

To get from here to there, society must change its attitudes and perspective. Above, the Commission considered new directions and opportunities being explored through voluntary measures and partnerships. Next, the Commission discusses considerations that are complex and theoretical. Governments have touched on parts of each but have not addressed them fully or head on. The Commission feels that the time for this is now and has detailed these considerations with recommendations for action. Achieving the future requires leading rather than being led by change. Society must actively engage in transition and also recognize and build upon the social and economic advantages of

ecosystem restoration and protection. To do so will require communication of information, active public participation and a change in governance.

Communication and Public Participation

Public support is crucial to restore and protect the environment. Active public involvement has had significant consequences for the environment. Direct public participation drives the development of regulations, conduct of cleanup actions, implementation of preventive measures and changes in societal attitudes. An informed and knowledgeable citizenry exerts a powerful influence on policy and decision-makers and allows the public to participate in policy development.

Public awareness of environmental issues is the first step. The key is information. Information and education provide understanding. Informed discussion allows the public to take ownership at the community level and to develop consensus and support for action. Effective communication relies on dialogue among all levels of the Great Lakes community.

The strength and interest of the public are reflected in requests for increasingly detailed and relevant information and in the nature and extent of their response to, and use of, that information. The public's attention and concern also are reflected in the positive contributions of Remedial Action Plan and Lake-wide Management Plan public advisory committees, the vigour of environmental non-government organizations, and the active and visible participation of a broad cross-section of the Great Lakes community in environmental issues.

The public's right and ability to participate in governmental processes and environmental decisions that affect it must be sustained and nurtured. Traditional environmental management institutions at senior levels of government in both countries are losing their capacity to act and effect needed changes, owing to the devolution of their powers and dwindling resources. For its part, the Commission will continue to provide the Great Lakes citizenry with opportunities to speak and be heard. Among the suggestions received at our 1997 Agreement Public Forum is the creation of a citizens' advisory board and an economic council, and active participation by native Americans and First Nations. Inclusion of public members on our recently proposed watershed boards is another avenue.[41]

The Commission urges governments to continue to effectively communicate information that the public needs and has come to expect, and to provide opportunities to be held publicly accountable for their work under the Agreement. The Commission also encourages greater incorporation of environmental and sustainable development perspectives into educational curricula, enhanced opportunities for active student involvement in environmental issues, and promotion of other opportunities to reach people. The Commission invites governments to develop and apply innovative mechanisms for meaningful public participation and partnership.

Transition

Change is inevitable. Our understanding of Great Lakes issues continues to evolve; the concept of governance continues to change. So must institutional structures and society's way of thinking. To ensure that the product of change is what society desires and seeks, people must fully participate in the transition process. The challenge is how to proceed.

In the context of toxic chemicals, the Commission views transition as a deliberate process through which society moves to a state where such chemicals are no longer produced or used. The transition generates plans and gives direction to change in an equitable and deliberate manner, putting into place the policies that can contravene negative impacts, and involving all sectors of society. The objective is not to reduce pollution per se, but to eliminate the production and use of products that contribute to environmental degradation, while at the same time protecting employment and earning capacity. More broadly, the Commission views transition as an orderly process that allows society to move toward sustainable development, with a particular emphasis on persistent toxic substances, concurrent with environmental restoration and protection.

Transition provides benefits, but it also entails costs and risks. Social, economic and cultural considerations must be taken into account, and more will be required than environmental regulations and conservation programs. The massive investment required, coupled with the potential loss of earnings during and subsequent to any change, are strong deterrents to timely action. The backdrop is highly competitive global markets. To *not* address transition now could, however, translate into greater long term environmental costs and health consequences in the future.

The Commission has suggested a consensus-building approach among affected sectors of society, with governments taking the lead. A broad social consensus is required, and alternative solutions must be protective of the environment and resources as well as being just, in order to protect the economic viability of the community and to prevent any sector from bearing an unfair portion of costs and impacts.

The Commission believes that transition is essential to deal with persistent toxic substances and achieve the Agreement's purpose. Transition must be far-reaching and comprehensive in terms of the chemicals addressed and the geographic scope. The Commission recognizes the enormity of the challenge.

Work now under way through the Great Lakes Binational Toxics Strategy addresses elements of transition. Activities are structured around seven chemicals or groups of chemicals. To explore more fully the applicability of transition, the Commission recommends the following:

18. **Governments structure a transition study and develop a transition model by December 31, 1999, for one of the chemicals presently under investigation through the Great Lakes Binational Toxics Strategy.**

Social and Economic Value of Ecosystem Restoration and Pollution Prevention

The time and resources expended in achieving the substantially improved ecosystem that society enjoys today are massive. Considerable expenditures are required to deal with persistent toxic substances that remain in the ecosystem, especially in sediment and groundwater, and with continuing sources and uses of these substances. The Agreement is quite clear that persistent toxic substances are to be virtually eliminated in order to protect human and ecosystem health. What is society's motivation to forge ahead?

There are social and economic benefits to ecosystem restoration and pollution prevention. A sustainable society should value the natural environment and human well-being more than high consumption of goods. But how can one measure benefits that have accrued and costs avoided by actions taken to date? How can one measure the social and economic costs of not taking additional action? How can one calculate the costs and benefits, including enhancement of the quality of life, when additional actions are taken? Consider, for example,

- the economic benefits of a restored waterfront, in terms of recreation and tourism;
- the avoided costs for future health care by reduction in the number of asthma cases;
- the increased earning capacity and human productivity from an increase in IQ and a reduction in employee absenteeism through improved health.

Monetary costs and uncertain benefits cannot be used as an argument to avoid restoration and protection of the Great Lakes. Clearly, many costs and benefits are not economic and do not lend themselves to quantification. How, then, does society identify and factor costs and benefits into the equation? Demonstrating the advantages of restoration and protection is a growing field.

- The Northeast Midwest Institute is developing a guidebook to evaluate the economic benefits of remediation and restoration.
- A Canadian government evaluation of the economic benefits of cleaning up the five Areas of Concern of Nipigon Bay, Metro Toronto and region, Hamilton Harbour, Thunder Bay and Cornwall found that environmental remediation is a social investment that pays real monetary returns almost immediately and will continue to pay dividends over the long term.

Local and national policies that bring persistent toxic substances to the lakes will continue because the practices are perceived as economically worthwhile. Existing policies and practices generally discount or exclude costs such as environmental degradation and natural resource depletion associated with producing, consuming and disposing of goods and services. Work is under way to identify those costs and to develop indicators that quantify changes in natural resource capital, non-renewable resources and renewable resources. Once these are identified, society will be in a better position to account for and internalize these costs.

Ecological economics is one approach.[42] Ecological economics incorporates the premise of conventional economics that consumer satisfaction depends on the consumption of material goods and services and that three factors -- land, labour and capital -- are used to produce output. In addition, it evaluates economic interactions with the ecosystem by including the stock of natural resources, renewable and non-renewable, and society's collective ability to organize for productive purposes. Ecological economics requires stakeholder participation to define values and evaluate results. The Commission points out the need for management in organizing the three factors and contributing to decision-making.

Ecological economics examines the satisfaction of human wants with three additional goals: recognizing the real limits of natural resources, dividing economic output and enjoyment of the natural environment, and minimizing the use of resources to achieve a given level of output. Two examples illustrate the advantages of ecological economics:

- Conventional economics recognizes the economic activity in cutting and processing a stand of timber; ecological economics also recognizes that the wealth of society has been diminished by reducing the stock of standing timber.
- When fossil fuels are burned, ecological economics recognizes a reduction in the stock of available energy resources and the increase in air pollution levels and associated damage.

Any action society takes -- or chooses not to take -- to restore and protect the ecosystem has associated monetary and social costs. Environmental cleanup and pursuit of environmentally sound practices are not only expenditures but also investments. Environmental degradation and natural resource depletion impact society as a whole, and future generations. Failure to recognize and adapt to resource constraints will bring about far more devastating environmental consequences for future generations than investment now to achieve sustainability.

Market-based approaches, such as pollution taxes, pollution prevention and clean manufacturing incentives, and tax and regulatory relief, already contribute to environmental restoration and protection. Ecological economics may be a further beneficial element, and application of its principles to Great Lakes environmental problems must be explored. Because ecological economics is a relatively novel concept, its application to the Great Lakes may pose particular challenges. Therefore, a pilot project for an Area of Concern using a selected pollutant or family of pollutants would be welcome. The project could examine one or more policies for dealing with specific environmental problems and evaluate the relative costs and benefits of those policies. The results would help establish the value of the approach.

As recommended by its Great Lakes Science Advisory Board, the Commission recommends the following:

19. **Governments commission a study to evaluate the practical value of utilizing the ecological economics approach.**

The Commission requests that the applicability of ecological economics to Great Lakes environmental issues constitute part of the Parties' 1999 report of programs and progress under the Agreement.

Governance -- The Case for Flexibility and Change

Governance is the institutional framework within which society deals with socio-economic, environmental and political priorities. Each institution or sector within the framework has a defined role and established means to focus on problems and opportunities. Each must evolve and adapt to ever-changing priorities and expectations.

The past decade has experienced a profound shift from a top-down, command-and-control, government-dominated approach to a bottom-up, partnership-based inclusive approach. This evolution is the manifestation of multiple -- not necessarily mutually compatible -- developments, including the change in federal/state and federal/provincial relationships, the greater demands and roles expected of local governments, increased emphasis on voluntary compliance and less-prescriptive means, fiscal constraints, downsizing, local community empowerment and watershed-based institution building.

To ensure efficiency and effectiveness in times of change and uncertainty, all basin stakeholders, within government and outside, must develop and pursue creative approaches to Great Lakes basin governance. Multi-jurisdictional, basin-oriented institutions such as the Great Lakes Commission and the Great Lakes Fishery Commission play a pivotal role. They provide a forum within which stakeholders can co-ordinate their shared implementing roles and focus on common problems and opportunities. They provide a testing ground for ideas and innovations, while serving as a buffer to temper the impact of individual and collective change among relevant political jurisdictions.

Key Players

Twenty-five years of progress under the Agreement were made possible through the combined efforts and participation of governments, industry, environmental non-governmental organizations, native Americans and First Nations, labour, the public and the Commission itself. Each has developed particular roles in Great Lakes governance and thus has become, in its own ways, a key player. After a quarter-century, however, we may all have become too set in our respective roles to tackle the arduous path ahead in the best way possible. The Commission has seen evidence of this during the last two biennial meetings, as well as during its extensive consultation process. When the same messages are delivered repeatedly by the same messengers, the recipients become less receptive, and the messengers become disheartened. This impedes progress. All the players need to re-examine how they themselves can change in order to respond to changes in society, without losing sight of their common goal. The Commission believes that the players themselves are in the best position to suggest new ways that are better adapted to their own nature and vision, and it expects to hear from them during the

coming year as to how they can make a pledge for renewal. The observations that follow are intended as a guide in this effort.

Governments

The federal, state and provincial governments must exhibit strong leadership to protect the public good, including human and ecosystem health. They must continue to investigate the specific causes of observed damage by toxic and persistent toxic substances, and also the continuing sources of specific pollutants to the ecosystem. As discussed earlier, governments must reduce bureaucracy, apply the precautionary principle, and foster co-operation and partnership among basin stakeholders.

The Commission believes the specific recommendations made to governments in this report are attainable. A number of enabling mechanisms are already in place, including the Great Lakes Binational Toxics Strategy. These incremental steps will take society closer to the Agreement's goal and prepare the way for a more thorough re-examination of the linkages between the environment and the economy and how transition can be achieved. By implementing the steps, governments will have demonstrated that they are willing to take a new approach.

Native Americans and First Nations

Native Americans and First Nations have brought to the Commission's attention their desire to be treated as governments under the Agreement. This issue is beyond the Commission's mandate. Native American and First Nations perspectives about the environment, however, are important considerations and of great interest to the Commission, which will seek out opportunities to call on their assistance in achieving the purpose of the Agreement.

The cultural and philosophical attitude of native Americans and First Nations toward the environment has become an integral part of how and why society sees the value of living in harmony with the environment. The concept of environmental justice has brought to everyone's attention the activities that led to contaminating other people's food base. The Commission believes that additional contributions toward achieving the Agreement's purpose can be made by native Americans and First Nations all across the basin by

- expanding their contacts and partnerships with other key players;
- maintaining their continued commitment to the environmental principles they espouse;
- exploring additional opportunities to communicate these principles to others;
- building on the success of the EAGLE (Effects on Aboriginals from the Great Lakes Environment) Project, identifying other studies that will help restore and protect human and ecosystem health; and
- examining the opportunity to team a native American or First Nations community in each country with a neighbouring community for the purpose of jointly

implementing, on a local level, the virtual elimination of one persistent toxic substance and activities and products that are based on that toxic chemical.

Industry

Over the last quarter-century, industry has responded and considerably reduced its releases of a number of toxic and persistent toxic substances. Throughout this period, however, some have denied that persistent toxic substances are an important factor in determining human health. The Council of Great Lakes Industries has recently suggested to the Commission that the focus be shifted away from persistent toxic substances and to other environmental issues. In view of the evidence available and the determination of consumers to see these substances removed from their lives, such a shift is premature.

At another level, corporations have become acutely aware of their liability for damage caused not only by present manufacturing operations but also by past practices. Some previously released persistent toxic substances have contaminated sediment or are leaching from landfills. In addition, contaminant release may occur after product use and disposal. Corporations must disclose their liability to their shareholders.

The Commission believes that the following changes on the part of industry would be beneficial to the basin as a whole. These proposals are aimed at achieving incremental improvements in order to reduce the quantities of toxic and persistent toxic substances, and more particularly the 11 Critical Pollutants that are currently being released to -- or are present in -- our environment as a legacy of the past. These proposals are addressed to all corporate entities within the basin, irrespective of whether they are direct producers or users of these substances. There is a need for industrial corporations within the next year to pledge to

- eliminating the use of chemicals and processes that lead to the release of any of the 11 Critical Pollutants to the environment, and examining other toxic substances in the same light;
- becoming active leaders and participants in the remediation of Areas of Concern;
- examining the opportunity of creating a common and independent fund for the restoration of contaminated sites, especially orphan sites, in such a way that their participation in this effort cannot be construed as an admission of liability, which is often a deterrent to voluntary action;
- giving a larger role and a higher standing to their internal environment committees or divisions in order to ensure that their main function is not strictly to secure permits and avoid liability, but also to re-examine all practices so as to bring their respective corporations to a new standard that better incorporates the environment into the economy;
- not being involved in the production and use of the 11 Critical Pollutants anywhere in the world;
- promoting alternative methods and processes in the developing world, to replace those involving persistent toxic substances;

- expanding exchanges with other players in the basin, including the Commission, being more willing to address environmental issues that others consider important, and bringing a greater number of spokespersons from various sectors of the business community into the arena, to assist in breaking out of the circle of confrontational and lobbying attitudes;
- collaborating to help small businesses reduce their use of toxic chemicals; and
- participating actively in the development and use of a green label on all their products that quantifies the contribution of such products in reducing the release of toxic chemicals to the environment.

Environmental non-governmental organizations

The formation of environmental non-governmental organizations (ENGOs) has led to a shift in responsibility whereby the latter assumed from governments the advocacy role for environmental protection. In the present context of governments embarked in a "3-D" process, ENGOs have become more important than ever. Yet, even though the public still holds the environment as a major concern, support for ENGOs has been wavering. The Commission believes that this trend must be reversed, as the basin cannot afford that any of its custodians lose strength at this juncture. The Commission suggests that environmental groups actively seek re-invigoration by

- re-examining adversarial approaches and broadening their willingness to engage in dialogue, negotiation and compromise;
- broadening their base of support, exerting more leadership and establishing partnerships, including with governments and industry;
- recommitting to activities and involvement at the local level;
- adopting an incremental step approach to zero discharge and virtual elimination, without losing sight of the ultimate goal;
- acknowledging progress by industry and governments where it has occurred; and
- establishing working relationships with other players, including industry and labour, in order to initiate and participate in the implementation of a green label strategy, as described above.

Labour

Labour has played a key role in implementing pollution prevention programs and voluntary compliance. Nevertheless, over the years, in their submissions to the Commission, labour unions have conveyed how their position is difficult, being caught between hammer and anvil: challenged by the need to maintain employment while acutely conscious of the fact that some of the plants in which they work contribute to their own and to other people's exposure to toxic chemicals. Yet, labour has never failed to engage in dialogue with the Commission. We believe that labour can achieve further and more significant progress through:

- finding new ways of establishing working partnerships with ENGOs and industry;

- promoting participation by their membership in environmental organizations and activities;
- giving a larger role and a higher standing to their internal environment committees or divisions in order to re-examine their own working environment and practices, with a view to finding ways to better merge the environment and the economy (this should be undertaken in collaboration with management);
- supporting any effort to eliminate the use of toxic chemicals outside of North America; and
- maintaining continued commitment to transition by fully participating in the initiation and completion of a transition model that would apply to one chemical, as a test case pursuant to Recommendation 18 above.

The public

Attainment of the Agreement's purpose ultimately depends on the public. Public pressure and participation are essential to ensure that releases of pollutants cease, cleanup takes place, and future contamination will not occur. Public diligence is required to ensure that progress continues.

Restoration and prevention are complex and will require a long time to achieve. There will always be differences of opinion about what should be done. The public must ensure that issues remain visible and that alternatives for their resolution are considered and action taken in a timely manner.

The Commission believes that the public can help get society closer to the goals of the Agreement by

- examining their daily activities in the context of their contribution to the release and dispersion of toxic chemicals;
- making their actions consistent with their belief that environmental issues are of paramount importance;
- pledging to promote, through their consuming habits, the success of a green label initiative; and
- becoming members or contributing to the activities of ENGOs that promote the goals of the Agreement.

The Commission

The Commission is exploring options to governance, within its mandate under the Boundary Waters Treaty and the Agreement.[41] The Commission assists in Agreement implementation, with specific responsibilities for monitoring progress and co-ordinating activities. To date, the Commission has relied on services and advice provided by Great Lakes institutions. As greater responsibility for environmental management is transferred to state, provincial and local levels of government, these bodies must be strengthened to meet the challenges of the future.

- The Commission will continue to bring key players together and provide opportunities for dialogue and collaboration.
- The Commission will promote opportunities and seek necessary resources for its boards to bring together all parties in order to identify present management and scientific problems with the goal of developing specific community-based solutions which can be shared throughout the basin.
- The Commission will bring examples of successful strategies and emerging issues of concern identified through the consultation process to the highest level of governments so that they can be addressed by the most efficient and effective bodies within the Great Lakes communities.
- The Commission reaffirms the importance it attaches to biennial reporting and input from all contributing entities within the Great Lakes basin.
- The Commission will seek more effective ways to use the advice received from its boards and various task forces.
- The Commission looks to identify areas where valued and shared resources may be at risk, and seeks opportunities for representatives from governments, Agreement institutions and stakeholders to adopt a more immediate face-to-face exchange of proposals for implementing the Agreement.
- The Commission looks to establish partnerships with departments, agencies, inter-governmental organizations, universities and foundations to avoid duplication and take full advantage of work already done, whenever such arrangements are satisfactory to the Commission and its advisory institutions. New avenues of scientific information exchange providing a sound basis for management of the Great Lakes will be sought from all basin communities, including citizens, industry, labour and news media.
- At the Commission's Agreement Public Forum, held in Niagara Falls, Ontario, on November 1-2, 1997, the public brought to the Commission's attention the time between release of the Commission's *Eighth Biennial Report* on June 6, 1996, and receipt of the Parties' responses, only days prior to the Forum. The time for such formal communication is inordinately long. The Commission undertakes to issue its *Tenth Biennial Report* within three months of the end of its 1997-99 priority cycle.

All of us

The Great Lakes community as a whole is bound together by the common goal of restoring and protecting the Great Lakes. All players make positive contributions to solutions from their own perspective and by applying their unique talents and expertise. None has a monopoly on the answers. As we collectively strive to find equitable and pragmatic solutions, the challenge is to discover and build upon what we hold in common. Several initiatives have been mounted to foster understanding, co-operation and partnerships. We must continue to build upon mutual and complementary interests and continue to nurture action by the Great Lakes community.

The Commission encourages governments and other stakeholders to examine their approach, to ensure that their decisions and actions remain timely and consistent with the

purpose of the Agreement, as well as continuing to fulfill obligations under domestic legislation and other mechanisms. The process should focus on review of the approach to governance, with a view to incorporating changes necessary to restore and protect the Great Lakes.

SUMMARY OF RECOMMENDATIONS

In its previous reports, the Commission has detailed the injury to human and ecosystem health caused by persistent toxic substances. The evidence continues to grow. The Commission acknowledges the considerable efforts and resources that have been devoted over the past quarter-century to reduce and eliminate inputs from all sources and pathways. In particular, the programs and measures directed at municipal and industrial point sources are examples to be emulated worldwide; governments and industry are to be congratulated.

The Commission also recognizes the opportunities created and the progress achieved through the interest and involvement of the entire Great Lakes community -- not only governments, but also business, agriculture, environmentalists, labour, native Americans and First Nations, educators, researchers, the news media and many others who have given their time and effort to make their communities better places to live in. Only with such dedication and commitment have we been able to travel this far in our journey.

Much remains to be done, however. The Commission presents 19 specific recommendations that will help Great Lakes society complete the journey and achieve the Agreement's purpose. Through these recommendations, the Commission seeks from governments specific commitments to action and the provision of data and information. Many of the actions suggested in the recommendations should fit into existing programs such as the Great Lakes Binational Toxics Strategy. The Commission requests detailed responses from governments as part of their 1999 report of programs and progress under the Agreement.

The Commission recommends the following.

Contaminated Sediment

1. Governments provide detailed work plans, schedules and benchmarks to complete sediment remediation projects in the eight Areas of Concern for which remediation decisions have been made but action is pending.
2. Governments make sediment remediation and management decisions for the 31 Areas of Concern that remain under assessment, and provide detailed work plans, schedules and benchmarks to initiate and complete sediment remediation.

Air Pollution

3. Governments accelerate development of integrated, binational programs, including common benchmarks and schedules, to reduce and eliminate sources of

specific toxic and persistent toxic substances to the atmosphere, including sources outside the Great Lakes basin.

4. Governments develop and communicate to the public, by December 31, 2000, a comprehensive strategy for altering established energy production and use patterns to achieve reductions in mercury and nitrogen oxide emissions.

Agricultural Practices

5. Governments adopt the following agricultural and land-use goals and targets:
    - to place at least 55 per cent of the Great Lakes basin row-crop acreage into conservation tillage by 2002;
    - to increase buffer-strip mileage in the Great Lakes basin by at least 30 per cent by 2002; and
    - to reduce herbicide loads to the Great Lakes by at least 30 per cent by 2005.

Areas of Concern

6. Governments implement the eight recommendations presented in the Commission's report, *Beacons of Light*, that deal with human health, public-private partnerships, funding and staffing, public participation, information transfer, quantification of environmental benefits and public advisory council funding.
7. Governments review the current environmental status and programs in place to address environmental issues in the Lake St. Clair and the St. Joseph River areas, and report this information to the Commission, so that the Commission may direct the Great Lakes Water Quality Board to advise on their possible designation as Areas of Concern under the Agreement.

Science and Research

8. Public and private sectors
    - fund research that expands understanding about the incidence of endocrine disruption in humans and wildlife;
    - conduct programs to measure and establish the concentration of endocrine-disrupting chemicals in human tissues and fluids; and
    - investigate endocrine-disrupting capability of chemical mixtures.

Communication of Scientific Information

9. Governments actively participate in the work of the Communications Task Force under the Council of Great Lakes Research Managers.

Ecosystem Models

10. Governments support the development and application of models to assist in the testing, evaluation and implementation of ecosystem indicators, monitoring strategies and management strategies for water quality, contaminants, fisheries and other ecosystem issues.

Surveillance and Monitoring

11. Governments identify surveillance and monitoring programs essential to track contaminant loadings to and concentration trends for each of the Great Lakes; provide assurances to the Commission and the public that these programs will be maintained; and provide on a timely basis data and information to quantify load reductions and ecosystem improvements.

Dioxins and Furans

12. Governments adopt a three-part strategy relating to: existing commercial operations, including manufacture, import, use and release into the environment; present day combustion facilities; and the legacy of dioxin-like substances from past human activities. Further, Governments adopt and report on a schedule outlining appropriate measures to be taken.

Mercury

13. Governments and business apply incentive-based approaches to identify and eliminate specific uses of mercury.

Polychlorinated Biphenyls

14. Governments develop a detailed program, including benchmarks and schedules, for the systematic destruction of PCBs in storage, in use and in the Great Lakes environment.

Radioactivity

15. Governments comprehensively review all monitoring at nuclear facilities in the Great Lakes basin with a view to making the monitoring more accommodating to the needs of the Agreement.
16. Governments monitor toxic chemicals used in large quantities at nuclear power plants, identify radioactive forms of the toxic chemicals and analyze their impact on the Great Lakes ecosystem.
17. Governments investigate and report toxicological and ecological problems associated with tritium, carbon-14, iodine-129, isotopes of plutonium and radium-226.

Transition

18. Governments structure a transition study and develop a transition model by December 31, 1999, for one of the chemicals presently under investigation through the Great Lakes Binational Toxics Strategy.

Socio-Economic Value

19. Governments commission a study to evaluate the practical value of utilizing the ecological economics approach.

SIGNED THIS 10TH DAY OF JUNE, 1998 AS THE NINTH BIENNIAL REPORT OF THE INTERNATIONAL JOINT COMMISSION PURSUANT TO THE GREAT LAKES WATER QUALITY AGREEMENT OF 1978.

Thomas L. Baldini United States Chairman	Leonard Legault Canadian Chairman
Susan B. Bayh Commissioner	Dr. Pierre Beland Commissioner
Alice Chamberlin Commissioner	C. Francis Murphy Commissioner

APPENDIX A
1995-97 PUBLIC CONSULTATION ACTIVITIES

Focus Group Sessions

May 21, 1997	Petoskey, MI	Michigan Tribes
June 6, 1997	Lac Courtes Oreilles, WI	Lake Superior Tribes
June 12, 1997	Windsor, ON	Industry/Business
June 25, 1997	Toronto, ON	Labor
June 13, 1997	Bkejwanong, ON	Walpole Island First Nation
Sept. 2, 1997	Cornwall, ON	Mohawk Council of Akwesasne

Sector Papers

November 15, 1997	Invitations sent
June 1, 1997	Responses received

IJC Roundtables

August 7, 1997	Ann Arbor, MI	To discuss sector papers
October 31,	Niagara-on-the-	Achieving the Future

1997	Lake, ON	
November 1-2, 1997	Niagara Falls, ON	Agreement Public Forum
IJC Board and Council Public Meetings/Workshops		
September 24, 1995	Duluth, MN	CGLRM: Future of Great Lakes science
May 3, 1996	Livonia, MI	Habitat session at watershed management conference
June 5, 1996	Detroit, MI	Partnerships in Progress Workshop
July 23-25, 1996	Racine, WI	Annex 2: Funding Strategies to Restore AOCs
August 8, 1996	Madison, WI	WQB: Pesticide Use Reduction (public mtg. & workshop)
Sept. 10, 1996	Windsor, ON	SAB: PCBs, the New Equilibrium?
October 18-19, 1996	Rochester, NY	WQB w/Water Resources Board of NY and Finger Lakes - Lake Ontario Watershed Protection Alliance
November 5, 1996	Windsor, ON	CGLRM: SOLEC Workshop
November 20, 1996	Detroit, MI	SAB: Scientific issues related to Detroit River RAP
November 21, 1996	Chicago, IL	IAQAB/HPTF
February 26, 1997	Chicago, IL	LAMP Workshop: Air Deposition Pathways
May 1997	Montreal, QC	CGLRM: Workshop at Human Health Scientific Conference
June 1997	Buffalo, NY	CGLRM: Workshop at International Association for Great Lakes Research Conference
June 1997	Collingwood, ON	Sediment Workshop
August 21, 1997	Toledo, OH	Pesticide Workshop
September 5-7, 1997	Racine, WI	SAB: Workshop on Policy Implications of Evidence Regarding Persistent Toxic Substances and Human Health
September 19, 1997	Cleveland, OH	Lake Erie LAMP: Human Health & Aquatic Life Considerations
October 21, 1997	Thunder Bay, ON	WQB Public Meeting
October 30, 1997	Niagara Falls, ON	CGLRM Public Meeting
Annex 2 Site Visits		
November 13-	Detroit River, ON	

14, 1996	- MI
May 22, 1996	Hamilton Harbour, ON
November 19, 1997	St. Marys River, ON - MI

WQB = Great Lakes Water Quality Board;
SAB = Great Lakes Science Advisory Board;
CGLRM = Council of Great Lakes Research Managers;
IAQAB = International Air Quality Advisory Board;
HPTF = Health Professionals Task Force

APPENDIX
INTERNATIONAL JOINT COMMISSION REPORTS ISSUED IN 1995-97 WITH RESPECT TO GREAT LAKES WATER QUALITY

Public Consultation

A Public Forum on the Future of Great Lakes Science -- A Summary. Held at Duluth, Minnesota, September 24, 1995. International Joint Commission, Windsor, Ontario. 2 pp. www.ijc.org/php/publications/html/glsci.html

The International Joint Commission and its Publics: Expanding Consultation under the Great Lakes Water Quality Agreement. International Joint Commission, Windsor, Ontario, 1996. www.ijc.org/rel/news/pubconpr.html

Public Consultation on Pesticide Usage. Summary report on consultation held in Madison, Wisconsin, August 8, 1996. www.ijc.org/php/publications/html/pubpes.html

Report on Public Meeting. Held November 5, 1996. Council of Great Lakes Research Managers, International Joint Commission. 5 pp. www.ijc.org/php/publications/html/cglrmmtg.html

The International Air Quality Advisory Board and Health Professionals Task Force Fall 1996 Joint Public Meeting. Chicago, Illinois, November 21, 1996. 4 pp.

A Report of the Conversation between Representatives of the International Joint Commission and the Michigan Tribal Environmental Group, May 21, 1997. www.ijc.org/php/publications/html/tribal02.html

Summary of Consultation between Tribal Representatives and the International Joint Commission, Lac Courte Oreilles, Wisconsin, June 6, 1997. www.ijc.org/php/publications/html/tribal01.html

Summary of Consultation between Representatives of the Business Community and the International Joint Commission, Windsor, Ontario, June 12, 1997.
www.ijc.org/php/publications/html/indust01.html

Summary of Consultation between Walpole Island First Nation and the International Joint Commission, Bkejwanong, Ontario, June 13, 1997.
www.ijc.org/php/publications/html/tribal03.html

Summary of a Focus Group Meeting between Representatives of Labour and the International Joint Commission, held in Toronto, Ontario, June 25, 1997.
www.ijc.org/php/publications/html/labour.html

Progress under the Great Lakes Water Quality Agreement -- Insight Provided by Basin Stakeholders. A compendium of eight papers submitted to the International Joint Commission. The documentation provided a basis for discussion among the eight stakeholder groups and the Commission at a roundtable held in Ann Arbor, Michigan, on August 7, 1997.

Achieving the Future -- The Next Step. Highlights of the International Joint Commission round table held in Niagara-on-the-Lake, Ontario, October 31, 1997. 2 pp.
www.ijc.org/php/publications/html/glround.html

Achieving the Future -- The Next Step. Facilitator's Report of the International Joint Commission roundtable held in Niagara-on-the-Lake, Ontario, October 31, 1997. 12 pp.
www.ijc.org/php/publications/html/achieve.html

International Joint Commission Great Lakes Water Quality Agreement Public Forum, Niagara Falls, Ontario, November 1-2, 1997. Transcript.
www.ijc.org/php/publications/html/pubforum97/index.html

Remedial Action Plans and Lakewide Management Plans

Evaluating Successful Implementation Strategies for Remedial Action Plans. Outcome of a Conference on Remedial Action Planning, held in Racine, Wisconsin, July 25-27, 1995. S. Cole-Misch and B. Kirschner, editors, January 1996. 115 pp.
www.ijc.org/rel/boards/annex2/rapconf.html

Proceedings of Partnerships for Progress Workshop, Detroit, Michigan, June 5, 1996. Sponsored by Canadian Consulate General, International Joint Commission, and Southeast Michigan Council of Governments. M. L. Becker and B. A. Kirschner, editors, July 1996. 35 pp. www.ijc.org/php/publications/html/partnws.html

Wingspread Conference: Funding Strategies for Restoration of Areas of Concern in the Great Lakes Basin. Summary Report. Wingspread, The Johnson Foundation, Racine, Wisconsin, July 23-25, 1996. International Joint Commission, August 1996. 12 pp.
www.ijc.org/rel/boards/annex2/wingrap.html

Position Statement on the Future of Great Lakes Remedial Action Plans. Great Lakes Water Quality Board, International Joint Commission, September 1996. 17 pp. www.ijc.org/php/publications/html/wqbrap.html

Pathways to Success: Workshops & Strategies for Sustaining RAP Public Advisory Committees. A Guidebook. Prepared by the LURA Group in association with the Cuyahoga River Community Planning Organization and the Collingwood RAP PAC Inc. Submitted to the International Joint Commission, September 1996. 76 pp.

Linking Local Watershed Management Efforts Across the Lake Ontario Basin. A Report on the 5th Annual Conference, October 18-19, 1996, Rochester Institute of Technology, Rochester, New York. Prepared by: Water Resources Board of the Finger Lakes-Lake Ontario Watershed Protective Alliance; Great Lakes Water Quality Board; and the New York State Department of Environmental Conservation, June 1997. 52 pp. Available from International Joint Commission, Windsor, Ontario. www.ijc.org/php/publications/html/llwme.html

Lake Superior Stage 1 Lakewide Management Plan Review. International Joint Commission, Windsor, Ontario, November 15, 1996. 4 pp. www.ijc.org/php/publications/html/lslamp.html

Detroit River Area of Concern Status Assessment. International Joint Commission, Windsor, Ontario, October 1997. www.ijc.org/php/publications/html/detroit.html

Beacons of Light. Successful Strategies Toward Restoration in Areas of Concern under the Great Lakes Water Quality Agreement. International Joint Commission, [Windsor, Ontario], March 1998. 25 pp. www.ijc.org/php/publications/html/beacon/beacon.html

Indicators

Lozon, Joseph. *Pilot Study of the Desired Outcomes Fishability, Virtual Elimination of Persistent Toxic Substances, and Biological Community Integrity and Diversity for Lakes Erie and Superior*. International Joint Commission, Windsor, Ontario, August 1997. 80 pp.

Howland, Grace. *Pilot Study: Phase Two. Status Report on Four Desired Outcomes: Fishability, the Virtual Elimination of Inputs of Persistent Toxic Substances, Biological Community Integrity and Diversity and Swimmability*. Progress Made Since the Pilot Study: Phase One Compilation Report. Canadian Side. Indicators Implementation Task Force, International Joint Commission, December 1997. 35 pp.

Woodward, Lucille W. *Indicators U.S. Pilot Study for Lake Superior and Lake Erie. Final Report*. Prepared for the Indicators Implementation Task Force, International Joint Commission, Windsor, Ontario, August 1997. 41 pp.

Woodward, Lucille W. *Indicators U.S. Pilot Study for Lake Superior and Lake Erie -- Phase Two. Final Report*. Prepared for the Indicators Implementation Task Force, International Joint Commission, Windsor, Ontario, December 1997. 50 pp + interspersed pages.

Howland, Grace. *Pilot Study Integration Report. Pilot Study: Phase One and Phase Two. Fishability, the Virtual Elimination of Inputs of Persistent Toxic Substances, Biological Community Integrity and Diversity, Swimmability*. A report presented to the Indicators Implementation Task Force, International Joint Commission [Windsor, Ontario], February 1998. 98 pp + appendices.

Pilot Study of Three Desired Outcomes -- Fishability, The Virtual Elimination of Inputs of Persistent Toxic Substances and Biological Community Integrity and Diversity. Pilot study researchers: Grace Howland, Joseph Lozon and Lucille Woodward. Compilation report prepared by Grace Howland. Indicators Implementation Task Force, International Joint Commission, Windsor, Ontario, September 1997. 39 pp + appendices.

Science and Research

1996 Great Lakes-St. Lawrence Research Inventory. Council of Great Lakes Research Managers, International Joint Commission. Available only on web site.
www.ijc.org/php/publications/html/ri96home.html

1997 Great Lakes-St. Lawrence Research Inventory. Council of Great Lakes Research Managers, International Joint Commission. Available only on web site.
www.ijc.org/php/publications/html/ri97home.html

Improving the Effectiveness of Great Lakes Research. White paper, for use at the November 7, 1996, breakout session on Research, Assessment and Analysis, 1996 State of the Lakes Ecosystem Conference, Windsor, Ontario. Council of Great Lakes Research Managers, International Joint Commission. 8 pp.
www.ijc.org/php/publications/html/incin.html

Progress Report 23. International Air Quality Advisory Board, International Joint Commission, Windsor, Ontario [Spring 1997].
www.ijc.org/php/publications/html/progress23/r23.html

Habitat

Practical Methods to Protect and Enhance Habitats. A Summary of the Habitat Session from the Practical and Cost-Effective Watershed Management Conference, Livonia, Michigan, May 3, 1996. 39 pp. Compiled and edited by the Rouge River Remedial Action Plan Advisory Council's Habitat Subcommittee.
www.ijc.org/rel/boards/wqb/hab_summ.html

Sediment

Overcoming Obstacles to Sediment Remediation in the Great Lakes Basin. White paper by the Sediment Priority Action Committee, Great Lakes Water Quality Board, International Joint Commission. November 19, 1997. http://www.ijc.org/php/publications/html/sedrem.html

Modelling

The Lake Erie Ecological Modelling Project [LEEMP]. Report of the Lake Erie Task Force to the International Joint Commission, February 1997. 22 pp. www.ijc.org/php/publications/html/letfrept.html

Radioactivity

Inventory of Radionuclides for the Great Lakes. Nuclear Task Force, International Joint Commission, December 1997. 111 pp.

Virtual Elimination

Linett, Bob. *Report on Applicability of Voluntary, Beyond Compliance Programs to the Virtual Elimination Strategy*. Submitted to the Great Lakes Water Quality Board, International Joint Commission, March 21, 1997. 38 pp. www.ijc.org/php/publications/html/beyond.html

Board and Council Priorities

1995-97 Priorities and Progress under the Great Lakes Water Quality Agreement. International Joint Commission, Windsor, Ontario, September 1997. 134 pp. www.ijc.org/php/publications/html/pr9597.html

APPENDIX C
OTHER ISSUES AND CONCERNS RAISED BY THE PUBLIC

The Agreement recognizes "that restoration and enhancement of the boundary waters cannot be achieved independently of other parts of the Great Lakes Basin Ecosystem with which these waters interact" (Preamble). In addition to toxic and persistent toxic substances, a number of other issues were brought to the Commission's attention. Many relate to the physical landscape of the basin, biological contamination, nutrients and water quantity.

- Concerns about the physical landscape include land use, shoreline alteration, watershed development and urban sprawl. These adversely impact wetlands and fish and wildlife habitat, including loss of spawning and nursery areas for Great Lakes fish and disruption and possibly permanent alteration of the food web and biodiversity.
- Biological contamination includes the long-standing sea lamprey problem, zebra mussels, purple loosestrife and a plethora of other plants and animals that impact

ecosystem health and integrity. Aquaculture and fish stocking programs may lead to biological contamination.
- Over-enrichment primarily concerns excess phosphorus.
- Water quantity includes consumptive uses, diversions and groundwater.

Other specific issues brought to the Commission's attention include mining, oil and gas drilling and underwater timber salvage. Concern also was expressed about the need to maintain biodiversity and health of ecological communities, which can be disrupted by a wide range of activities, including genetic engineering. The Commission is exploring where and how it can best contribute to the resolution of these issues and concerns.

The Commission continues to support programs to deal with exotic species and appropriate land-use practices. The Commission recognizes the connection among these stressors and between them and water quality. It is also conscious that, because of the complex nature of the ecosystem, decisions taken to resolve the persistent toxic substances problem will affect other issues as well.

NOTES

1. The Agreement defines "Parties" as "the Government of Canada and the Government of the United States of America." In this report, "governments" collectively refers to the two federal governments, the eight Great Lakes states of Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania and Wisconsin and the province of Ontario.
2. In March 1998, the Manistique Paper Company, on Lake Michigan, was recognized as the first chlorine-free paper mill in the Great Lakes basin.
3. The definition of critical pollutant in Annex 2 of the Agreement is different from the 11 Critical Pollutants identified by the Water Quality Board in 1985. The Board's Critical Pollutants are polychlorinated biphenyls (PCBs), DDT and its metabolites (including DDE), dieldrin, toxaphene, 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD), 2,3,7,8-tetrachlorodibenzofuran (TCDF), mirex, mercury, alkylated lead, benzo(a)pyrene and hexachlorobenzene.
4. Colborn *et al.*, 1993.
5. *PCBs, the New Equilibrium?* Workshop of the Great Lakes Science Advisory Board's Workgroup on Parties Implementation, held in Windsor, Ontario, September 10, 1996.
6. Courval *et al.*, 1997; Jacobson *et al.*, 1984; Lonky *et al.*, 1996; Tay *et al.*, 1997; Jacobson and Jacobson, 1996*a*, 1996*b*; Hauser *et al.*, 1998.
7. See Johnson *et al.*, and *Public Health Implications of PCB Exposures*. Agency for Toxic Substances and Disease Registry, U.S. Department of Health and Human Services, Atlanta, Georgia; and U.S. Environmental Protection Agency, Washington, D.C., December 1996.
8. The nine desired outcomes are fishability, swimability, drinkability, healthy human populations, economic viability, biological community integrity and diversity, virtual elimination of inputs of persistent toxic substances, absence of excess phosphorus and physical environment integrity.

9. U.S. General Accounting Office, 1997; and Guerrero, 1998.
10. Davies and Mazurek, 1997.
11. Heaton, 1997.
12. Greer and Sels, 1997.
13. See *Overcoming Obstacles to Sediment Remediation in the Great Lakes Basin,* 1997.
14. Identifying the Value-added Role of the IJC in Overcoming Obstacles to Sediment Remediation in the Great Lakes Basin. Workshop held in Collingwood, Ontario, June 1997.
15. See, for example, *Summary Report on the Workshop on Great Lakes Atmospheric Deposition*, held October 29-31, 1986, at Scarborough, Ontario. Sponsored by the Great Lakes Science Advisory Board, Great Lakes Water Quality Board and International Air Quality Advisory Board. This report estimated that up to 90 per cent of the PCBs, 96 per cent of the benzo-a-pyrene and 97 per cent of the lead found in Lake Superior was deposited there as a result of atmospheric transport.
16. See *Deposition of Air Pollutants to the Great Waters,* 1997.
17. See *The Great Lakes Binational Toxics Strategy. Canada-United States Strategy for the Virtual Elimination of Persistent Toxic Substances in the Great Lakes,* 1997.
18. *An Agricultural Profile of the Great Lakes Basin: Characteristics and Trends in Production, Land-Use and Environmental Impacts,* 1996.
19. Schottler and Eisenreich, 1994.
20. Documentation developed by the International Reference Group on Great Lakes Pollution from Land Use Activities (PLUARG) and follow-up Commission activities.
21. Establishing Partnerships for Cost-effective Agricultural Pollution Prevention in the Great Lakes Basin: Practices and Partnerships. Workshop held August 1996. International Joint Commission.
22. Pesticides: Examining Efficient and Cost Effective Agricultural Pollution Prevention. Workshop held August 1997. International Joint Commission.
23. See *An Agricultural Profile of the Great Lakes Basin: Characteristics and Trends in Production, Land-Use and Environmental Impacts*. Project funded by the Great Lakes Protection Fund and presented at the Great Lakes Agricultural Summit, April 1996.
24. See *Beacons of Light,* 1998.
25. See Cole-Misch and Kirschner , 1996; Becker and Kirschner, 1996; *Wingspread Conference: Funding Strategies for Restoration of Areas of Concern in the Great Lakes Basin. Summary Report,* 1996; *Position Statement on the Future of Great Lakes Remedial Action Plans,* 1996; *Pathways to Success: Workshops & Strategies for Sustaining RAP Public Advisory Committees. A Guidebook,* 1996; *Linking Local Watershed Management Efforts Across the Lake Ontario Basin,* 1997; *Lake Superior Stage 1 Lakewide Management Plan Review*; *Detroit River Area of Concern Status Assessment,* 1997; *Beacons of Light,* 1998.
26. See *1995-97 Priorities and Progress under the Great Lakes Water Quality Agreement*. 1997.

27. *The Incidence and Severity of Sediment Contamination in Surface Waters of the United States*. 3 volumes. 1997.
28. See Michigan Department of Environmental Quality, 1997.
29. See New York State Department of Environmental Conservation, 1995.
30. Cohen *et al.*, 1995.
31. See *A Policy Statement on the Incineration of Municipal Waste*, 1996.
32. Commoner *et al.*, 1996.
33. Pearson *et al.*, 1997.
34. See *Emissions of Dioxins in the Netherlands*, 1996.
35. See *The Mercury Study: Report to Congress*, 1997; Davidson *et al.*, 1995; and Myers *et al.*, 1997.
36. See *The Mercury Study: Report to Congress*, 1997.
37. See *The Status of Mercury in Canada*, 1996.
38. See *The Mercury Study: Report to Congress*, 1997.
39. See *The Study of Hazardous Air Pollutant Emissions from Electric Utility Steam Generating Units. Final Report to Congress*, 1998.
40. See *Inventory of Radionuclides for the Great Lakes*, 1997.
41. See *The IJC and the 21st Century*,1997.
42. See *1995-97 Priorities and Progress under the Great Lakes Water Quality Agreement*, 1997; Daily, 1997; Prugh, 1995; and Costanza *et al.*, 1996.

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